The 15th International IEEE Conference on Intelligent Transportation Systems

ITSC2012

September 16~19, 2012, Anchorage, Alaska, USA

Program Book

Table of Contents

Welcome Message from the General Chair

Jeffrey Miller

I would like to welcome everyone to Anchorage, Alaska and the 15th IEEE Intelligent Transportation Systems Conference – The Wild Frontier in Intelligent Transportation! Over the past few years, this conference has been held in a lot of great places around the world – Toronto, Seattle, Beijing, St. Louis, Madeira, Washington DC. All of those conferences had a great turn out of attendees, a tremendous technical program, and social events that displayed the unique culture of the city. The organizing committee of ITSC 2012 has tried to build on the success of the previous years and continue to raise the bar for future ITSCs. I hope the organizers in The Hague, Qingdao, and Las Palmas take good notes during this conference.

I really was quite fortunate in the organizing committee I had for this conference. Wei-Bin Zhang and Yinhai Wang have put together a tremendous technical program with high quality papers and plenary sessions that span North America, Europe, and Asia, as well as academia, industry, and government. Javier Sanchez Medina was by far the best registration chair I could have hoped for, and he also picked up the web site, all the social networking, and many other tasks that did not fall on any specific person. Jim Krogmeier kept us all in line with the finances, and Brendan Morris has some great student activities planned. Heng Wei was responsible for the program, and as you all can see, the program turned out great. Zhiheng Li put together all of the workshops that we have prior to the start of the conference, and our publicity co-chairs, Urbano Nunes, Fei-Yue Wang, and Matt Barth, helped get the word out to all of you about the conference deadlines.

In addition to having a very active committee, I want to acknowledge two members of the organizing committee in particular who put in more time and effort than any volunteer should. Wei-Bin Zhang spent countless hours on the technical program, from following up with reviewers and the technical program committee to organizing all of the accepted papers into the sessions. He worked to get all of the plenary speakers, and his dedication to this conference, as well as balancing his role as the Program Manager at PATH, was definitely required for it to be the success that it is. Javier Sanchez Medina was also instrumental in making sure that all of the intricate details of the conference were handled. Javier helped us through all of the complications that Papercept gave us in the paper upload and registration process. (NOTE: That last sentence is definitely an understatement.) He managed the web site and made updates nearly as fast as they were requested. I think he may be the only other person who tries to clear out his inbox on a daily basis as quickly as I do. I can't tell you how many times we were responding to each other's emails nearly in real-time. When you see Wei-Bin and Javier at the conference, please acknowledge their contributions to the conference with a sincere "thank you."

The social activities we have planned for the conference include a lot of Alaskan culture. You will get exposed to native Alaskan dancers, the folksy flavor of Alaskan music, the animals that call the state home, and some of the best local cuisine you can find in the state. There should be ample time to catch up with old colleagues, network with new ones, see a small part of the largest state in the US, and enjoy the great culture that happens in the Last Frontier.

For anyone who is thinking about running a conference, I would highly recommend talking with any of the people on the ITSC 2012 organizing committee. They all would be invaluable resources for you. For anyone thinking about being a general chair, you should know that I have received over 4000 emails in the prior two years leading up to the conference. I think I needed to respond to at least 3000 of those.

Now that you are at the conference, if you have any questions, please ask one of the student volunteers or members of the organizing committee. I hope you are able to network with colleagues, learn about some new and different ideas, enjoy the great food and culture of Alaska, and see at least one moose before you leave!

Prof. Jeffrey Miller, Ph.D.
ITSC2012 General Chair
University of Alaska Anchorage
Anchorage, Alaska
USA

Welcome Message from the Program Chairs

Wei-Bin Zhang and Yinhai Wang

We are excited about the technical program for the 15th IEEE Intelligent Transportation Systems Conference (ITSC 2012). Highlighted by the conference theme, *The Wild Frontier in Intelligent Transportation*, ITSC 2012 covers a broad range of topics critical to ITS planning, technology development, implementation, research, education, and cost-to-benefit analysis. As will soon be witnessed, the technical program for ITSC 2012 is both intellectually stimulating and practically informative.

We are proud to announce that ITSC 2012 attracted 438 submissions from 44 countries or regions, making it a truly international conference. As in the previous years, the majority of papers came from the U.S. (102), followed by Mainland China (82), Germany (40), Japan (32), France (22), Taiwan (12), Canada (11), South Korea (11), United Kingdom (11), India (10), and the Netherlands (10). After a rigorous review process, a total of 318 papers were included in the final technical program for presentation and publication in the conference proceedings.

These papers address important research fields, including simulation and modeling (8.9%), driver assistance systems (6.4%), optimization and control (4.2%), data mining and analysis (4.0%), traffic control (3.9%), imaging and image analysis (3.9%), advanced vehicle safety systems (3.6%), etc. Seventy-two technical sessions, including sixty-seven regular sessions and five special sessions, have been scheduled for the paper authors to share their knowledge with conference participants. Such a rich technical program allows as many as eight parallel tracks for ITSC 2012 attendees to choose from during non-plenary session periods.

More excitingly, six internationally recognized experts from North America, Europe, and Asia have committed their in-depth presentations at three plenary sessions. They will offer their valuable findings, thoughts, and vision on important ITS issues, such as cutting edge research on connected vehicles and state of the art on high-speed rail system development.

Furthermore, four pre-conference workshops have been scheduled with top notch experts being the panelists to discuss key issues on pedestrian/bicycle data collection, probe data analysis, unmanned aerial vehicle applications, and transportation data management. We believe that these workshops will identify effective solutions and future work directions to these important problems.

Completion of such a rich conference program would not have been possible without strong voluntary help. During the preparation of ITSC 2012, we received strong support from ITS professionals around the world as evidenced by the high amount of paper submissions,

quality reviews, and session commitments. Particularly, we would like to express our deep gratitude to the 65 associate editors and 688 paper reviewers for their dedication and great efforts. Also, we are grateful to all authors, speakers, conference committee members, sponsors, and other conference participants for their hard work and great efforts that will lead ITSC 2012 to a great success!

ITSC has been an excellent platform for information exchange, experience sharing, and professional networking over the past fourteen years. We hope ITSC 2012 to be another wonderful and rewarding experience in your memory.

Wish you a very pleasant stay in Anchorage!

Mr. Wei-Bin Zhang
ITSC 2012 Program Co-Chair
University of California, Berkeley
USA

Prof. Yinhai Wang, Ph.D.
ITSC 2012 Program Co-Chair
University of Washington
USA

Organizing and Executive Committee

General Chair

Jeffrey Miller, Ph.D.
University of Alaska Anchorage
Anchorage, Alaska, USA
jeffrey.miller@ieee.org

Program Co-Chair

Wei-Bin Zhang
PATH Program
University of California
Berkeley, California, USA
wbzhang@path.berkeley.edu

Program Co-Chair

Yinhai Wang, Ph.D.
University of Washington
USA
yinhai@uw.edu

Finance Chair

James Krogmeier, Ph.D.
Purdue University
USA
jvkrogmeier@gmail.com

Publications Chair

Heng Wei, Ph.D., P.E.
University of Cincinnati
USA
heng.wei@uc.edu

Workshop/Tutorials Chair

Zhiheng Li, Ph.D.
Tsinghua University
China
zhhli@mail.tsinghua.edu.cn

Registration Chair

Javier J. Sanchez-Medina, Ph.D.
University of Las Palmas
de Gran Canaria
Las Palmas de Gran Canaria
Canary Islands, Spain
javier.sanchez.medina@ieee.org

Local Arrangements Chair

Jeffrey Miller, Ph.D.
University of Alaska
Anchorage
Anchorage, Alaska, USA
jeffrey.miller@ieee.org

Student Activities Chair

Brendan Morris, Ph.D.
University of Nevada, Las
Vegas, USA
brendan.morris@unlv.edu

Publicity Co-Chair

Urbano Nunes, Ph.D.
University of Coimbra
Portugal
urbano@deec.uc.pt

Publicity Co-Chair

Fei-Yue Wang, Ph.D.
National Laboratory
Chinese Academy of Sciences
Beijing, China
feiyue@ieee.org

Publicity Co-Chair

Matthew J Barth, Ph.D.
University of California-
Riverside
Riverside, California USA
matthew.barth@ucr.edu

International Technical Program Committee

Onur Altintas, Toyota InfoTechnology Center, Japan
Constantinos Antoniou, National Technical University of Athens, Greece
Erel Avineri, University of the West of England, UK
Matthew Barth, University of California, USA
Luis M. Bergasa, University of Alcala, Spain
Alberto Broggi, University of Parma, Italy
António Castro, LIACC, Portugal
Hilmi Berk Celikoglu, Technical University of Istanbul, Turkey
Yaobin Chen, Purdue School of Engineering and Technology, USA
Andrea D'Ariano, Delft University of Technology, Northlands
Christopher Day, Purdue University, USA
Arnaud de La Fortelle, Mines ParisTech University, France
Bart De Schutter, Delft University of Technology, Northlands
Joseph M. Ernst, Oak Ridge National Lab, USA
David Fernandez Llorca, Escuela Politecnica Superior, Spain
Dimitar Filev, Ford Research & Advanced Engineering, USA
Nikolas Geroliminis, Ecole Polytechnique Fédérale de Lausanne, Switzerland
Davide Giglio, University of Genova, Italy
Gabriel Gomes, University of California at Berkeley, USA
Somak Datta Gupta, University of California at Berkeley, USA
Ali Haghani, University of Maryland, USA
Jianming Hu, Tsinghua University, China
Makoto Itami, Tokyo Science University, Japan
Nazli E. Kahveci, IEEE, USA
Shunsuke Kamijo, University of Tokyo, Japan
Hironori Kato, University of Tokyo, Japan
Sun-il Kim, University of Alaska, USA
Rajesh Krishnan, Imperial College, UK
Jing-Quan Li, University of California at Berkeley, USA
Li Li, Tsinghua University, China
Zhiheng Li, Tsinghua University, China
Zhixia Li, University of Wisconsin-Madison, USA
Yingyan Lou, University of Alabama, USA
Mike Lowry, University of Washington, USA
Chang-Tien Lu, Virginia Tech University, USA
Meng Lu, Dutch Institute for Advanced Logistics, Netherlands
Jianming Ma, Texas Depart of Trans, USA
Xiaoliang Ma, Royal Institute of Technology, Sweden
Brendan Morris, University of Nevada, USA
Urbano Nunes, University of Coimbra, Portugal
Nikos Papanikolopoulos, University of Minnesota, USA
Brian Park Byungkyu, University of Virginia, USA
Danil Prokhorov, Toyota Research Institute NA, Japan
Yi Qi, Texas Southern University, USA
Xiao Qin, South Dakota State Univiersity, USA
Tony Qiu, University of Alberta, Canada
Hesham A. Rakha, Virginia Tech Transportation Institute, USA
Anand Ranganathan, IBM TJ Watson Research Center, USA
Javier J. Sanchez-Medina, Universidad de Las Palmas de Gran Canaria, Spain
Venky Shankar, Penn State University, USA
Christoph Stiller, Karlsruhe University, Germany
Hualiang Teng, University of Nevada, USA
Keiichi Uchimura, Kumamoto University, Japan
Francesco Viti, Kathoilieke Universiteit Leuven, Belgium
Eleni Vlahogianni, National Technical University of Athens, Greece
Bruce Wang, Texas A&M University, USA
Qian Wang, University of Buffalo, USA
Yao-Jan Wu, St. Louis University, USA
Yu Yuan, IBM Research, USA
Guohui Zhang, University of New Mexico, USA
Liping Zhang, Google, USA
Sheng Zhang, Tsinghua University, Chinaq
Yu Zhang, University of South Florida, USA
Jianyang Zheng, Maryland Department of Transportation, USA
Kun Zhou, University of California at Berkeley, USA
Fenghua Zhu, Chinese Academy of Sciences, China

Introduction to Keynote Speakers

Dr. Joseph I. Peters

Director, Federal Highway Administration's Office of Operations Research and Development

Keynote Speech: "*Pioneering the Wild Frontier in Intelligent Transportation"*

Over 50 years ago, the federal government pioneered the building of the interstate highway system in the US. Over 20 years ago, the federal government pioneered a new era defined by the "Intelligent Vehicle-Highway Systems Act of 1991." Today, the federal challenge is to pioneer the transportation frontiers in telecommunications, big data, and automation in ways that will revolutionize the ways we live.

Dr. Joseph I. Peters, Director of the Federal Highway Administration's Office of Operations Research and Development, will address the role that the federal government plays in creating R&D opportunities for electrical and electronics engineers who are pioneering the frontier in intelligent transportation. He will briefly highlight provisions of new legislation entitled, "Moving Ahead for Progress in the 21st Century Act," especially as they apply to intelligent transportation research. He will describe activities and opportunities at the Turner-Fairbank Highway Research Center and its new Saxton Transportation Operations Laboratory, as well as ongoing efforts as part of US DOT's connected vehicle research.

Dr. Joseph I. Peters directs a multi-disciplined staff in planning, conducting, and coordinating research, development, test, evaluation, and technology transfer initiatives aimed at improving traveler mobility on the Nation's highways. Over the past five years, his office has accomplished pioneering research and development of cooperative adaptive cruise control systems showing significant throughput, fuel savings, and environmental benefits associated with reduction of stop and go traffic. His office is currently developing and testing communications technologies for broadcasting traffic signal phase and timing information to vehicles and pedestrians as well as cooperative vehicle-highway communications technologies for enabling eco drive applications at signalized intersections. With the new Saxton Transportation Operations Laboratory up and running, his office will be providing new opportunities for senior level and student fellowships on site at the lab.

Joe has over 40 years of R&D experience including positions with the US DOT's Intelligent Transportation Systems Joint Program Office, a large government consulting company, US Air Force Systems Command, the US Army Research Institute for the Behavioral and Social Sciences, and, in the very beginning of his career, a research position at FHWA's Fairbank Highway Research Station. Dr. Peters is a graduate of Loyola College in Baltimore, MD, where he majored in Biology. He received his M.A. in Human Factors Psychology and his Ph.D. in Applied-Experimental Psychology from The Catholic University of America. He is the recipient of the Secretary of Transportation's Award for Meritorious Achievement and the FHWA Administrator's Award for Superior Achievement.

Mr. John Horsley

Executive Director, American Association of State Highway and Transportation Officials (AASHTO)

Keynote Speech: "*State of the ITS Industry"*

Twenty years ago, transportation professionals recognized that technologies are essential for getting the most out of our existing infrastructure – leading to the establishment of Intelligent Transportation Systems (ITS) programs in the United States. Today, using advanced technologies to improve information for travelers, reduce congestion, and improve safety is a growing practice among state DOTs. States are increasingly using "smart technologies" to improve system performance, safety and reliability. Citizens have come to expect that transportation agencies will use new technologies to help them get where they want to go, when they want to get there.

John Horsley, the Executive Director of the American Association of State Highway and Transportation Officials (AASHTO), will discuss about some great examples of how states across the country are turning to high-tech solutions to solve their transportation challenges.

In 1999, John Horsley became Executive Director of AASHTO, which advocates policies and provides technology leadership on behalf of States to improve the Nation's transportation system.

Previously, Horsley was nominated by the President and confirmed by the Senate as Associate Deputy Secretary of Transportation where he served from 1993 to 1999 as the Department's advocate for intermodal policies, quality of life initiatives and as liaison to State and Local Governments, US Congress, and transportation constituencies.

A native of the Northwest, Horsley was elected to five terms as County Commissioner in Kitsap County, a community just west of Seattle. He is a graduate of Harvard, an Army veteran, a former Peace Corps volunteer and Congressional aide, and did graduate study at Georgetown University. He is Past President of the National Association of Counties, and was founding Chairman of the Rebuild America Coalition.

He and his wife Deanna have been married for 36 years and have two children: Adam and Jennifer.

Dr. Christoph Stiller

President of the IEEE Intelligent Transportation Systems Society (2012-2013)

Keynote Speech: *"Towards Swarms of Self-Driving Automobiles"*

This presentation focuses on key technologies for automobiles that perceive their environment and based on this knowledge automatically navigate through everyday traffic in an autonomous and cooperative manner. Methods for 3D machine perception based on lidar, radar, and video sensors are outlined. The possible contribution of prior knowledge from digital maps is elaborated. Beyond classical metrology the recognition and basic understanding of situations must be accomplished for automated decision-making and trajectory planning. When multiple self-driving automobiles are present they are able to communicate their plans and mutually negotiate their trajectories. Inspired by biological swarms it is shown that a coordinated and homogenized traffic flow can be achieved through cooperative yet distributed planning. Results from autonomous vehicles are shown in real world urban and platooning scenarios including AnnieWAY the recent winner of the Grand Cooperative Driving Challenge.

Christoph Stiller studied Electrical Engineering in Aachen, Germany and Trondheim, Norway, and received the Diploma degree and the Dr.-Ing. degree (Ph.D.) from Aachen University of Technology in 1988 and 1994, respectively. He worked with INRS-Telecommunications in Montreal, Canada for a post-doctoral year as Member of the Scientific Staff in 1994/1995.

In 1995 he joined the Corporate Research and Advanced Development of Robert Bosch GmbH, Germany.

In 2001 he became chaired professor and director of the Institute for Measurement and Control Systems at Karlsruhe Institute of Technology, Germany.

Dr. Stiller serves as President of the IEEE Intelligent Transportation Systems Society (2012-2013), Associate Editor for the IEEE Transactions on Intelligent Transportation Systems (2004-ongoing), IEEE Transactions on Image Processing (1999-2003) and for ther IEEE Intelligent Transportation Systems Magazine (2012-ongoing). He has served as Editor-in-Chief of the IEEE Intelligent Transportation Systems Magazine (2009-2011). He has been program chair of the IEEE Intelligent Vehicles Symposium 2004 in Italy and General Chair of the IEEE Intelligent Vehicles Symposium 2011 in Germany. His autonomous driving team AnnieWAY has been finalist in the Darpa Urban Challenge 2007 and winner of the Grand Cooperative Driving Challenge in 2011.

Dr. Bin Ning

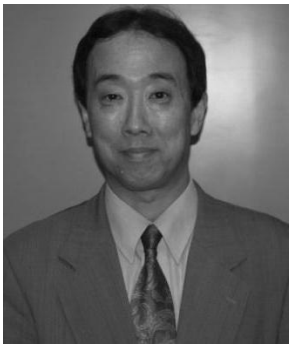
President of Beijing Jiaotong University, China

Keynote Speech: *"CTCS2 and CTCS3: Train Operation Control Systems for High Speed Railways in China"*

According to the standardization of Chinese Train Control System (CTCS), there are the two train operation control systems for high speed railways in China: CTCS2 and CTCS3. The two systems are widely applied in high speed railways in China to ensure the safety and efficiency of operation for high speed trains. This presentation will provide an overview of the train operation control systems for high speed railways in China. The discussions will also be about the operation principle of CTCS2 and CTCS3 and the challenges train operation control systems face, as well as further developments of the two systems for high speed railway networks in China.

Professor Bin Ning was a Vice President of Beijing Jiaotong University (BJTU) since December 1997 and the Executive Vice President of BJTU since 2004, and he was appointed President of Beijing Jiaotong University in 2008. Professor Bin Ning received his Bachelor, Master and Ph.D. degrees of Engineering from Beijing Jiaotong University. He is a fellow of the Association of International Railway Signaling Engineers (IRSE), a member of IEEE, a fellow of the Institute of Engineering and Technology (IET), and a fellow of the China Railway Society. He also serves as the Deputy Director of the China Traffic System Engineering Society and the Deputy Director of the Beijing Railway Society.

Dr. Makoto Itami



Professor of Tokyo University of Science, Japan

Keynote Speech: *"ITS Wireless Communication Systems in Japan"*

Recently, ITS systems are widely being developed and deployed in order to realize a safe and comfortable traffic environment. In ITS, wireless communication technology is one of the most important technologies. Dr. Makoto Itami will discuss about the development and deployment of ITS wireless communication systems in Japan such as VICS (Vehicular Information and Communication Service), ETC (Electronic Toll Collection) and ITS spot based on DSRC. In addition, the Japanese standard for inter-vehicle communication using the UHF band and its use in safety applications are also introduced.

Dr. Makoto Itami received his B.E., M.E. and D.E. degrees in Electrical Engineering from the University of Tokyo in 1984, 1986 and 1989, respectively. He then joined Department of Applied Electronics, Tokyo University of Science. He has been engaged in researches in digital communication systems, especially OFDM, UWB, spectrum spread communication and ITS communication. Between 2002 and 2003, he was a visiting research fellow of King's College, London. He is currently a professor of Tokyo University of Science. He is a member of IEEE, IEICE and ITE.

Mr. Ocie Adams

Project Manager for Statewide Maintenance and Operations Intelligent Transportation Systems for the Alaska DOT and Public Facilities

Keynote Speech: *"Smart Maintenance and Operations Vehicles"*

The Alaska Department of Transportation and Public Facilities partnered with the University of Minnesota to deploy the Smart Maintenance and Operations Vehicles in 2005 in Thompson Pass, Alaska. Thompson Pass receives an average annual snow fall of around 250 inches and winds in excess of 122 MPH. The port of Valdez is a primary shipping and resupply line for Eastern Alaska and the termination point of the Alaska Oil Pipeline. Closure of the Richardson Highway can result in emergency services and commercial operators not being able to deliver critical medical services, fuel, groceries, and pipeline maintenance supplies to the Richardson and Alaskan Highways.

With frequent zero visibility conditions in Thompson Pass the department needed a system that could assist the operators with snow removal and ice control duties. The University of Minnesota offered the best solution to our question. How do we give our operators tools that will help them stay on the road when the visibility would otherwise curtail snow and ice control operations? The University of Minnesota's solution was technology similar to that used in a fighter aircraft. Attend the Smart M&O Vehicles presentation to hear the solution.

Mr. Ocie Adams serves within the Commissioner's Office as the Project Manager for Statewide Maintenance and Operations Intelligent Transportation Systems for the Alaska Department of Transportation and Public Facilities. In this capacity, Ocie oversees the safe and efficient maintenance and operation through the use of technology of over 5600 miles of state owned roadways, 253 rural airports, 845 bridges and 720 State owned and/or managed buildings. His deployment of communications technology ensures that the department can do business even from the remotest parts of Alaska. Ocie is also responsible for managing the Airport Improvement Plan for the Surface Preservation Maintenance, the Obstruction Removal and the Airport Equipment Purchase programs. He has 11 years with the department. Ocie started his career working in Operations and Maintenance serving in the United States Air Force for 25 years as: Operator, Operator Mechanic, Air Traffic Controller, Combat Control Superintendent (Air Force Special Operations), Operations Superintendent, and retired from the Air Force as the Maintenance & Operations Superintendent 11th Air Force.

Ocie states that he absolutely loves living and working in Alaska with the unique challenges it poses. He said after being in the Air Force and traveling around the world several time, he finds the rest of the world a disappointment when compared to Alaska.

About ITSS

The IEEE Intelligent Transportation Systems Society (ITSS) advances the theoretical, experimental, and operational aspects of Electrical Engineering and Information Technologies as applied to ITS. The Society is interested in theoretical, experimental, and operational aspects of electrical and electronics engineering and information technologies as applied to ITS, defined as those systems utilizing synergistic technologies and systems engineering concepts to develop and improve transportation systems of all kinds.

The ITS Society has three different publications that are distributed quarterly. The Transactions on Intelligent Transportation Systems has repeatedly had the highest impact factor of all ITS and transportation-related journals. The Intelligent Transportation Systems Magazine appeals to a wider audience and publishes papers and articles that relate to all areas of ITS. The papers published in the Magazine undergo the same review process as that of the Transactions and have a similar acceptance rate. The Intelligent Transportation Systems Newsletter provides a large number of readers with information about the ITS Society, abstracts from the next issue of the Transactions, and other items that are of interest to a reader-base that does not solely consist of ITS Society members.

The ITS Society is overseen by the Board of Governors. This consists of 15 individuals elected by the members of the Society, and 10 individuals elected by the Board (known as the Executive Committee). The Board of Governors meets three times annually, typically through a teleconference in spring and in-person meetings in conjunction with the Intelligent Vehicles Symposium and the Intelligent Transportation Systems Conference. The Executive Committee meets one additional time in winter. If you are interested in becoming a BOG member, please speak with any of the current BOG members to find out more.

General Information about ITSC 2012

The 15th IEEE Intelligent Transportation Systems Conference (ITSC2012) is held September 16-19, 2012 in Anchorage, Alaska. The ITSC2012 theme is The Wild Frontier in Intelligent Transportation. The conference brings together researchers, engineers, practitioners, managers, and policy makers from academia, industry, and government to share and discuss the latest in Intelligent Transportation Systems (ITS) research and development (R&D) results and implementation strategies. It will include dedicated sessions, workshops, and forums at which researchers, practitioners, government experts, and decision makers will share the latest research, success stories, and implementation needs of ITS.

Venue: Hilton Anchorage

500 West Third Avenue
Anchorage, Alaska 99501, USA
Tel: +1 907 272 7411
Fax: +1 907 265 7044

The Hilton Anchorage is conveniently located in downtown Anchorage. Taxis are available to transport people from the Anchorage International Airport to the Hilton Anchorage. The ride should take approximately 10 minutes and cost around $20. Cars can be rented, though the Hilton does charge for valet parking. Street parking is permissible, though check posted signs as most of the streets in downtown Anchorage are metered.

Registration for the conference will be on the second floor of the Hilton, starting on Sunday at noon. Registration will continue through Wednesday afternoon, opening one hour before the first session and closing 30 minutes after the last session.

The plenary sessions and the lunches will occur in the Alaska/Aleutian ballrooms on the second floor of the Hilton. All of the sessions of the conference will be either on the first floor (Lupine, Fireweed), second floor (Dillingham, Katmai, King Salmon, Iliamna, Denali), or the 15th floor (Chart). The reception on Sunday evening will occur in the Top of the World restaurant on the 15th floor, and the banquet on Tuesday evening will be in both the Top of the World restaurant and the Chart room on the 15th floor.

Please make sure to wear your badge for all conference events, including the reception and the banquet. Tickets for beverages included in your bag should be brought to the designated event as well.

Any questions or concerns should be brought to the attention of the registration desk. The volunteers at the registration desk will be able to direct you to the appropriate person to handle the question if they are not able to.

Sightseeing Information

For those of you who have time to see a different part of the state other than the inside of the Hilton, here are a few recommendations.

- No visit to Alaska would be complete without seeing the largest peak in North America – Denali, also known as Mount McKinley, stands 20,320 feet high (6193.5 meters). Although the Denali National Park is about a three hour drive from Anchorage, seeing the beautiful, pristine forests and mountains along the way makes it perfect for wildlife viewing as well. Transportation can be provided by renting a car, riding a bus, or taking the Alaska railroad. If you are going by car or bus, make sure to note Sarah Palin's city of Wasilla on the way.
- Driving south from Anchorage will put you on the scenic Seward Highway along the Cook Inlet. Watch for beluga whales in the inlet to the west and dall sheep on the cliffs to the east.
- Continuing south about 90 minutes from Anchorage can take you through the longest tunnel in North America (2.5 miles or 4.0 kilometers) to the small city of Whittier. Taking a glacier cruise out of Whittier will show you more glaciers than you have probably seen in your entire life – some companies advertise showing you at least 26!
- Even though you should always be on the lookout for moose, bears, and bald eagles while in Alaska, there are only two places where viewing them can be guaranteed. The Alaska Zoo is in Anchorage and features many cold-weather animals, not just from Alaska. This is the only place you can see a polar bear in Anchorage, though my favorite animal is the musk ox. The Alaska Wildlife Conservation Center is a rehabilitation center for Alaskan animals about an hour south of Anchorage. You can see the Alaskan animals in enclosures that closely resemble their natural surroundings, and the center features many of Alaska's wildlife.
- I know that many of you have heard about the great fishing we have in Alaska. Since we are a little late in the season, I would suggest getting in touch with some fishing charters to see if they are still operating. Some charters run out of Seward (about two hours south of Anchorage) and Whittier (about 90 minutes south of Anchorage).
- If you want to stay a little closer in Anchorage and still see nature, the coastal trail, which is just a few minute walk from the Hilton, will provide you with amazing views of Cook Inlet, which is part of the Pacific Ocean.
- The Anchorage Museum, many wonderful dining options, tourist stores, fur shops, and many other attractions can be found by walking a few blocks in any direction from the Hilton Anchorage. If you are interested in seeing the local nightlife in Alaska, I would recommend F Street Bar or Darwin's Theory, both within walking (or stumbling) distance of the Hilton.

Although this just touches the surface of all Alaska has to offer, I hope this gives you some ideas for planning your time in Alaska away from the conference. Please do not hesitate to ask any of the local students or committee members. Any of us would love to tell you about all of the great activities Alaska has to offer.

Useful Sightseeing Web Links

- http://www.travelalaska.com/
- http://www.travelguidebook.com/index.cfm?inc=state&state_id=49
- http://www.whygoalaska.com/

Conference Program At A Glance

15th International IEEE Conference on Intelligent Transportation Systems
September 16-19, 2012, Anchorage, Alaska, USA

ITSC 2012 Technical Program for Sunday September 16, 2012

Track 1	Track 2
13:00-15:00 SA1 Dillingham Workshop 1: Emerging Technologies for Pedestrian/Bicycle Detection	13:00-15:00 SA2 King Salmon Workshop 2: Probe Data Analysis, Challenges, & Opportunities

15:30-17:30 SB1 Dillingham Workshop 3: Transportation Applications of Unmanned Aerial Vehicles	15:30-17:30 SB2 King Salmon Workshop 4: Transportation Data Management and Sharing

ITSC 2012 Technical Program for Monday September 17, 2012

Track 1	Track 2	Track 3	Track 4	Track 5	Track 6	Track 7	Track 8
08:00-10:30 MP1L Aleutian/Alaska Plenary Session on Monday							
11:00-12:30 MA1 Chart Automated Vehicle Operation 1	11:00-12:30 MA2 Denali Communication Technologies and Protocols 1	11:00-12:30 MA3 Dillingham Pedestrian and Vehicle Detection	11:00-12:30 MA4 Fireweed Lidar, Vision and Radar Sensing	11:00-12:30 MA5 Iliamna Calibration, Validation and Sensitivity Analysis of Traffic Simulation Models	11:00-12:30 MA6 Katmai Congestion Pricing and Demand Management	11:00-12:30 MA7 King Salmon Incident Detection	11:00-12:30 MA8 Lupine Eco Driving and Energy Efficient Intelligent Infrastructure 1
14:00-15:30 MB1 Chart Automated Vehicle Operation 2	14:00-15:30 MB2 Denali Communication Technologies and Protocols 2	14:00-15:30 MB3 Dillingham Lane Detection and Lane Keeping	14:00-15:30 MB4 Fireweed Vision Sensing and Image Processing -1	14:00-15:30 MB5 Iliamna Agent-Based Methods for Modeling and Analysis	14:00-15:30 MB6 Katmai Traveler Information	14:00-15:30 MB7 King Salmon Traffic Management and Control 1	14:00-15:30 MB8 Lupine Eco Driving and Energy Efficient Intelligent Infrastructure 2
16:00-17:30 MC1 Chart Advanced Vehicle Active Safety Systems	16:00-17:30 MC2 Denali Communication Technologies and Protocols 3	16:00-17:30 MC3 Dillingham Vehicle Detection and Classification	16:00-17:30 MC4 Fireweed Vision Sensing and Image Processing 2	16:00-17:30 MC5 Iliamna Simulation and Modeling 2	16:00-17:30 MC6 Katmai Travel Time Estimation and Prediction	16:00-17:30 MC7 King Salmon Traffic Management and Control 2	16:00-17:30 MC8 Lupine Eco-Driving and Energy Efficient Intelligent Infrastructure 3

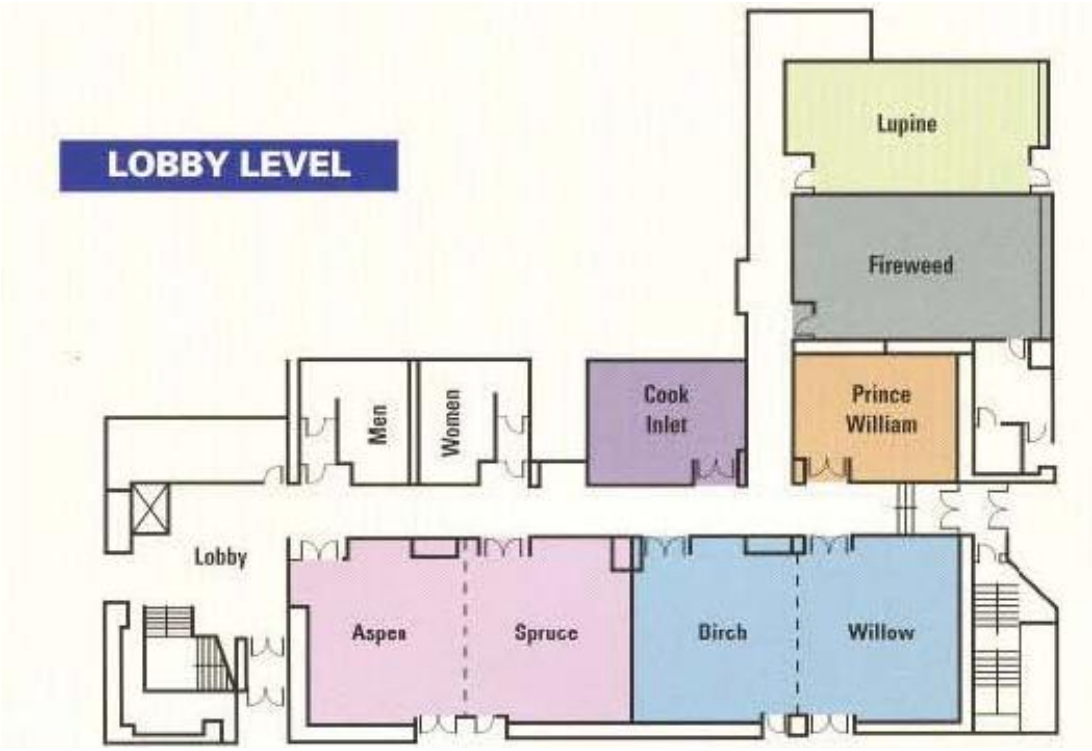
ITSC 2012 Technical Program for Tuesday September 18, 2012

Track 1	Track 2	Track 3	Track 4	Track 5	Track 6	Track 7	Track 8
09:00-10:30 TPL1 **Aleutian** **Plenary Session on Tuesday A**				**09:00-10:30 TPL2** **Alaska** **Plenary Session on Tuesday B**			
11:00-12:30 TA1 Chart Driver Behavior and Safety System	11:00-12:30 TA2 Denali Communication Technologies and Protocols 4	11:00-12:30 TA3 Dillingham Detection of Driving Environment 1	11:00-12:30 TA4 Fireweed Vision Sensing and Image Processing 3	11:00-12:30 TA5 Iliamna Simulation and Modeling 4	11:00-12:30 TA6 Katmai Route Planning and Guidance	11:00-12:30 TA7 King Salmon Parallel Transportation Management Systems	11:00-12:30 TA8 Lupine Eco Driving and Energy Efficiency
14:00-15:30 TB1 Chart Driver Behavior and Safety Systems 2	14:00-15:30 TB2 Denali Connected Vehicle Technology and Applications	14:00-15:30 TB3 Dillingham Detection of Driving Environment 2	14:00-15:30 TB4 Fireweed Imaging and Image Analysis	14:00-15:30 TB5 Iliamna Simulation and Modeling 6	14:00-15:30 TB6 Katmai Route Guidance and Demand Analysis Using Taxi Data	14:00-15:30 TB7 King Salmon Lane Level Traffic Management	14:00-15:30 TB8 Lupine Electric and Hybrid Vehicles
16:00-17:30 TC1 Chart Driver Assistance Systems - Speed Control	16:00-17:30 TC2 Denali Safety Analysis and Technologies	16:00-17:30 TC3 Dillingham Advanced Technologies and Innovative Concepts for Promoting Traffic Safety and Mobility	16:00-17:30 TC4 Fireweed Intersection Detection and Safety	16:00-17:30 TC5 Iliamna Simulation and Modeling 5	16:00-17:30 TC6 Katmai Emergency and Freight Operation	16:00-17:30 TC7 King Salmon Emergency Operation and Management	16:00-17:30 TC8 Lupine Parking Technologies

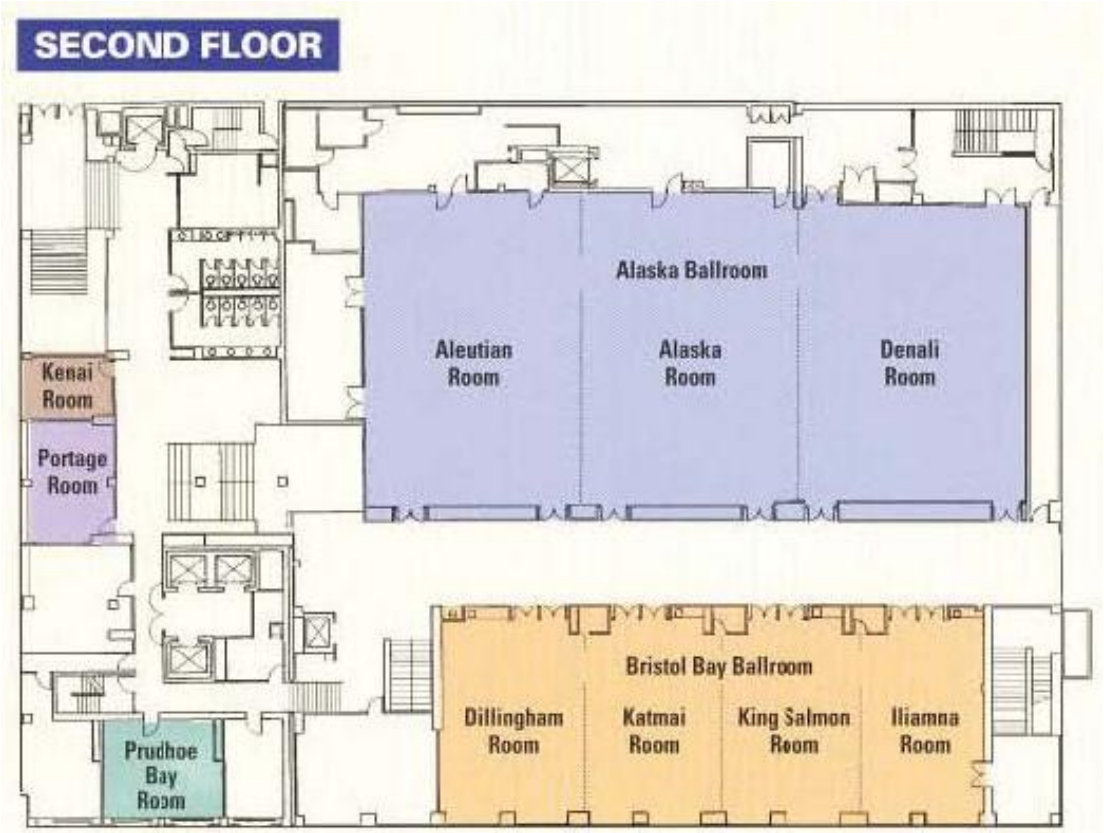
ITSC 2012 Technical Program for Wednesday September 19, 2012

Track 1	Track 2	Track 3	Track 4	Track 5	Track 6	Track 7	Track 8
09:00-10:30 WA1 Chart Driver Assist Systems - Traffic Signal/Sign Recognition	09:00-10:30 WA2 Denali Advanced Vehicle Technologies 1	09:00-10:30 WA3 Dillingham Vehicle Localization and Autonomous Navigation 1	09:00-10:30 WA4 Fireweed ITS Implementations 2	09:00-10:30 WA5 Iliamna Simulation and Modeling 1	09:00-10:30 WA6 Katmai Intelligent Solutions for Air Transportation and Air Space – (ISATAS)	09:00-10:30 WA7 King Salmon Weather Response Systems	09:00-10:30 WA8 Lupine Traffic Data Fusion
11:00-12:30 WB1 Chart Driver Assistance Systems 1	11:00-12:30 WB2 Denali Driver Assistance Systems 2	11:00-12:30 WB3 Dillingham Vehicle Localization and Autonomous Navigation 2	11:00-12:30 WB4 Fireweed ITS Implementations 1	11:00-12:30 WB5 Iliamna Simulation and Modeling 3	11:00-12:30 WB6 Katmai Travel Time Estimation and Its Applications	11:00-12:30 WB7 King Salmon Traffic Flow Management	11:00-12:30 WB8 Lupine Analysis Using Probe Vehicle Data
14:00-15:30 WC1 Chart Driver Assistance Systems - Lateral Control	14:00-15:30 WC2 Denali Advanced Vehicle Technologies 2	14:00-15:30 WC3 Dillingham Pedestrian Detection	14:00-15:30 WC4 Fireweed Human Factors Studies	14:00-15:30 WC5 Iliamna Simulation and Modeling 7	14:00-15:30 WC6 Katmai Advanced Public Transportation Systems	14:00-15:30 WC7 King Salmon Experimental Investigations	14:00-15:30 WC8 Lupine Network Level Traffic Analysis

Conference Floor Plan (Function Space Layouts)



WEST TOWER



Detailed Technical Program

Technical Program for Sunday September 16, 2012

Workshop 1: Emerging Technologies for Pedestrian/Bicycle Detection

Sunday, September 16th, 1:00 PM – 3:00 PM
SA1 Invited Session
Dillingham

Workshop Description

Sustainable transportation is a concept that is quickly gaining momentum. Walking and biking are becoming much more popular, and the demand for larger networks of pedestrian and bike trails is increasing quickly. This requires good quality pedestrian and bicycle data for both planning and facility operations purposes. Present pedestrian and bicycle data collection approaches are largely limited to surveys, which are either administered on location or via a broad distribution and manual counts, which involve field data collection by personnel and automatic spot counts. Existing algorithms for automatic spot counts are not satisfactory. New methods and technologies are desired to reduce the cost and improve the accuracy for pedestrian and bicycle data collection. This workshop brings top experts in the pedestrian and bicycle data collection field to share their knowledge and vision on the following issues:

(1) Needs for Pedestrian and Bicycle Detection;
(2) Existing Technologies and Challenges;
(3) Emerging Technologies that Can Be Applied in the Future; and
(4) Future Directions and Resources

Panelists

- **Al Fletcher,** Field Operations Engineer / Safety / Team Leader, FHWA's Division Office in Alaska
- **Jean-Francois Rheault,** Director, Eco-Counter
- **Edgar Seemann,** Professor, Darmstadt University of Technology
- **Luis F. Miranda-Moreno,** Assistant Professor, McGill University
- **Yinhai Wang,** Professor, University of Washington [Panel Chair]

Workshop 2: Probe Data Analysis, Challenges, & Opportunities

Sunday, September 16th, 1:00 PM – 3:00 PM
SA2 Invited Session
King Salmon

Workshop Description

The wide availability of probe-based data either from crowd-sourced apps, passenger vehicles, freight and other means is opening doors for many new applications, performance monitoring capabilities, and operational enhancements. However, probe data presents unique challenges with respect to collection, interpolation, aggregation, sheer data quantity, data quality, and a lack of volume measurements--just to name a few. This workshop will explore ways in

which researchers in both the public and private sector are working with probe data to address these issues. Attendees will also see demonstrations of several cutting edge probe data applications that are being developed for safety, operations, and performance measurement. Following brief presentations and demonstrations, workshop attendees will be engaged in a moderated discussion relating to various probe-data issues and processing methodologies.

Panelists

- **Alexandre Bayen**, UC Berkeley: Mobile Millennium. GPS enabled smartphones for integrated corridor management.
- **Walter Fehr**, RITA: The Federal perspective on massive probe data challenges with examples from a 1-year Safety Pilot Model Deployment of over 3,000 vehicles.
- **Michael L. Pack**, University of Maryland CATT Laboratory: Rapid, Multi-state Bottleneck Prioritization & Corridor Analysis using Probe Data. [Panel Chair]
- **Ted Trapanier**, INRIX: Multistate next-Gen passenger probe data safety sensor analysis.
- **Stan Young**, Traffax: Bluetooth probe data analysis and potential.

Workshop 3: Transportation Applications of Unmanned Aerial Vehicles

Sunday, September 16th, 3:30 PM – 5:30 PM
SB1 Invited Session
Dillingham

Workshop Description

Unmanned aerial vehicle (UAV) technologies are getting into the stage for commercial applications. Off the shelf UAV products became smaller and less expensive. Combining surveillance video technologies with UAV may enable data collection in areas where the geographic locations of potential transportation-related problems are only crudely known or in areas where conventional data collection technologies based on point detections cannot gather the data needed for important transportation studies. This workshop brings together top experts who conducted pilot studies on UAV applications in transportation to share their knowledge and vision on the following issues:

(1) Existing UAV Technologies Suitable for Transportation Applications;
(2) Success Stories and Lessons Learned;
(3) Potential Benefits of Data Collectable from UAV-based Systems; and
(4) Future Directions and Resources.

Panelists

- **Qingzhou Mao,** Associate Director, State Key Laboratory of Information Engineering in Surveying, Mapping, and Remote Sensing, Wuhan University
- **Zhong-Ren Peng,** Professor, University of Florida
- **Martin Ruhé,** Dipl.-Ing., Transportation Studies, German Aerospace Center
- **Zuo Zhang,** Associate Dean, School of Information Science and Technology, Tsinghua University [Panel Chair]

Workshop 4: Transportation Data Management and Sharing

Sunday, September 16th, 3:30 PM – 5:30 PM
SB2 Invited Session
King Salmon

Workshop Description

In recent years, traffic detectors have been intensively deployed in major highway systems across the country. These sensors generate tremendous traffic data that are extremely valuable for traffic management, forecast, and control. How to manage the data efficiently and produce the most useful information out of them have been crucial challenges faced by traffic professionals. This need is particularly highlighted by the recent "big data" initiatives. Considering that many different kinds of transportation data management systems have been developed, this workshop brings together top experts with such experience to share their knowledge and vision on the following issues:

(1) Needs and Challenges for Transportation Data Management and Sharing
(2) Existing Platforms and Their Pros and Cons
(3) Emerging Technologies that Can Be Applied in the Future
(4) Future Directions and Resources

Panelists

- **Jonathan Corey,** STAR Lab Manager, University of Washington
- **Zhaocheng He,** Associate Professor, ITS Laboratory, Sun Yat-Sen University
- **Michael Pack,** Director, CATT Laboratory, University of Maryland
- **Yi Zhang,** Professor, Tsinghua University [Panel Chair]

Technical Program for Monday September 17, 2012

MP1L Aleutian/Alaska

Plenary Session on Monday (Plenary Session)

08:00-09:30 MP1L.1

*Pioneering the Wild Frontier in Intelligent Transportation**.

Peters, Joseph	USDOT/Federal Highway Administration

09:30-10:30 MP1L.2

*State of the ITS Industry**.

Horsley, John	American Association of State Highway & Transportation Officials

MA1 Chart

Automated Vehicle Operation 1 (Regular Session)

11:00-11:18 MA1.1

Performance Limitations in Vehicle Platoon Control, pp. 1-6.

Solyom, Stefan	Volvo Car Corp.
Coelingh, Erik	Volvo Car Corp.

11:18-11:36 MA1.2

Temporal Analysis of the Gate Concept As Enabler for Highly Automated Driving Based on the Conduct-By-Wire Approach, pp. 7-12.

Geyer, Sebastian	Tech. Univ. Darmstadt
Karg, Melanie	Tech. Univ. Darmstadt
Hakuli, Stephan	IPG Automotive GmbH
Winner, Hermann	Tech. Univ. Darmstadt
Franz, Benjamin	Tech. Univ. Darmstadt
Kauer, Michaela	Tech. Univ. Darmstadt

11:36-11:54 MA1.3

A Scaled-Down Traffic System Based on Autonomous Vehicles: A New Experimental System for ITS Research, pp. 13-18.

He, Wen	Tsinghua Univ.
Guisheng, Chen	Chinese Inst. of Electronic System Engineering
Shuming, Tang	Chinese Acad. of Sciences
Deyi, Li	Chinese Inst. of Electronic System Engineering
Mu, Guo	Tsinghua Univ.
Tianlei, Zhang	Tsinghua Univ.
Peng, Jia	Military Transportation Inst.
Feng, Jin	Xi'an Communication Inst.

11:54-12:12 MA1.4

A New Fuzzy Speed Control Strategy Considering Lateral Vehicle Dynamics, pp. 19-24.

Sezer, Volkan	Istanbul Tech. Univ.
Ercan, Ziya	Istanbul Tech. Univ.
Heceoglu, Hasan	Istanbul Tech. Univ.
Gokasan, Metin	Istanbul Tech. Univ. Electrical & Electronics Engineeringi
Bogosyan, Seta	Istanbul Tech. Univ.

MA2 Denali

Communication Technologies and Protocols 1 (Regular Session)

11:00-11:18 MA2.1

Highway Test of V2V Mesh Communications Over WSN, pp. 25-30.

Naranjo, Jose	Univ. Pol. de Madrid
Talavera, Edgar	Univ. Pol. de Madrid
Anaya, Jose Javier	Univ. Pol. de Madrid
Jiménez, Felipe	Univ. Pol. de Madrid
Zato, José Gabriel	Univ. Pol. de Madrid
Gomez, Nuria	Univ. Pol. de Madrid

11:18-11:36 MA2.2

Performance Evaluation of V2I-Based Channel Aware Floating Car Data Transmission Via LTE, pp. 31-36.

Ide, Christoph	TU Dortmund Univ.
Dusza, Bjoern	TU Dortmund Univ.
Wietfeld, Christian	TU Dortmund Univ.

11:36-11:54 MA2.3

The Multi-Adaptive Routing Protocol for Obstacles and without Obstacles on VANET, pp. 37-41.

Vijitkunsawat, Wuttichai	Rajamangala Univ. of Tech. Krungthep
Anunvrapong, Pramote	Rajamangala Univ. of Tech. Krungthep

11:54-12:12 MA2.4

Cooperative Intersection Management: Real Implementation and Feasibility Study of a Sequence Based Protocol for Urban Applications, pp. 42-47.

Perronnet, Florent	Univ. de Tech. de Belfort-Montbéliard (UTBM)
Abbas-Turki, Abdeljalil	Univ. de Tech. de Belfort Montbéliard
Buisson, Jocelyn	Voxelia
El Moudni, Abdellah	Univ. of Tech. of Belfort-Montbeliard (UTBM)
Zéo, Renan	Voxelia
Ahmane, Mourad	Univ. of Tech. of Belfort-Montbeliard (UTBM)

MA3 Dillingham

Pedestrian and Vehicle Detection (Regular Session)

11:00-11:18 MA3.1

Real-Time Robust Vehicle Flow Statistics Based on Adjacent Frames Clustering, pp. 48-53.

Liu, Yan	Peking Univ.
Lu, Xiaoqing	Peking Univ.
Xu, Jianbo	Peking Univ. Founder Group Co.LTD
Qin, Yeyang	Peking Univ.
Tang, Zhi	Peking Univ.

11:18-11:36 MA3.2

Positioning of Road Users by RSSI with Road Surface Reflection Model, pp. 54-60.

Hisaka, Shoma	The Univ. of Tokyo
Kamijo, Shunsuke	The Univ. of Tokyo

11:36-11:54 MA3.3

Monocular Target Detection on Transport Infrastructures with Dynamic and Variable Environments, pp. 61-66.

Alvarez Pardo, Sergio	Univ. of Alcala
Fernandez Llorca, David	Univ. of Alcala
Sotelo, Miguel A.	Univ. of Alcala
García Lorente, Alejandro	Univ. of Alcalá

11:54-12:12 MA3.4

Urban Road User Classification Framework Using Local Feature Descriptors and HMM, pp. 67-72.

Takahashi, Toshimitsu	The Univ. of Tokyo
Kim, HyungKwan	The Univ. of Tokyo
Kamijo, Shunsuke	The Univ. of Tokyo

12:12-12:30 MA3.5

Two-Stage Part-Based Pedestrian Detection, pp. 73-77.

Møgelmose, Andreas	Aalborg Univ.
Prioletti, Antonio	Univ. of Parma
Trivedi, Mohan M.	Univ. of California at San Diego
Broggi, Alberto	Univ. of Parma
Moeslund, Thomas B.	Aalborg Univ.

MA4 Fireweed

Lidar, Vision and Radar Sensing (Regular Session)

11:00-11:18 MA4.1

Sensor System Blockage Detection for Night Time Headlight Control Based on Camera and Radar Sensor Information, pp. 78-83.

Gavriilidis, Alexandros	Univ. of Wuppertal
Mueller, Dennis	Delphi Electronics & Safety
Müller-Schneiders, Stefan	Delphi Deutschland GmbH
Kummert, Anton	Univ. of Wuppertal
Velten, Jörg	Univ. of Wuppertal

11:18-11:36 MA4.2

A Cost-Effective Radar System for Automotive Powertrain Control Applications, pp. 84-89.

Beg, Chris	Univ. of Waterloo
Vajedi, Mahyar	Univ. of Waterloo
Nezhad-Ahmadi, Mohammad-Reza	Univ. of Waterloo
L. Azad, Nasser	Univ. of Waterloo
Safavi-Naeini, Safieddin	Univ. of Waterloo

11:36-11:54 MA4.3

Vision-Based Lateral Position Improvement of RADAR Detections, pp. 90-97.

Nishigaki, Morimichi	Honda R&D Europe (Deutschland) GmbH
Rebhan, Sven	Honda Res. Inst. Europe GmbH
Einecke, Nils	Honda Res. Inst. Europe GmbH

11:54-12:12 MA4.4

Rear Obstacle Detection System Based on Depth from Kinect, pp. 98-101.

Choi, Jinwook	Yonsei Univ.
Kim, Deukhyeon	Yonsei Univ.
Yoo, Hunjae	Yonsei Univ.
Sohn, Kwanghoon	Yonsei Univ.

MA5 Iliamna

Calibration, Validation and Sensitivity Analysis of Traffic Simulation Models (Special Session)

Organizer: Antoniou, Constantinos	National Tech. Univ. of Athens
Organizer: Punzo, Vincenzo	European Commission Joint Res. Centre
Organizer: Brackstone, Mark	IOMI Consulting

11:00-11:18 MA5.1

Parallel Public Transport System and Its Application in the Evacuation of Large-Scale Activities (I), pp. 102-107.

Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Chen, Songhang	Chinese Acad. of Sciences
Lv, Yisheng	Chinese Acad. of Sciences
Ye, Peijun	Chinese Acad. of Sciences

11:18-11:36 MA5.2

Calibration of Microscopic Traffic Flow Models against Time-Series Data (I), pp. 108-114.

Montanino, Marcello	Univ. of Naples Federico II
Ciuffo, Biagio	Joint Res. Centre - European Commission
Punzo, Vincenzo	European Commission Joint Res. Centre

11:36-11:54 MA5.3

Efficient Real Time OD Matrix Estimation Based on Principal Component Analysis (I), pp. 115-121.

Djukic, Tamara	Delft Univ. of Tech.
Flötteröd, Gunnar	KTH Royal Inst. of Tech.
van Lint, Hans	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.

11:54-12:12 MA5.4

Evolutionary Approach to Calibration of Cellular Automaton Based Traffic Simulation Models, pp. 122-129.

Korcek, Pavol	Brno Univ. of Tech.
Sekanina, Lukas	Brno Univ. of Tech. - Faculty of InformationTechnology
Fucik, Otto	Brno Univ. of Tech. - Faculty of InformationTechnology

12:12-12:30 MA5.5

Effectiveness of Speed Measures to Improve Roundabout Capacity "Case Study", pp. 130-133.

Abaza, Osama	Univ. of Alaska Anchorage

MA6 Katmai

Congestion Pricing and Demand Management (Regular Session)

11:00-11:18 MA6.1

London Congestion Charging: Successes, Gaps and Future Opportunities Offered by Cooperative ITS, pp. 134-139.

Kaparias, Ioannis	City Univ. London
Bell, Michael Geoffrey Harrison	Imperial Coll. London

11:18-11:36 MA6.2

Empirical Evaluation of a Dynamic and Distributed Taxi-Sharing System, pp. 140-146.

d'Orey, Pedro M.	Univ. of Porto, Inst. de Telecomunicações
Fernandes, Ricardo	Inst. de Telecomunicações
Ferreira, Michel	Inst. de Telecomunicações

11:36-11:54 MA6.3

Dynamic Traffic Congestion Pricing Mechanism with User-Centric Considerations, pp. 147-154.

Bui, Kim	Massachusetts Inst. of Tech.
Huynh, Vu	Massachusetts Inst. of Tech.
Frazzoli, Emilio	Massachusetts Inst. of Tech.

11:54-12:12 MA6.4

Assessing Economic Impacts of Implementing a Vehicle of Miles Traveled Fee in Nevada, pp. 155-159.

Paz, Alexander	Univ. of Nevada, Las Vegas
Nordland, Andrew	Univ. of Nevada, Las Vegas
Khan, Alauddin	Nevada Department of Transportation

12:12-12:30 MA6.5

TruCentive: A Game-Theoretic Incentive Platform for Trustworthy Mobile Crowdsourcing Parking Services, pp. 160-166.

Hoh, Baik	Nokia Res. Center
Yan, Tingxin	Univ. of Massachusetts, Amherst
Deepak, Ganesan	Univ. of Massachusetts, Amherst
Ken, Tracton	Nokia Res. Center
Toch, Iwuchukwu	Nokia Res. Center
Juong-Sik, Lee	Nokia Res. Center

MA7 King Salmon

Incident Detection (Regular Session)

11:00-11:18 MA7.1

Prediction of Freeway Traffic Incident Delay Based on Simulation, pp. 167-171.

Zhang, Hongbin	Southeast Univ.
Ni, Fujian	Southeast Univ.
Yang, Shunxin	Southeast Univ.

11:18-11:36 MA7.2

An Unsupervised Feature Learning Approach to Improve Automatic Incident Detection, pp. 172-177.

Ren, Jimmy SJ.	City Univ. of Hong Kong
Wang, Wei	City Univ. of Hong Kong
Wang, Jiawei	USTC-CityU Joint Advanced Res. Centre
Liao, Stephen	City Univ. of Hong Kong

11:36-11:54 MA7.3

Advanced Method of Detection of Unnecessary Conflicts of Traffic Flows, pp. 178-181.

Dadic, Ivan	Faculty of Traffic and Transportation Sciences
Damir, Skaro	AK Siget
Vidovic, Kresimir	Faculty of Traffic and Transportation Sciences
Ševrović, Marko	Faculty of Transport and Traffic Sciences
Sostaric, Marko	Faculty of Traffic and Transportation Sciences
Jeremic, Dragana	Faculty of Tech. Sciences

11:54-12:12 MA7.4

Traffic Incident Detection System Using Series of Point Detectors, pp. 182-187.

Hiriotappa, Kittipong	NECTEC
Thajchayapong, Suttipong	NECTEC
Likitkhajorn, Chakrit	NECTEC
Poolsawat, Anurak	NECTEC

MA8 Lupine

Eco Driving and Energy Efficient Intelligent Infrastructure 1 (Regular Session)

11:00-11:18 MA8.1

Field Operational Testing of ECO-Approach Technology at a Fixed-Time Signalized Intersection, pp. 188-193.

Xia, Haitao	Univ. of California-Riverside
Boriboonsomsin, Kanok	Univ. of California-Riverside
Schweizer, Friedrich	BMW Tech. Office Mountain View
Winckler, Andreas	BMW Tech. Office Mountain View
Zhou, Kun	Univ. of California-Berkeley
Zhang, Wei-Bin	Univ. of California-Berkeley
Barth, Matthew	Univ. of California-Riverside

11:18-11:36 MA8.2

Optimization of Driving Styles for Fuel Economy Improvement, pp. 194-199.

Malikopoulos, Andreas	Oak Ridge National Lab.
Aguilar, Juan	Oak Ridge National Lab.

11:36-11:54 MA8.3

Enhanced Eco-Driving System Based on V2X Communication, pp. 200-205.

Chen, Yuxiao	Tsinghua Univ.
Zhang, Dezhao	Tsinghua Univ.
Li, Keqiang	Tsinghua Univ.

11:54-12:12 MA8.4

A RFID Based E-STOP Sign and Its Impacts to Vehicle Emissions, pp. 206-211.

Qiao, Fengxiang	Texas Southern Univ.
Wang, Jinghui	Texas Southern Univ.

Wang, Xiaobing	Texas Southern Univ.
Jia, Jing	Texas Southern Univ.
Yu, Lei	Texas Southern Univ.

12:12-12:30 MA8.5

Fuel Efficiency Driver Assistance System for Manufacturer Independent Solutions, pp. 212-217.

Guan, Tianyi	Fraunhofer IOSB
Frey, Christian	Fraunhofer IOSB

MB1 Chart

Automated Vehicle Operation 2 (Regular Session)

14:00-14:18 MB1.1

Outdoor Intersection Detection for Autonomous Exploration, pp. 218-223.

Tourani, Siddharth	IIIT Hyderabad
Mukhija, Piyoosh	International Inst. of Information Tech.
Krishna, K Madhava	IIIT Hyderabad

14:18-14:36 MB1.2

Shader-Based Sensor Simulation for Autonomous Car Testing, pp. 224-229.

Wang, Shuiying	Freie Univ. Berlin
Heinrich, Steffen	Freie Univ. Berlin
Wang, Miao	Freie Univ. Berlin
Rojas, Raúl	Freie Univ. Berlin

14:36-14:54 MB1.3

A Novel Approach for a Double-Check of Passable Vegetation Detection in Autonomous Ground Vehicles, pp. 230-236.

Nguyen, Duong-Van	Univ. of Siegen, Germany
Kuhnert, Lars	Univ. of Karlsruhe
Schlemper, Jens	Univ. of Siegen
Thamke, Stefan	Univ. of Siegen
Kuhnert, Klaus-Dieter	Univ. of Siegen, Germany

14:54-15:12 MB1.4

A Surveillance and Safety System Based on Performance Criteria and Functional Degradation for an Autonomous Vehicle, pp. 237-242.

Reschka, Andreas	Univ. Hildesheim
Böhmer, Jürgen Rüdiger	Univ. Hildesheim
Nothdurft, Tobias	Tech. Univ. Braunschweig
Hecker, Peter	Tech. Univ. Braunschweig
Lichte, Bernd	Tech. Univ. Braunschweig
Maurer, Markus	TU Braunschweig

MB2 Denali

Communication Technologies and Protocols 2 (Regular Session)

14:00-14:18 MB2.1

Positioning Error Correction for DS-CDMA IVC under Location Oriented PN Code Allocation Scheme, pp. 243-247.

Namiki, Taro	Tokyo Univ. of Science
Ogata, Satoshi	Tokyo Univ. of Science
Sakakibara, Sho	Tokyo Univ. of science
Ohno, Kohei	Tokyo Univ. of Science
Itami, Makoto	Tokyo Univ. of Science

14:18-14:36 MB2.2

Continuous Broadband Communication System Based on Existing Open Source Network Tools for Vehicular Environments, pp. 248-253.

Urquiola, Gorka	Univ. of Deusto
Perallos, Asier	Univ. of Deusto
Carballedo, Roberto	Univ. of Deusto

14:36-14:54 MB2.3

Improving Performance of Inter-Vehicle Communication Scheme Using Location Oriented PN Code Allocation Technique, pp. 254-259.

Ogata, Satoshi	Tokyo Univ. of Science
Sakakibara, Sho	Tokyo Univ. of science
Ohno, Kohei	Tokyo Univ. of Science
Itami, Makoto	Tokyo Univ. of Science

14:54-15:12 MB2.4

CANOPNR: CAN-OBD Programmable-Expandable Network-Enabled Reader for Real-Time Tracking of Slippery Road Conditions Using Vehicular Parameters, pp. 260-264.

Enriquez, Dj	Univ. of Alaska, Anchorage; Honeywell HPS
Bautista, Alexander	Univ. of Alaska Anchorage
Field, Paloma	Univ. of Alaska Anchorage
Kim, Sun-il	Univ. of Alaska, Anchorage
Jenson, Sean	Univ. of Alaska Anchorage
Ali, Muhammad	Univ. of Alaska, Anchorage
Miller, Jeffrey	Univ. of Alaska Anchorage

MB3 Dillingham

Lane Detection and Lane Keeping (Regular Session)

14:00-14:18 MB3.1

Dynamic Delay Compensation for Lane Departure Warning System, pp. 265-269.

Zhang, Sumin	Jilin Univ.
Deng, Weiwen	General Motors Corp.
Wang, Ye	Jilin Univ.
Zhao, Qingrong	General Motors Company

14:18-14:36 MB3.2

A Random Finite Set Approach to Multiple Lane Detection, pp. 270-275.

Deusch, Hendrik	Univ. of Ulm
Wiest, Juergen	Univ. of Ulm
Reuter, Stephan	Univ. of Ulm
Szczot, Magdalena	Univ. of Ulm
Konrad, Marcus	EvoBus GmbH - Daimler Buses
Dietmayer, Klaus	Univ. of Ulm

14:36-14:54 MB3.3

A Global and Local Condensation for Lane Tracking, pp. 276-281.

Yao, Wentao	Tsinghua Univ.
Deng, Zhidong	Tsinghua Univ.

Chen, Zhenhua	Tsinghua Univ.

14:54-15:12 MB3.4

A Unified Framework of the Automated Lane Centering/Changing Control for Motion Smoothness Adaptation, pp. 282-287.

Lee, Jin-Woo	General Motors, Res. and Development
Litkouhi, Bakhtiar	General Motor R&D Center

15:12-15:30 MB3.5

Spatial Ray Features for Real-Time Ego-Lane Extraction, pp. 288-293. Attachment

Kühnl, Tobias	Bielefeld Univ.
Kummert, Franz	Bielefeld Univ.
Fritsch, Jannik	Honda Res. Inst. Europe GmbH

MB4 Fireweed

Vision Sensing and Image Processing -1 (Regular Session)

14:00-14:18 MB4.1

Track and Turnout Detection in Video-Signals Using Probabilistic Spline Curves, pp. 294-299.

Ross, Ralph Werner	Karlsruhe Inst. of Tech.

14:18-14:36 MB4.2

Trinocular Optical Flow Estimation for Intelligent Vehicle Applications, pp. 300-306.

Kitt, Bernd	KIT
Lategahn, Henning	Inst. of Measurement & Control

14:36-14:54 MB4.3

Tomographical Scene Reconstruction in the Active Safety Car Project, pp. 307-312.

Velten, Joerg	Univ. of Wuppertal
Schauland, Sam	Riedel Communications
Gavriilidis, Alexandros	Univ. of Wuppertal
Schwerdtfeger, Tim	Univ. of Wuppertal
Boschen, Fritz	Univ. of Wuppertal
Kummert, Anton	Univ. of Wuppertal

14:54-15:12 MB4.4

Multiresolution Based Sigma-Delta for Motion Segmentation, pp. 313-318. Attachment

Mukherjee, Dibyendu	Univ. of Windsor
Saha, Ashirbani	Univ. of Windsor
Wu, Q. M. Jonathan	Univ. of Windsor

MB5 Iliamna

Agent-Based Methods for Modeling and Analysis (Regular Session)

14:00-14:18 MB5.1

Multi-Agent Reinforcement Learning for Integrated Network of Adaptive Traffic Signal Controllers (MARLIN-ATSC), pp. 319-326.

El-Tantawy, Samah	Univ. of Toronto
Abdulhai, Baher	Univ. of Toronto

14:18-14:36 MB5.2

A Survey of Urban Traffic Signal Control for Agent Recommendation System, pp. 327-333.

Chen, Cheng	Inst. of Automation, Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of Sciences
Ai, Yunfeng	Inst. of Automation, Chinese Acad. of Sciences

14:36-14:54 MB5.3

Approximately Orchestrated Routing and Transportation Analyzer: Large-Scale Traffic Simulation for Autonomous Vehicles, pp. 334-339.

Carlino, Dustin	Univ. of Texas at Austin
Depinet, Michael	Univ. of Texas
Khandelwal, Piyush	Univ. of Texas at Austin
Stone, Peter	The Univ. of Texas at Austin

14:54-15:12 MB5.4

Reconsider Your Strategy - an Agent-Based Conceptualisation of Compensatory Driver Behaviour, pp. 340-346.

Lützenberger, Marco	Tech. Univ. Berlin
Ahrndt, Sebastian	Tech. Univ. Berlin
Hirsch, Benjamin	Khalifa Univ.
Masuch, Nils	Tech. Univ. Berlin
Heßler, Axel	Tech. Univ. Berlin
Albayrak, Sahin	Tech. Univ. Berlin

MB6 Katmai

Traveler Information (Regular Session)

14:00-14:18 MB6.1

An Integrated Architecture for the Development and Assessment of ADAS, pp. 347-354.

Noth, Sebastian	NISYS GmbH
Edelbrunner, Hannes	NISYS GmbH
Iossifidis, Ioannis	HRW Univ. of Applied Sciences

14:18-14:36 MB6.2

Relocation Strategies and Algorithms for Free-Floating Car Sharing Systems, pp. 355-360.

Weikl, Simone	Univ. of Federal Armed Forces Munich
Dr. Bogenberger, Klaus	Univ. of Federal Armed Forces Munich

14:36-14:54 MB6.3

Contextual Information in User Information Systems in Public Transportation: A Systematic Review, pp. 361-366.

Borgiani, Felipe Silveira Mello	Federal Univ. of Pernambuco
Tito, Adriano	Univ. Federal de Pernanbuco
Santos, Rodolfo	Federal Univ. of Pernambuco
Tedesco, Patricia Cabral de Azevedo Restelli	Federal Univ. of Pernambuco
Salgado, Ana Carolina	Federal Univ. of Pernambuco

14:54-15:12 MB6.4

Adaptive Route Guidance System with Real-Time Traffic Information, pp. 367-372.

Li, Caixia	the Univ. of New South Wales
Anavatti, Sreenatha	Univ. of New South Wales

15:12-15:30 MB6.5

A Model for Automatic Collection and Dynamic Transmission of Traffic Information Based on VANET, pp. 373-378.

Zhang, Qi	Univ. of Science & Tech. Beijing
Zhao, JianHao	Univ. of Science & Tech. Beijing

MB7 King Salmon

Traffic Management and Control 1 (Regular Session)

14:00-14:18 MB7.1

Evaluations of Intelligent Traffic Signal Control Algorithms under Realistic Landmark-Based Traffic Patterns Over the NCTUns Network Simulator, pp. 379-384.

Wang, Shie-Yuan	National Chiao Tung Univ.
Li, Yu-Wei	National Chiao Tung Univ.

14:18-14:36 MB7.2

Signal Control Strategy between Expressway Off-Ramp and On-Ramp Area in Beijing, pp. 385-390.

Zhang, Haizheng	Tsinghua Univ.
Li, Weixia	Tsinghua Univ.
Li, Zhiheng	Tsinghua Univ.
Tan, Jiyuan	Tsinghua Univ.
Yao, Danya	Tsinghua Univ.
Li, Li	Tsinghua Univ.

14:36-14:54 MB7.3

Optimized Two-Stage Fuzzy Control for Urban Traffic Signals at Isolated Intersection and Paramics Simulation, pp. 391-396.

Yang, Wenchen	School of Transportation Engineering, Tongji Univ.
Zhang, Lun	School of Transportation Engineering, Tongji Univ.
He, Zhaocheng	Intelligent Transportation Res. Centre, Sun Yat-senUniversit
Zhuang, Lijian	Intelligent Transportation Res. Centre, Sun Yat-senUniversit

14:54-15:12 MB7.4

Delay Analysis of Signal Control Policies for an Isolated Intersection, pp. 397-402.

Ghavami, Abouzar	Rensselaer Pol. Inst.
Kar, Koushik	Rensselaer Pol. Inst.
Ukkusuri, Satish	Purdue Univ.

15:12-15:30 MB7.5

Improving Intersection Performance with Left Turn Phase Reservice Strategies, pp. 403-408.

Corey, Jonathan	Univ. of Washington
Lao, Yunteng	Univ. of Washington
Xin, Xin	Univ. of Washington
Wang, Yinhai	Univ. of Washington

MB8 Lupine

Eco Driving and Energy Efficient Intelligent Infrastructure 2 (Regular Session)

14:00-14:18 MB8.1

Optimal Real-Time Navigation System: Application to a Hybrid Electrical Vehicle, pp. 409-414.

Hrazdira, Adam	Brno Univ. of Tech.
Cela, Arben	ESIEE Paris
Hamouche, Redha	ESIEE Paris
Reama, Abdellatif	ESIEE Paris
Rezende, Bernardo	Univ. Federal de Minas Gerais
Niculescu, Silviu-Iulian	Lab. de Signaux et Systemes (L2S, UMR CNRS 8506)
Villedieu, Christophe	AKKA Tech.

14:18-14:36 MB8.2

Comparison of VSP Profiles for Three Types of Intersection Control and Implications for Emissions, pp. 415-420.

Hallmark, Shauna	Iowa State Univ. USA
Mudgal, Abhisek	Iowa State Univ.

14:36-14:54 MB8.3

A Self-Learning Traffic Signal Control Method for CO2 Reduction Using Prediction of Vehicle Arrivals, pp. 421-426.

Umedu, Takaaki	Osaka Univ.
Togashi, Yuji	OsakaUniversity
Higashino, Teruo	Osaka Univ.

14:54-15:12 MB8.4

Energy Efficient Driving Strategy for Trains in MRT Systems, pp. 427-432.

Gu, Qing	Beijing Jiaotong Univ.
Cao, Fang	state key Lab. of rail traffic control and safety,Beijing
Tang, Tao	Beijing Jiaotong Univ.

15:12-15:30 MB8.5

An Analysis on Excursion Characteristics of Electric Assist Bicycles by Travel Behavioral Comparison Based on Trajectory Data, pp. 433-437.

Inagaki, Tomoyuki	Seikei Univ.
Mimura, Yasuhiro	Toyota Transportation Res. Inst.
Ando, Ryosuke	TTRI (Toyota Transportation Res. Inst.)

MC1 Chart

Advanced Vehicle Active Safety Systems (Special Session)

Organizer: Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Organizer: Du, Eliza	Indiana Univ. Univ. Indianapolis

16:00-16:18 MC1.1

Plant Error Analysis and Compensation in Adaptive Cruise Control Systems (I), pp. 438-443.

Meadows, Alex	Indiana Univ. Univ. Indianapolis
Li, Lingxi	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI

Widmann, Glenn	Delphi Electronics and Safety

16:18-16:36 MC1.2

Semantic-Based Road Environment Recognition in Mixed Traffic for Intelligent Vehicles and Advanced Driver Assistance Systems (I), pp. 444-450.

Guo, Chunzhao	Toyota Central R&D Lab. Inc.
Mita, Seiichi	Toyota Tech. Inst.

16:36-16:54 MC1.3

Automatic Categorization-Based Multi-Stage Pedestrian Detection (I), pp. 451-456.

Yang, Kai	Indiana Univ. Univ. Indianapolis
Du, Eliza	Indiana Univ. Univ. Indianapolis
Jiang, Pingge	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Sherony, Rini	Toyota Motor Engineering and Manufacturing North America
Takahashi, Hiroyuki	Toyota Motor Corp.

16:54-17:12 MC1.4

Minimizing Driver Interference under a Probablistic Safety Constraint in Emergency Collision Avoidance Systems (I), pp. 457-462.

Johnson, Jeffrey	Indiana Univ.
Zhang, Yajia	Indiana Univ.
Hauser, Kris	Indiana Univ.

MC2 Denali

Communication Technologies and Protocols 3 (Regular Session)

16:00-16:18 MC2.1

Simulation Modeling of Visible Light Communication Channel for Automotive Applications, pp. 463-468.

Lee, SeokJu	Yeungnam Univ.
Kwon, Jae Kyun	Yeungnam Univ.
Jung, Sung-Yoon	Yeungnam Univ.
Kwon, Young-Hoon	LED-IT Fusion Tech. Res. Center

16:18-16:36 MC2.2

Radar Simulation in SiVIC Platform for Transportation Issues Antenna and Propagation Channel Modelling, pp. 469-474.

Pechberti, Steve	IFSTTAR
Gruyer, Dominique	IFSTTAR
Vigneron, Vincent	Univ. d'Evry - Informatique, Biologie Intégrative etSystème

16:36-16:54 MC2.3

Printed Antenna for DSRC Systems with Omnidirectional Circular Polarization, pp. 475-478.

Varum, Tiago	Inst. de Telecomunicações, Univ. de Aveiro
Matos, Joao	Inst. of Telecom, Univ. of Aveiro
Pinho, Pedro	Inst. de Telecomunicações, Inst. Superior deEngenharia d
Oliveira, Arnaldo	Univ. de Aveiro

16:54-17:12 MC2.4

NLOS-Communication between Shadowed Vehicles Using By-Standing Relay Vehicles, pp. 479-484.

Dhakal, Sagar	Res. In Motion
Jia, Yupeng	Univ. of Rochester
Nguyen, Nam	Res. In Motion

MC3 Dillingham

Vehicle Detection and Classification (Regular Session)

16:00-16:18 MC3.1

Tire Classification from Still Images and Video, pp. 485-490.

Bulan, Orhan	Xerox Corp.
Bernal, Edgar	Xerox Corp.
Loce, Robert	Xerox Corp.
Wu, Wencheng	Xerox Corp.

16:18-16:36 MC3.2

Application of Random Forest Algorithm to Classify Vehicles Detected by a Multiple Inductive Loop System, pp. 491-495.

Shajahan, Sheik Mohammed Ali	Indian Inst. of Tech. Madras
Joshi, Niranjan	Indian Inst. of Tech. Madras
George, Boby	Indian Inst. of Tech. Madras
Vanajakshi, Lelitha	Indian Inst. of Tech. Madras

16:36-16:54 MC3.3

Novel Vehicle and Motorcycle Classification Using Single Element Piezoelectric Sensor, pp. 496-501.

Rajab, Samer	The Univ. of Oklahoma
Othman, Ahmad	The Univ. of Oklahoma
Refai, Hazem	The Univ. of Oklahoma

16:54-17:12 MC3.4

Approaching Car Detection Via Clustering of Vertical-Horizontal Line Scanning Optical Edge Flow, pp. 502-507.

Karaduman, Ozgur	Firat Univ.
Eren, Haluk	Firat Univ.
Kurum, Hasan	Firat Univ.
Celenk, Mehmet	The Ohio Univ.

MC4 Fireweed

Vision Sensing and Image Processing 2 (Regular Session)

16:00-16:18 MC4.1

A Smart Vision Systems for Advanced LGV Navigation and Obstacle Detection, pp. 508-513. Attachment

Bertozzi, Massimo	Univ. of Parma - Italy
Bombini, Luca	Univ. of Parma - Italy
Broggi, Alberto	Univ. of Parma - Italy
Coati, Alessandro	Univ. of Parma - VisLab - The Artificial Vision andIntellig

16:18-16:36 MC4.2

Robust Free Space Detection in Occupancy Grid Maps by Methods of Image Analysis and Dynamic B-Spline Contour Tracking, pp. 514-521.

Schreier, Matthias	TU Darmstadt
Willert, Volker	TU Darmstadt

16:36-16:54 MC4.3

Real-Time 3D Visual Perception : Detection and Localisation of Static and Moving Objects from a Moving Stereo Rig, pp. 522-527.

Lefaudeux, Benjamin	INRIA
Nashashibi, Fawzi	INRIA

16:54-17:12 MC4.4

Scale Change and TTC Filter for Longitudinal Vehicle Control Based on Monocular Video, pp. 528-533.

Stierlin, Susanne	Robert Bosch GmbH
Dietmayer, Klaus	Univ. of Ulm

MC5 Iliamna

Simulation and Modeling 2 (Regular Session)

16:00-16:18 MC5.1

A Short-Term Freeway Traffic Flow Prediction Method Based on Road Section Traffic Flow Structure Pattern, pp. 534-539.

Zhang, Ping	Peking Univ.
Xie, Kunqing	Peking Univ.
Song, Guojie	PKU

16:18-16:36 MC5.2

Measurement Analysis of Traffic Flow Uncertainty on Chinese Highway Network, pp. 540-545.

Liu, Ruiqi	Peking Univ.
Xing, Xingxing	Peking Univ.
Song, Guojie	Peking Univ.
Xie, Kunqing	Peking Univ.
Zhang, Ping	Peking Univ.

16:36-16:54 MC5.3

Simulating Coherent Flow with Cellular Automaton Model, pp. 546-551.

Zheng, Yichen	Tsinghua Univ.
Zhang, Yi	Tsinghua Univ.
Hu, Jianming	Tsinghua Univ.
Li, Li	Tsinghua Univ.
Pei, Xin	Tsinghua Univ.

16:54-17:12 MC5.4

Microscopic Traffic Simulation Tool for Intelligent Transportation Systems, pp. 552-557.

Jaworski, Pawel	MIRA Ltd
Edwards, Tim	MIRA Ltd
Burnham, Keith	Coventry Univ.
Haas, Olivier	Coventry Univ.

17:12-17:30 MC5.5

An Extended Cell Transmission Model Based on Digraph for Urban Traffic Road Network, pp. 558-563.

Han, Xingguang	Beijing Univ. of Tech.
Chen, Yangzhou	Beijing Univ. of Tech.
Shi, Jianjun	Beijing Univ. of Tech.
He, Zhonghe	Beijing Univ. of Tech.

MC6 Katmai

Travel Time Estimation and Prediction (Regular Session)

16:00-16:18 MC6.1

Kullback-Leibler Comparison Framework for the Evaluation of Travel Time Distribution Estimates, pp. 564-569.

Ernst, Joseph M.	Oak Ridge National Lab.
Krogmeier, James V.	Purdue Univ.
Bullock, Darcy	Purdue Univ.

16:18-16:36 MC6.2

Experienced Travel Time Prediction for Freeway Systems, pp. 570-575.

Yildirimoglu, Mehmet	Ec. Pol. Federale de Lausanne
Geroliminis, Nikolas	Ec. Pol. Fédérale de Lausanne

16:36-16:54 MC6.3

Prediction of Dynamic Freeway Travel Times Based on Vehicle Trajectory Construction, pp. 576-581.

Chen, Hao	Virginia Tech.
Rakha, Hesham A.	Virginia Tech.

16:54-17:12 MC6.4

Short-Term Travel Time Estimation and Prediction for Long Freeway Corridor Using NN and Regression, pp. 582-587.

Wang, J.Y.	National Chiao Tung Univ.
Wong, K.I.	National Chiao Tung Univ.
Chen, Y.Y.	National Chiao Tung Univ.

MC7 King Salmon

Traffic Management and Control 2 (Regular Session)

16:00-16:18 MC7.1

Distributed Traffic Signal Control for Maximum Network Throughput, pp. 588-595.

Wongpiromsarn, Tichakorn	Singapore-MIT Alliance for Res. & Tech.
Uthaicharoenpong, Tawit	Nangyang Tech. Univ.
Wang, Yu	NANYANG Tech. Univ.
Frazzoli, Emilio	Massachusetts Inst. of Tech.
Wang, Danwei	Nanyang Tech. Univ.

16:18-16:36 MC7.2

Traffic Signal Control Using Reinforcement Learning and the Max-Plus Algorithm As a Coordinating Strategy, pp. 596-601.

Medina, Juan C	Univ. of Illinois at Urbana - Champaign
Benekohal, Rahim F.	Univ. of Illinois Urbana-Champaign

16:36-16:54 MC7.3

Signal Timing for Fleeting Multiple Intersecting Roadways, pp. 602-607.

Miller, Jeffrey	Univ. of Alaska Anchorage
Donat, Wolfram	Univ. of Alaska Anchorage
Harris, John	Univ. of Alaska Anchorage

16:54-17:12 MC7.4

Adaptive Control of Hyperbolic PDE System with Uncertain Parameters, pp. 608-612.

Wadoo, Sabiha	New York Inst. of Tech.

MC8	Lupine
Eco-Driving and Energy Efficient Intelligent Infrastructure 3 (Regular Session)	
16:00-16:18	MC8.1
Optimization of Fuel Cost and Emissions with Vehicular Networks at Traffic Intersections, pp. 613-619.	
Alsabaan, Maazen	Univ. of Waterloo and King Saud Univ.
Naik, Kshirasagar	Univ. of Waterloo
Khalifa, Tarek	Univ. of Waterloo
Nayak, Amiya	Univ. of Ottawa
16:18-16:36	MC8.2
Simulation of the Impact of Traffic Lights Placement on Vehicle's Energy Consumption and CO2 Emissions, pp. 620-625.	
Corti, Andrea	Pol. di Milano
Manzoni, Vincenzo	Pol. di Milano
Savaresi, Sergio	Pol. di Milano
16:36-16:54	MC8.3
Vehicle's Energy Estimation Using Low Frequency Speed Signal, pp. 626-631.	
Corti, Andrea	Pol. di Milano
Manzoni, Vincenzo	Pol. di Milano
Savaresi, Sergio	Pol. di Milano
16:54-17:12	MC8.4
Estimation of Missing Values in Traffic Density Maps, pp. 632-637.	
Petrlik, Jiri	Brno Univ. of Tech.
Korcek, Pavol	Brno Univ. of Tech.
Fucik, Otto	Camea spol. s r.o.
Beszedes, Marian	Camea spol. s r.o.
Sekanina, Lukas	Brno Univ. of Tech.

Technical Program for Tuesday September 18, 2012

TPL1	Aleutian
Plenary Session on Tuesday A (Plenary Session)	
09:00-09:45	TPL1.1
*Train Operation Control Systems for High Speed Railways in China**.	
Ning, Bin	Beijing JiaoTong Univ.
09:45-10:30	TPL1.2
*ITS Wireless Communication Systems in Japan**.	
Itami, Makoto	Tokyo Univ. of Science

TPL2	Alaska
Plenary Session on Tuesday B (Plenary Session)	
09:00-09:45	TPL2.1
*Smart Maintenance and Operations Vehicles**.	
Adams, Ocie	Alaska DOT
09:45-10:30	TPL2.2
*Towards Swarms of Self-Driving Automobiles**.	
Stiller, Christoph	Karlsruhe Inst. of Tech.

TA1	Chart
Driver Behavior and Safety System (Regular Session)	
11:00-11:18	TA1.1
Prediction of Driver Behavior on a Limited Sensory Setting, pp. 638-643.	
Garcia Ortiz, Michael	Bielefeld Univ.
Kummert, Franz	Bielefeld Univ.
Schmuedderich, Jens	Honda Res. Inst. Europe GmbH
11:18-11:36	TA1.2
Measuring Driver Awareness Based on Correlation between Gaze Behavior and Risks of Surrounding Vehicles, pp. 644-647.	
Mori, Masataka	Nagoya Univ.
Miyajima, Chiyomi	Nagoya Univ.
Angkititrakul, Pongtep	Nagoya Univ.
Hirayama, Takatsugu	Nagoya Univ.
Li, Yiyang	Nagoya Univ.
Kitaoka, Norihide	Nagoya Univ.
Takeda, Kazuya	Nagoya Univ.
11:36-11:54	TA1.3
Modeling the Steering Behavior of Intoxicated Drivers, pp. 648-653.	
M. Shirazi, Mehran	Simon Fraser Univ.
B. Rad, Ahmad	Simon Fraser Univ.
11:54-12:12	TA1.4
Towards Collision Alarming Based on Visual Motion, pp. 654-659.	
Kilicarslan, Mehmet	IUPUI
Zheng, Jiang Yu	IUPUI
12:12-12:30	TA1.5
Leveraging Sensor Information from Portable Devices towards Automatic Driving Maneuver Recognition, pp. 660-665.	
Sathyanarayana, Amardeep	The Univ. of Texas at Dallas
Sadjadi, Seyed Omid	The Univ. of Texas at Dallas
Hansen, John	Univ. of Texas at Dallas

TA2	Denali
Communication Technologies and Protocols 4 (Regular Session)	
11:00-11:18	TA2.1
Ipass: Intelligent Pavement Signaling System, pp. 666-671.	
Claussen, Heiko	Siemens Corp. Res. and Tech.
Aparicio, Juan	Siemens Corp. Res. and Tech.
Rosca, Justinian	Siemens Corp. Res. and Tech.
Tas, Nazif	Siemens Corp. Res. and Tech.

11:18-11:36 TA2.2

Increasing the Probability of Timely and Correct Message Delivery in Road Side Unit Based Vehicular Communication, pp. 672-679.

Jonsson, Magnus	Halmstad Univ.
Kunert, Kristina	Halmstad Univ.
Böhm, Annette	Halmstad Univ.

11:36-11:54 TA2.3

Person-To-Infrastructure (P2I) Wireless Communication for Work Zone Safety Enhancement, pp. 680-684.

Qiao, Yijun	The Univ. of Texas at Austin
Qiao, Fengxiang	Texas Southern Univ.

11:54-12:12 TA2.4

A Smartphone-Based Traffic Information Service Platform for Pedestrian and Bicycle Systems, pp. 685-690.

Du, Jun	Tsinghua Univ.
Zheng, Chenyu	Univ. of Colorado
Zeqi, Zhang	Tsinghua Univ.
Zhongqiang, Zhai	Tsinghua Univ.
Yang, Yu	Tsinghua Univ.
Nengqiang, He	Tsinghua Univ.
Sicker, Douglas	Univ. of Colorado
Ren, Yong	Tsinghua Univ.

TA3 Dillingham

Detection of Driving Environment 1 (Regular Session)

11:00-11:18 TA3.1

A Generic Map Based Environment Representation for Driver Assistance Systems Applied to Detect Convoy Tracks, pp. 691-696.

Weiherer, Tobias	Tech. Univ. München
Bouzouraa, Mohamed Essayed	AUDI AG
Hofmann, Ulrich	AUDI AG

11:18-11:36 TA3.2

Simulation Architecture for the Design of Cooperative Collision Warning Systems, pp. 697-703.

Gruyer, Dominique	IFSTTAR
Demmel, Sébastien	QUT & IFSTTAR
D'Andrea-Novel, Brigitte	Mines ParisTech
Lambert, Alain	IFSTTAR
Rakotonirainy, Andry	Queensland Univ. of Tech.

11:36-11:54 TA3.3

Robust Traffic Sign Recognition and Tracking for Advanced Driver Assistance Systems, pp. 704-709.

Zheng, Zhihui	Beijing Inst. of Tech.
Zhang, Hanxizi	Beijing Institute of Tech.
Wang, Bo	Beijing Inst. of Tech.
Gao, Zhifeng	Beijing Inst. of Tech.

11:54-12:12 TA3.4

Interacting Multiple Model Road Curvature Estimation, pp. 710-715.

Shen, Truman	Takata Holdings Inc.

12:12-12:30 TA3.5

Probabilistic Estimation of Temporary Lanes at Road Work Zones, pp. 716-721.

Graf, Regine	Univ. of Ulm
Wimmer, Andreas	Univ. of Ulm
Dietmayer, Klaus	Univ. of Ulm

TA4 Fireweed

Vision Sensing and Image Processing 3 (Regular Session)

11:00-11:18 TA4.1

Real-Time Modeling of Dynamic Environments in Traffic Scenarios Using a Stereo-Vision System, pp. 722-727.

Vatavu, Andrei	Tech. Univ. of Cluj-Napoca
Nedevschi, Sergiu	Tech. Univ. of Cluj-Napoca

11:18-11:36 TA4.2

Unsupervised Video Leap Segmentation for Fast Detection of Salient Segment Transformations in Mobile Sequences, pp. 728-733.

Forsthoefel, Dana	Georgia Inst. of Tech.
Wills, D. Scott	Georgia Inst. of Tech.
Wills, Linda M.	Georga Inst. of Tech.

11:36-11:54 TA4.3

Performance Evaluation of the Improved Hazard Detection System for the Safety of a Handle Type Electric Wheelchair, pp. 734-739.

Kim, Jeyeon	Saitama Univ.
Hasegawa, Takaaki	Saitama Univ.

11:54-12:12 TA4.4

A Novel Technique for Raindrop Detection on a Car Windshield Using Geometric-Photometric Model, pp. 740-745.

Sugimoto, Masanori	Univ. of Tokyo
Kakiuchi, Noriaki	Univ. of Tokyo
Ozaki, Noriyuki	DENSO Corp.
Sugawara, Ryoichi	DENSO Corp.

TA5 Iliamna

Simulation and Modeling 4 (Regular Session)

11:00-11:18 TA5.1

Overtaking and Giving Way: Design and Validation of a Lightweight Extended Cellular Automata Urban Traffic Simulator, pp. 746-751.

Sanchez-Medina, Javier J.	ULPGC
Medina-Machin, Elisa	ULPGC, CICEI
Diaz-Cabrera, Moises	ULPGC
Galan-Moreno, Manuel	ULPGC, DMAT, CICEI
Rubio-Royo, Enrique	ULPGC, CICEI

11:18-11:36 TA5.2

Extended Safety Descriptor Measures for Relative Safety Assessment in Mixed Road Traffic, pp. 752-757.

Derbel, Oussama	MIPS - UHA
Mourllion, Benjamin	MIPS EA 2332 UHA

Basset, Michel	Univ. of Haute-Alsace

11:36-11:54 TA5.3

Traffic Simulation Using Activity Place Related Information Acquisition from the Web, pp. 758-763.

Chen, Songhang	Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences

11:54-12:12 TA5.4

A Cellular Automata Based Evacuation Model on GPU Platform, pp. 764-768.

Miao, Qinghai	Graduate Univ. Chinese Acad. of Sciences
Lv, Yisheng	Chinese Acad. of Sciences
Zhu, Fenghua	Chinese Acad. of Sciences

12:12-12:30 TA5.5

Car-Following Model with Multiple Predicting and Controlling Modules Based on Assumptions of Anticipation Behavior, pp. 769-775.

Kasai, Makoto	Tokyo Univ. of Science

TA6 Katmai

Route Planning and Guidance (Regular Session)

11:00-11:18 TA6.1

Online Map-Matching Based on Hidden Markov Model for Real-Time Traffic Sensing Applications, pp. 776-781.

Goh, Chong Yang	Nanyang Tech. Univ.
Dauwels, Justin	Nanyang Tech. Univ.
Mitrovic, Nikola	Nanyang Tech. Univ.
Asif, Muhammad Tayyab	Nanyang Tech. Univ.
Oran, Ali	SMART
Jaillet, Patrick	MIT

11:18-11:36 TA6.2

Dynamic Optimal Routing Based on a Reverse Stackelberg Game Approach, pp. 782-787.

Groot, Noortje	Delft Univ. of Tech.
De Schutter, Bart	Delft Univ. of Tech.
Hellendoorn, Hans	Delft Univ. of Tech.

11:36-11:54 TA6.3

Realization of ITS Applications through Mapping Technologies: A Survey of Advanced Traveler Information Systems, pp. 788-795.

Campbell, Patrick	Univ. of Oklahoma
Havlicek, Joseph	Univ. of Oklahoma
Stevenson, Alan	Oklahoma Department of Transportation:
Barnes, Ronald	Univ. of Oklahoma

11:54-12:12 TA6.4

Azimuth Angle of GPS Data and Its Application in Map-Matching, pp. 796-801.

Li, Lan	Hitachi (China) Res. & Development Corp.
Liu, Bo	Hitachi (China) Res. & Development Corp.
Lai, Yimin	Hitachi Beijing Tech. Information Systems Co., Ltd.
Tang, Xiaochun	Res. Center of Transport and Logistics, Ministry of Transpor

12:12-12:30 TA6.5

Automated Transportation Transfer Detection Using GPS Enabled Smartphones, pp. 802-807.

Stenneth, Leon	Univ. of Illinois Chicago
Thompson, Kenville	The Graduate Center CUNY
Stone, Waldin	The Graduate Center CUNY
Alowibdi, Jalal	Univ. of Illinois Chicago

TA7 King Salmon

Parallel Transportation Management Systems (Special Session)

Organizer: Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Organizer: Rossetti, Rosaldo	Univ. do Porto - LIACC
Organizer: Kong, Qing-Jie	Shanghai Jiao Tong Univ.
Organizer: Li, Lefei	Tsinghua Univ.
Organizer: Miao, Qinghai	Graduate Univ. Chinese Acad. of Sciences

11:00-11:18 TA7.1

Quadtree-Based Domain Decomposition for Parallel Map-Matching on GPS Data (I), pp. 808-813.

Xia, Yingjie	Hangzhou Normal Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.
Ye, Zhoumin	Hangzhou Inst. of Service Engineering, Hangzhou NormalUniver
Wu, Wei	Enjoyor Company
Zhu, Mingzhe	Hangzhou Inst. of Service Engineering, Hangzhou NormalUniver

11:18-11:36 TA7.2

Comparison of Urban Traffic Prediction Methods between UTN-Based Spatial Model and Time Series Models (I), pp. 814-819.

Xu, Yanyan	Shanghai Jiao Tong Univ.
Kong, Qing-Jie	Shanghai Jiao Tong Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.

11:36-11:54 TA7.3

A Dynamic Network Partition Method for Heterogenous Urban Traffic Networks (I), pp. 820-825.

Zhou, Zhao	Shanghai Jiao Tong Univ.
Lin, Shu	Shanghai Jiao Tong Univ.
Xi, Yugeng	Shanghai Jiao Tong Univ.

11:54-12:12 TA7.4

Reaching Low-Density Urban Areas with the Network-Inspired Transportation System, pp. 826-831.

Edwards, Derek	Georgia Inst. of Tech.
Elangovan, Arun Kumar	RideCell, LLC
Watkins, Kari E.	Georgia Inst. of Tech.

12:12-12:30 TA7.5

Exact Solutions to Traffic Density Estimation Problems Involving the Lighthill-Whitham-Richards Traffic Flow Model Using Mixed Integer Programming, pp. 832-839.

S Canepa, Edward Esteban	King Abdullah Univ. of Science and Tech.

Claudel, Christian	King Abdullah Univ. of Science and Tech.

TA8 Lupine

Eco Driving and Energy Efficiency (Regular Session)

11:00-11:18 TA8.1

Agent-Based Modeling of Eco-Cooperative Adaptive Cruise Control Systems in the Vicinity of Intersections, pp. 840-845.

Kamalanathsharma, Raj Kishore	Virginia Tech. Transportation Inst.
Rakha, Hesham A.	Virginia Tech.

11:18-11:36 TA8.2

Fuel Consumption and Emission Models Development and Application for Advanced Traffic Management Strategies, pp. 846-851.

Liao, Tsai-Yun	National Chiayi Univ.
Ho, Wei-Ming	National Cheng Kung Univ.
Hu, Ta-Yin	National Cheng Kung Univ.

11:36-11:54 TA8.3

Development of Deceleration Intention Indicating System of Forward Vehicle: Effect of the System, pp. 852-857.

Saito, Yuichi	Univ. of Tsukuba, Japan
Hashimoto, Naohisa	National Inst. of AIST
Kato, Shin	National Inst. of AIST
Tsugawa, Sadayuki	Meijo Univ.

11:54-12:12 TA8.4

Research on Soft-Switching Circuit of Contactless Power Transmission System of Autonomous Underwater Vehicle, pp. 858-862.

Wang, Hongjian	409 Department, Automation Coll. Harbin Engineering Univ.
Yu, Le	409 Department, Automation Coll. Harbin, Harbin Engineering U
Li, Juan	Automation Coll. Engineering Univ.
Liu, Xiangbo	409 Department, Automation Coll. Harbin, Harbin Engineering U
Tang, Zhaodong	409 Department, Automation Coll. Harbin, Harbin Engineering U

12:12-12:30 TA8.5

Electric Load Forecasting: A Multi-Agent Systems Approach, pp. 863-869.

Nejat, Ali	Texas Tech. Univ.
Mohsenian-Rad, Hamed	Univ. of California at Riverside

TB1 Chart

Driver Behavior and Safety Systems 2 (Regular Session)

14:00-14:18 TB1.1

Detection of Driver Distraction Based on Temporal Relationship between Eye-Gaze and Peripheral Vehicle Behavior, pp. 870-875.

Hirayama, Takatsugu	Nagoya Univ.
Mase, Kenji	Nagoya Univ.
Takeda, Kazuya	Nagoya Univ.

14:18-14:36 TB1.2

An Intelligent Driver Model with Trajectory Planning, pp. 876-881.

Zhang, Sumin	Jilin Univ.
Deng, Weiwen	Jilin Univ.
Zhao, Qingrong	General Motors Company
Sun, Hao	Jilin Univ.

14:36-14:54 TB1.3

Optical Flow Based Head Movement and Gesture Analysis in Automotive Environment, pp. 882-887.

Martin, Sujitha	Univ. of California at San Diego
Tran, Cuong	Univ. of California at San Diego
Tawari, Ashish	Univ. of California at San Diego
Kwan, Jade	Univ. of California at San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

14:54-15:12 TB1.4

Deciding What to Inspect First: Incremental Situation Assessment Based on Information Gain, pp. 888-893.

Platho, Matthias	Univ. of Ilmenau
Eggert, Julian	Honda Res. Inst. Europe GmbH

15:12-15:30 TB1.5

Driver Behavior Classification Model Based on an Intelligent Driving Diagnosis System, pp. 894-899.

Quintero M., Christian G.	Univ. del Norte
Oñate López, José	Univ. del Norte
Cuervo Pinilla, Andres C.	Univ. del Norte

TB2 Denali

Connected Vehicle Technology and Applications (Regular Session)

14:00-14:18 TB2.1

On-Ramp Traffic Merging Using Cooperative Intelligent Vehicles: A Slot-Based Approach, pp. 900-906. Attachment

Marinescu, Dan	Trinity Coll. Dublin
Čurn, Jan	Trinity Coll. Dublin
Bouroche, Mélanie	Trinity Coll. Dublin
Cahill, Vinny	Trinity Coll. Dublin

14:18-14:36 TB2.2

Inter-Vehicle Sensor Fusion for Accurate Vehicle Localization Supported by V2V and V2I Communications, pp. 907-914. Attachment

Conde Bento, Luis Manuel	Inst. de Sistemas e Robotica
Nunes, Urbano	Inst. de Sistemas e Robotica
Parafita, Ricardo Jorge Pedrosa	Inst. de Sistemas e Robótica - Univ. de Coimbra

14:36-14:54 TB2.3

Urban Vehicle-To-Infrastructure Wireless Communications Range Evaluation, pp. 915-920.

Hyncica, Ondrej	Brno Univ. of Tech.
Honzik, Petr	Brno Univ. of Tech.
Kucera, Pavel	Brno Univ. of Tech.
Pavlata, Karel	Brno Univ. of Tech.

14:54-15:12 TB2.4

Mobility-Assisted Fast Handover for Proxy Mobile IPv6 in Vehicle-To-Infrastructure Communications, pp. 921-926.

Lu, Henghui	Tsinghua Univ.
Zhang, Sheng	Tsinghua Univ.
Lin, Xiaokang	Tsinghua Univ.

TB3 Dillingham

Detection of Driving Environment 2 (Regular Session)

14:00-14:18 TB3.1

Can Priors Be Trusted? Learning to Anticipate Roadworks, pp. 927-932.

Mathibela, Bonolo	Univ. of Oxford
Osborne, Michael A.	Oxford Univ.
Posner, Ingmar	Oxford Univ.
Newman, Paul	Univ. of Oxford

14:18-14:36 TB3.2

Generator of Road Marking Textures and Associated Ground Truth.Applied to the Evaluation of Road Marking Detection, pp. 933-938.

Revilloud, Marc	IFSTTAR
Gruyer, Dominique	IFSTTAR
Pollard, Evangeline	Inria-Rocquencourt

14:36-14:54 TB3.3

Automated Lane Identification Using Precise Point Positioning: An Affordable and Accurate GPS Technique, pp. 939-944.

Knoop, Victor L.	Delft Univ. of Tech.
Buist, Peter J.	Delft Univ. of Tech.
Tiberius, Christiaan C.J.M.	Delft Univ. of Tech.
van Arem, Bart	Delft Univ. of Tech.

14:54-15:12 TB3.4

Model Based Vehicle Localization for Urban Traffic Surveillance Using Image Gradient Based Matching, pp. 945-950.

Zheng, Yuan	Inst. of Automation, Chinese Acad. of Sciences
Peng, Silong	Inst. of Automation, Chinese Acad. of Sciences

TB4 Fireweed

Imaging and Image Analysis (Regular Session)

14:00-14:18 TB4.1

Vehicle Detection, Tracking and Classification in Urban Traffic, pp. 951-956.

Chen, Zezhi	Kingston Univ.
Ellis, Tim	Kingston Univ.
Velastin, Sergio A	Kingston Univ.

14:18-14:36 TB4.2

Detection of Scene Obstructions and Persistent View Changes in Transportation Camera Systems, pp. 957-962.

Raghavan, Ajay	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Price, Robert	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Liu, Juan	Palo Alto Res. Center Inc. (PARC, A Xerox Company)

14:36-14:54 TB4.3

Reference Image-Independent Fault Detection in Transportation Camera Systems for Nighttime Scenes, pp. 963-968.

Raghavan, Ajay	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Liu, Juan	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Saha, Bhaskar	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Price, Robert	Palo Alto Res. Center Inc. (PARC, A Xerox Company)

14:54-15:12 TB4.4

Subsign Detection with Region-Growing from Contrasted Seeds, pp. 969-974.

Puthon, Anne-Sophie	Ec. des Mines de Paris
Moutarde, Fabien	Mines ParisTech
Nashashibi, Fawzi	INRIA

15:12-15:30 TB4.5

A System for Real-Time Detection and Tracking of Vehicles from a Single Car-Mounted Camera, pp. 975-982. Attachment

Caraffi, Claudio	Toyota Motor Europe
Vojir, Tomas	Czech Tech. Univ. in Prague
Trefný, Jiří	Czech Tech. Univ. in Prague
Sochman, Jan	Center for Machine Perception, Faculty of Elec. Eng., CzechTechn
Matas, George	Czech Tech. Univ.

TB5 Iliamna

Simulation and Modeling 6 (Regular Session)

14:00-14:18 TB5.1

Unsupervised Learning Based Performance Analysis of N-Support Vector Regression for Speed Prediction of a Large Road Network, pp. 983-988.

Asif, Muhammad Tayyab	Nanyang Tech. Univ.
Dauwels, Justin	Nanyang Tech. Univ.
Goh, Chong Yang	Nanyang Tech. Univ.
Oran, Ali	SMART
Fathi Loshani, Esmail	Nanyang Tech. Univ.
Xu, Muye	Nanyang Tech. Univ.
Menoth, Dhanya	Nanyang Tech. Univ.
Mitrovic, Nikola	Nanyang Tech. Univ.
Jaillet, Patrick	MIT

14:18-14:36 TB5.2

A System for Storing and Retrieving Huge Amount of Trajectory Data, Allowing Spatio-Temporal Dynamic Queries, pp. 989-994.

d'Acierno, Antonio	ISA - CNR
Leone, Marco	Univ. of Salerno
Saggese, Alessia	Univ. of Salerno
Vento, Mario	Univ. of Salerno

14:36-14:54 TB5.3

Multi-Objective Traffic Light Control System Based on Bayesian Probability Interpretation, pp. 995-1000.

Khamis, Mohamed A.	Egypt-Japan Univ. of Science and Tech. (E-JUST)
Gomaa, Walid	Egypt-Japan Univ. of Science and Tech. (E-JUST)
El-Shishiny, Hisham	IBM Center for Advanced Studies in Cairo

14:54-15:12 TB5.4

Assessing Traffic Performance Using Position Density of Sparse FCD, pp. 1001-1005.

Graser, Anita	Austrian Inst. of Tech.
Ponweiser, Wolfgang	Austrian Inst. of Tech.
Dragaschnig, Melitta	Austrian Inst. of Tech.
Brändle, Norbert	Austrian Inst. of Tech.
Widhalm, Peter	Austrian Inst. of Tech.

TB6 Katmai

Route Guidance and Demand Analysis Using Taxi Data (Regular Session)

14:00-14:18 TB6.1

Congestion-Aware Traffic Routing System Using Sensor Data, pp. 1006-1013.

Aslam, Javed	Northeastern Univ.
Lim, Sejoon	MIT
Rus, Daniela	MIT

14:18-14:36 TB6.2

A Predictive Model for the Passenger Demand on a Taxi Network, pp. 1014-1019.

Moreira-Matias, Luís	LIAAD - INESC TEC
Gama, João	Faculdade de Ec. Univ. do Porto
Ferreira, Michel	Inst. de Telecomunicações
Damas, Luis	Geolink

14:36-14:54 TB6.3

Exploring the Relationship between Mobile Phone Call Intensity and Taxi Volume in Urban Area, pp. 1020-1025.

Veloso, Marco	Univ. of Coimbra
Phithakkitnukoon, Santi	Culture Lab. School of Computing Science, Newcastle University
Bento, Carlos	Univ. of Coimbra

14:54-15:12 TB6.4

Framework of Experienced Route Planning Based on Taxis' GPS Data, pp. 1026-1031.

Zhuang, Lijian	Res. Center of ITS, Sun Yat-sen Univ.
Gong, Junfeng	Res. Center of ITS, Sun Yat-sen Univ.
He, Zhaocheng	Res. Center of ITS, Sun Yat-sen Univ.
Xu, Feifei	Res. Center of ITS, Sun Yat-sen Univ.

TB7 King Salmon

Lane Level Traffic Management (Regular Session)

14:00-14:18 TB7.1

Dynamic Lane Separation to Prevent Blocking Back - a Comparison of Two Dynamic Lane Separation Controllers, pp. 1032-1037.

Soekroella, Aroen	TU Delft
Hegyi, Andreas	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.
van Kooten, Jaap	Arane

14:18-14:36 TB7.2

Simulation-Based Benefit Evaluation of Dynamic Lane Grouping Strategies at Isolated Intersections, pp. 1038-1043.

Wu, Guoyuan	Univ. of California-Riverside
Boriboonsomsin, Kanok	Univ. of California-Riverside
Zhang, Liping	Univ. of California, Berkeley
Barth, Matthew	Univ. of California-Riverside

14:36-14:54 TB7.3

A Genetic Fuzzy System for Modeling Mandatory Lane Changing, pp. 1044-1048.

Hou, Yi	Univ. of Missouri-Columbia
Edara, Praveen	Univ. of Missouri-Columbia
Sun, Carlos	Univ. of Missouri-Columbia

14:54-15:12 TB7.4

Using a Centralized Controller to Optimize the Traffic of Intelligent Vehicles in a Single Lane Highway Provided with a Suicide Lane, pp. 1049-1054.

Reghelin, Ricardo	Univ. Tecnológica Federal do Paraná
Arruda, Lúcia Valéria Ramos	Univ. Tecnológica Federal do Paraná (UTFPR)

TB8 Lupine

Electric and Hybrid Vehicles (Regular Session)

14:00-14:18 TB8.1

System Architecture and Mathematical Model of Public Transportation System Utilizing Wireless Charging Electric Vehicles, pp. 1055-1060.

Jang, Young Jae	Korea Advanced Inst. of Science and Tech.
Ko, Young Dae	Korea Advanced Inst. of Science and Tech.

14:18-14:36 TB8.2

Analysis of Impact Factors for Plug-In Hybrid Electric Vehicles Energy Management, pp. 1061-1066.

Khayyer, Pardis	The Ohio State Univ.
Wollaeger, James	The Ohio State Univ.
Onori, Simona	The Ohio State Univ.
Marano, Vincenzo	The Ohio State Univ.
Ozguner, Umit	The Ohio State Univ.
Rizzoni, Giorgio	The Ohio State Univ.

14:36-14:54 TB8.3

Research on Shift Schedule of Hybrid Bus Based on Dynamic Programming Algorithm, pp. 1067-1071.

Yu, Huilong	Beijing Institute of Tech.
Xi, Junqiang	Beijing Institute of Tech.
Chen, Yongdan	Beijing Institute of Tech.

14:54-15:12 TB8.4

Deviations in Markov Chain Modeled Electric Vehicle Charging Patterns from Real World Data, pp. 1072-1077.

Hill, Graeme	NEWCASTLE Univ.
Blythe, Phil	NEWCASTLE Univ.

15:12-15:30 TB8.5

Map-Based Driving Profile Simulation for Energy Consumption Estimation of Electric Vehicles, pp. 1078-1084.

Adam, Christian	Chemnitz Univ. of Tech.
Wanielik, Gerd	Chemnitz Univ. of Tech.

TC1 Chart

Driver Assistance Systems - Speed Control (Regular Session)

16:00-16:18 TC1.1

Speeding Prediction with a Mathematical Model and Its Validation, pp. 1085-1090.

Zhao, Guozhen	Inst. of Psychology, Chinese Acad. of Sciences
Wu, Changxu	Inst. of Psychology, Chinese Acad. of Sciences

16:18-16:36 TC1.2

A Context Aware Intelligent Speed Adaptation System: A Field Operational Test, pp. 1091-1096.

Hoogendoorn, Raymond G.	Delft Univ. of Tech.
Breukink, Johan	Delft Univ. of Tech.
van Arem, Bart	Delft Univ. of Tech.

16:36-16:54 TC1.3

Game Theory Algorithm for Intersection-Based Cooperative Adaptive Cruise Control (CACC) Systems, pp. 1097-1102.

Zohdy, Ismail	Virginia Tech.
Rakha, Hesham A.	Virginia Tech.

16:54-17:12 TC1.4

A New Braking and Warning Scoring System for Vehicle Forward Collision Imminent Braking Systems, pp. 1103-1108.

Chien, Stanley	Indiana Univ. Univ. Indianapolis
Li, Lingxi	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI

17:12-17:30 TC1.5

Intersection Management for Autonomous Vehicles Using Icacc, pp. 1109-1114.

Zohdy, Ismail	Virginia Tech.
Kamalanathsharma, Raj Kishore	Virginia Tech. Transportation Inst.
Rakha, Hesham A.	Virginia Tech.

TC2 Denali

Safety Analysis and Technologies (Regular Session)

16:00-16:18 TC2.1

Speed Reduction Impact of Dynamic Speed Feedback Signs on High Crash Curves, pp. 1115-1120.

Hallmark, Shauna	Iowa State Univ. USA
Hawkins, Neal	Iowa State Univ.
Smadi, Omar	Iowa State Univ.

16:18-16:36 TC2.2

Computation of Driver Safety Rating Using In-Vehicle Data Recorders: Case Study of Bangkok Public Transportation, pp. 1121-1126.

Saiprasert, Chalermpol	National Electronics and Computer Tech. Center
Pattara-atikom, Wasan	National Electronics and Computer Tech. Center

16:36-16:54 TC2.3

GIS-Based Road Safety Evaluation Model for Cyclist in Campus of Higher Education Mega Center, pp. 1127-1131.

Hu, Jihua	Sun Yat-sen Univ.
Zhong, Guangpeng	Sun Yat-sen Univ.
Cheng, Zhifeng	Sun Yat-sen Univ.
Wang, Dalei	Beijing Jiaotong Univ.

16:54-17:12 TC2.4

Rail Extraction Technique Using Gradient Information and a Priori Shape Model, pp. 1132-1136.

Corsino Espino, Jorge	Mines Paris-Tech.
Stanciulescu, Bogdan	Ec. des Mines de Paris (ParisTech)

17:12-17:30 TC2.5

Investigating Pedal Errors and Multi-Modal Effects: Driving Testbed Development and Experimental Analysis, pp. 1137-1142.

Tran, Cuong	Univ. of California, San Diego
Doshi, Anup	Univ. of California, San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

TC3 Dillingham

Advanced Technologies and Innovative Concepts for Promoting Traffic Safety and Mobility (Special Session)

Organizer: Wei, Heng	Univ. of Cincinnati
Organizer: Li, Zhixia	Univ. of Wisconsin-Madison

16:00-16:18 TC3.1

Effectiveness of Arterial Traffic Status Monitoring Using System Detector Data Based on a V-Plus-O Approach (I), pp. 1143-1148.

Li, Zhixia	Univ. of Wisconsin-Madison
Yang, Qingyan	Iteris Inc.
Wei, Heng	Univ. of Cincinnati

16:18-16:36 TC3.2

Simplified, Data-Driven, Errorable Car-Following Model to Predict the Safety Effects of Distracted Driving (I), pp. 1149-1154.

Przybyla, Jay	Univ. of Utah
Taylor, Jeff	Univ. of Utah
Jupe, Jason	Armstrong Forensic Engineers
Zhou, Xuesong	Univ. of Utah

16:36-16:54 TC3.3

Parts-Based Object Recognition Seeded by Frequency-Tuned Saliency for Child Detection in Active Safety, pp. 1155-1160.

Cheng, Shinko	Hrl Lab. LLC

Molineros, Jose	HRL Lab. LLC
Owechko, Yuri	HRL Lab. LLC
Levi, Dan	General Motors, Advanced Tech. Center, Israel
Zhang, Wende	General Motors, Res. and Development

16:54-17:12 TC3.4

Level of Service for Parking Facilities (I), pp. 1161-1165.

He, Yulong	Beijing Univ. of Tech.
Sun, Xiaoduan	Univ. of Louisiana
Du, Lizhen	Beijing Univ. of Tech.
Ruan, Jinmei	Beijing Municipal Inst. of City Planning & Design
Das, Subasish	Univ. of Louisiana

17:12-17:30 TC3.5

Driving Motion Capture Based Driver Behavior Analysis (I), pp. 1166-1171.

Shi, Jianjun	Beijing Univ. of Tech.
Wei, Heng	Univ. of Cincinnati
Shi, Shengqing	Beijing Univ. of Tech.

TC4 Fireweed

Intersection Detection and Safety (Regular Session)

16:00-16:18 TC4.1

Multi-Object Tracking at Intersections Using the Cardinalized Probability Hypothesis Density Filter, pp. 1172-1177.

Reuter, Stephan	Univ. of Ulm
Meissner, Daniel	Univ. of Ulm
Dietmayer, Klaus	Univ. of Ulm

16:18-16:36 TC4.2

Cooperative Multi Sensor Network for Traffic Safety Applications at Intersections, pp. 1178-1183.

Goldhammer, Michael	Univ. of Applied Sciences Aschaffenburg
Strigel, Elias	Univ. of Ulm
Meissner, Daniel	Univ. of Ulm
Brunsmann, Ulrich	Univ. of Applied Sciences Aschaffenburg
Doll, Konrad	Univ. of Applied Sciences Aschaffenburg
Dietmayer, Klaus	Univ. of Ulm

16:36-16:54 TC4.3

Iicas: Intelligent Intersection Collision Avoidance System, pp. 1184-1190.

Kaadan, Asaad	Univ. of Oklahoma
Refai, Hazem	Univ. of Oklahoma

16:54-17:12 TC4.4

VeloRegistration Based Intersection Detection for Autonomous Driving in Challenging Urban Scenarios, pp. 1191-1196.

Zhu, Quanwen	Wuhan Univ.
Mao, Qingzhou	Wuhan Univ.
Chen, Long	Wuhan Univ.
Li, Ming	Wuhan Univ.
Li, Qingquan	Wuhan Univ.

17:12-17:30 TC4.5

A Feasibility Study on a Cooperative Safety Application for Cyclists Crossing Intersections, pp. 1197-1204.

Thielen, Daniel	German Aerospace Center (DLR)
Lorenz, Tobias	German Aerospace Center (DLR)
Hannibal, Marco	German Aerospace Center (DLR)
Köster, Frank	German Aerospace Center (DLR)
Plättner, Jens	German Aerospace Center (DLR)

TC5 Iliamna

Simulation and Modeling 5 (Regular Session)

16:00-16:18 TC5.1

Determinants of Powered Two-Wheelers Virtual Lane Width in Urban Arterials, pp. 1205-1210.

Nikias, Vasileios	National Tech. Univ. of Athens
Vlahogianni, Eleni	School of Civil Engineering, National Tech. Athe
Lee, Tzu-Chang	National Cheng Kung Univ.
Golias, John	National Tech. Univ. of Athens

16:18-16:36 TC5.2

Investigation on Traffic Flow Competition between Main Road and On-Ramp on Urban Freeway, pp. 1211-1214.

He, Shuyan	Beijing Jiaotong Univ.
Guan, Wei	Beijing Jiaotong Univ. Beijing P.R.C

16:36-16:54 TC5.3

Estimating Flexible Route Choice Models Using Sparse Data, pp. 1215-1220.

Fadaei Oshyani, Masoud	KTH Royal Inst. of Tech.
Sundberg, Marcus	KTH Royal Inst. of Tech.
Karlstrom, Anders	KTH Royal Inst. of Tech.

16:54-17:12 TC5.4

Analysis and Prediction of Deceleration During Car Following Using Stochastic Driver-Behavior Model, pp. 1221-1226.

Angkititrakul, Pongtep	Nagoya Univ.
Miyajima, Chiyomi	Nagoya Univ.
Takeda, Kazuya	Nagoya Univ.

17:12-17:30 TC5.5

Predicting Arrival Times of Buses Using Real-Time GPS Measurements, pp. 1227-1232.

Sinn, Mathieu	IBM Res.
Yoon, Ji Won	IBM Res.
Calabrese, Francesco	IBM Res.
Bouillet, Eric	IBM Res.

TC6 Katmai

Emergency and Freight Operation (Regular Session)

16:00-16:18 TC6.1

Modeling Monetary Costs of Multi-Class Traffic Flow – Application to the Dynamic Management of Truck Lanes, pp. 1233-1238.

Schreiter, Thomas	Delft Univ. of Tech.
Pel, Adam	Delft Univ. of Tech.
van Lint, Hans	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.

16:18-16:36 TC6.2

Freight Origin-Destination Estimation Based on Multiple Data Sources, pp. 1239-1244.

Ma, Yinyi	Erasmus Univ.
Van Zuylen, H.J.	Delft Univ. of Tech.
Kuik, Roelof	Erasmus Univ. Rotterdam

16:36-16:54 TC6.3

GPS Tracking of Freight Vehicles to Identify and Classify Bottlenecks, pp. 1245-1249.

Dailey, Daniel J.	Univ. of Washington
McCormack, Ed	Univ. of Washington
Zhao, Wenjuan	Washington State Department of Transportation

16:54-17:12 TC6.4

The Multi-Modal Evacuation System (MES) for Baltimore Metropolitan Region, pp. 1250-1257.

Zhang, Xin	Univ. of Maryland
Chang, Gang-Len	UMD

TC7 King Salmon

Emergency Operation and Management (Regular Session)

16:00-16:18 TC7.1

Multi-Objective Optimization Model Based on Heuristic Ant Colony Algorithm for Emergency Evacuation, pp. 1258-1262.

Duan, Pengfei	Wuhan Univ. of Tech.
Xiong, Shengwu	Wuhan Univ. of Tech.
Jiang, Hongxin	Wuhan Univ. of Tech.

16:18-16:36 TC7.2

Sensitivity Analysis of Driver Behavior under Emergency Conditions (I), pp. 1263-1268.

Prionisti, Elena	National Tech. Univ. of Athens
Antoniou, Constantinos	National Tech. Univ. of Athens

16:36-16:54 TC7.3

Emergency Traffic Evacuation Control Based on the Orthogonal Experimental Design Method (I), pp. 1269-1273.

Lv, Yisheng	Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Miao, Qinghai	Graduate Univ. Chinese Acad. of Sciences
Ye, Peijun	Inst. of Automation, Chinese Acad. of Sciences
Chen, Songhang	Chinese Acad. of Sciences

16:54-17:12 TC7.4

An RFID-Based Inventory Management Framework for Efficient Emergency Relief Operations, pp. 1274-1279.

Ozguven, Eren Erman	Rutgers Univ.
Ozbay, Kaan	Rutgers, The State Univ. of NJ

TC8 Lupine

Parking Technologies (Regular Session)

16:00-16:18 TC8.1

Detection of Parking Spots Using 2D Range Data, pp. 1280-1287.

Zhou, Jifu	Carnegie Mellon Univ.
Navarro-Serment, Luis	Carnegie Mellon Univ.
Hebert, Martial	Carnegie Mellon Univ.

16:18-16:36 TC8.2

A New Base Stations Placement Approach for Enhanced Vehcile Position Estimation in Parking Lot, pp. 1288-1293.

Kiwan, H.	Univ. of Regina
Bais, A.	Univ. of Regina
Morgan, Y. L.	Univ. of Regina

16:36-16:54 TC8.3

Fully-Automatic Recognition of Various Parking Slot Markings in Around View Monitor (AVM) Image Sequences, pp. 1294-1299.

Suhr, Jae Kyu	Hanyang Univ.
Jung, Ho Gi	Hanyang Univ.

16:54-17:12 TC8.4

Computationally Inexpensive Parallel Parking Supervisor Based on Video Processing, pp. 1300-1305.

Espejo, Caterina	Pontificia Univ. Catolica del Peru
Rodriguez, Paul	Pontificia Univ. Catolica del Peru

Technical Program for Wednesday September 19, 2012

WA1 Chart

Driver Assist Systems - Traffic Signal/Sign Recognition (Regular Session)

09:00-09:18 WA1.1

Impact of Introducing Signal Recognition Enhancement System on Traffic Flow at Signalized Intersection, pp. 1306-1309.

Nakazawa, Masatoshi	City of Yokohama
Fukuda, Atsushi	Nihon Univ.
Suzuki, Hironori	Nippon Inst. of Tech.
Okamura, Makoto	Almec Corp.

09:18-09:36 WA1.2

Traffic Sign Detection and Analysis: Recent Studies and Emerging Trends, pp. 1310-1314.

Møgelmose, Andreas	Aalborg Univ.
Trivedi, Mohan M.	Univ. of California at San Diego
Moeslund, Thomas	Aalborg Univ.

09:36-09:54 WA1.3

Suspended Traffic Lights Detection and Distance Estimation Using Color Features, pp. 1315-1320.

Diaz-Cabrera, Moises	Univ. of Las Palmas de Gran Canaria

Cerri, Pietro	Univ. of Parma
Sanchez-Medina, Javier J.	Univ. of Las Palmas de Gran Canaria

09:54-10:12 WA1.4

Visibility Estimation of Traffic Signals under Rainy Weather Conditions for Smart Driving Support, pp. 1321-1326.

Sato, Ryuhei	Nagoya Univ.
Doman, Keisuke	Nagoya Univ.
Deguchi, Daisuke	Nagoya Univ.
Mekada, Yoshito	Chukyo Univ.
Ide, Ichiro	Nagoya Univ.
Murase, Hiroshi	Nagoya Univ.
Tamatsu, Yukimasa	DENSO Corp.

WA2 Denali

Advanced Vehicle Technologies 1 (Regular Session)

09:00-09:18 WA2.1

Vehicle Control Based on a LPV Control and a Nonlinear Control to Detect Critical Driving Situation Due to High Dynamic Loads, pp. 1327-1332.

Menhour, Lghani	Mathématiques et Systèmes CAOR
Charara, Ali	HEUDIASYC UMR UTC/CNRS 6599
Lechner, Daniel	INRETS-MA

09:18-09:36 WA2.2

Nonlinear Observers of Tire Forces and Sideslip Angle Estimation Applied to Road Safety: Simulation and Experimental Validation, pp. 1333-1338.

Wang, Bin	HEUDIASYC UMR UTC/CNRS 7253
Cheng, Qi	Heudiasyc
Victorino, Alessandro	Univ. de Tech. de Compiegne, Departement de GenieInfor
Charara, Ali	HEUDIASYC UMR UTC/CNRS 6599

09:36-09:54 WA2.3

Traffic Situation Assessment by Recognizing Interrelated Road Users, pp. 1339-1344.

Platho, Matthias	Univ. of Ilmenau
Gross, Horst-Michael	Ilmenau Univ. of Tech.
Eggert, Julian	Honda Res. Inst. Europe GmbH

09:54-10:12 WA2.4

Genesis of Booster Curves in Electric Power Assistance Steering Systems, pp. 1345-1350.

Ciarla, Valentina	GipsaLab
Cahouet, Violaine	Univ. Joseph Fourier GipsaLab
Canudas de Wit, Carlos	Grenoble
Quaine, Franck	Univ. Joseph Fourier GipsaLab

10:12-10:30 WA2.5

Temporal Association Rule Mining for the Preventive Diagnosis of Onboard Subsystems within Floating Train Data Framework, pp. 1351-1356.

Sammouri, Wissam	UPE, IFSTTAR, GRETTIA
Come, Etienne	UPE, IFSTTAR, GRETTIA
Oukhellou, Latifa	UPE, IFSTTAR,GRETTIA
Aknin, Patrice	UPE, IFSTTAR,GRETTIA
Fonlladosa, Charles-Eric	Alstom Transport
Prendergast, Kevin	Alstom Transport

WA3 Dillingham

Vehicle Localization and Autonomous Navigation 1 (Regular Session)

09:00-09:18 WA3.1

Real Time Localization, Path Planning and Motion Control for Autonomous Parking in Cluttered Environment with Narrow Passages, pp. 1357-1364. Attachment

Tehrani Nik Nejad, Hossein	DENSO Corp.
Do, Quoc Huy	Toyota Tech. Inst.
Sakai, Ryohei	Toyota Tech. Inst.
Han, Long	Toyota Tech. Inst.
Mita, Seiichi	Toyota Tech. Inst.

09:18-09:36 WA3.2

Multi-Sensor Localization – Visual Odometry As a Low Cost Proprioceptive Sensor, pp. 1365-1370.

Bak, Adrien	DxO Lab.
Gruyer, Dominique	IFSTTAR
Bouchafa, Samia	Univ. Paris Sud XI
Aubert, Didier	IFSTTAR

09:36-09:54 WA3.3

Continually Improving Large Scale Long Term Visual Navigation of a Vehicle in Dynamic Urban Environments, pp. 1371-1376.

Churchill, Winston	Oxford Univ.
Newman, Paul	Oxford Univ.

09:54-10:12 WA3.4

A Sequential Test for Autonomous Localisation of Map Errors for Driving Assistance Systems, pp. 1377-1382.

Zinoune, Clément	Univ. of Tech. of Compiègne, Renault SAS
Bonnifait, Philippe	Univ. of Tech. of Compiegne
Ibanez Guzman, Javier	Renault S.A.S,

WA4 Fireweed

ITS Implementations 2 (Regular Session)

09:00-09:18 WA4.1

Motion Stereo-Based Collision Avoidance for an Intelligent Smart Car Door System, pp. 1383-1389.

Scharfenberger, Christian	Univ. of Waterloo
Chakraborty, Samarjit	Tech. Univ. München
Zelek, John	Univ. of Waterloo, Systems Design Engineering, Canada
Clausi, David	Univ. of Waterloo, Systems Design Engineering, Canada

09:18-09:36 WA4.2

Mobile Based Event-Activated Vehicle Tracking in Urban Environments, pp. 1390-1395.

Srinivasa, Ramakrishna	Intel Tech.
Agnihotri, Samar	The Chinese Univ. of Hong Kong

Jadhupathi, Prem	Mphasis
Namballa, Revathipathi	Mphasis

09:36-09:54 WA4.3

Hybridization of Appearance and Symmetry for Vehicle-Logo Localization, pp. 1396-1401.

Zhou, Kai	Automation and Control Inst. Vienna Univ.
Varadarajan, Karthik Mahesh	ACIN, TU Vienna
Vincze, Markus	ACIN, TU Vienna
Liu, Fuqiang	Tongji Univ.

09:54-10:12 WA4.4

Research on Compressed EKF Based SLAM Algorithm for Unmanned Underwater Vehicle, pp. 1402-1406.

Wang, Hongjian	Automation Coll. Harbin Engg. Univ.
Li, Cun	Automation Coll. Harbin Engg. Univ.
Lv, Hongli	Automation Coll. Harbin Engg. Univ.
Chen, Xinghua	Automation Coll. Harbin Engg. Univ.

WA5 Iliamna

Simulation and Modeling 1 (Regular Session)

09:00-09:18 WA5.1

Link Observability without Path Enumeration: A Revisit, pp. 1407-1410.

Ng, ManWo	Old Dominion Univ.

09:18-09:36 WA5.2

Measurement of Heavy Traffic Using Temporal Template, pp. 1411-1416.

Tsukanome, Takuma	Hirosaki Univ.
Onoguchi, Kazunori	Hirosaki Univ.

09:36-09:54 WA5.3

Calibration of CORSIM Models Considering All Model Parameters Simultaneously, pp. 1417-1422.

Paz, Alexander	Univ. of Nevada, Las Vegas
Molano, Victor	Univ. of Nevada, Las Vegas
Gaviria, Carlos	Univ. of Cauca

09:54-10:12 WA5.4

Traffic Jam Modeling and Simulation (I), pp. 1423-1428.

Yin, Derek	Univ. of Alberta
Qiu, Tony	Univ. of Alberta
09:54-10:12	WA5.4

10:12-10:30 WA5.5

Dynamic Model Development of Performance Indices for Planning of Sustainable Transportation Systems, pp. 1924-1930.

Maheshwari, Pankaj	Univ. of Nevada, Las Vegas
Khaddar, Romesh	Univ. of Nevada, Las Vegas
Kachroo, Pushkin	Univ. of Nevada, Las Vegas
Paz, Alexander	Univ. of Nevada, Las Vegas
Shlayan, Neveen	Univ. of Nevada, Las Vegas

WA6 Katmai

Intelligent Solutions for Air Transportation and Air Space – (ISATAS) (Special Session)

Organizer: Castro, António	LIACC, Univ. of Porto

09:00-09:18 WA6.1

Towards an Autonomous and Intelligent Airline Operations Control (I), pp. 1429-1434.

Castro, António J. M.	LIACC, Univ. of Porto
Rocha, Ana Paula	Faculty of Engineering of Porto (Portugal)
Oliveira, Eugénio	Faculty of Engineering, Univ. of Porto

09:18-09:36 WA6.2

Revisit the Fairness Issues in Flight Landing Scheduling, pp. 1435-1440.

Wang, Yong	National Univ. of Defense Tech.
Wang, Feng	The Univ. of Mississippi
Wang, Dan	The Hong Kong Pol. Univ.
Gong, Zhenghu	National Univ. of Defense Tech.
Liu, Jiangchuan	Simon Fraser Univ.

09:36-09:54 WA6.3

Analysis of Aircraft Trajectories Using Fourier Descriptors and Kernel Density Estimation, pp. 1441-1446.

Annoni Jr., Ronald	Inst. Tecnologico de Aeronautica
Forster, Carlos H. Q.	Inst. Tecnologico de Aeronautica

09:54-10:12 WA6.4

Optimal Configuration for Intersecting Flows of Aircraft, pp. 1447-1452.

Huang, Shimeng	Univ. of Pittsburgh
Feron, Eric	Georgia Inst. of Tech.
Mao, Zhi-Hong	Univ. of Pittsburgh

WA7 King Salmon

Weather Response Systems (Regular Session)

09:00-09:18 WA7.1

907-Plow - Anchorage's Approach to Real-Time Snowplow Tracking, pp. 1453-1458.

Menard, Timothy	Univ. of Alaska, Anchorage
Lund, John	Univ. of Alaska Anchorage
Miller, Jeffrey	Univ. of Alaska Anchorage
Petersen, Todd	Univ. of Alaska Anchorage

09:18-09:36 WA7.2

Impact Assessment of Network Reliability with Route Information under Severe Weather, pp. 1459-1464.

Ho, Wei-Ming	National Cheng Kung Univ.
Chen, Li-Wen	Chung Hua Univ.
Hu, Ta-Yin	National Cheng Kung Univ.

09:36-09:54 WA7.3

A Prototype for a Real-Time Weather Responsive System, pp. 1465-1470.

Krings, Axel	Univ. of Idaho
Serageldin, Ahmed	Univ. of Idaho
Abdel-Rahim, Ahmed	Univ. of Idaho

09:54-10:12 WA7.4

Simulation Analysis of Longitudinal Ventilation System with Jet Fan Speed Control for MPC Strategy in a Road Tunnel, pp. 1471-1476.

Tan, Zhen	Zhejiang Univ.
Huang, Zhiyi	Zhejiang Univ.
Wu, Ke	Zhejiang Univ.
Xu, Leiting	Hang Zhou Urban Infrastructure Construction and Development Cent

WA8 Lupine

Traffic Data Fusion (Regular Session)

09:00-09:18 WA8.1

Traffic State Estimation Based on Data Fusion Techniques (I), pp. 1477-1482.

Cipriani, Ernesto	Univ. di Roma Tre.
Gori, Stefano	Univ. di Roma Tre.
Mannini, Livia	Univ. di Roma Tre.

09:18-09:36 WA8.2

Current State and Future Outlook of Traffic Data Fusion in London, pp. 1483-1488.

Hu, Jun	Imperial Coll. London
Kaparias, Ioannis	City Univ. London
Bell, Michaeal Geoffrey Harrison	Imperial Coll. London

09:36-09:54 WA8.3

First Order Velocity Based Travel Time Model, pp. 1489-1494.

Farokhi Sadabadi, Kaveh	Univ. of Maryland
Haghani, Ali	Univ. of Maryland

09:54-10:12 WA8.4

Road Intersection Intelligent Traffic Management Supported by Inter-Vehicle Sensor Fusion, pp. 1495-1502. Attachment

Conde Bento, Luis Manuel	Inst. de Sistemas e Robotica
Nunes, Urbano	Inst. de Sistemas e Robotica
Parafita, Ricardo Jorge Pedrosa	Inst. de Sistemas e Robótica - Univ. de Coimbra

WB1 Chart

Driver Assistance Systems 1 (Regular Session)

11:00-11:18 WB1.1

Comparison of Model Reference and Map Based Control Method for Vehicle Stability Enhancement, pp. 1503-1508.

Baek, Seunghwan	Inje Univ.
Son, Minhyuk	TNO Automotive Korea
Boo, Kwangsuk	Inje Univ.
Kim, Heungseob	Inje Univ.
Song, Jeonghoon	Tongmyong Univ.

11:18-11:36 WB1.2

Using Grid Maps to Reduce the Number of False Positive Measurements in Advanced Driver Assistance Systems, pp. 1509-1514.

Nuss, Dominik	Univ. of Ulm
Reuter, Stephan	Univ. of Ulm
Konrad, Marcus	EvoBus GmbH - Daimler Buses
Munz, Michael	-
Dietmayer, Klaus	Univ. of Ulm

11:36-11:54 WB1.3

Are Drivers Aware of Their Behavior Changes When Using In-Vehicle Systems, pp. 1515-1518.

Yang, Yan	Univ. of Southampton
McDonald, Mike	Univ. of Southampton
Bryan, Reimer	Massachusetts Inst. of Tech.
Bruce, Mehler	Massachusetts Inst. of Tech.

11:54-12:12 WB1.4

Real-Time Vehicle Detection by Parts for Urban Driver Assistance, pp. 1519-1524.

Sivaraman, Sayanan	Univ. of California at San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

WB2 Denali

Driver Assistance Systems 2 (Regular Session)

11:00-11:18 WB2.1

An Analysis on Users' Evaluation for Self-Balancing Two-Wheeled Personal Mobility Vehicles, pp. 1525-1530.

Ando, Ryosuke	TTRI (Toyota Transportation Res. Inst.
Li, Ang	Urban Transport Center, Ministry of Housing and Urban-RuralDevel

11:18-11:36 WB2.2

Fault-Tolerant Controller Design for Automated Guided Vehicle Systems Based on Petri Nets, pp. 1531-1536.

Yan, Jiaxiang	Indiana Univ. Univ. Indianapolis (IUPUI)
Li, Lingxi	Indiana Univ. Univ. Indianapolis (IUPUI)

11:36-11:54 WB2.3

Reachability Analysis of Cooperative Adaptive Cruise Controller, pp. 1537-1542.

Kianfar, Roozbeh	Chalmers Univ. of Tech.
Falcone, Paolo	Chalmers Univ. of Tech.
Fredriksson, Jonas	Chalmers Univ. of Tech.

11:54-12:12 WB2.4

Driver Assistance Systems Modeling by Model Predictive Control, pp. 1543-1548.

Wang, Meng	Delft Univ. of Tech.
Daamen, Winnie	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.
van Arem, Bart	Delft Univ. of Tech.

WB3 Dillingham

Vehicle Localization and Autonomous Navigation 2 (Regular Session)

11:00-11:18 WB3.1

Positioning Accuracy Improvement Via Distributed Location Estimate in Cooperative Vehicular Networks, pp. 1549-1554.

Liu, Kai	Nanyang Tech. Univ.
Lim, Hock Beng	Intelligent Systems Centre,

	Nanyang Tech. Univ.

11:18-11:36 WB3.2

Communicationless Navigation through Robust Visual Odometry, pp. 1555-1560.

Van Hamme, David	Univ. Coll. Ghent
Veelaert, Peter	Ghent Univ. - Univ. Coll. Ghent
Philips, Wilfried	Ghent Univ. IBBT

11:36-11:54 WB3.3

Lightweight Lane Positioning of Vehicles Using a Smartphone GPS by Monitoring the Distance from the Center Line, pp. 1561-1565.

Sekimoto, Yoshihide	Univ. of Tokyo
Matsubayashi, Yutaka	Kokusai Kogyo Co., Ltd.
Yamada, Harutoshi	Center for Spatial Information Science, Univ. of Tokyo
Imai, Ryuichi	National Inst. of Land and Infrastructure Management, MLIT
Usui, Tomotaka	Center for Spatial Information Science, Univ. of Tokyo
Kanasugi, Hiroshi	Inst. of Industrial Science, Univ. of Tokyo

11:54-12:12 WB3.4

Illumination Robust Road Detection Using Geometric Information, pp. 1566-1571.

Oh, Changbeom	Yonsei Univ.
Son, Jongin	Yonsei Univ.
Sohn, Kwanghoon	Yonsei Univ.

WB4 Fireweed

ITS Implementations 1 (Regular Session)

11:00-11:18 WB4.1

A Distributed Algorithm for Adaptive Traffic Lights Control, pp. 1572-1577.

Faye, Sébastien	Telecom ParisTech
Chaudet, Claude	Telecom ParisTech
Demeure, Isabelle	Télécom ParisTech

11:18-11:36 WB4.2

DVS: A Distributed Virtual Signboard for Information Dissemination and Preservation in Vehicular Networks, pp. 1578-1583.

Hu, Zhengqing	Nanyang Pol.
Motani, Mehul	National Univ. of Singapore

11:36-11:54 WB4.3

Vehicle Mass Estimation Using a Total Least-Squares Approach, pp. 1584-1589.

Rhode, Stephan	Karlsruhe Inst. of Tech.
Gauterin, Frank	Karlsruhe Inst. of Tech.

11:54-12:12 WB4.4

Application of Reinforcement Learning with Continuous State Space to Ramp Metering in Real-World Conditions, pp. 1590-1595.

Rezaee, Kasra	Univ. of Toronto
Abdulhai, Baher	Univ. of Toronto
Abdelgawad, Hossam	Univ. of Toronto

WB5 Iliamna

Simulation and Modeling 3 (Regular Session)

11:00-11:18 WB5.1

A K-Nearest Neighbor Locally Weighted Regression Method for Short-Term Traffic Flow Forecasting, pp. 1596-1601.

Li, Shuangshuang	Inst. of Automation, Chinese Acad. of Sciences
Shen, Zhen	Inst. of Automation, Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of Sciences
Xiong, Gang	Inst. of Automation, Chinese Acad. of Sciences

11:18-11:36 WB5.2

Scalability in Urban Autonomy through Overlapping Decompositions of Hybrid-State Systems, pp. 1602-1607.

Kurt, Arda	The Ohio State Univ.
Ozguner, Umit	Ohio State Univ.

11:36-11:54 WB5.3

Networked Driving Simulator Based on SIGVerse and Lane-Change Analysis According to Frequency of Driving, pp. 1608-1613.

Bando, Takashi	DENSO Corp.
Shibata, Tomohiro	Nara Inst. of Science and Tech.

11:54-12:12 WB5.4

Parameter Sensitivity Analysis of a Cooperative System by Means of Microscopic Traffic Simulation, pp. 1614-1619.

Riemann, Raffaela	TUM CREATE - Centre for Electromobility
Baur, Mathias	Tech. Univ. München
Fullerton, Matthew	Tech. Univ. München

WB6 Katmai

Travel Time Estimation and Its Applications (Regular Session)

11:00-11:18 WB6.1

Towards an Uncertainty Aware Short-Term Travel Time Prediction Using GPS Bus Data: Case Study in Dublin, pp. 1620-1625.

Trigueiro Baptista, Arthur	Royal Inst. of Tech. KTH, Sweden
Bouillet, Eric	IBM Res.
Pompey, Pascal	IBM Res.

11:18-11:36 WB6.2

Reliability in Stochastic Time-Dependent Traffic Networks with Correlated Link Travel Times, pp. 1626-1631.

Dong, Wei	Swinburne Univ. of Tech.
Li, Minyi	Swinburne Univ. of Tech.
Vo, Quoc Bao	Swinburne Univ. of Tech.
Vu, Hai L.	Swinburne Univ. of Tech.

11:36-11:54 WB6.3

Unscented Kalman Filter for Urban Link Travel Time

Estimation with Mid-Link Sinks and Sources, pp. 1632-1637.

Hage, Ré-mi	IFSTTAR
Bétaille, David	IFSTTAR
Peyret, Francois	IFSTTAR
Meizel, Dominique	ENSIL
Smal, Jean-christophe	IFSTTAR

11:54-12:12 WB6.4

Practical Time-Dependent and Stochastic Routing with Historical Measurements of Travel Times, pp. 1638-1643.

Demeyer, Sofie	Ghent Univ.
Audenaert, Pieter	Ghent Univ.
Logghe, Steven	Be-Mobile
Pickavet, Mario	Ghent Univ.
Demeester, Piet	Ghent Univ.

12:12-12:30 WB6.5

Evaluation of Travel Time Estimation Based on LWR-V and CTM-V: A Case Study in Stockholm, pp. 1644-1649.

Allström, Andreas	Linköping Univ.
Gundlegård, David	Linköping Univ.
Rydergren, Clas	Linköping Univ.

WB7 King Salmon

Traffic Flow Management (Regular Session)

11:00-11:18 WB7.1

Compare Linear Interpolation and Adaptive Smoothing Methods on Traffic Flow Information Reconstruction, pp. 1650-1655.

Guo, Wei	Tsinghua Univ.
Wang, Qi	Tsinghua Univ.
Li, Zhiheng	Tsinghua Univ.
Zhang, Yi	Tsinghua Univ.
Li, Li	Tsinghua Univ.
Zhang, Zuo	Tsinghua Univ.

11:18-11:36 WB7.2

The Optimal Discretized Timing Plan for Individual Oversaturated Intersections, pp. 1656-1660.

Zou, Bin	Tsinghua Univ.
Hu, Jianming	Tsinghua Univ.
Zhang, Yi	Tsinghua Univ.

11:36-11:54 WB7.3

Towards a Realistic Optimization of Urban Traffic Flows, pp. 1661-1668.

Angius, Fabio	Univ. of California
Reineri, Massimo	Pol. di Torino
Chiasserini, Carla Fabiana	Pol. di Torino
Gerla, Mario	Univ. of California
Pau, Giovanni	Univ. of California

11:54-12:12 WB7.4

Traffic Incident Detection by Multiple Kernel Support Vector Machine Ensemble, pp. 1669-1673.

Xiao, Jianli	Shanghai Jiao Tong Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.

WB8 Lupine

Analysis Using Probe Vehicle Data (Regular Session)

11:00-11:18 WB8.1

Queue Length Estimation Using Conventional Vehicle Detector and Probe Vehicle Data, pp. 1674-1681.

Badillo, Brian E.	Harmonia Holdings Group, LLC
Rakha, Hesham A.	Virginia Tech.
Rioux, Thomas W.	Rioux Engineering & Harmonia Holdings Group
Abrams, Marc	Harmonia Holdings Group, LLC

11:18-11:36 WB8.2

Wide-Area, Web-Based Mobility Analysis Using Probe Data, pp. 1682-1686.

Pack, Michael	Univ. of Maryland Center for AdvancedTransportationTechnolo

11:36-11:54 WB8.3

Automatic Inference of Map Attributes from Mobile Data, pp. 1687-1692.

Hofleitner, Aude	Univ. of California, Berkeley
Come, Etienne	UPE, IFSTTAR, GRETTIA
Oukhellou, Latifa	UPE, IFSTTAR, GRETTIA
Lebacque, Jean-Patrick	UPE, IFSTTAR, GRETTIA
Bayen, Alexandre	Univ. of California, Berkeley

11:54-12:12 WB8.4

Robust Road Link Speed Estimates for Sparse or Missing Probe Vehicle Data, pp. 1693-1697.

Widhalm, Peter	Austrian Inst. of Tech.
Piff, Markus	Austrian Inst. of Tech. (AIT)
Brändle, Norbert	Austrian Inst. of Tech.
Koller, Hannes	Austrian Inst. of Tech.
Reinthaler, Martin	Austrian Inst. of Tech.
Ponweiser, Wolfgang	Austrian Inst. of Tech.

12:12-12:30 WB8.5

Path Inference of Low-Frequency GPS Probes for Urban Networks (I), pp. 1698-1701.

Rahmani, Mahmood	KTH Royal Inst. of Tech.
Koutsopoulos, Haris N.	KTH Royal Inst. of Tech.

WC1 Chart

Driver Assistance Systems - Lateral Control (Regular Session)

14:00-14:18 WC1.1

Steering Assisting System for Obstacle Avoidance Based on Personalized Potential Field, pp. 1702-1707.

Noto, Noriyasu	Nagoya Univ.
Okuda, Hiroyuki	Nagoya Univ.
Tazaki, Yuichi	Nagoya Univ.
Suzuki, Tatsuya	Nagoya Univ.

14:18-14:36 WC1.2

A New Nonlinear Observer of Sideslip Angle with Unknown Vehicle Parameter Using the Dual Unscented Kalman Filter, pp. 1708-1713.

Cheng, Qi	Heudiasyc
Victorino, Alessandro	Univ. de Tech. de Compiegne, Departement de GenieInfor
Charara, Ali	HEUDIASYC UMR UTC/CNRS 6599

14:36-14:54 WC1.3

Integrated Threat Assessment and Control Design for Roadway Departure Avoidance, pp. 1714-1719.

Gray, Andrew	Univ. of California, Berkeley
Ali, Mohammad	Volvo Cars
Gao, Yiqi	Univ. of California, Berkeley
Hedrick, J. Karl	Univ. of California, Berkeley
Borrelli, Francesco	Univ. of California, Berkeley

14:54-15:12 WC1.4

Model of Collision Avoidance with Lane Departure Warning in Real-World Departure Collisions with Fixed Roadside Objects, pp. 1720-1725.

Kusano, Kristofer	Virginia Tech.
Gabler, Hampton Clay	Virginia Tech.

15:12-15:30 WC1.5

Self-Defensive Coordinated Maneuvering of an Intelligent Vehicle Platoon in Mixed Traffic, pp. 1726-1733.

Guo, Chunzhao	Toyota Tech. Inst.
Wan, Nianfeng	Clemson Univ.
Mita, Seiichi	Toyota Tech. Inst.
Yang, Ming	Shanghai Jiao Tong Univ.

WC2 Denali

Advanced Vehicle Technologies 2 (Regular Session)

14:00-14:18 WC2.1

Anti-Trap Protection for an Intelligent Smart Car Door System, pp. 1734-1740.

Scharfenberger, Christian	Univ. of Waterloo
Chakraborty, Samarjit	Tech. Univ. München
Zelek, John	Univ. of Waterloo, Systems Design Engineering, Canada
Clausi, David	Univ. of Waterloo, Systems Design Engineering, Canada

14:18-14:36 WC2.2

Optimal Braking and Steering Control for Active Safety, pp. 1741-1746.

Moshchuk, Nikolai	General Motors Company
Chen, Shih-Ken	General Motors Company
Zagorski, Chad	General Motors Company
Chatterjee, Aamarapali	General Motors Company

14:36-14:54 WC2.3

Shared Control System to Safeguard Mobility of Wheeled, Actively Articulated Truck-Trailer Vehicles on Structured and Rough Terrain, pp. 1747-1752.

Labenda, Patrick	Ruhr-Univ. Bochum

14:54-15:12 WC2.4

In-Vehicle Speaker Recognition Using Independent Vector Analysis, pp. 1753-1758.

Yamada, Toshiro	Univ. of California at San Diego
Tawari, Ashish	Univ. of California at San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

WC3 Dillingham

Pedestrian Detection (Regular Session)

14:00-14:18 WC3.1

Early Detection of the Pedestrian's Intention to Cross the Street, pp. 1759-1764. Attachment

Köhler, Sebastian	Univ. of Applied Sciences Aschaffenburg
Goldhammer, Michael	Univ. of Applied Sciences Aschaffenburg
Bauer, Sebastian	Friedrich-Alexander-Univ. Erlangen-Nuremberg
Doll, Konrad	Univ. of Applied Sciences Aschaffenburg
Brunsmann, Ulrich	Univ. of Applied Sciences Aschaffenburg
Dietmayer, Klaus	Univ. of Ulm

14:18-14:36 WC3.2

Nighttime Pedestrian Detection by Selecting Strong Near-Infrared Parts and Enhanced Spatially Local Model, pp. 1765-1770.

Lee, Yi-shu	National Taiwan Univ.
Chan, Yi-Ming	National Taiwan Univ.
Fu, Li-Chen	National Taiwan Univ.
Hsiao, Pei-Yung	National Univ. of Kaohsiung
Chuang, Li-An	National Taiwan Univ.
Chen, Yi-Hsiang	National Taiwan Univ.
Luo, Ming-Fang	Chung-Shan Inst. of Science and Tech.

14:36-14:54 WC3.3

Video–based Pedestrian Head Pose Estimation for Risk Assessment, pp. 1771-1776.

Schulz, Andreas	Robert Bosch GmbH
Stiefelhagen, Rainer	Fraunhofer-Inst. für Optronik, Systemtechnikund Bildauswertung

14:54-15:12 WC3.4

Comparison of Granules Features for Pedestrian Detection, pp. 1777-1782.

Kao, Yu-Fu	National Taiwan Univ.
Chan, Yi-Ming	National Taiwan Univ.
Fu, Li-Chen	National Taiwan Univ.
Hsiao, Pei-Yung	National Univ. of Kaohsiung
Huang, Shih-Shinh	National Kaohsiung First Univ. of Science and Tech.
Wu, Cheng-En	National Taiwan Univ.
Luo, Min-Fang	Chung-Shan Inst. of Science and Tech.

15:12-15:30 WC3.5

Reliable Pedestrian Recognition Combining High-Definition LIDAR and Vision Data, pp. 1783-1788.

Kidono, Kiyosumi	Toyota Central R&D Lab. Inc.
Naito, Takashi	Toyota Central R&D Lab. Inc.
Miura, Jun	Toyohashi Univ. of Tech.

WC4 Fireweed

Human Factors Studies (Regular Session)

14:00-14:18 WC4.1

Predicting Cruising Speed through Data-Driven Driver Modeling, pp. 1789-1796.

McNew, John-Michael	Toyota Tech. Center

14:18-14:36 WC4.2

Driver Head Pose and Gaze Estimation Based on Multi-Template ICP 3D Point Cloud Alignment, pp. 1797-1802.

Bär, Tobias	FZI Forschungszentrum Informatik
Reuter, Jan-Felix	FZI Forschungszentrum Informatik
Zöllner, J. Marius	FZI Forschungszentrum Informatik

14:36-14:54 WC4.3

A Generic Concept of a System for Predicting Driving Behaviors, pp. 1803-1808.

Bonnin, Sarah	bielefeld Univ. Cor-Lab.
Kummert, Franz	Bielefeld Univ.
Schmuedderich, Jens	Honda Res. Inst. Europe GmbH

14:54-15:12 WC4.4

IC-DEEP: A Serious Games Based Application to Assess the Ergonomics of In-Vehicle Information Systems, pp. 1809-1814.

Gonçalves, Joel	Univ. do Porto - DEI/FEUP
Rossetti, Rosaldo	Univ. do Porto - LIACC
Olaverri Monreal, Cristina	Faculty of Mechanical Engineering,Tech.

15:12-15:30 WC4.5

Coupling Instrumented Vehicles and Driving Simulators: Opportunities from the DRIVE IN2 Project, pp. 1815-1820.

Bifulco, Gennaro Nicola	Univ. of Naples Federico II
Pariota, Luigi	Univ. of Naples Federico II
Galante, Francesco	Univ. of Naples Federico II
Fiorentino, Anita	Fiat Group Automobile

WC5 Iliamna

Simulation and Modeling 7 (Regular Session)

14:00-14:18 WC5.1

Short-Term Traffic Flow Prediction Using EMD-Based Recurrent Hermite Neural Network Approach, pp. 1821-1826.

Chen, Syuan-Yi	Industrial Tech. Res. Inst.
Wei-Yao, Chou	Industrial Tech. Res. Inst.

14:18-14:36 WC5.2

A Micro-Simulation Model of Pedestrian-Vehicle Interaction Behavior at Unsignalized Mid-Block Locations, pp. 1827-1833.

Wang, Tianjiao	Univ. of Southampton
Wu, Jianping	Tsinghua Univ.
McDonald, Mike	Univ. of Southampton

14:36-14:54 WC5.3

Modelling Traffic Dynamics in Motorway Networks, pp. 1834-1839.

Fitzgerald, Aidan	Queen's Univ. Belfast
Marshall, Adele H.	Queen's Univ. Belfast
Moutari, Salissou	Queen's Univ. Belfast

14:54-15:12 WC5.4

Micro-Simulation Study on the Effect of On-Street Parking on Vehicular Flow, pp. 1840-1845.

Guo, Hongwei	Department of Transportation Engineering,BeijingInstituteof Tech.
Wang, Wuhong	Department of Transportation Engineering,BeijingInstituteof Tech.
Guo, Weiwei	Department of Transportation Engineering,BeijingInstituteof Tech.

WC6 Katmai

Advanced Public Transportation Systems (Regular Session)

14:00-14:18 WC6.1

A Sequential Testing Approach for Change-Point Detection on Bus Door Systems, pp. 1846-1851.

Cheifetz, Nicolas	Univ. Paris-Est, IFSTTAR/GRETTIA
Samé, Allou	Univ. Paris-Est, IFSTTAR/GRETTIA
Aknin, Patrice	Univ. Paris-Est, IFSTTAR/GRETTIA

14:18-14:36 WC6.2

Sitting, Waiting, Wishing: Waiting Time Perception in Public Transport, pp. 1852-1857.

Millonig, Alexandra	Austrian Inst. of Tech.
Sleszynski, Marek	Austrian Inst. of Tech.
Ulm, Michael	Austrian Inst. of Tech.

14:36-14:54 WC6.3

A Portable Pedometer Based on Inductive Proximity, pp. 1858-1861.

Shajahan, Sheik Mohammed Ali	Indian Inst. of Tech. Madras
George, Boby	Indian Inst. of Tech. Madras

14:54-15:12 WC6.4

Making Public Transportation Schedule Information Consumable for Improved Decision Making, pp. 1862-1867.

Gupta, Raj	IBM Res.
Srivastava, Biplav	IBM Res.
Tamilselvam, Srikanth	IBM Res.

WC7 King Salmon

Experimental Investigations (Regular Session)

14:00-14:18 WC7.1

BSM Emulator – Advanced Vehicle Safety Application Testbed, pp. 1868-1873.

Gupta, Somak Datta	PATH, UC Berkeley
Lin, Chih-Che	Information and Communications Research Lab.,Industrial Technology
Chan, Ching-Yao	ITS, Univ. of California at Berkeley

14:18-14:36 WC7.2

A Robotic Platform to Evalute Autonomous Driving Systems, pp. 1874-1879.

Belbachir, Assia	IFSTTAR
Smal, Jean-christophe	IFSTTAR : French Inst. of science and Tech. fortranspor
Blosseville, Jean-marc	IFSTTAR

14:36-14:54 WC7.3

A System for Coupled Road Traffic Utility Maximisation and Risk Management Using VANET, pp. 1880-1887.

Fitzgerald, Emma	Univ. of Sydney
Landfeldt, Bjorn	Lund Univ.

14:54-15:12 WC7.4

An Experimental Study on Changes of Muscle Fatigue among Utilizing Standing-Type Mobile Vehicles and Walking, pp. 1888-1893.

Hashimoto, Naohisa	National Inst. of AIST
Sakurai, Yoshihisa	Japan Inst. of Sports Sciences
Suzuki, Yusuke	AIST
Tomita, Kohji	AIST
Horiuchi, Eichi	AIST
Matsumoto, Osamu	AIST
Yokozuka, Masashi	AIST

WC8 Lupine

Network Level Traffic Analysis (Regular Session)

14:00-14:18 WC8.1

Network Zoning Based on Community Detection for Urban Traffic Control, pp. 1894-1899.

Chen, Cheng	Inst. of Automation, Chinese Acad. of Sciences
Ai, Yunfeng	Inst. of Automation, Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of Sciences

14:18-14:36 WC8.2

Effects of Traffic Network Dynamics on Hierarchical Community-Based Representations of Large Road Networks, pp. 1900-1905.

Movahed Nejad, Mahyar	Wayne State Univ.
Mashayekhy, Lena	Wayne State Univ.
Chinnam, Ratna Babu	Wayne State Univ.

14:36-14:54 WC8.3

Markov-Based Redistribution Policy Model for Future Urban Mobility Networks, pp. 1906-1911.

Volkov, Mikhail	Massachusetts Inst. of Tech.
Rus, Daniela	MIT
Aslam, Javed Alexander	NEU

14:54-15:12 WC8.4

Modeling ITS Data Sources for Generating Realistic Traffic Operating Parameters for Project-Level Conformity Analysis, pp. 1912-1917.

Liu, Hao	Univ. of Cincinnati
Wei, Heng	Univ. of Cincinnati
Yao, Zhuo	Univ. of Cincinnati

15:12-15:30 WC8.5

A Platoon of Vehicles Approaching an Intersection: A Testing Platform for Safe Intersections, pp. 1918-1923.

Diab, Hilal	RWTH Aachen Univ.
Ben Makhlouf, Ibtissem	RWTH Aachen Univ.
Kowalewski, Stefan	RWTH Aachen Univ.

Special Sessions

Special Session MA5: Calibration, Validation and Sensitivity Analysis of Traffic Simulation Models

11:00-12:30, Monday September 17, 2012, Iliamna

Special Session Organizers:

Constantinos Antoniou. Assistant Professor, National Technical University of Athens, Greece
Vincenzo Punzo. Senior Researcher at European Commission - Joint Research Centre, and Assistant Professor at University of Naples Federico II, Italy
Mark Brackstone. Consultant, IOMI, Southampton, U.K.

Abstract:

Over the past few decades, a lot of research activity has been devoted on the development of traffic simulation models, which have, at the same time, seen extensive use in the commercial sector. These models are often complex systems of components with many diverse types of inputs and parameters. A few of these can be directly measured in the real word and fixed at certain values, while suitable probability density functions need to be estimated for all the others. Such estimation processes are essential to replicate measured conditions and account for the variability in the real world. While originally this involved primarily trial-and-error type approaches, during the last decade the process for the management of uncertainty in simulation models has been formalized. Tools and frameworks have been developed for systematic calibration and validation of models and sensitivity analysis is receiving increasing attention among researchers in the field as the main tool for providing the required feedback on the whole process and additional insight into the model properties and behaviors. Papers on all aspects of calibration, validation and sensitivity analysis of traffic simulation models are suitable for this session, including papers focused on:

(1) Algorithms and methodological framework development;
(2) Demand and supply calibration and validation;
(3) Case studies and applications.

Speakers and Contributed Presentations:

11:00-11:18	MA5.1
Parallel Public Transport System and Its Application in the Evacuation of Large-Scale Activities (I), pp. 102-107.	
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Chen, Songhang	Chinese Acad. of Sciences
Lv, Yisheng	Chinese Acad. of Sciences
Ye, Peijun	Chinese Acad. of Sciences
11:18-11:36	MA5.2
Calibration of Microscopic Traffic Flow Models against Time-Series Data (I), pp. 108-114.	
Montanino, Marcello	Univ. of Naples Federico II
Ciuffo, Biagio	Joint Res. Centre - European Commission
Punzo, Vincenzo	European Commission Joint Res. Centre
11:36-11:54	MA5.3
Efficient Real Time OD Matrix Estimation Based on Principal Component Analysis (I), pp. 115-121.	
Djukic, Tamara	Delft Univ. of Tech.
Flötteröd, Gunnar	KTH Royal Inst. of Tech.

Van Lint, Hans	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.

11:54-12:12 MA5.4

Evolutionary Approach to Calibration of Cellular Automaton Based Traffic Simulation Models, pp. 122-129.

Korcek, Pavol	Brno Univ. of Tech.
Sekanina, Lukas	Brno Univ. of Tech. - Faculty of InformationTechnology
Fucik, Otto	Brno Univ. of Tech. - Faculty of InformationTechnology

12:12-12:30 MA5.5

Effectiveness of Speed Measures to Improve Roundabout Capacity "Case Study", pp. 130-133.

Abaza, Osama	Univ. of Alaska Anchorage

Special Session MC1: Advanced Vehicle Active Safety Systems

16:00-17:30, Monday September 17, 2012, Chart

Special Session Organizers:

Yaobin Chen, Ph.D., Professor and Director, Transportation Active Safety Institute, Purdue School of Engineering and Technology, IUPUI. Indianapolis, U.S.A.

Eliza Y. Du, Ph.D., Associate Professor, Transportation Active Safety Institute, Purdue School of Engineering and Technology, IUPUI. Indianapolis, USA

Abstract:

Every year, there are a large number of injuries and fatalities caused by vehicle crashes. Vehicle active safety systems can sense and identify potential crash events and prevent or mitigate the collision either by warning the driver or by taking appropriate control actions such as autonomous braking. Recent advances in advanced vehicle active safety technology have greatly improved vehicle safety and significantly reduced vehicle crashes, thus saving many lives. The objective of this special session is to bring leading researchers from academia and industry together to exchange the latest research results in the field. This session will provide an interdisciplinary forum for researchers, developers, and practitioners to present state-of-the art algorithms, techniques, and system designs in vehicle active safety and discuss the potential problems and solutions in real applications.

Speakers and Contributed Presentations:

16:00-16:18 MC1.1

Plant Error Analysis and Compensation in Adaptive Cruise Control Systems (I), pp. 438-443.

Meadows, Alex	Indiana Univ. Univ. Indianapolis
Li, Lingxi	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Widmann, Glenn	Delphi Electronics and Safety

16:18-16:36 MC1.2

Semantic-Based Road Environment Recognition in Mixed Traffic for Intelligent Vehicles and Advanced Driver Assistance Systems (I), pp. 444-450.

Guo, Chunzhao	Toyota Central R&D Lab. Inc.
Mita, Seiichi	Toyota Tech. Inst.

16:36-16:54 MC1.3

Automatic Categorization-Based Multi-Stage Pedestrian Detection (I), pp. 451-456.

Yang, Kai	Indiana Univ. Univ. Indianapolis
Du, Eliza	Indiana Univ. Univ. Indianapolis
Jiang, Pingge	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Sherony, Rini	Toyota Motor Engineering and Manufacturing North America
Takahashi, Hiroyuki	Toyota Motor Corp.

16:54-17:12 MC1.4

Minimizing Driver Interference under a Probablistic Safety Constraint in Emergency Collision Avoidance Systems (I), pp. 457-462.

Johnson, Jeffrey	Indiana Univ.
Zhang, Yajia	Indiana Univ.
Hauser, Kris	Indiana Univ.

Special Session TA7: Parallel Transportation Management System

11:00-12:30, Tuesday September 18, 2012, King Salmon

Special Session Organizers:

Fenghua Zhu. Associate Professor, Institute of Automation, Chinese Academy of Sciences, China.
Dr. Rosaldo Rossetti, Assistant Professor, Department of Informatics Engineering at the University of Porto, Portugal
Qingjie Kong. Assistant Professor, Shanghai Jiaotong University, China.
Lefei Li. Associate Professor, Tsinghua University, China.
Qinghai Miao. Associate Professor, College of Computing and Communication Engineering, Graduate University of the Chinese Academy of Sciences, China.

Abstract:

Recently, ACP-based Parallel System Theory (PST), has been proposed as a new mechanism for conducting operations of complex systems, especially those involving complexity issues of both engineering and social dimensions, such as transportation systems. Basically, this theory consists of three steps: 1) modeling and representation using Artificial societies; 2) analysis and evaluation by Computational experiments; and 3) control and management through Parallel execution of real and artificial systems. In some complex urban traffic networks, PST has been successfully applied and validated in the real world. However, when applying PST to Intelligent Transportation Systems (ITS), the related ITS theory and technologies all face new challenges and need to be further investigated. This special session is proposed under the umbrella of the Artificial Transportation Systems & Simulation Technical Activities sub-committee of IEEE ITS Society, and aims to bring together researchers and practitioners to discuss issues, challenges and future directions of PST applied to Transportation Management Systems and share their R&D findings as well as their experiences in related areas.

Speakers and Contributed Presentations:

11:00-11:18 TA7.1

Quadtree-Based Domain Decomposition for Parallel Map-Matching on GPS Data (I), pp. 808-813.

Xia, Yingjie	Hangzhou Normal Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.
Ye, Zhoumin	Hangzhou Inst. of Service Engineering, Hangzhou NormalUniver

Wu, Wei	Enjoyor Company
Zhu, Mingzhe	Hangzhou Inst. of Service Engineering, Hangzhou NormalUniver

11:18-11:36 TA7.2

Comparison of Urban Traffic Prediction Methods between UTN-Based Spatial Model and Time Series Models (I), pp. 814-819.

Xu, Yanyan	Shanghai Jiao Tong Univ.
Kong, Qing-Jie	Shanghai Jiao Tong Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.

11:36-11:54 TA7.3

A Dynamic Network Partition Method for Heterogenous Urban Traffic Networks (I), pp. 820-825.

Zhou, Zhao	Shanghai Jiao Tong Univ.
Lin, Shu	Shanghai Jiao Tong Univ.
Xi, Yugeng	Shanghai Jiao Tong Univ.

11:54-12:12 TA7.4

Reaching Low-Density Urban Areas with the Network-Inspired Transportation System, pp. 826-831.

Edwards, Derek	Georgia Inst. of Tech.
Elangovan, Arun Kumar	RideCell, LLC
Watkins, Kari E.	Georgia Inst. of Tech.

12:12-12:30 TA7.5

Exact Solutions to Traffic Density Estimation Problems Involving the Lighthill-Whitham-Richards Traffic Flow Model Using Mixed Integer Programming, pp. 832-839.

S Canepa, Edward Esteban	King Abdullah Univ. of Science and Tech.
Claudel, Christian	King Abdullah Univ. of Science and Tech.

Special Session TC3: Advanced Technologies and Innovative Concepts for Promoting Traffic Safety and Mobility

16:00-17:30, Tuesday September 18, 2012, Dillingham

Special Session Organizers:

Dr. Heng Wei, Associate Professor, University of Cincinnati, USA
Dr. Zhixia Li, Research Asscoiate, University of Wisconsin-Madison, USA

Special Session Co-Organizers:

Dr. Javier J. Sánchez Medina, University of Las Palmas de Gran Canaria, Spain
Dr. Ryan N. Fries, Southern Illinois University, USA
Dr. Xuesong Zhou, University of Utah, USA

Abstract:

The importance of applying advanced communication, detection, and computational technologies to highway transportation systems has been arising in different areas of transportation society, especially for addressing various safety and congestion issues at arterial corridors and intersections. The continuously increasing traffic demand has revealed the inability of traditional traffic control systems to accommodate traffic in a safe and efficient manner. At the same time, numerous innovative concepts and unconventional solutions, which apply advanced technologies into traffic management and control, have emerged extensively. They are intended to promote both mobility and safety of exiting transportation systems, or explore long-term solutions that are potentially applied in future practice. The advanced technologies and innovative concepts include but are not limited to:

- Machine-learning and other artificial intelligence techniques in traffic control and management
- Advanced detection technologies and computational methods in intersection signal control
- Autonomous vehicle management, including autonomous vehicle control strategies at intersections
- ITS solutions in collision avoidance systems and incidence management systems
- Computational methods and advanced technologies in speed enforcement, travel time prediction, intersection delay estimation, traffic state estimation, vehicle classification, and bottleneck traffic operations
- GIS-T technologies in addressing traffic safety and real-time traffic management
- Simulation techniques in promoting traffic safety

This special session is designated to invite relevant experts in traffic operations and management as well as highway safety to share their latest research and practical experiences in the aforementioned areas of interests. The objective of the special session is to provide a discussion forum focusing on the emerging advanced technologies and innovative concepts for promoting traffic safety and mobility.

Speakers and Contributed Presentations:

16:00-16:18	TC3.1
Effectiveness of Arterial Traffic Status Monitoring Using System Detector Data Based on a V-Plus-O Approach (I), pp. 1143-1148.	
Li, Zhixia	Univ. of Wisconsin-Madison
Yang, Qingyan	Iteris, Inc.
Wei, Heng	Univ. of Cincinnati
16:18-16:36	TC3.2
Simplified, Data-Driven, Errorable Car-Following Model to Predict the Safety Effects of Distracted Driving (I), pp. 1149-1154.	
Przybyla, Jay	Univ. of Utah
Taylor, Jeff	Univ. of Utah
Jupe, Jason	Armstrong Forensic Engineers
Zhou, Xuesong	Univ. of Utah
16:36-16:54	TC3.3
Parts-Based Object Recognition Seeded by Frequency-Tuned Saliency for Child Detection in Active Safety, pp. 1155-1160.	
Cheng, Shinko	Hrl Lab. LLC
Molineros, Jose	HRL Lab. LLC
Owechko, Yuri	HRL Lab. LLC
Levi, Dan	General Motors, Advanced Tech. Center, Israel
Zhang, Wende	General Motors, Res. and Development
16:54-17:12	TC3.4
Level of Service for Parking Facilities (I), pp. 1161-1165.	
He, Yulong	Beijing Univ. of Tech.
Sun, Xiaoduan	Univ. of Louisiana
Du, Lizhen	Beijing Univ. of Tech.
Ruan, Jinmei	Beijing Municipal Inst. of City Planning & Design
Das, Subasish	Univ. of Louisiana
17:12-17:30	TC3.5
Driving Motion Capture Based Driver Behavior Analysis (I), pp. 1166-1171.	

Shi, Jianjun	Beijing Univ. of Tech.
Wei, Heng	Univ. of Cincinnati
Shi, Shengqing	Beijing Univ. of Tech.

Special Session WA6: *Intelligent Solutions for Air Transportation and Air Space – (ISATAS)*

09:00-10:30, Wednesday September 19, 2012, Katmai

Special Session Organizers:

Eugénio Oliveira: Full Professor at the University of Porto

Vladimir Gorodetsky: Professor of Computer Science, Chief Scientists of Intelligent, Systems Laboratory of the St. Petersburg Institute for Informatics and Automation of the Russian Academy of Science

Ana Paula Rocha: Auxiliar Professor at the Department of Computing Engineering, University of Porto

António Castro: Software Engineer at TAP Portugal, the Portuguese airline company

Abstract:

The aim of the ISATAS Special Session is to foster the discussion on issues concerning the development of Intelligent Solutions for real Air Transportation and Air Space problems, including Disruption Management, Airline Operations Control, Air Space Operations Control, Air Traffic Management and Control, Airport Logistics, Airspace Logistics, etc. By intelligent solutions we mean any that are the outcome of an intelligent system that is able to autonomously react and adapt to changes in the dynamic environment. This will be achieved through autonomic decision-making as well as by including features representing all the involved players' problem-solving intelligent capabilities to reach their ultimate goals and intentions in the Air Transportation domain.

On the basis of theories and methodologies borrowed from a wide spectrum of disciplines, such as the Social Sciences, Distributed Computing, Artificial Intelligence and Multi-agent Systems, and many others, many important issues arise which challenge and motivate many researchers and practitioners from multidisciplinary fields, as well as different technical and scientific communities. We encourage and welcome contributions reporting on how the scientific community and practitioners are using intelligent techniques and methodologies to address real Air Transportation problems.

Speakers and Contributed Presentations:

09:00-09:18	WA6.1
Towards an Autonomous and Intelligent Airline Operations Control (I), pp. 1429-1434.	
Castro, António J. M.	LIACC, Univ. of Porto
Rocha, Ana Paula	Faculty of Engineering of Porto (Portugal)
Oliveira, Eugénio	Faculty of Engineering, Univ. of Porto
09:18-09:36	WA6.2
Revisit the Fairness Issues in Flight Landing Scheduling, pp. 1435-1440.	
Wang, Yong	National Univ. of Defense Tech.
Wang, Feng	The Univ. of Mississippi
Wang, Dan	The Hong Kong Pol. Univ.
Gong, Zhenghu	National Univ. of Defense Tech.
Liu, Jiangchuan	Simon Fraser Univ.
09:36-09:54	WA6.3

Analysis of Aircraft Trajectories Using Fourier Descriptors and Kernel Density Estimation, pp. 1441-1446.

Annoni Jr., Ronald	Inst. Tecnologico de Aeronautica
Forster, Carlos H. Q.	Inst. Tecnologico de Aeronautica

09:54-10:12 WA6.4

Optimal Configuration for Intersecting Flows of Aircraft, pp. 1447-1452.

Huang, Shimeng	Univ. of Pittsburgh
Feron, Eric	Georgia Inst. of Tech.
Mao, Zhi-Hong	Univ. of Pittsburgh

Abstracts

Technical Program for Monday September 17, 2012

MP1L Aleutian/Alaska

Plenary Session on Monday (Plenary Session)

08:00-09:30 MP1L.1

*Pioneering the Wild Frontier in Intelligent Transportation**

Peters, Joseph USDOT/Federal Highway Administration

Over 50 years ago, the federal government pioneered the building of the interstate highway system in the US. Over 20 years ago, the federal government pioneered a new era defined by the "Intelligent Vehicle-Highway Systems Act of 1991." Today, the federal challenge is to pioneer the transportation frontiers in telecommunications, big data, and automation in ways that will revolutionize the ways we live.

Dr. Joseph I. Peters, Director of the Federal Highway Administration's Office of Operations Research and Development, will address the role that the federal government plays in creating R&D opportunities for electrical and electronics engineers who are pioneering the frontier in intelligent transportation. He will briefly highlight provisions of new legislation entitled, "Moving Ahead for Progress in the 21st Century Act," especially as they apply to intelligent transportation research. He will describe activities and opportunities at the Turner-Fairbank Highway Research Center and its new Saxton Transportation Operations Laboratory, as well as ongoing efforts as part of US DOT's connected vehicle research.

Dr. Joseph I. Peters directs a multi-disciplined staff in planning, conducting, and coordinating research, development, test, evaluation, and technology transfer initiatives aimed at improving traveler mobility on the Nation's highways. Over the past five years, his office has accomplished pioneering research and development of cooperative adaptive cruise control systems showing significant throughput, fuel savings, and environmental benefits associated with reduction of stop and go traffic. His office is currently developing and testing communications technologies for broadcasting traffic signal phase and timing information to vehicles and pedestrians as well as cooperative vehicle-highway communications technologies for enabling eco drive applications at signalized intersections. With the new Saxton Transportation Operations Laboratory up and running, his office will be providing new opportunities for senior level and student fellowships on site at the lab.

Joe has over 40 years of R&D experience including positions with the US DOT's Intelligent Transportation Systems Joint Program Office, a large government consulting company, US Air Force Systems Command, the US Army Research Institute for the Behavioral and Social Sciences, and, in the very beginning of his career, a research position at FHWA's Fairbank Highway Research Station. Dr. Peters is a graduate of Loyola College in Baltimore, MD, where he majored in Biology. He received his M.A. in Human Factors Psychology and his Ph.D. in Applied-Experimental Psychology from The Catholic University of America. He is the recipient of the Secretary of Transportation's Award for Meritorious Achievement and the FHWA Administrator's Award for Superior Achievement.

09:30-10:30 MP1L.2

*State of the ITS Industry**

Horsley, John American Association of State Highway & Transportation Officials

Twenty years ago, transportation professionals recognized that technologies are essential for getting the most out of our existing infrastructure – leading to the establishment of Intelligent Transportation Systems (ITS) programs in the United States. Today, using advanced technologies to improve information for travelers, reduce congestion, and improve safety is a growing practice among state DOTs. States are increasingly using "smart technologies" to improve system performance, safety and reliability. Citizens have come to expect that transportation agencies will use new technologies to help them get where they want to go, when they want to get there.

John Horsley, the Executive Director of the American Association of State Highway and Transportation Officials (AASHTO), will discuss about some great examples of how states across the country are turning to high-tech solutions to solve their transportation challenges.

In 1999, John Horsley became Executive Director of ASHTO, which advocates policies and provides technology leadership on behalf of States to improve the Nation's transportation system.

Previously, Horsley was nominated by the President and confirmed by the Senate as Associate Deputy Secretary of Transportation where he served from 1993 to 1999 as the Department's advocate for intermodal policies, quality of life initiatives and as liaison to State and Local Governments, US Congress, and transportation constituencies.

A native of the Northwest, Horsley was elected to five terms as County Commissioner in Kitsap County, a community just west of Seattle. He is a graduate of Harvard, an Army veteran, a former Peace Corps volunteer and Congressional aide, and did graduate study at Georgetown University. He is Past President of the National Association of Counties, and was founding Chairman of the Rebuild America Coalition.

He and his wife Deanna have been married for 36 years and have two children: Adam and Jennifer.

MA1 Chart

Automated Vehicle Operation 1 (Regular Session)

11:00-11:18 MA1.1

Performance Limitations in Vehicle Platoon Control, pp. 1-6

Solyom, Stefan Volvo Car Corp.
Coelingh, Erik Volvo Car Corp.

One of the major benefits of driving vehicles in controlled, close formations such as platoons is that of reduced air drag. However, this will set hard performance requirements on the system actuators, sensors and controllers of each vehicle. This paper analyzes the effects of fundamental limitations on the longitudinal and lateral control performance of a platoon and the effects on following distance, perceived safety and fuel economy. The trade-off between minimizing fuel consumption and maintaining a safe following distance is

analyzed and described. The analysis is based on fundamental properties of linear systems such as Bode's phase area relation. Design guidelines are proposed and results from vehicle testing are presented.

11:18-11:36 MA1.2

Temporal Analysis of the Gate Concept As Enabler for Highly Automated Driving Based on the Conduct-By-Wire Approach, pp. 7-12

Geyer, Sebastian	Tech. Univ. Darmstadt
Karg, Melanie	Tech. Univ. Darmstadt
Hakuli, Stephan	IPG Automotive GmbH
Winner, Hermann	Tech. Univ. Darmstadt
Franz, Benjamin	Tech. Univ. Darmstadt
Kauer, Michaela	Tech. Univ. Darmstadt

Conduct-by-Wire (CbW) is an innovative vehicle guidance concept that shifts the vehicle control task from the stabilization level to the guidance level. Instead of continuous stabilization on a designated trajectory – using the conventional control elements for manual steering, braking and accelerating – a CbW vehicle is controlled by means of maneuver commands. One important element on the way to realizing CbW might be the gate concept that consists in a segmentation of the vehicle guidance task and the identification of decision points during the execution of a driver's maneuver command. This article introduces an approach for the analysis of the time available for decision-making in systematically derived scenarios. For the first time, the results offer the basis for a suitability evaluation of the gate concept and thus a fundamental contribution to the technical feasibility assessment of CbW.

11:36-11:54 MA1.3

A Scaled-Down Traffic System Based on Autonomous Vehicles: A New Experimental System for ITS Research, pp. 13-18

He, Wen	Tsinghua Univ.
Guisheng, Chen	Chinese Inst. of Electronic System Engineering
Shuming, Tang	Chinese Acad. of Sciences
Deyi, Li	Chinese Inst. of Electronic System Engineering
Mu, Guo	Tsinghua Univ.
Tianlei, Zhang	Tsinghua Univ.
Peng, Jia	Military Transportation Inst.
Feng, Jin	Xi'an Communication Inst.

In this paper, we present our recent efforts on developing a physical environment for performing traffic experiments. The two main characteristics of this environment are: (1) the whole environment is scaled down from the real traffic, (2) the traffic behaviors are performed by numbers of miniature autonomous vehicles. Performing traffic experiments in an actual environment has long been a hard problem. Moreover, modeling traffic phenomena is also a tough task, due to the complexity of the natural traffic system. However, with the rapid development of autonomous vehicle technology, we have an opportunity to improve these problems from a new perspective. That is using autonomous vehicles to perform traffic experiments. But with the limitations in cost and land availability, directly using full size autonomous vehicles also seemed unrealistic. Thus, we built a 1/10 scaled-down traffic experimental system (SDTS) with more than 50 miniature autonomous vehicles. The environmental design, autonomous vehicles developing, agent modeling, traffic control, and real-time monitoring is considered systematically in system design. And this SDTS can be used as a repeatable, appraisable, and verifiable experimental platform for traffic researches, such as testing traffic solutions, verifying key technologies in intelligent vehicles, and performing experiments about ITS. By now, the SDTS has supported a series of workshops, exchange activities and competitions in China.

11:54-12:12 MA1.4

A New Fuzzy Speed Control Strategy Considering Lateral Vehicle Dynamics, pp. 19-24

Sezer, Volkan	Istanbul Tech. Univ.
Ercan, Ziya	Istanbul Tech. Univ.
Heceoglu, Hasan	Istanbul Tech. Univ.
Gokasan, Metin	Istanbul Tech. Univ. Electrical & Electronics Engineeri
Bogosyan, Seta	Istanbul Tech. Univ.

This paper introduces a new speed control strategy for autonomous/semi-autonomous navigation of ground vehicles. Different from the previous studies, steering angle is considered in addition to speed error and integral of the speed error. Because of the highly nonlinear nature of vehicle model, fuzzy logic strategy is used for controller design. Vehicle modeling equations and used parameters are also illustrated in the paper. Simulations are carried out to verify and demonstrate the effectiveness of the new method over the classical one which does not consider the steering angle. Both of these two methods have similar performances when steering angle is relatively low. However, in a more aggressive steering scenario, classical approach fails and vehicle loses its yaw stability while our method still continues to track the speed with a stable yaw dynamics.

MA2 Denali

Communication Technologies and Protocols 1 (Regular Session)

11:00-11:18 MA2.1

Highway Test of V2V Mesh Communications Over WSN, pp. 25-30

Naranjo, Jose	Univ. Pol. de Madrid
Talavera, Edgar	Univ. Pol. de Madrid
Anaya, Jose Javier	Univ. Pol. de Madrid
Jiménez, Felipe	Univ. Pol. de Madrid
Zato, José Gabriel	Univ. Pol. de Madrid
Gomez, Nuria	Univ. Pol. de Madrid

Wireless vehicular communications are one of the most important technologies in the ITS field to improve the transport safety as well efficiency impact. Several standards definitions, hardware developments, research projects, use cases definitions and field operational tests are currently under deployment in order to accelerate the market availability of this technology. Nevertheless, though the possible applications of vehicular communications are defined, there is a lack of availability of completely functional communication technology to support these applications. In this paper we present the results of a V2V communications field operational test using Wireless Sensor Networks (WSN) as nodes of the VANET and three vehicles that circulate on public highways in free flow traffic situations. These results show that this communications technology is able to support continuous mesh data transmission with enough features of efficiency and reliability to be used as main data source in a

big set of advanced driver assistance systems (ADAS).

11:18-11:36 MA2.2

Performance Evaluation of V2I-Based Channel Aware Floating Car Data Transmission Via LTE, pp. 31-36

Ide, Christoph	TU Dortmund Univ.
Dusza, Bjoern	TU Dortmund Univ.
Wietfeld, Christian	TU Dortmund Univ.

The collection of Floating Car Data (FCD) is very important for dynamic traffic forecasts. For this purpose, sensor notes in cars are supposed to transmit traffic information via Long Term Evolution (LTE). In this paper, we evaluate this data transmission with regard to several Key Performance Indicators (KPIs) for a channel aware transmission. These indicators are the negative impact on human communication, the power consumption of the mobile devices and the local distribution of cars sending FCD in the scenario. As methodology for performance evaluation a close-to-reality parameterized Markovian model, laboratory data rate as well as power consumption measurements and ray tracing simulations are used. By applying channel aware transmission the Quality of Service (QoS) level of human communication can be obtained and simultaneously the power consumption is significantly reduced. In addition, the fraction of active FCD devices on the highway can be increased.

11:36-11:54 MA2.3

The Multi-Adaptive Routing Protocol for Obstacles and without Obstacles on VANET, pp. 37-41

Vijitkunsawat, Wuttichai	Rajamangala Univ. of Tech. Krungthep
Anunvrapong, Pramote	Rajamangala Univ. of Tech. Krungthep

Inter-vehicle communication is said to be part of the Next Generation Internet where vehicles can communication to other vehicles or a base station in ad hoc manner to realize the Intelligent Transport System (ITS) which can increase road safety and provide traffic information etc. Several existing routing protocols are extensively studied for inter-vehicle communication. In this paper, we proposed the “Multi-Adaptive Routing Protocol”(MAR) which compared AODV and DSR protocols on the condition of with and without obstacle. The results show that MAR perform better than AODV and DSR protocols cause the throughput of MAR higher than AODV and DSR , but packet drop and packet collision are lower than ones.

11:54-12:12 MA2.4

Cooperative Intersection Management: Real Implementation and Feasibility Study of a Sequence Based Protocol for Urban Applications, pp. 42-47

Perronnet, Florent	Univ. de Tech. de Belfort-Montbéliard (UTBM)
Abbas-Turki, Abdeljalil	Univ. de Tech. de Belfort Montbéliard
Buisson, Jocelyn	Voxelia
El Moudni, Abdellah	Univ. of Tech. of Belfort-Montbeliard (UTBM)
Zéo, Renan	Voxelia
Ahmane, Mourad	Univ. of Tech. of Belfort-Montbeliard (UTBM)

This paper is a step towards a realization of a new way of controlling the ordinary traffic at urban intersections. The right of way is addressed to each vehicle individually, according to an optimized sequence. The paper aims to deepen the feasibility issue of a protocol dedicated to human drivers (ordinary vehicles). The proposed protocol is tested through a realistic intersection where vehicles are safely directed through the intersection. The implementation has raised some issues related to wireless communication and positioning systems. These issues are discussed and solutions are given for controlling particular intersections in urban area.

MA3 Dillingham

Pedestrian and Vehicle Detection (Regular Session)

11:00-11:18 MA3.1

Real-Time Robust Vehicle Flow Statistics Based on Adjacent Frames Clustering, pp. 48-53

Liu, Yan	Peking Univ.
Lu, Xiaoqing	Peking Univ.
Xu, Jianbo	Peking Univ. Founder Group Co. LTD
Qin, Yeyang	Peking Univ.
Tang, Zhi	Peking Univ.

In this paper, a clustering method of adjacent frames is proposed for vehicle flow statistics to overcome the fault of low robustness of video-based detection algorithms in complex environments. In the method, the boundaries of the abrupt or gradual visual content changing in consecutive video frames are described by color and intensity histogram method. The clustered frames containing different vehicles are segmented by these boundaries. In order to enhance the robustness of the algorithm, the interaction of adjacent multi-frames is weighted by gauss function which is the function of the interval between frames. Vehicle flow statistics are accomplished by detecting local maxima of the objective function. Experiments show that this method works stable in different weather and traffic status with the real-time performance of over 30 frames per second and with the mean detection precision of 93.2%.

11:18-11:36 MA3.2

Positioning of Road Users by RSSI with Road Surface Reflection Model, pp. 54-60

Hisaka, Shoma	The Univ. of Tokyo
Kamijo, Shunsuke	The Univ. of Tokyo

We have developed a dedicated onboard “sensor” utilizing wireless communication devices for collision avoidance around road intersections. The “sensor” estimates the positions of transmitters on traffic participants by comparing the strengths of signals received by four ZigBee receivers installed at the four corners of observing vehicle. In our previous work, the “sensor” was proposed as an alternative tool for collision avoidance around intersections. Herein, we extend our previous work by considering a road surface reflection model to improve the estimation accuracy. By using this model, we succeeded in reducing the error mismatches between the observed data and tthe calibration data of the estimation algorithm. The validity of the reflection model is verified via FDTD electro-magnetic wave propagating simulation. The proposed system will be realized on the basis of these enhancements.

11:36-11:54 MA3.3

Monocular Target Detection on Transport Infrastructures with Dynamic and Variable Environments, pp. 61-66

Alvarez Pardo, Sergio	Univ. of Alcala

Fernandez Llorca, David	Univ. of Alcala
Sotelo, Miguel A.	Univ. of Alcala
García Lorente, Alejandro	Univ. of Alcalá

This paper describes a target detection system on transport infrastructures, based on monocular vision, for applications in the framework of Intelligent Transportation Systems (ITS). Using structured elements of the image, a vanishing point extraction is proposed to obtain an automatic calibration of the camera, without any prior knowledge. This calibration provides an approximate size of the searched targets (vehicles or pedestrians), improving the performance of the detection steps. After that, a background subtraction method, based on GMM and shadow detection algorithms, is used to segment the image. Next a feature extraction, optical flow analysis and clustering methods are used to track the objects. The algorithm is robust to camera jitter, illumination changes and shadows. Therefore it can work indoor and outdoor, in different conditions and scenarios, and independent of the position of the camera. In the paper, we present and discuss the results achieved up to date in real traffic conditions.

11:54-12:12 MA3.4

Urban Road User Classification Framework Using Local Feature Descriptors and HMM, pp. 67-72

Takahashi, Toshimitsu	The Univ. of Tokyo
Kim, HyungKwan	The Univ. of Tokyo
Kamijo, Shunsuke	The Univ. of Tokyo

Surveillance and safety systems for pedestrians and bicyclists are becoming much more important because there continue to be a large number of traffic accidents that involve vulnerable road users. In this paper, we propose an urban road user classification framework using local feature descriptors and hidden Markov models (HMM). Our framework achieved pedestrians, bicyclists, motorcyclist classification in high accuracy. The framework consists of two classification methods: pedestrian-bicyclist classification and bicyclist-motorcyclist classification. First, we discriminate between pedestrians and bicyclist-like objects using histograms of oriented gradients (HOG)-based classifiers. We implemented a cascade classifier using generic HOG and our original local feature descriptor called co-occurrence semantic HOG. Bicyclist-like objects mainly consist of bicyclists and motorcyclists. We focused on the objects' leg motions and classify them using the hidden Markov models (HMM)-based motion models. We conducted experiments with real traffic scenes to evaluate the performance of our framework. The experiments for pedestrian-bicyclist classification and bicyclist-motorcyclist classification are conducted independently and both methods achieve nearly 90% on classification.

12:12-12:30 MA3.5

Two-Stage Part-Based Pedestrian Detection, pp. 73-77

Møgelmose, Andreas	Aalborg Univ.
Prioletti, Antonio	Univ. of Parma
Trivedi, Mohan M.	Univ. of California at San Diego
Broggi, Alberto	Univ. of Parma
Moeslund, Thomas B.	Aalborg Univ.

This paper introduces a part-based two-stage pedestrian detector. The system finds pedestrian candidates with an AdaBoost cascade on Haar-like features. It then verifies each candidate using a part-based HOG-SVM doing first a regression and then a classification based on the estimated function output from the regression. It uses the Histogram of Oriented Gradients (HOG) computed on both the full, upper and lower body of the candidates, and uses these in the final verification. The system has been trained and tested on the INRIA dataset and performs better than similar previous work, which uses full-body verification.

MA4 Fireweed

Lidar, Vision and Radar Sensing (Regular Session)

11:00-11:18 MA4.1

Sensor System Blockage Detection for Night Time Headlight Control Based on Camera and Radar Sensor Information, pp. 78-83

Gavriilidis, Alexandros	Univ. of Wuppertal
Mueller, Dennis	Delphi Electronics & Safety
Müller-Schneiders, Stefan	Delphi Deutschland GmbH
Kummert, Anton	Univ. of Wuppertal
Velten, Jörg	Univ. of Wuppertal

Driver assistance systems support overstrained and affected drivers and become more and more essential for series-production vehicles. In this paper a procedure for detection of a misaligned or blocked sensor system, including a radar and a camera sensor, will be introduced. It is important to inform the driver if an automatic headlight control is working reliable, in other words without limitations caused by external influence (e.g. dirt on the windscreen). The blockage detection algorithm is based on the fusion result of electronic radar measurements and a vision based head- and taillight detection algorithm. Results of the blockage detection algorithm are evaluated on misaligned measurements and online in a vehicle test system.

11:18-11:36 MA4.2

A Cost-Effective Radar System for Automotive Powertrain Control Applications, pp. 84-89

Beg, Chris	Univ. of Waterloo
Vajedi, Mahyar	Univ. of Waterloo
Nezhad-Ahmadi, Mohammad-Reza	Univ. of Waterloo
L. Azad, Nasser	Univ. of Waterloo
Safavi-Naeini, Safieddin	Univ. of Waterloo

This paper describes a new and unique merger of radar technology to automotive powertrain control systems, in particular, with the goal of increasing fuel efficiency in hybrid electric vehicles. The power management system can make more intelligent decisions impacting fuel consumption and emissions if it has knowledge of objects surrounding the vehicle. Furthermore, this paper proposes a scheme for creating a cost effective radar sensor. Discussed in detail is how such a system capable of providing the necessary information for powertrain control applications may be designed specifically to minimize cost and complexity. Finally, an evaluation and prototyping platform consisting of both hardware and software is described, which allows for evaluation and verification of the design tradeoffs. The same platform will also provide the future possibility of the powertrain control algorithm verification on the road as a later step of this research.

11:36-11:54 MA4.3

Vision-Based Lateral Position Improvement of RADAR

Detections, pp. 90-97

Nishigaki, Morimichi	Honda R&D Europe (Deutschland) GmbH
Rebhan, Sven	Honda Res. Inst. Europe GmbH
Einecke, Nils	Honda Res. Inst. Europe GmbH

Detecting vehicles in front by sensors mounted on a ego-vehicle is an essential element of Advanced Driver Assistance Systems (ADAS). Although millimeter-wave radar sensors are very robust at detecting vehicles, the lateral position resolution is very low. However, a more precise lateral position would not only improve the performance of existing ADAS but it would also enable a wide range of additional applications. In this paper, we propose a method for improving the lateral position of radar sensor detections by fusing these with a vision sensor. Our method is based on a robust symmetry axis detection of vehicles rear sides. In contrast, to the typical approach of detecting symmetry by means of edges, we use a patch-matching-based approach together with a robust cost function. The initial lateral position of the radar detection is improved by conducting a local symmetry search in the image region corresponding to the objects detected by the radar. The experimental results show that the proposed method is able to improve the lateral position accuracy by a factor of seven. Furthermore, additional consistency checks discover miss-detections of the symmetry axis thus ensuring that the lateral position never drops below the accuracy of the radar detection.

11:54-12:12 MA4.4

Rear Obstacle Detection System Based on Depth from Kinect, pp. 98-101

Choi, Jinwook	Yonsei Univ.
Kim, Deukhyeon	Yonsei Univ.
Yoo, Hunjae	Yonsei Univ.
Sohn, Kwanghoon	Yonsei Univ.

This paper presents a rear obstacle detection system based on depth information obtained from Kinect sensor. The proposed system can be used for parking assistance applications and backup aid. It improves the false detection rate in single view based algorithms by using depth information. In addition, real distance to obstacles can be calculated by depth information. It is possible to alarm to driver effectively according to distance. Although the proposed system is based on conventional edge detection algorithm, we confirm the feasibility of combining depth map with color image by improving the accuracy of detection. Experimental results show that depth fusion based obstacle detection algorithm is more accurate than single view based algorithms in terms of false detection rate.

MA5 Iliamna

Calibration, Validation and Sensitivity Analysis of Traffic Simulation Models (Special Session)

Organizer: Antoniou, Constantinos	National Tech. Univ. of Athens
Organizer: Punzo, Vincenzo	European Commission Joint Res. Centre
Organizer: Brackstone, Mark	IOMI Consulting

11:00-11:18 MA5.1

Parallel Public Transport System and Its Application in the Evacuation of Large-Scale Activities (I), pp. 102-107

Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Chen, Songhang	Chinese Acad. of Sciences
Lv, Yisheng	Chinese Acad. of Sciences
Ye, Peijun	Chinese Acad. of Sciences

ACP (Artificial societies, Computational experiments, and Parallel execution) approach is adopted by our method to build parallel public transport system (PPTS). The framework of PPTS is proposed and some components are analyzed. Two key steps in building up PPTS are discussed. The first is growing up artificial public transport system from bottom up using agent-based technology. The second is implementing schedule plans of public vehicles using cloud computing. One specific PPTS is established for Guangzhou 2010 Asian Games. Its effectiveness is verified and illustrated by comparing the traffic parameters between before and after the employment.

11:18-11:36 MA5.2

Calibration of Microscopic Traffic Flow Models against Time-Series Data (I), pp. 108-114

Montanino, Marcello	Univ. of Naples Federico II
Ciuffo, Biagio	Joint Res. Centre - European Commission
Punzo, Vincenzo	European Commission Joint Res. Centre

In the field of traffic simulation, the calibration of uncertain inputs against real data is usually taken to cover the epistemic uncertainty regarding the un-modeled details of the phenomena and the aleatory not predicted by the models. For this reason, model parameters are usually indirectly derived by means of an optimization framework, which tries to maximize the fit between real and simulated measures of the traffic system. This is the case, for example, of the calibration of car-following models' parameters against vehicle trajectory data. Only recently, it has been proven that the capability of the optimization framework to provide the parameters' values that allow the car-following model reproducing real trajectories at its best is strictly connected to the setup of the optimization framework itself. This, in particular, entails the necessity to carefully choose an appropriate combination of optimization algorithm and measure of goodness of fit (GOF). In this study, the authors focus the attention on this latter element of the problem. Specifically, it is claimed here that the commonly used GOFs are not able to capture the dynamics of the time-series which calibration is performed against. Therefore, a spectral analysis based approach to evaluate the overall performance of the simulation model in the objective function is proposed. The new measure of goodness of fit is tested in the calibration of the Intelligent Driver Model against synthetic trajectory data. Resul

11:36-11:54 MA5.3

Efficient Real Time OD Matrix Estimation Based on Principal Component Analysis (I), pp. 115-121

Djukic, Tamara	Delft Univ. of Tech.
Flötteröd, Gunnar	KTH Royal Inst. of Tech.
van Lint, Hans	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.

In this paper we explore the idea of dimensionality reduction and approximation of OD demand based on principal component analysis (PCA). First, we show how we can apply PCA to linearly transform the high dimensional OD matrices into the lower dimensional space without significant loss of accuracy. Next, we define a new transformed set of variables

(demand principal components) that is used to represent the fixed structure of OD matrices in lower dimensional space. We update online these new variables from traffic counts in a novel reduced state space model for real time estimation of OD demand. Through an example we demonstrate the quality improvement of OD estimates using this new formulation and a so-called 'colored' Kalman filter over the standard Kalman filter approach for OD estimation, when correlated measurement noise is accounted due to reduction of variables in state vector.

11:54-12:12 MA5.4

Evolutionary Approach to Calibration of Cellular Automaton Based Traffic Simulation Models, pp. 122-129

Korcek, Pavol	Brno Univ. of Tech.
Sekanina, Lukas	Brno Univ. of Tech. - Faculty of InformationTechnology
Fucik, Otto	Brno Univ. of Tech. - Faculty of InformationTechnology

Microscopic traffic simulation models have become very popular in the evaluation of transportation engineering and planning practices in the past few decades. To achieve high fidelity and credibility of simulations, a model calibration and validation must be performed prior to deployment of the simulator. In this paper, we proposed an effective calibration method of the microscopic traffic simulation model. The model is based on the cellular automaton, which allows fast large-scale real-time simulation. For its calibration, we utilized a genetic algorithm which is able to optimize different parameters much better that a human expert. Furthermore, it is possible to readjust the model to given field data coming from standard surveillance technologies such as loop detectors in our case. We have shown that the precision of simulations can be increased by 20% with respect to a manually tuned model.

12:12-12:30 MA5.5

Effectiveness of Speed Measures to Improve Roundabout Capacity "Case Study", pp. 130-133

Abaza, Osama	Univ. of Alaska Anchorage

The objective of this study is to analyze the effectiveness of speed measures to improve capacity at the roundabouts under near saturation level. Alaska Department of Transportation and Public Facilities introduced measures of using speed humps on multilane roundabout to slow down vehicular traffic entering the roundabout which might improve safety and capacity. Spot speed, vehicular volume and queued data have been collected and analyzed before and after the speed measures. Results show use of speed humps bring insignificant change in speed profiles through the roundabout with little or no effect on capacity. In addition, measured and calculated queue lengths also show no significant change.

MA6 Katmai

Congestion Pricing and Demand Management (Regular Session)

11:00-11:18 MA6.1

London Congestion Charging: Successes, Gaps and Future Opportunities Offered by Cooperative ITS, pp. 134-139

Kaparias, Ioannis	City Univ. London
Bell, Michael Geoffrey Harrison	Imperial Coll. London

The London Congestion Charging (LCC) scheme was initially introduced on 17 February 2003. Being the largest of its kind and employing advanced technology, it marked a major innovation in the field of urban road user charging and provided inspiration to several other cities worldwide. Nine years on, and following a number of operational changes that have taken place, this study analyzes successes and pitfalls, and identifies potential future opportunities in the light of latest technological developments in the field of cooperative Intelligent Transport Systems (ITS). The analysis concentrates primarily on the LCC scheme itself, but draws broader conclusions about the future of urban road charging in general.

11:18-11:36 MA6.2

Empirical Evaluation of a Dynamic and Distributed Taxi-Sharing System, pp. 140-146

d'Orey, Pedro M.	Univ. of Porto, Inst. de Telecomunicações
Fernandes, Ricardo	Inst. de Telecomunicações
Ferreira, Michel	Inst. de Telecomunicações

Modern societies rely on efficient transportation systems for sustainable mobility. In this paper, we perform a large-scale and empirical evaluation of a dynamic and distributed taxi-sharing system. The novel system takes advantage of nowadays widespread availability of communication and computation to convey a cost-efficient, door-to-door and flexible system, offering a quality of service similar to traditional taxis. The shared taxi service is assessed in a real-city scenario using a highly realistic simulation platform. Simulation results have shown the system's advantages for both passengers and taxi drivers, and that trade-offs need to be considered. Compared with the current taxi operation model, results show a increase of 48% on the average occupancy per traveled kilometer with a full deployment of the taxi-sharing system.

11:36-11:54 MA6.3

Dynamic Traffic Congestion Pricing Mechanism with User-Centric Considerations, pp. 147-154

Bui, Kim	Massachusetts Inst. of Tech.
Huynh, Vu	Massachusetts Inst. of Tech.
Frazzoli, Emilio	Massachusetts Inst. of Tech.

We consider the problem of designing real-time traffic routing systems in urban areas. Optimal dynamic routing for multiple passengers is known to be computationally hard due to its combinatorial nature. To overcome this difficulty, we propose a novel mechanism called User-Centric Dynamic Pricing (UCDP) based on recent advances in algorithmic mechanism design. The mechanism allows for congestion-free traffic in general road networks with heterogeneous users, while satisfying each user's travel preference. The mechanism first informs whether a passenger should use public transportation or the road network. In the latter case, a passenger reports his maximum accepted travel time with a lower bound announced publicly by the road authority. The mechanism then assigns the passenger a path that matches with his preference given the current traffic condition in the network. The proposed mechanism introduces a fairness constrained shortest path (FCSP) problem with a special structure, thus enabling polynomial time computation of path allocation that maximizes the sequential social surplus and guarantees fairness among passengers. The tolls of paths are then computed according to marginal cost payments. We show that reporting true preference is a weakly dominant strategy.

The superior performance of the proposed mechanism is demonstrated on several simulated routing experiments in comparison to user equilibrium and system optimum.

11:54-12:12 MA6.4

Assessing Economic Impacts of Implementing a Vehicle of Miles Traveled Fee in Nevada, pp. 155-159

Paz, Alexander	Univ. of Nevada, Las Vegas
Nordland, Andrew	Univ. of Nevada, Las Vegas
Khan, Alauddin	Nevada Department of Transportation

This study develops a linear regression model to estimate the number of miles driven by households in Nevada, using data from the 2009 National Household Travel Survey. The regression model is designed to be sensitive to changes in the cost to drive. Hence, the model is used to evaluate different mechanisms used to charge for the use of the highway system. In particular, two alternative Vehicle Miles of Travel (VMT) Fees are compared with the existing fuel tax system. In each case, it was estimated how different houses experience different effects on charges as a consequence of different fuel efficiencies. The analysis performed considers the average changes in the household tax burden and VMT as well as the aggregated change in VMT and the corresponding change in revenue collected.

12:12-12:30 MA6.5

TruCentive: A Game-Theoretic Incentive Platform for Trustworthy Mobile Crowdsourcing Parking Services, pp. 160-166

Hoh, Baik	Nokia Res. Center
Yan, Tingxin	Univ. of Massachusetts, Amherst
Deepak, Ganesan	Univ. of Massachusetts, Amherst
Ken, Tracton	Nokia Res. Center
Toch, Iwuchukwu	Nokia Res. Center
Juong-Sik, Lee	Nokia Res. Center

The shortage of parking in crowded urban areas causes severe societal problems such as traffic congestion, environmental pollution, and many others. Recently, crowdsourced parking, where smartphone users are exploited to collect real-time parking availability information, has attracted significant attention. However, existing crowdsourced parking information systems suffer from low user participation rate and data quality due to the lack of carefully designed incentive schemes.

In this paper, we address the incentive problem of trustworthy crowdsourced parking information systems by presenting an incentive platform named TruCentive, where high utility parking data can be obtained from unreliable crowds of mobile users. Our contribution is three-fold. First, we provide hierarchical incentives to stimulate the participation of mobile users for contributing parking information. Second, by introducing utility-related incentives, our platform encourages participants to contribute high utility data and thereby enhances the quality of collected data. Third, our active confirmation scheme validates the parking information utility by game-theoretically formulated incentive protocols. The active confirming not only validates the utility of contributed data but re-sells the high utility data as well. Our evaluation through user study on Amazon Mechanical Turk and simulation study demonstrate the feasibility and stability of TruCentive incentive platform.

MA7 King Salmon

Incident Detection (Regular Session)

11:00-11:18 MA7.1

Prediction of Freeway Traffic Incident Delay Based on Simulation, pp. 167-171

Zhang, Hongbin	Southeast Univ.
Ni, Fujian	Southeast Univ.
Yang, Shunxin	Southeast Univ.

In order to study the influence of different vehicles to incident delay, traffic simulation is applied to make the delay predictions. Three major parts, respectively the establishment of simulation platform and parameter calibration, survey and calculation of traffic data, and case study, are described in the paper. For the establishment of simulation platform and parameter calibration, at first, the local parameter and the global parameter, which need to be calibrated while making the delay simulation, are chosen. Then, the performance evaluation index and the performance evaluation target are proposed and the minimum simulation times are determined based on the statistical analysis. Finally, the flow of parameter calibration is designed, which first calibrates the local parameter and then calibrates the global parameter. For the survey and calculation of traffic data, at first, based on the toll data, the calculation method of the vehicle data, the evaluation index data and the incident delay data, are proposed. Then, these data are taken as the true values to calibrate the parameters and validate the simulation delay. At the same time, the incident duration is predicted. For case study, this paper takes six traffic incidents which took place in link 170002 of Nanjing-Nantong freeway (hereinafter as Ning-Tong freeway) in 2010 as sample data to calibrate the parameters and simulate the delay, and further compares the simulation delay with the true delay. The simulation resul

11:18-11:36 MA7.2

An Unsupervised Feature Learning Approach to Improve Automatic Incident Detection, pp. 172-177

Ren, Jimmy SJ.	City Univ. of Hong Kong
Wang, Wei	City Univ. of Hong Kong
Wang, Jiawei	USTC-CityU Joint Advanced Res. Centre
Liao, Stephen	City Univ. of Hong Kong

Sophisticated automatic incident detection (AID) technology plays a key role in contemporary transportation systems. Though many papers were devoted to study incident classification algorithms, few study investigated how to enhance feature representation of incidents to improve AID performance. In this paper, we propose to use an unsupervised feature learning algorithm to generate higher level features to represent incidents. We used real incident data in the experiments and found that effective feature mapping function can be learnt from the data crosses the test sites. With the enhanced features, detection rate (DR), false alarm rate (FAR) and mean time to detect (MTTD) are significantly improved in all of the three representative cases. This approach also provides an alternative way to reduce the amount of labeled data, which is expensive to obtain, required in training better incident classifiers since the feature learning is unsupervised.

11:36-11:54 MA7.3

Advanced Method of Detection of Unnecessary Conflicts of Traffic Flows, pp. 178-181

Dadic, Ivan	Faculty of Traffic and Transportation Sciences

Damir, Skaro	AK Siget
Vidovic, Kresimir	Faculty of Traffic and Transportation Sciences
Ševrović, Marko	Faculty of Transport and Traffic Sciences
Sostaric, Marko	Faculty of Traffic and Transportation Sciences
Jeremic, Dragana	Faculty of Tech. Sciences

Relations between the traffic flows in intersections are one of the causes of reduced throughput. Avoiding the unnecessary conflicts and reduction of breakage of traffic flows are one of the possible significant factors that may favorably affect the increase in intersection capacity. Relationships among the traffic flows in the form of unnecessary conflicts occur mainly at intersections, and also on roads between intersections, and are caused by the organization and direction of traffic flow in the network. For advanced identification of unnecessary intersections, modern IT solutions are used as a novelty approach in research and visualisation of this phenomenon. The goal of this research is to create a computer tool based on open source technologies that use data stored in a GIS environment about the movement of the users within the transport network for identification of unnecessary conflicts by monitoring the flow of vehicles and deviations in speed. Further development and research will be focused on creating algorithms for automatic identification of unnecessary conflicts based on gathered input data.

11:54-12:12 MA7.4

Traffic Incident Detection System Using Series of Point Detectors, pp. 182-187

Hiriotappa, Kittipong	NECTEC
Thajchayapong, Suttipong	NECTEC
Likitkhajorn, Chakrit	NECTEC
Poolsawat, Anurak	NECTEC

This paper proposed a traffic incident detection system that can report the occurrence of traffic incidents, which occur between detectors. Based on the previously proposed dynamic time warping algorithm, this incident detection system monitors and assesses changes at upstream and downstream sites. Then, if the upstream-downstream changes are associated with traffic incidents, the system raised an alarm and report CCTV images on site, which are sent to traffic operators to further response. Performance evaluations are conducted using real-world traffic data where it is shown that the incident detection algorithm used in the proposed system achieves 94% detection rate and low false alarm rate. We also show that the proposed incident detection system outperforms a previously proposed incident detection system algorithm.

MA8 Lupine

Eco Driving and Energy Efficient Intelligent Infrastructure 1 (Regular Session)

11:00-11:18 MA8.1

Field Operational Testing of ECO-Approach Technology at a Fixed-Time Signalized Intersection, pp. 188-193

Xia, Haitao	Univ. of California-Riverside
Boriboonsomsin, Kanok	Univ. of California-Riverside
Schweizer, Friedrich	BMW Tech. Office Mountain View
Winckler, Andreas	BMW Tech. Office Mountain View
Zhou, Kun	Univ. of California-Berkeley
Zhang, Wei-Bin	Univ. of California-Berkeley
Barth, Matthew	Univ. of California-Riverside

As part of a number of Intelligent Transportation (ITS) applications aimed at providing an environmental benefit, eco-approach technology is one that is feasible in the near-term. An eco-approach application uses Signal Phase and Timing (SPaT) and intersection map information of signalized intersections to provide drivers with recommendations in order to encourage “green” driving while approaching, passing through, and departing the intersections. Upon receiving SPaT information, in-vehicle systems calculate and provide speed advice to the driver, allowing the driver to adapt the vehicle's speed to pass through the upcoming signal on green or to decelerate to a stop in the most eco-friendly manner. Eco-approach methods have been proposed and simulated showing promising results. In this study, both simulation experimentation and field operational testing have been carried out to demonstrate the eco-approach application and to quantify its potential fuel and carbon dioxide (CO2) savings. Furthermore, it has been shown that a communication platform based on a 4G/LTE network link and a cloud-based server infrastructure is effective and sufficient for this kind of application. It was found in both the simulation experiment and the field operational testing that on average 14% fuel and CO2 savings can be achieved.

11:18-11:36 MA8.2

Optimization of Driving Styles for Fuel Economy Improvement, pp. 194-199

Malikopoulos, Andreas	Oak Ridge National Lab.
Aguilar, Juan	Oak Ridge National Lab.

Modern vehicles have sophisticated electronic control units, particularly to control engine operation with respect to a balance between fuel economy, emissions, and power. These control units are designed for specific driving conditions and testing. However, each individual driving style is different and rarely meets those driving conditions. In the research reported here we investigate those driving style factors that have a major impact on fuel economy. An optimization framework is proposed with the aim of optimizing driving styles with respect to these driving factors. A set of polynomial metamodels are constructed to reflect the responses produced by changes of the driving factors. Then we compare the optimized driving styles to the original ones and evaluate the efficiency and effectiveness of the optimization formulation.

11:36-11:54 MA8.3

Enhanced Eco-Driving System Based on V2X Communication, pp. 200-205

Chen, Yuxiao	Tsinghua Univ.
Zhang, Dezhao	Tsinghua Univ.
Li, Keqiang	Tsinghua Univ.

The concept of Eco-driving is proposed to reduce the fuel consumption of vehicles while maintaining dynamic performance. MPC controller has been introduced to achieve comprehensive goals including safety, fuel consumption and comfort of driving. Yet the information of the surrounded vehicles and road conditions have not been fully utilized. An enhanced algorithm taking the driving style of preceding vehicle, host vehicle drivers and road information into account is proposed in this paper. It is tested by the results of simulation that the controller becomes more flexible and can reduce the fuel consumption of the controlled vehicle in different working conditions with the help of the enhanced

algorithm.

11:54-12:12 MA8.4

A RFID Based E-STOP Sign and Its Impacts to Vehicle Emissions, pp. 206-211

Qiao, Fengxiang	Texas Southern Univ.
Wang, Jinghui	Texas Southern Univ.
Wang, Xiaobing	Texas Southern Univ.
Jia, Jing	Texas Southern Univ.
Yu, Lei	Texas Southern Univ.

Traditional STOP signs at unsignalized intersections are easily blocked by trees, trucks and other obstacles, which will induce high risk of incidents and even extra vehicle emissions. The so-called Infrastructure–to-Vehicle (I2V) communications can automatically inform drivers of earlier awareness through in-vehicle display and audio device, which alternates vehicle driving behaviors and operation modes, and will possibly reduce vehicle emissions. In this paper, the feasible working range of the RFID based e-STOP sign within the smart guide signing system (SGSS) at unsignalized intersections is firstly tested, and its impacts on vehicle emissions are further identified. Test and emission estimation results indicate that the RFID based e-STOP sign can reduce vehicle emissions at unsignalized intersections, especially when vehicles make turnings.

12:12-12:30 MA8.5

Fuel Efficiency Driver Assistance System for Manufacturer Independent Solutions, pp. 212-217

Guan, Tianyi	Fraunhofer IOSB
Frey, Christian	Fraunhofer IOSB

Energy efficiency has become a major issue in modern trade, business and environmental perception. While the next generation of zero emission propulsion systems are still under development, it is already possible to increase fuel efficiency in regular vehicles by applying a more fuel efficient driving behaviour. This particularly holds true for transport companies, where even small percentage savings can accumulate to huge absolute savings. Although there are common fuel efficiency guidelines, they are often imprecise and not adapted to a specific vehicle. Furthermore drivers may not even know the fuel efficiency rules or lack the motivation to apply them in practice. In this paper, an online driving assistance system is presented that assist drivers during their journeys by giving them fuel efficiency guidelines that are suited for the current situation and vehicle. The driver assistance system uses an internal manufacturer independent model that can adapt to the current vehicle solely based on online CAN-Bus data.

MB1 Chart

Automated Vehicle Operation 2 (Regular Session)

14:00-14:18 MB1.1

Outdoor Intersection Detection for Autonomous Exploration, pp. 218-223

Tourani, Siddharth	IIIT Hyderabad
Mukhija, Piyoosh	International Inst. of Information Tech.
Krishna, K Madhava	IIIT Hyderabad

In the field of outdoor navigation, there still remain largely unsolved problems. In this paper we address the problem of detecting road intersections. We present two approaches to solve the problem of intersection detection in an unstructured outdoor setting. The first is a natural extension of the popular VFH obstacle avoidance algorithm. It detects intersections and tracks, over a period of time, the angles at which gaps in the robot's certainty grid (CG) are first observed. The second approach uses techniques from image processing and computational geometry on the certainty grid image, to extract a skeleton of the navigable region, thus providing the intersections. We show experimental results portraying intersection detection due to both methods and show the results. On the whole, we found that the robot was able to detect all possible intersections.

14:18-14:36 MB1.2

Shader-Based Sensor Simulation for Autonomous Car Testing, pp. 224-229

Wang, Shuiying	Freie Univ. Berlin
Heinrich, Steffen	Freie Univ. Berlin
Wang, Miao	Freie Univ. Berlin
Rojas, Raúl	Freie Univ. Berlin

During autonomous car system development, sensor simulation can help to test and evaluate algorithms such as sensor fusion and object tracking in simulated dynamic scenarios at an early stage; thus, time and cost can be spared and more reliable system can be guaranteed. In this paper, shader-based LiDAR and Radar simulations are extended into autonomous car testing. Besides realizing sensor simulations producing information of interest scan data, conceptual programming interfaces to full featured physical models are also provided. Simulation accuracy is discussed and corresponding improvement methods are proposed. Optimistic results are displayed with a software-in-loop test for autonomous car and the computational cost is reported. Comparison between ray-tracing based and shader-based LiDAR simulation in terms of computational cost is also carried out and discussed.

14:36-14:54 MB1.3

A Novel Approach for a Double-Check of Passable Vegetation Detection in Autonomous Ground Vehicles, pp. 230-236

Nguyen, Duong-Van	Univ. of Siegen, Germany
Kuhnert, Lars	Univ. of Karlsruhe
Schlemper, Jens	Univ. of Siegen
Thamke, Stefan	Univ. of Siegen
Kuhnert, Klaus-Dieter	Univ. of Siegen, Germany

The paper introduces an active way to detect vegetation which is at front of the vehicle in order to give a better decision-making in navigation. Blowing devices are to be used for creating strong wind to effect vegetation. Motion compensation and motion detection techniques are applied to detect foreground objects which are presumably judged as vegetation. The approach enables a double-check process for vegetation detection which was done by a multi-spectral approach, but more emphasizing on the purpose of passable vegetation detection. In all real world experiments we carried out, our approach yields a detection accuracy of over 98%. We furthermore illustrate how the active way can improve the autonomous navigation capabilities of autonomous ground vehicles.

14:54-15:12 MB1.4

A Surveillance and Safety System Based on Performance Criteria and Functional Degradation for an Autonomous Vehicle, pp. 237-242

Reschka, Andreas	Univ. Hildesheim
Böhmer, Jürgen Rüdiger	Univ. Hildesheim
Nothdurft, Tobias	Tech. Univ. Braunschweig
Hecker, Peter	Tech. Univ. Braunschweig
Lichte, Bernd	Tech. Univ. Braunschweig
Maurer, Markus	TU Braunschweig

Autonomous driving in urban environments is potentially dangerous since a malfunction of vehicle guidance systems can lead to severe situations for passengers inside the autonomous vehicle and other road users. Therefore both, monitoring the current system operation state by a surveillance system, which is able to detect failures of software and hardware modules, and a safety system, which reacts on these failures immediately, is necessary.

In this paper an approach based on performance criteria and functional degradation is proposed, which is used in the autonomous vehicle Leonie developed within the Stadtpilot project. The surveillance part of the system collects data from sensors, software modules, hardware, and the vehicle to combine this data with heuristics to performance criteria. Based on these criteria degradation actions are executed to keep the operation of Leonie in a safe state. The safety system can influence driving maneuvers like lane changes and turning maneuvers, modify driving parameters like maximum speed and safe time headway and even force driving maneuvers like emergency stops and controlled stops at the side of the road.

Currently, the safety driver onboard of Leonie is the fallback solution in case of a system malfunction. Using the proposed safety system should reduce the number of situations where the safety driver has to take control over the vehicle though.

MB2 Denali

Communication Technologies and Protocols 2 (Regular Session)

14:00-14:18 MB2.1

Positioning Error Correction for DS-CDMA IVC under Location Oriented PN Code Allocation Scheme, pp. 243-247

Namiki, Taro	Tokyo Univ. of Science
Ogata, Satoshi	Tokyo Univ. of Science
Sakakibara, Sho	Tokyo Univ. of science
Ohno, Kohei	Tokyo Univ. of Science
Itami, Makoto	Tokyo Univ. of Science

This paper discusses the IVC (Inter Vehicle Communication) system for ITS. DS-SS (Direct Sequence Spread Spectrum) is used for the IVC because it has CDMA (Code Division Multiple Access) capability. However, efficient PN code allocation scheme is a problem to solve because the vehicles communication directly without base stations. In this paper, the location oriented PN code allocation scheme is adopted for the DS-SS IVC system. The influence of the positioning error for the communication performance is evaluated. The improved performance is shown even when the positing error exists in the IVC system. To improve the performance, the positioning error correction scheme is proposed. The distance between the vehicles are estimated by using the received signal strength after de-spreading. From the simulation result, the positioning error can be mitigated by using proposed technique.

14:18-14:36 MB2.2

Continuous Broadband Communication System Based on Existing Open Source Network Tools for Vehicular Environments, pp. 248-253

Urquiola, Gorka	Univ. of Deusto
Perallos, Asier	Univ. of Deusto
Carballedo, Roberto	Univ. of Deusto

Due to the widespread adoption of Intelligent Transportation Systems, the number of applications used in vehicular environments is growing very quickly. This fact implies a greater consumption of network bandwidth and a competition for network use. Consequently an exhaustive control of the bandwidth consumption is needed to provide Quality of Service according to the demands of certain applications, giving priority to the most relevant data traffic. Moreover, to guarantee the continuous communication in mobile environments (between vehicles and ground control centers) is another target to be tackled. In this paper a software system to provide continuous broadband communication in vehicular environments, as well as other capabilities such as the management of the Quality of Service and priority of applications, transparent change of the active communication link and security of the data transmission, is presented. The remarkable challenge is that has been addressed a solution to this problem not based on a proprietary software development, but by reusing already implemented and tested software utilities, originally designed to be used in several non-mobile environments.

14:36-14:54 MB2.3

Improving Performance of Inter-Vehicle Communication Scheme Using Location Oriented PN Code Allocation Technique, pp. 254-259

Ogata, Satoshi	Tokyo Univ. of Science
Sakakibara, Sho	Tokyo Univ. of science
Ohno, Kohei	Tokyo Univ. of Science
Itami, Makoto	Tokyo Univ. of Science

In this paper, improvement of the performance of the IVC system using the location oriented PN code allocation is studied. In this system, allocation of PN codes for each vehicle is easy. However interference problem occurs when multiple vehicles are locating in the area where the equivalent PN code is allocated. In order to mitigate the interference, MCS scheme is adopted under asynchronous transmission and time-slot allocation is adopted under synchronous transmission. In this paper, DS-CDMA scheme is evaluated by computer simulation. As the result, the effectiveness of the proposed IVC system is confirmed under several situations.

14:54-15:12 MB2.4

CANOPNR: CAN-OBD Programmable-Expandable Network-Enabled Reader for Real-Time Tracking of Slippery Road Conditions Using Vehicular Parameters, pp. 260-264

Enriquez, Dj	Univ. of Alaska, Anchorage; Honeywell HPS
Bautista, Alexander	Univ. of Alaska Anchorage
Field, Paloma	Univ. of Alaska Anchorage
Kim, Sun-il	Univ. of Alaska, Anchorage
Jenson, Sean	Univ. of Alaska Anchorage
Ali, Muhammad	Univ. of Alaska, Anchorage
Miller, Jeffrey	Univ. of Alaska Anchorage

We describe the design and implementation of a programmable and expandable OBD-device that is capable of not only reading the various vehicular parameters from the

ECU, but also detecting whether or not the vehicle slippage has occurred in real-time. The information is transmitted to a central server via a cellular network along with GPS information to allow real-time monitoring of both the vehicle and the road conditions.

Commercially available tools are limited to specific functionalities and do not allow customization by the end-users. Furthermore, the ABS data (which can be used to detect vehicle slippage without the need for adding special sensors), available through the ECU, is tightly guarded by the vehicle manufacturers and is not readily accessible. Our device allows for customization by the user and is capable of reading the ABS information. We also present a solution that allows the end-user to obtain the ABS equivalent information using a combination of other readily available parameters for vehicles that are not equipped with ABS. Our goal is to provide an open-source tool for the research community, such that anyone can build the device and tailor it to the needs of his or her application(s). Our software is tuned and optimized to allow low power consumption, error-checking, and transmission of data at a settable time interval. Our experiments show that the vehicle slippage information obtained through the CANOPNR is accurate and reliable.

MB3 Dillingham

Lane Detection and Lane Keeping (Regular Session)

14:00-14:18 MB3.1

Dynamic Delay Compensation for Lane Departure Warning System, pp. 265-269

Zhang, Sumin	Jilin Univ.
Deng, Weiwen	General Motors Corp.
Wang, Ye	Jilin Univ.
Zhao, Qingrong	General Motors Company

Vision-based active safety and driver assistance systems, such as lane departure warning (LDW) system, have increasingly gained popularity in automotive applications, due to its fairly good performance at relatively low cost. However, the excessive time delay caused by slow image capturing and image processing can greatly impact the performance of the system. The LDW system as discussed in this paper may consequently produce inaccurate value of time-to-lane-crossing (TLC), which can lead to false alarm or warning at inappropriate time to driver of potential danger of lane departure. This paper presents a method that dynamically compensates the time delay, and thus, improves the accuracy of the TLC calculation, which in turn leads to reduced false alarm rate. Simulation has been conducted and the results have shown that the proposed method is effective in compensating the excessive time delay for improved TLC computation.

14:18-14:36 MB3.2

A Random Finite Set Approach to Multiple Lane Detection, pp. 270-275

Deusch, Hendrik	Univ. of Ulm
Wiest, Juergen	Univ. of Ulm
Reuter, Stephan	Univ. of Ulm
Szczot, Magdalena	Univ. of Ulm
Konrad, Marcus	EvoBus GmbH - Daimler Buses
Dietmayer, Klaus	Univ. of Ulm

Robust lane detection is the precondition for advanced driver assistance systems like lane departure warning and overtaking assistants. While detecting the vehicle's lane is sufficient for lane departure warning, overtaking assistants or autonomous driving functions also need to detect adjacent lanes. In this contribution, a novel approach to multiple lane detection based on multi-object Bayes filtering is presented. This method allows for directly considering the dependencies between multiple lanes without explicit data association in post processing. Furthermore, the proposed lane detection algorithm is applied to a challenging scenario of a rural road.

14:36-14:54 MB3.3

A Global and Local Condensation for Lane Tracking, pp. 276-281

Yao, Wentao	Tsinghua Univ.
Deng, Zhidong	Tsinghua Univ.
Chen, Zhenhua	Tsinghua Univ.

In this paper, we present a new condensation filtering algorithm that combines local and global information for tracking of lane markings. Local model is used for condensation particle filtering while global one for resampling of local filters and vehicle control command. The detection and tracking process is done based on bird's-eye images in real-time. Unlike most of the state-of-art systems, in our system, with the help of a 3D lidar mounted on the vehicle, the computation of bird's-eye image and the dynamic pitch estimation could be readily and accurately accomplished through joint calibration of camera and 3D lidar. In addition, multiple image features are fused to weight particles. The experimental results on various road environments demonstrate the robustness of our approach.

14:54-15:12 MB3.4

A Unified Framework of the Automated Lane Centering/Changing Control for Motion Smoothness Adaptation, pp. 282-287

Lee, Jin-Woo	General Motors, Res. and Development
Litkouhi, Bakhtiar	General Motor R&D Center

This paper describes an automated lane centering/changing control algorithm that was developed at General Motors Research and Development. Over the past few decades, there have been numerous studies in the autonomous vehicle motion control. These studies typically focused on improving the control accuracy of the autonomous driving vehicles. In addition to the control accuracy, driver/passenger comfort is also an important performance measure of the system. As an extension of authors' prior study, this paper further considers vehicle motion control to provide driver/passenger comfort based on the adjustment of the lane change maneuvering time in various traffic situations. While defining the driver/passenger comfort level is a human factor study topic, this paper proposes a framework to integrate the motion smoothness into the existing lane centering/changing control problem. The proposed algorithm is capable of providing smooth and aggressive lane change maneuvers according to traffic situation and driver preference. Several simulation results as well as on-road vehicle test results confirm the effectiveness of the proposed algorithm.

15:12-15:30 MB3.5

Spatial Ray Features for Real-Time Ego-Lane Extraction, pp. 288-293

Kühnl, Tobias	Bielefeld Univ.
Kummert, Franz	Bielefeld Univ.

Fritsch, Jannik Honda Res. Inst. Europe GmbH

In order to support driver assistance systems in unconstrained environments, we propose to extend local appearance-based road classification with a spatial feature generation and classification. Therefore, a hierarchical approach consisting of multiple low level base classifiers, the novel spatial feature generation, as well as a final road terrain classification, is used. The system perceives a variety of local properties of the environment by means of base classifiers operating on patches extracted from monocular camera images, each represented in a metric confidence map. The core of the proposed approach is the computation of spatial ray features (SPRAY) from these confidence maps. With this, the road-terrain classifier can decide based on local visual properties and their spatial layout in the scene. In order to show the feasibility of the approach, the extraction and evaluation of the metric ego-lane driving corridor on an inner city stream is demonstrated. This is a challenging task because on a local appearance level, ego-lane is not distinguishable from other asphalt parts on the road. However, by incorporating the proposed SPRAY features the distinction is possible without requiring an explicit lane model. Due to the parallel structure of this bottom-up approach, the implemented system operates in real-time with approximately 25 Hz on a GPU.

Attachment. The video shows the ego-lane detection performance of the proposed system using SPRAY features in exemplary scenes. It contains typical situations with bad lane-markings and curbstones delimiting the road.

MB4 Fireweed

Vision Sensing and Image Processing -1 (Regular Session)

14:00-14:18 MB4.1

Track and Turnout Detection in Video-Signals Using Probabilistic Spline Curves, pp. 294-299

Ross, Ralph Werner Karlsruhe Inst. of Tech.

Track selective localization for rail vehicles is a task that is not yet solved completely as far as autonomous localization methods are concerned. Satellite-based navigation can not fulfill all demands as the signal might not always be available. The localization information might be corrupted as well. So, a fusion with other sensors can be useful to enhance availability. In this paper a monofocal camera based turnout detection is described. It can be used for localization when used together with a digital map. The tracks are represented by spline curves that are adjusted in every frame by a recursive estimation algorithm. The efficiency of the algorithm is shown through experimental results.

14:18-14:36 MB4.2

Trinocular Optical Flow Estimation for Intelligent Vehicle Applications, pp. 300-306

Kitt, Bernd KIT
Lategahn, Henning Inst. of Measurement & Control

Motion is an important clue for many tasks in visual scene perception. In this paper, we present a new matching-based algorithm to estimate nearly dense optical flow fields for the static parts of the scene, i.e. those parts whose motion is induced by the moving observer only. Our algorithm is designed for applications in intelligent vehicles usually equipped with stereo camera rigs. To address the computational effort of matching-based approaches we use constraints arising from the geometry between multiple views. To this end, we compute both an approximated optical flow field and an approximated disparity field between left and right image. Hence, we can predict the position of the corresponding candidate and limit the search space to a small neighborhood around the predicted position leading to near real-time capabilities. Experiments on different challenging real world images show the accuracy and efficiency of the proposed approach.

14:36-14:54 MB4.3

Tomographical Scene Reconstruction in the Active Safety Car Project, pp. 307-312

Velten, Joerg Univ. of Wuppertal
Schauland, Sam Riedel Communications
Gavriilidis, Alexandros Univ. of Wuppertal
Schwerdtfeger, Tim Univ. of Wuppertal
Boschen, Fritz Univ. of Wuppertal
Kummert, Anton Univ. of Wuppertal

Tomographical reconstruction algorithms can be applied to camera based mesaurements and thus reconstruct the scenery without knowledge about included objects. The latter is interesting in the domain of driver assistance systems that have to monitor the driveway independently from a priori knowledge about possibly appearing objects. The paper presents tomographical background information, the transfer from radiographing to visual light rays and its negative impacts, and some first result obtained by applying the presented algorithm to images of a fromt view camera.

14:54-15:12 MB4.4

Multiresolution Based Sigma-Delta for Motion Segmentation, pp. 313-318

Mukherjee, Dibyendu Univ. of Windsor
Saha, Ashirbani Univ. of Windsor
Wu, Q. M. Jonathan Univ. of Windsor

Motion segmentation is an important research field as it forms the stepping stone for traffic monitoring, video surveillance, activity analysis, gait recognition and many other automatic imaging applications. In this work, a novel generic multiresolution (MR) based framework has been proposed in conjunction with Sigma-delta based motion segmentation algorithm. The framework provides a general platform to use any MR analysis method to 1) incorporate subbands information containing varying features for enhanced motion extraction and 2) combine the information obtained to incrementally form the background using Sigma-delta method and upscale to original frame resolution. The validity of the proposed method is demonstrated using four popular MR analysis methods. Comparison of the proposed framework with sigma-delta and wavelet based change detection reflects several improvements over these methods.

Attachment. The video contained in the supplementary section is the comparative result of the following algorithms in order - Original frame, Wave_Change, Sigma-delta, WaveSigma-delta, CurveSigma-delta, ContSigma-delta and MRSVDSigma-delta. The frame rate is kept at 10 fps for clarity. VID1.mpg contains 151 frames. VID1 shows an outdoor scene with very noisy background and fast moving small object.

MB5 Iliamna

Agent-Based Methods for Modeling and Analysis (Regular Session)

14:00-14:18 MB5.1

Multi-Agent Reinforcement Learning for Integrated Network of Adaptive Traffic Signal Controllers (MARLIN-ATSC), pp. 319-326

El-Tantawy, Samah — Univ. of Toronto

Abdulhai, Baher — Univ. of Toronto

Traffic congestion in Greater Toronto Area costs Canada $ 6 billion /year and is expected to grow up to $ 15 billion /year in the next few decades. Adaptive Traffic Signal Control(ATSC) is a promising technique to alleviate traffic congestion. For medium-large transportation networks, coordinated ATSC is becoming a challenging problem because the number of system states and actions grows exponentially as the number of networked intersections grows. Efficient and robust controllers can be designed using a multi-agent reinforcement learning (MARL) approach in which each controller (agent) is responsible for the control of traffic lights around a single traffic junction. This paper presents a novel, decentralized and coordinated adaptive real-time traffic signal control system using Multi-Agent Reinforcement Learning for Integrated Network of Adaptive Traffic Signal Controllers (MARLIN-ATSC) that aims to minimize the total vehicle delay in the traffic network. The system is tested using microscopic traffic simulation software (PARAMICS) on a network of 5 signalized intersections in Downtown Toronto. The performance of MARLIN-ATSC is compared against two approaches: the conventional pretimed signal control (B1) and independent RL-based control agents (B2), i.e. with no coordination. The results show that network-wide average delay savings range from 32% to 63% relative to B1 and from 7% to 12% relative to B2 under different demand levels and arrival profiles.

14:18-14:36 MB5.2

A Survey of Urban Traffic Signal Control for Agent Recommendation System, pp. 327-333

Chen, Cheng — Inst. of Automation, Chinese Acad. of Sciences

Zhu, Fenghua — Inst. of Automation, Chinese Acad. of Sciences

Ai, Yunfeng — Inst. of Automation, Chinese Acad. of Sciences

Dynamic changes and uncertainty in traffic environments directly spawned lots of strategies about traffic signal control (TSC). Meanwhile, the differences in the traffic environment and demand of control have a significant impact on the performance of strategies about TSC. In order to enable dynamic selection of the most appropriate TSC agents for each specific traffic state in urban traffic transportation system, we firstly propose a survey about urban TSC, which helps us to understand the characteristics of TSC strategies. This survey focuses on the traffic environment about the application of TSC and the demand of TSC. Then, based on the aforementioned survey, we propose one recommendation mechanism for agent-based distributed and adaptive platform for transportation systems to adapt to traffic dynamic characteristic.

14:36-14:54 MB5.3

Approximately Orchestrated Routing and Transportation Analyzer: Large-Scale Traffic Simulation for Autonomous Vehicles, pp. 334-339

Carlino, Dustin — Univ. of Texas at Austin

Depinet, Michael — Univ. of Texas

Khandelwal, Piyush — Univ. of Texas at Austin

Stone, Peter — The Univ. of Texas at Austin

Autonomous vehicles have seen great advancements in recent years, and such vehicles are now closer than ever to being commercially available. The advent of driverless cars provides opportunities for optimizing traffic in ways not possible before. This paper introduces an open source multiagent microscopic traffic simulator called AORTA, which stands for Approximately Orchestrated Routing and Transportation Analyzer, designed for optimizing autonomous traffic at a city-wide scale. AORTA creates scale simulations of the real world by generating maps using publicly available road data from OpenStreetMap (OSM). This allows simulations to be set up through AORTA for a desired region anywhere in the world in a matter of minutes. AORTA allows for traffic optimization by creating intelligent behaviors for individual driver agents and intersection policies to be followed by these agents. These behaviors and policies define how agents interact with one another, control when they cross intersections, and route agents to their destination. This paper demonstrates a simple application using AORTA through an experiment testing intersection policies at a city-wide scale.

14:54-15:12 MB5.4

Reconsider Your Strategy - an Agent-Based Conceptualisation of Compensatory Driver Behaviour, pp. 340-346

Lützenberger, Marco — Tech. Univ. Berlin

Ahrndt, Sebastian — Tech. Univ. Berlin

Hirsch, Benjamin — Khalifa Univ.

Masuch, Nils — Tech. Univ. Berlin

Heßler, Axel — Tech. Univ. Berlin

Albayrak, Sahin — Tech. Univ. Berlin

Currently, there are many models available which can be used to describe a driver's behaviour for a traffic simulation. Despite the number of available formalisms it is our opinion that existing approaches neglect the interplay between the simulation topology and strategic decisions of simulated drivers. Existing models either disregard strategy updates or focus on short-term strategies only. In this paper we tackle this problem and propose a model which incorporates (long-term) strategic reactions of simulated drivers to influences of the surrounding infrastructure. In doing so, we formalise a certain type of human behaviour which is commonly known as strategic-level compensation.

MB6 Katmai

Traveler Information (Regular Session)

14:00-14:18 MB6.1

An Integrated Architecture for the Development and Assessment of ADAS, pp. 347-354

Noth, Sebastian — NISYS GmbH

Edelbrunner, Hannes — NISYS GmbH

Iossifidis, Ioannis — HRW Univ. of Applied Sciences

Advanced Driver Assistant Systems act, by definition in natural, often poorly structured, environments and are supposed to closely interact with human operators. Both, natural environments as well as human behaviour have no inherent metric and can not be modelled/measured in the classical way physically plausibly behaving systems are described.

This makes the development of a new methodology and

especially the development of an experimental environment necessary, reflecting all constraints of the task to be observed, incorporating the influence of each single component and the generation of variations over scenes and behaviours.

In this contribution we focus on the development of an integrated architecture based on a simulated reality framework incorporating simple behavioural models of autonomous acting humans, physical plausible behaving scene objects, a dynamic scene generator and an advanced recording and analysing system, operating on-line on all data streams. The architecture allows to develop, asses and benchmark embedded components, as well as whole ADAS.

14:18-14:36 MB6.2

Relocation Strategies and Algorithms for Free-Floating Car Sharing Systems, pp. 355-360

Weikl, Simone	Univ. of Federal Armed Forces Munich
Dr. Bogenberger, Klaus	Univ. of Federal Armed Forces Munich

During the last two years so-called free-floating Car Sharing Systems became very popular. These systems in comparison to the conventional Car Sharing Systems allow short one-way trips. Today, the spatial distribution of vehicles within free-floating Car Sharing Systems is either self-organized, which means it is only dependent on the customer's demand or in a few cases the positioning is manually controlled by system operators. None of the known free-floating Car Sharing Systems has a clear defined relocation strategy or is online optimized based on the current demand. Within this paper several relocation strategies are introduced and categorized. For each category a relocation algorithm is described and evaluated. Also a new integrated two-step algorithm for optimal positioning and strategy selection is described in detail. This new approach consists of an offline demand clustering that allows for strategy pre-selection. The online module of the approach measures the differences between optimal vehicle positioning and current positioning and selects the best relocation strategy for implementation.

14:36-14:54 MB6.3

Contextual Information in User Information Systems in Public Transportation: A Systematic Review, pp. 361-366

Borgiani, Felipe Silveira Mello	Federal Univ. of Pernambuco
Tito, Adriano	Univ. Federal de Pernanbuco
Santos, Rodolfo	Federal Univ. of Pernambuco
Tedesco, Patricia Cabral de Azevedo Restelli	Federal Univ. of Pernambuco
Salgado, Ana Carolina	Federal Univ. of Pernambuco

The accelerated urbanization rates have brought along an ever-increasing number of vehicles, which, in their turn, causes serious delays in people's daily travels. Users of public transportation, in particular bus passengers, have suffered the most, due to the lack of information about transportation means and traffic conditions. This creates anxiety and uncertainty about the travel, especially on metropolitan regions in developing countries. In this light, User Information Systems (UIS) aim to provide precise information, taking into account the context of the passenger and of the traffic. Hence, it is possible to better support users decisions and increase users' trust on the transportation means reliability. This work presents a systematic literature review, which aims to identify how (if at all) contextual information is used by Public Transportation User Information Systems.

14:54-15:12 MB6.4

Adaptive Route Guidance System with Real-Time Traffic Information, pp. 367-372

Li, Caixia	the Univ. of New South Wales
Anavatti, Sreenatha	Univ. of New South Wales

This paper presents a systematic approach to adaptively realize the vehicle routing with the real-time traffic information during the whole time period of day. This paper focuses on the route planning procedures for determining the optimal route based on analytical hierarchy process (AHP) and fuzzy logic theory. This approach can adaptively switch from pre-routing to real-time routing based on real-time traffic information to find an optimal route for each OD pairs. The AHP-FUZZY approach is a multi-criteria combination system, which can greatly simplify the definition of decision strategy and represent the multiple criteria explicitly. A simulation is implemented to compare with the traditional route guidance system and the results are validated.

15:12-15:30 MB6.5

A Model for Automatic Collection and Dynamic Transmission of Traffic Information Based on VANET, pp. 373-378

Zhang, Qi	Univ. of Science & Tech. Beijing
Zhao, JianHao	Univ. of Science & Tech. Beijing

As the existing traffic information system based on the fixed traffic information center needs high cost for construct, and the other traffic information system based on inter vehicle communication pays more attention to safe driving information but pays less attention to traffic congestion information, especially for the traffic congestion information in the road network. This paper studies and puts forward a pattern for automatic traffic information service which realizes the function of automatic collection and dynamic transmission of traffic information in the road network on the basis of VANET, and with no need for fixed traffic information center. According to this pattern, we build the models for automatic collecting, integrating and processing, transmitting of traffic information, and automatic generating and dynamic updating of traffic information which covers the whole road network. Finally, in this paper, we also carry out traffic simulation for these models, analyze and evaluate rationality of these models and transmission effect.

MB7 King Salmon

Traffic Management and Control 1 (Regular Session)

14:00-14:18 MB7.1

Evaluations of Intelligent Traffic Signal Control Algorithms under Realistic Landmark-Based Traffic Patterns Over the NCTUns Network Simulator, pp. 379-384

Wang, Shie-Yuan	National Chiao Tung Univ.
Li, Yu-Wei	National Chiao Tung Univ.

In this paper, we use the NCTUns network simulator to study intelligent traffic signal control algorithms. NCTUns is both a microscopic traffic simulator and a network simulator. We imported the real-life map of a district of the Taipei city into

NCTUns to let simulated vehicles move on the roads of the imported map. Then, we used a new and unique feature of NCTUns -- each simulated vehicle moves towards its assigned landmark on the map as its destination, to create more realistic traffic patterns in the studied district. With these realistic settings, we studied an intelligent traffic signal control algorithm that has been proposed in the literature. We found that this algorithm has unfairness problems and thus we proposed two mechanisms to improve it. Our simulation results show that, when compared with the original algorithm, the improved algorithm can further reduce the average time needed for a vehicle to reach its destination. In addition, the improved algorithm can mitigate the unfairness problem.

14:18-14:36 MB7.2

Signal Control Strategy between Expressway Off-Ramp and On-Ramp Area in Beijing, pp. 385-390

Zhang, Haizheng	Tsinghua Univ.
Li, Weixia	Tsinghua Univ.
Li, Zhiheng	Tsinghua Univ.
Tan, Jiyuan	Tsinghua Univ.
Yao, Danya	Tsinghua Univ.
Li, Li	Tsinghua Univ.

This paper mainly focuses on different influences on traffic flow in large traffic flow conditions, caused by different distances between off-ramp and on-ramp on expressways. In addition, a signal control strategy on side road is proposed and discussed. Our research is based on traffic simulation software (VISSIM). In this research, the characteristics to describe traffic features include average travelling speed and density. Specifically, we simulate 5 scenarios with different on-ramp and off-ramp distances from 200m to 600m and analyze features of traffic flow and their relations with the distance. When the distance decreases to 200m, traffic states deteriorate significantly. Therefore, the scenario with the distance of 200m is focused, and a signal control strategy on side road is used to alleviate congestions on side roads and expressways. After simulation with the strategy, comparisons and analyses are also given in this paper.

14:36-14:54 MB7.3

Optimized Two-Stage Fuzzy Control for Urban Traffic Signals at Isolated Intersection and Paramics Simulation, pp. 391-396

Yang, Wenchen	School of Transportation Engineering, Tongji Univ.
Zhang, Lun	School of Transportation Engineering, Tongji Univ.
He, Zhaocheng	Intelligent Transportation Res. Centre, Sun Yat-senUniversit
Zhuang, Lijian	Intelligent Transportation Res. Centre, Sun Yat-senUniversit

This paper presents two adaptive two-stage fuzzy controllers for traffic signals at isolated intersections. Firstly, a two-stage combination fuzzy controller is designed. For traffic status variables in two-stage controller leading to the inefficiency of traffic states weakening under low traffic flow, the controller introduces 0-1 combination and determines the combination of traffic status variables of fuzzy controller's inputs from the perspective of structural optimization. Secondly, aiming at the problems of fuzzy controller parameter empirical settings and functional disability of learning, a two-stage fuzzy logic traffic signal controller with online optimization is proposed; this controller introduces the rolling horizon framework and optimizes the parameters of membership functions and controller rules by using hybrid genetic algorithm. The performance of two proposed models is validated via online Paramics-based simulation platform, and extensive simulation tests have demonstrated the potential of developed controllers for adaptive traffic signal control.

14:54-15:12 MB7.4

Delay Analysis of Signal Control Policies for an Isolated Intersection, pp. 397-402

Ghavami, Abouzar	Rensselaer Pol. Inst.
Kar, Koushik	Rensselaer Pol. Inst.
Ukkusuri, Satish	Purdue Univ.

In this paper, we analyze the delay performance of three traffic signal control algorithms that can attain maximum system throughput, for a single four-way intersection. The first is a static (state-independent) fixed-time scheduling (FTS) policy which is followed in current practice. The second is a dynamic maximum weight (backlog) scheduling (MWS) policy that determines the traffic signal phase (the set of collision-free lanes chosen to be scheduled) based on the backlogs (number of queued vehicles) in the different lanes of the intersection, but the schedule length (green time) is kept fixed. The third is adaptive length MWS (aMWS), a variant of MWS in which the schedule length (green time of the phase) is also adjusted based on the backlogs, in addition to the phases. We show that while the dynamic signal control policies (MWS and aMWS) outperform the static (FTS) policy in general, the performance of a fixed-length schedule like MWS can be seriously affected when loss of scheduling time due to ``lag effects'' is considered. However, with adaptive adjustment of the schedule lengths (green times), a dynamic signal control policy (like aMWS) can outperform the FTS policy at all traffic loads.

15:12-15:30 MB7.5

Improving Intersection Performance with Left Turn Phase Reservice Strategies, pp. 403-408

Corey, Jonathan	Univ. of Washington
Lao, Yunteng	Univ. of Washington
Xin, Xin	Univ. of Washington
Wang, Yinhai	Univ. of Washington

Left turns often have a large impact on traffic signal operations. Advanced signal operations offer practitioners an opportunity to reduce delay at their intersections at minimal cost by using features already included in their signal control software. One advanced operations technique is phase reservice and its associated feature conditional reservice. This research examines the performance improvement gained by applying these techniques to the left turn at Hall Blvd. on 99W in Tigard, OR. Significant delay savings were seen for the left turn movement with an average delay reduction of more than 30 seconds at the cost of approximately 3 seconds increased delay for the opposing through movement. Intersection delay reduction was found to be dependent on the ratio of left turning vehicles to opposing through traffic.

MB8 Lupine

Eco Driving and Energy Efficient Intelligent Infrastructure 2 (Regular Session)

14:00-14:18 MB8.1

Optimal Real-Time Navigation System: Application to a Hybrid Electrical Vehicle, pp. 409-414

Hrazdira, Adam	Brno Univ. of Tech.
Cela, Arben	ESIEE Paris
Hamouche, Redha	ESIEE Paris
Reama, Abdellatif	ESIEE Paris
Rezende, Bernardo	Univ. Federal de Minas Gerais
Niculescu, Silviu-Iulian	Lab. de Signaux et Systemes (L2S, UMR CNRS 8506)
Villedieu, Christophe	AKKA Tech.

Abstract—In this paper we present an Optimal Real Time Navigation System (ORTNS) implemented on an Android Smart Device capable of calculating the route to destination based on a permanent Internet connection and information flow obtained from SYTADIN, a traffic Information System. A multi-objective criterion is defined in order to offer the drivers different route to destination parameterization. The ORTNS is not only capable of optimal route to destination calculation with respect to traffic state but also makes the vehicle On-Board energy optimization and/or gas emission reduction possible. As an application example we propose a real time energy management for a Hybrid Electrical Vehicle (HEV) composed of batteries and Super-Capacitors (SC). Based on calculated 3D route to destination and average speeds for each road segment the state of charge (SOC) for batteries and Super-Capacitors (SC) for each receding horizon are optimaly predicted and modified in real time.

14:18-14:36 MB8.2

Comparison of VSP Profiles for Three Types of Intersection Control and Implications for Emissions, pp. 415-420

Hallmark, Shauna	Iowa State Univ. USA
Mudgal, Abhisek	Iowa State Univ.

Roundabouts have generally been considered to have lower emissions as compared to signal controlled and 4-way stop-control intersections since they improve traffic flow and average speed. However, roundabouts slow all vehicles to speed ranges where emissions are higher, while signals stop and delay only a portion of vehicles. Roundabouts have the potential to increase the amount of acceleration and deceleration for all vehicles. Emissions are correlated to these modal events, therefore the impacts should be considered in the evaluation of roundabouts.

Vehicle activity (instantaneous speed and acceleration) are key inputs to modal emission models such as the US Environmental Protection Agency's MOVES. The objective of this paper was to compare the vehicle activity of a roundabout to 4-way stop control and signal controlled intersections. The paper presents result of a study which collected second-by-second vehicle activity on-road along a corridor in Urbandale, Iowa. Vehicle activity for the three different types of traffic control was compared.

14:36-14:54 MB8.3

A Self-Learning Traffic Signal Control Method for CO2 Reduction Using Prediction of Vehicle Arrivals, pp. 421-426

Umedu, Takaaki	Osaka Univ.
Togashi, Yuji	OsakaUniversity
Higashino, Teruo	Osaka Univ.

A large part of CO2 emission comes from road transportation. The amount of CO2 emission from vehicles can be reduced by controlling traffic flows using traffic signals, because it is strongly affected by vehicular behavior. Although there are a number of traffic signal control systems to reduce travel time, such systems might not be effective to reduce vehicular emission because of the trade-off between stop duration and stop frequency at signals. In this paper, we propose a decentralized signal control technique for reduction of vehicle stops using vehicle arriving information collected by inter-vehicle communication. The proposing technique controls signals based on an evaluation function to predict CO2 emission amount. The function is gradually improved by an unsupervised learning technique. Through simulation based evaluation, we show that the proposing technique is efficient to reduce CO2 emissions from vehicles without increasing the average travel time not so much.

14:54-15:12 MB8.4

Energy Efficient Driving Strategy for Trains in MRT Systems, pp. 427-432

Gu, Qing	Beijing Jiaotong Univ.
Cao, Fang	state key Lab. of rail traffic control and safety,Beijing
Tang, Tao	Beijing Jiaotong Univ.

This paper focus on energy efficient driving strategy for MRT trains. In MRT systems, Automatic Train Operation (ATO) has been widely used. The calculation of a reference trajectory seems more important, since it could improve the performance of ATO. The operation demands for MRT trains are different from freight trains, such as energy saving demand and the characteristic of traction. In this paper, based on the characteristic of traction and some results got by the former researchers, a new energy efficient strategy model is proposed by using nonlinear programming method. It is the first time to combine the analytical and numerical method together in this area. By applying the new method, it is unnecessary to pre-given any key value. Moreover, since it is easy to solve, it could be used in real-time operation adjustment. The feasibility and effectiveness are verified th

15:12-15:30 MB8.5

An Analysis on Excursion Characteristics of Electric Assist Bicycles by Travel Behavioral Comparison Based on Trajectory Data, pp. 433-437

Inagaki, Tomoyuki	Seikei Univ.
Mimura, Yasuhiro	Toyota Transportation Res. Inst.
Ando, Ryosuke	TTRI (Toyota Transportation Res. Inst.

Electric assist bicycles which are becoming a part of modern life have the possibility to promote bicycle's excursion and the potentiality for the new travel mode responsive to the hilly landform and the aged society, so that it is important to verify practical effectiveness of them. In this paper, an analysis of effects of electric assist facilities on the excursion of bicyclists is conducted by comparing the travel behavior of the electric assist bicycles with that of the normal bicycles, using the trajectory data of the users of rent-a-bicycle in the urban area. As a result, it is shown that the use of the electric assist bicycle increases the travel distance and the coefficient for the utilization of slopes and this tendency is particularly true respect with the elderly, and that the running speed is less influenced by the longitudinal gradient value of the slopes.

MC1 Chart

Advanced Vehicle Active Safety Systems (Special Session)

Organizer: Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Organizer: Du, Eliza	Indiana Univ. Univ. Indianapolis

16:00-16:18 MC1.1

Plant Error Analysis and Compensation in Adaptive Cruise Control Systems (I), pp. 438-443

Meadows, Alex	Indiana Univ. Univ. Indianapolis
Li, Lingxi	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Widmann, Glenn	Delphi Electronics and Safety

The parameters of an adaptable cruise control system may change considerably during the course of operation. The addition of passengers, the increased friction as parts wear and the reduction in mass as fuel is consumed all provided changes to the load of the system. These variations and many others may be modeled as a non-perfect plant, called an uncertain or corrupted plant. In initial control analysis, the adaptive cruise control systems are assumed to have a perfect plant; that is to say, the plant always behaves as commanded. Plant corruption may come from a variation in performance through use or misuse, or from noise or imperfections in the sensor signal data. A model for plant corruption is applied and methods for analysis and compensation are explored. To facilitate analysis, system identification has been employed to produce a reduced-order model.

16:18-16:36 MC1.2

Semantic-Based Road Environment Recognition in Mixed Traffic for Intelligent Vehicles and Advanced Driver Assistance Systems (I), pp. 444-450

Guo, Chunzhao	Toyota Central R&D Lab. Inc.
Mita, Seiichi	Toyota Tech. Inst.

Comprehensive situational awareness is paramount to the effectiveness of higher-level functions of the intelligent vehicles and advanced driver assistance systems (ADASs). This paper addresses a hierarchical vision system designed for recognizing a number of objects of interest in mixed traffic, in which, the host vehicle have to drive inside the road boundary and interact with other road users. In the proposed system, the semantic knowledge of the scene is utilized to construct a graph. Stereo vision associated with the semantic graph is employed to seek the drivable road boundary in a Hidden Markov Model (HMM). The results are then used as the road contextual information for the following procedure, in which, particular objects of interest, including vehicles, pedestrians, motorcycles and bicycles, are recognized by using a multi-class object detector. Experimental results in various typical but challenging scenarios show the effectiveness of the proposed system.

16:36-16:54 MC1.3

Automatic Categorization-Based Multi-Stage Pedestrian Detection (I), pp. 451-456

Yang, Kai	Indiana Univ. Univ. Indianapolis
Du, Eliza	Indiana Univ. Univ. Indianapolis
Jiang, Pingge	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI
Sherony, Rini	Toyota Motor Engineering and Manufacturing North America
Takahashi, Hiroyuki	Toyota Motor Corp.

Pedestrian safety has become an important issue for automobile design. Although a lot of research has been done or is ongoing in developing in-car camera-based pedestrian protection systems, robust and reliable in-car camera based pedestrian analysis is still very challenging, especially for real-time systems or large scale dataset analysis. In this paper, we propose a new pedestrian detection and analysis system based on automatic categorization. A category-based multi-stage pedestrian detection and data analysis approach is developed to efficiently process the extremely large scale driving data collected in this research. The experimental results on part of the collecting dataset show that the proposed method is promising.

16:54-17:12 MC1.4

Minimizing Driver Interference under a Probablistic Safety Constraint in Emergency Collision Avoidance Systems (I), pp. 457-462

Johnson, Jeffrey	Indiana Univ.
Zhang, Yajia	Indiana Univ.
Hauser, Kris	Indiana Univ.

Automated emergency maneuvering systems can avoid or reduce the severity of collisions by taking control of a vehicle away from the driver during high-risk situations. To do so, these systems must be capable of making certain decisions: there is the choice of when to interfere in the driver's control, which is made challenging in the presence of dynamic obstacles and uncertain information (such as that provided by imperfect sensors), and there is the choice of how to interfere, since, in general, controls that mitigate collisions will not be unique. We address both of these questions with a probabilistic decision threshold framework that overrides the driver's control only when safety drops beneath a problem-specific threshold, and minimizes the magnitude of the interference. We demonstrate its application to two scenarios: collision-imminent braking for obstacles traveling along the vehicle's path, and braking and accelerating for unprotected lane crossings.

MC2 Denali

Communication Technologies and Protocols 3 (Regular Session)

16:00-16:18 MC2.1

Simulation Modeling of Visible Light Communication Channel for Automotive Applications, pp. 463-468

Lee, SeokJu	Yeungnam Univ.
Kwon, Jae Kyun	Yeungnam Univ.
Jung, Sung-Yoon	Yeungnam Univ.
Kwon, Young-Hoon	LED-IT Fusion Tech. Res. Center

In this paper, we provide simulated channel models reflecting practical conditions for the usage of visible light communications (VLC) in intelligent transportation system (ITS). Practical vehicular LED Head Lamp and Street Lamp considering the lighting regulation for transportation is used to design ITS scenario based on VLC. We model vehicle-to-vehicle (V2V) and vehicle-to-infra(V2I) communication links in two usage scenario (crossroad and metropolitan scenario) by using CATIA V5 tool. Then, measurements for VLC channel modeling are gathered by using Ray-Tracing scheme with commercial LightTools software. From the obtained channel impulse response in both scenario, we found that VLC channels for ITS has dominant multiple LOS links and less multipath components. However, we can notice that V2I link and metropolitan scenario show more dispersive multipath channel characteristics than others.

16:18-16:36 MC2.2

Radar Simulation in SiVIC Platform for Transportation Issues Antenna and Propagation Channel Modelling, pp. 469-474

Pechberti, Steve	IFSTTAR
Gruyer, Dominique	IFSTTAR
Vigneron, Vincent	Univ. d'Evry - Informatique, Biologie Intégrative etSystème

This article presents a new radar sensor modelling for the simulator SiVIC. Lots of simulator exists already for this issue, but none of them have been designed to match objectives such as real-time computing, signal generation and hardware in the loop development. It has lead the LIVIC to developped its own simulator to manage both ADAS development by simulation and signal processing for radar. Different technologies of radar sensors are described before focusing on those used in automotive. The global sensor model is explained and each sub model is detailed with electromagnetic waves and environmental objects modelling and the hypothesis done to realize it. A simple FSK radar is presented as illustration for the defined architecture and initial results are presented. Finally, the next stage of model is described such as issues encountered during development.

16:36-16:54 MC2.3

Printed Antenna for DSRC Systems with Omnidirectional Circular Polarization, pp. 475-478

Varum, Tiago	Inst. de Telecomunicações, Univ. de Aveiro
Matos, Joao	Inst. of Telecom, Univ. of Aveiro
Pinho, Pedro	Inst. de Telecomunicações, Inst. Superior deEngenharia d
Oliveira, Arnaldo	Univ. de Aveiro

Emerging vehicular communications are a key to combat several mobility issues, like road safety and efficiency. Dedicated short range communications (DSRC) is a wireless technology, operating at 5.9GHz, designed for automotive use. To operate, this technology has two types of devices, one for vehicles and another for roadside. This paper presents the design of an antenna for the vehicle unit of the DSRC system. High bandwidth, omnidirectional radiation pattern with circular polarization and reduced dimensions make this antenna particularly suitable for this application.

16:54-17:12 MC2.4

NLOS-Communication between Shadowed Vehicles Using By-Standing Relay Vehicles, pp. 479-484

Dhakal, Sagar	Res. In Motion
Jia, Yupeng	Univ. of Rochester
Nguyen, Nam	Res. In Motion

We consider a dual-hop vehicle to vehicle (V2V) relay channel, where a source vehicle communicates with a destination vehicle using a third vehicle as a relay node. The inter-vehicle relay channel is the product of two independent fading processes generated by two independent groups of scatterers. A novel MMSE estimator is proposed for the aforementioned dual-hop relay channel. The fading process at each hop is modeled as Rayleigh fading as well as Nakagami-m fading. The latter is widely used for modeling severe fading in V2V channels.

MC3 Dillingham

Vehicle Detection and Classification (Regular Session)

16:00-16:18 MC3.1

Tire Classification from Still Images and Video, pp. 485-490

Bulan, Orhan	Xerox Corp.
Bernal, Edgar	Xerox Corp.
Loce, Robert	Xerox Corp.
Wu, Wencheng	Xerox Corp.

The use of different types of tires (e.g., all-season, snow, studded, summer) is regulated by law in several states and countries. Violation of tire usage laws typically results in substantial fines for infringers. In this paper, we propose an automated method to classify tires into snow, all-season and summer tires from still images or from a sequence of video frames. Our method first trains a Suport Vector Machine (SVM) classifier on features extracted from a set of training images. Classification of test tire images is a two-stage process that entails feature extraction and tire classification based on the processing of the extracted features by the previously trained SVM classifier. The principle underlying the feature extraction stage is the representation of tire images via a low-dimensional approximation obtained from Principal Component Analysis (PCA). In order to improve robustness to changes in illumination and perspective, the features are extracted from the frequency representation of the binary edge map of the tire tread image. Our experimental results show that the proposed method achieves high classification accuracy.

16:18-16:36 MC3.2

Application of Random Forest Algorithm to Classify Vehicles Detected by a Multiple Inductive Loop System, pp. 491-495

Shajahan, Sheik Mohammed Ali	Indian Inst. of Tech. Madras
Joshi, Niranjan	Indian Inst. of Tech. Madras
George, Boby	Indian Inst. of Tech. Madras
Vanajakshi, Lelitha	Indian Inst. of Tech. Madras

This paper presents a suitable algorithm to classify vehicles detected by a multiple inductive loop system, developed for measuring traffic parameters in a heterogeneous and no-lane disciplined traffic. The proposed classification scheme employs Random Forest (RF) algorithm. This scheme is suited not only for classifying the detected vehicles as bicycle, motorcycle, scooter, car and bus but also for counting them accurately under a mixed traffic condition. The algorithm has been implemented and tested. Its performance has also been compared with other algorithms based on threshold values and signature patterns. The threshold, signature and RF based algorithms use the number of loops a vehicle occupies as an important factor for classification. Results from a prototype system developed show that the RF based algorithm provides better accuracy compared to the threshold based and signature based methods.

16:36-16:54 MC3.3

Novel Vehicle and Motorcycle Classification Using Single Element Piezoelectric Sensor, pp. 496-501

Rajab, Samer	The Univ. of Oklahoma
Othman, Ahmad	The Univ. of Oklahoma
Refai, Hazem	The Univ. of Oklahoma

Accurate data reporting ensures suitable roadway design for safety and capacity. Currently, vehicle classifier devices employ inductive loops, piezoelectric sensors, or some combination of both to identify 13 different FHWA vehicle classifications. Systems using inductive loops have failed to

accurately classify motorcycles and record relative pertinent data. Previous investigations have focused on classification techniques utilizing inductive loop signal output, magnetic sensor output with neural networks, or the fusion of several sensor outputs. This paper presents a novel vehicle classification setup that uses a single piezoelectric sensor placed diagonally across the traffic lane to accurately identify motorcycles from among other vehicles by detecting the number of vehicle tires. A vehicle classification algorithm based on number of tires detected and axle/tire spacing was formulated and deployed in an embedded system for field testing.

16:54-17:12 MC3.4

Approaching Car Detection Via Clustering of Vertical-Horizontal Line Scanning Optical Edge Flow, pp. 502-507

Karaduman, Ozgur	Firat Univ.
Eren, Haluk	Firat Univ.
Kurum, Hasan	Firat Univ.
Celenk, Mehmet	The Ohio Univ.

Here, we describe a method that detects vehicle(s) approaching from behind to a commuting car in the lane in which both are travelling. This research contributes to the development of driver assistance systems by means of informing them about the approaching traffic from behind and warn the drivers in case they are drowsy or not alert and the driving conditions are hazardous. We use the image pairs extracted from a video clip obtained from a video camera mounted on the back side of the car. This allows detection of the moving objects from the video image pairs using optical flow. Objects which are determined as not cars or vehicles have been eliminated by edge extraction. In turn, this approach leads to lessen the operation processing cost. Then, Density Histogram of Cluster Rows (DHCR) and Density Histogram of Cluster Columns (DHCC) are generated for the purpose of classification of motion vectors (MVs). Consequently, approching vehicles and cars are detected by localizing the place of the motion vector clusters using Vertical Horizontal Line Scanning (VHLS) as experimental results demonstrate.

MC4 Fireweed

Vision Sensing and Image Processing 2 (Regular Session)

16:00-16:18 MC4.1

A Smart Vision Systems for Advanced LGV Navigation and Obstacle Detection, pp. 508-513

Bertozzi, Massimo	Univ. of Parma - Italy
Bombini, Luca	Univ. of Parma - Italy
Broggi, Alberto	Univ. of Parma - Italy
Coati, Alessandro	Univ. of Parma - VisLab - The Artificial Vision andIntellig

This article presents the VisLab solution for obstacle detection and navigation support for unmanned vehicles in industrial environments. Although the literature contains many examples to tackle this problem, this solution can be considered innovative as it improves traditional laser-based systems. The proposed system is composed by two sub-systems. The first one in an obstacle detection system, which also allows the detection of hanging obstacles, within a 3D monitored area. This solution outperforms the original laser scanner based system used for safety which was limited to bi-dimensional areas only. Another vision system is used for tracking a guideline on the ground, that solves problems of localizations and drifts that sometimes can happen using the laser and vehicle odometry only. After a long testing phase, the system is actually installed in a modern industrial warehouse in Parma in order to finally estimate its robustness and reliability.

Attachment. This article presents the VisLab solution for obstacle detection and navigation support for unmanned vehicles in industrial environments. Although the literature contains many examples to tackle this problem, this solution can be considered innovative as it improves traditional laser-based systems.The proposed system is composed by two sub-systems. The first one is an obstacle detection system, which also allows the detection of hanging obstacles, within a 3D monitored area. This solution outperforms the original laser scanner based system used for safety which was limited to bi-dimensional areas only. Another vision system is used for tracking a guideline on the ground, that solves problems of localizations and drifts that sometimes can happen using the laser and vehicle odometry only.

16:18-16:36 MC4.2

Robust Free Space Detection in Occupancy Grid Maps by Methods of Image Analysis and Dynamic B-Spline Contour Tracking, pp. 514-521

Schreier, Matthias	TU Darmstadt
Willert, Volker	TU Darmstadt

We propose a new method for free space detection and description for Advanced Driver Assistance Systems (ADAS) and autonomous vehicles. The detection is based on successive morphological image processing steps that are applied to an occupancy grid map-based environment representation acquired by an automotive radar sensor. The boundary of the found free space segment is traced and serves as a virtual measurement for a time-variant Kalman Filter in order to estimate and track the control points of a two-dimensional B-spline closed free space contour over time. In contrast to existing free space detection methods, the proposed solution incorporates knowledge about the vehicle's dimensions and does not exclude free space that is not directly in the line of sight, but mapped beforehand, as well as free space behind obstacles. Furthermore, the algorithm shows advantages in terms of an intuitive control over spatial and temporal smoothness of the solution as well as an inherent robustness due to model-based filtering. Moreover, the control points of the B-spline curve are proposed as a new low-dimensional representation of drivable free space of arbitrary shape. The effectiveness of the algorithm is demonstrated in real traffic scenarios.

16:36-16:54 MC4.3

Real-Time 3D Visual Perception : Detection and Localisation of Static and Moving Objects from a Moving Stereo Rig, pp. 522-527

Lefaudeux, Benjamin	INRIA
Nashashibi, Fawzi	INRIA

Perception of the surrounding environment is one of the many tasks an automated vehicle has to achieve in a complex and ever-changing playground. This includes several distinct sub-tasks, such as map-building, localisation, static obstacles detection, pedestrian detection or classification. Some of this tasks are nowadays very well known, such as map-building, whereas the perception, localisation and classification of moving objects from a moving vehicle are still very much a work in progress. In this paper, we propose a vision-based approach built on the extensive tracking of numerous visual features over time from a stereo-vision pair, without any other

information as regards vehicle displacement. Through on-the-fly environment 3D reconstruction, we propose an integrated method to detect and localise static and moving obstacles, whose position, orientation and speed vector is estimated. Our implementation runs at the moment in a slow real-time (9fps), and should in the future be enclosed in a more complete, probabilistic pipeline.

16:54-17:12 MC4.4

Scale Change and TTC Filter for Longitudinal Vehicle Control Based on Monocular Video, pp. 528-533

Stierlin, Susanne Robert Bosch GmbH

Dietmayer, Klaus Univ. of Ulm

This paper presents a filter algorithm that derives robust input values for longitudinal control of driver assistance systems, based on noisy scale change measurements from a monocular video system. In particular, we calculate filtered scale change and reliable Time-To-Collision (TTC), two values that can be applied for video based Active-Cruise-Control and Forward-Collision-Warning systems. We exploit the fact that TTC is directly related to scale change and the calculation can be performed without accurate distance measurements. To meet the requirements of an automotive environment, where high dynamic driving maneuvers may occur, TTC calculation has to consider relative velocity and relative acceleration between the ego vehicle and the target. We do this by applying an Interacting-Multiple-Model filter, which directly processes the noisy scale change measurements and estimates normalized motion parameters. For better smoothing during accelerated driving situations, we propose an extended IMM configuration. Results presented are based on the evaluation of NCAP test sequences.

MC5 Iliamna

Simulation and Modeling 2 (Regular Session)

16:00-16:18 MC5.1

A Short-Term Freeway Traffic Flow Prediction Method Based on Road Section Traffic Flow Structure Pattern, pp. 534-539

Zhang, Ping Peking Univ.

Xie, Kunqing Peking Univ.

Song, Guojie PKU

Accurate short-term traffic flow prediction is the foundation of the efficient and proactive management of freeway networks, especially on the abnormal traffic states. The relationship between traffic flow on the current section and the upstream stations can be utilized to predict short-term traffic flow. In this paper, we reveal this relationship by the traffic flow structure pattern. The structure pattern can be drawn from real freeway toll data and a few video detective cameras on the freeway segments. Based on the stability pattern, a new traffic flow prediction algorithm has been proposed; Experimental based on real data showed that the prediction method based on structure pattern was a promising and effective approach for traffic flow prediction, especially on the abnormal traffic state.

16:18-16:36 MC5.2

Measurement Analysis of Traffic Flow Uncertainty on Chinese Highway Network, pp. 540-545

Liu, Ruiqi Peking Univ.

Xing, Xingxing Peking Univ.

Song, Guojie Peking Univ.

Xie, Kunqing Peking Univ.

Zhang, Ping Peking Univ.

Extensive research has been done on traffic forecasting. However, performance of forecasting models is highly influenced by traffic uncertainty and predictability. Traffic uncertainty is important for road users and governors as well. With support of adequate real data, we reveal laws in traffic flow uncertainty by employing dispersion coefficient. For further study, Hurst exponent and Approximate Entropy reflect temporal characteristics, indicating long-term randomness and short-term complexity respectively. These measurements all suggest that traffic flow uncertainty drops with the increase of time interval. Our study provides theoretical evidence for 15 minutes time horizon in short-term traffic prediction. Daily periodicity exists that highway traffic flow at night is more uncertain than in day time, and off-peak hour flows are more uncertain than peak hour flows. Finally, initial investigation into traffic predictability exhibits acme at 7 a.m. in our case.

16:36-16:54 MC5.3

Simulating Coherent Flow with Cellular Automaton Model, pp. 546-551

Zheng, Yichen Tsinghua Univ.

Zhang, Yi Tsinghua Univ.

Hu, Jianming Tsinghua Univ.

Li, Li Tsinghua Univ.

Pei, Xin Tsinghua Univ.

At present, different viewpoints and theories are put forward on divisions and transitions of traffic states in highway, for which decide the fundamental properties of traffic flow. Coherent-moving state, among these states, was firstly proposed in Helbing's paper [1] to discuss the hypothetical steady states in mixed traffic flow in highway traffic. Since then, possible explanations on existence, stability and transition of coherent-moving state have been proposed in other research. In the paper, fast simulation and scenario reproduction in cellular automaton model are taken to test and verify those assumptions. A two-lane highway scenario with variety of vehicle parameters is built to reproduce the situation where coherent-moving phenomenon is likely to occur. At last, according to the simulation results, we bring forward our explanations on coherent-moving state which may be helpful on further study.

16:54-17:12 MC5.4

Microscopic Traffic Simulation Tool for Intelligent Transportation Systems, pp. 552-557

Jaworski, Pawel MIRA Ltd

Edwards, Tim MIRA Ltd

Burnham, Keith Coventry Univ.

Haas, Olivier Coventry Univ.

This paper describes a microscopic traffic simulation tool for assessing the performance of ITS traffic and vehicle control systems. The scope of simulation is very broad. The traffic network is simulated in microscopic scale with nanoscopic components being available as well. The vehicles can be simulated down to basic physical properties including throttle and brake settings, fuel consumption and others. This allows for in-depth behavioural analysis of both individual vehicles and the whole traffic flow as a result of use of different traffic management systems. The simulator also allows investigating inter-vehicle interactions including platooning behaviour and its consequences such as the string stability problem. The simulator has been designed to be modular and easily extensible to allow for new functionality in future.

17:12-17:30 MC5.5

An Extended Cell Transmission Model Based on Digraph for Urban Traffic Road Network, pp. 558-563

Han, Xingguang	Beijing Univ. of Tech.
Chen, Yangzhou	Beijing Univ. of Tech.
Shi, Jianjun	Beijing Univ. of Tech.
He, Zhonghe	Beijing Univ. of Tech.

This paper proposes a macroscopic traffic flow model for urban traffic road network. First, dynamic digraph is used to model the urban traffic road network's topological structure. Then, traffic flow data which is based on an extended cell transmission model and the traffic shock wave theory are endowed to the dynamic digraph to construct a weighted dynamic digraph model. Finally, the modeling method is applied to a local road network to illustrate the availability of the modeling method when compared with real data.

MC6 Katmai

Travel Time Estimation and Prediction (Regular Session)

16:00-16:18 MC6.1

Kullback-Leibler Comparison Framework for the Evaluation of Travel Time Distribution Estimates, pp. 564-569

Ernst, Joseph M.	Oak Ridge National Lab.
Krogmeier, James V.	Purdue Univ.
Bullock, Darcy	Purdue Univ.

In the 1970s a framework was developed by Oppenlander for evaluation of travel time estimation studies. This framework is still recommended today. This paper develops a new framework to improve upon the ideas set forth by Oppenlander. This new framework is based upon the Kullback-Leibler divergence. It allows for travel time studies to be evaluated in a more comprehensive way. Travel time estimation methods can now be evaluated on their ability to estimate travel time distributions instead of only the mean travel time. Also, this framework can be used on any travel time distribution whereas the Oppenlander framework was only properly suited for Gaussian distributions. The Kullback-Leibler divergence also allows for both ID matching and signature matching travel time estimation algorithms to be evaluated, while the Oppenlander framework was best suited for the ID matching algorithms.

In this paper the Kullback-Leibler comparison framework for travel time studies is developed. The framework is then used to provide a comparison of an example ID matching and an example signature matching algorithm to demonstrate how both can be evaluated in a single framework. Finally, conclusions are made about the usefulness of the Kullback-Leibler comparison framework.

16:18-16:36 MC6.2

Experienced Travel Time Prediction for Freeway Systems, pp. 570-575

Yildirimoglu, Mehmet	Ec. Pol. Federale de Lausanne
Geroliminis, Nikolas	Ec. Pol. Fédérale de Lausanne

Travel time is considered as one of the most important performance measures for roadway systems, and dissemination of travel time information can help travelers to make reliable travel decisions such as route choice or time departure. Since the traffic data collected in real time reflects the past or the current conditions on the roadway, a predictive travel time methodology should be used to obtain the information to be disseminated. However, an important part of the literature either uses instantaneous travel time assumption, and sums the travel time of roadway segments at the starting time of the trip, or uses statistical forecasting algorithms to predict the future travel time. This study benefits from the available traffic flow essentials (e.g. shockwave analysis, bottleneck identification), and makes use of both historical and real time traffic information to provide travel time prediction. The experimental results based on the loop detector data on Californian freeways indicate that the proposed method provides promising travel time predictions under varying traffic conditions.

16:36-16:54 MC6.3

Prediction of Dynamic Freeway Travel Times Based on Vehicle Trajectory Construction, pp. 576-581

Chen, Hao	Virginia Tech.
Rakha, Hesham A.	Virginia Tech.

The paper proposes a new approach to construct vehicle trajectories using real-time and historical traffic data for the prediction of dynamic travel times. The purpose of this paper is to predict travel times considering the transportation system evolution. The approach combines real-time and historical data within a particle filter framework to dynamically predict future traffic state maps. The future travel trajectory is then constructed using the velocity map and thus travel time is predicted. Based on the nature of particle filters, the variance of each speed grid traversed during the trip can be calculated and then used to compute the travel time variance. The proposed approach is tested using simulated data along a section of I-66. The results demonstrate the effectiveness of the proposed algorithm in predicting travel times.

16:54-17:12 MC6.4

Short-Term Travel Time Estimation and Prediction for Long Freeway Corridor Using NN and Regression, pp. 582-587

Wang, J.Y.	National Chiao Tung Univ.
Wong, K.I.	National Chiao Tung Univ.
Chen, Y.Y.	National Chiao Tung Univ.

Travel time information is a fundamental component in Advanced Traveler Information System. In this paper, we propose a short-term travel time estimation and prediction framework for long freeway corridor, considering measurements from vehicle detectors (VD) and floating car data (FCD). The modeling approach is based on a modified Nearest-Neighborhood (NN) model with threshold and a regression model capturing the within day variations. The advantages are that our approach allows for missing data without the need of data imputation in real-time, and is suitable for travel time prediction of long corridors. The validation analysis using an 88 km long section of freeway shows satisfactory results.

MC7 King Salmon

Traffic Management and Control 2 (Regular Session)

16:00-16:18 MC7.1

Distributed Traffic Signal Control for Maximum Network Throughput, pp. 588-595

Wongpiromsarn, Tichakorn	Singapore-MIT Alliance for Res. & Tech.
Uthaicharoenpong, Tawit	Nangyang Tech. Univ.

Wang, Yu	NANYANG Tech. Univ.
Frazzoli, Emilio	Massachusetts Inst. of Tech.
Wang, Danwei	Nanyang Tech. Univ.

We propose a distributed algorithm for controlling traffic signals. Our algorithm is adapted from backpressure routing, which has been mainly applied to communication and power networks. We formally prove that our algorithm ensures global optimality as it leads to maximum network throughput even though the controller is constructed and implemented in a completely distributed manner. Simulation results show that our algorithm significantly outperforms SCATS, an adaptive traffic signal control system that is being used in many cities.

16:18-16:36 MC7.2

Traffic Signal Control Using Reinforcement Learning and the Max-Plus Algorithm As a Coordinating Strategy, pp. 596-601

Medina, Juan C	Univ. of Illinois at Urbana - Champaign
Benekohal, Rahim F.	Univ. of Illinois Urbana-Champaign

This paper explores the performance of decentralized reinforcement learning agents with communication capabilities for the operation of traffic signals in an oversaturated network. An explicit coordinating mechanism is implemented as part of the reward structure of the agent using the max-plus algorithm, aiming at improving the network-wide performance. Results from a simulated network with realistic features showed that Q-learning agents could process a greater number of vehicles than optimized signal timings from state-of-practice simulation software TRANSYT7F, even under varying oversaturation conditions. The effect of adding the max-plus algorithm was limited, but towards improved performance in terms of both total throughput and reduced number of stops per vehicle. Ongoing research evaluates potential conditions where the coordination should be emphasized to further enhance results, as well as alternative implementations of the max-plus algorithm.

16:36-16:54 MC7.3

Signal Timing for Fleeting Multiple Intersecting Roadways, pp. 602-607

Miller, Jeffrey	Univ. of Alaska Anchorage
Donat, Wolfram	Univ. of Alaska Anchorage
Harris, John	Univ. of Alaska Anchorage

Increasing transportation efficiency by expanding roadway infrastructure is limited by maintenance costs, real estate, and lengthened commutes. An alternate solution has been optimizing traffic flow by fleeting traffic signals. A roadway is fleeted when its signal sequence allows a platoon of vehicles to travel its length without being stopped by a red light, which in turn reduces congestion. The advantages of fleeting could be increased by fleeting multiple intersecting roadways. Our research examines the conditions necessary to accomplish timing traffic signals in intersecting directions so that both directions can have platooned vehicles simultaneously. The traffic signals at the intersecting roadways must be synchronized to maintain the fleeting sequences for both roadways. Through our analysis, we conclude that the time to travel along the roadways between traffic signals that are timed for platooning in multiple directions must be equivalent. Since many roadway distances are already known (unless a new road is being constructed), the only variable affecting the time to travel along a roadway is the speed limit. If variable speed limits are used, traffic signals on intersecting roadways are able to be fleeted.

16:54-17:12 MC7.4

Adaptive Control of Hyperbolic PDE System with Uncertain Parameters, pp. 608-612

Wadoo, Sabiha	New York Inst. of Tech.

The main contribution of this paper is the stability analysis and adaptive control design of a hyperbolic Partial Differential Equation (PDE) system model for crowd dynamics. The feedback control of crowd dynamics has become an important area of research and has been under investigation in recent years. The control of such systems is difficult to achieve as the dynamics are governed by hyperbolic PDEs. This paper presents the design of a nonlinear adaptive controller for a hyperbolic partial differential equation model representing crowd dynamics. Most of the adaptive control in literature is studied for parabolic PDEs. The major contribution of this paper is the study of adaptive control for hyperbolic PDEs. The feedback control is designed in the presence of uncertainties due to unknown parameters. The controller is designed using the Lyapunov method. The controller designed is shown to achieve uniform boundedness.

MC8 Lupine

Eco-Driving and Energy Efficient Intelligent Infrastructure 3 (Regular Session)

16:00-16:18 MC8.1

Optimization of Fuel Cost and Emissions with Vehicular Networks at Traffic Intersections, pp. 613-619

Alsabaan, Maazen	Univ. of Waterloo and King Saud Univ.
Naik, Kshirasagar	Univ. of Waterloo
Khalifa, Tarek	Univ. of Waterloo
Nayak, Amiya	Univ. of Ottawa

The volatile world economy has greatly affected fuel prices, while pollution and gas emissions are increasing to negatively impact global warming. Vehicular networks offer a promising approach that can be applied in transportation systems to reduce fuel consumption and emissions. One of the interesting applications involves a traffic light signal sending information to approaching vehicles. Based on that information, the vehicle receiving the message adapts its speed to a speed called the recommended speed (SR), which is the speed that helps the vehicle to reduce fuel consumption and emissions. In this paper, we propose an optimization model with the objective of minimizing fuel consumption and emissions. The speed that can achieve this goal is the optimum SR. We also propose an efficient heuristic expression to compute near-optimal values of the optimum SR.

16:18-16:36 MC8.2

Simulation of the Impact of Traffic Lights Placement on Vehicle's Energy Consumption and CO2 Emissions, pp. 620-625

Corti, Andrea	Pol. di Milano
Manzoni, Vincenzo	Pol. di Milano
Savaresi, Sergio	Pol. di Milano

This paper proposes a method to estimate the impact of traffic light placement policies in term of vehicles' fuel consumption and CO2 emissions. The method comprises two steps. First, speed profiles are generated representing vehicle's behavior. Then, the mechanical energy spent by the vehicle is

computed. The estimation is then used to compare different policies of traffic light placement. Simulations have been carried out to analyze the impact of semaphores distributed into a real road. The relation between the number of traffic lamps and the energy spent is quantified. Finally, a sensitivity analysis is provided considering different classes of vehicles travelling on urban roads.

16:36-16:54 MC8.3

Vehicle's Energy Estimation Using Low Frequency Speed Signal, pp. 626-631

Corti, Andrea Pol. di Milano
Manzoni, Vincenzo Pol. di Milano
Savaresi, Sergio Pol. di Milano

Everyday vehicles' fleets positions and speeds are collected by private companies and public authorities, stored in servers and used for vehicle's tracking and diagnostic.

These data are usually sampled and transferred over the long-range wireless network with low sampling rates for cost savings in term of network bandwidth and storage. This policy limits the use of the data for fine-grained estimation of vehicle energy, and therefore of fuel consumption and CO2 emissions.

This paper analyzes the effect of a low-frequency sampling rate of inertial variables on vehicle's energy estimation. It statistically quantifies the error with respect to accurate signals. An experimental campaign carried out on different vehicles in different days supports the analysis. Experimental results show that the estimation error mean and variance depends on the sample rate and the time window size and that they do not significantly varies within vehicles of the same class.

16:54-17:12 MC8.4

Estimation of Missing Values in Traffic Density Maps, pp. 632-637

Petrlik, Jiri Brno Univ. of Tech.
Korcek, Pavol Brno Univ. of Tech.
Fucik, Otto Camea spol. s r.o.
Beszedes, Marian Camea spol. s r.o.
Sekanina, Lukas Brno Univ. of Tech.

The traffic density map (TDM) represents the density of road network traffic as the number of vehicles per a specific time interval. TDMs are used by traffic experts as a base documentation for planning a new infrastructure (longterm) or by drivers for showing a current trafic status (shortterm). We propose two methods for estimation of missing density values in TDMs. In the first method, the problem is formulated relatively strictly in terms of quadratic programming (QP) and a QP solver is utilized to find a solution. The second, more general method is based on a multiobjective genetic algorithm which allows us to find a reasonable compromise among several objectives that a traffic expert may formulate. These two methods can work automatically or they can be used by a traffic expert for an iterative density estimation. Results of experimental evaluation based on real and randomly generated data are presented.

Technical Program for Tuesday September 18, 2012

TPL1 Aleutian

Plenary Session on Tuesday A (Plenary Session)

09:00-09:45 TPL1.1

*Train Operation Control Systems for High Speed Railways in China**

Ning, Bin Beijing JiaoTong Univ.

According to the standardization of Chinese Train Control System (CTCS), there are the two train operation control systems for high speed railways in China: CTCS2 and CTCS3. The two systems are widely applied in high speed railways in China to ensure the safety and efficiency of operation for high speed trains.

Professor Bin Ning, President of Beijing Jiaotong University, will provide an overview of the train operation control systems for high speed railways in China. Bin Ning will discuss about the operation principle of CTCS2 and CTCS3 and the challenges train operation control systems face. He will discuss about the further developments of the two systems for high speed railway network in China.

09:45-10:30 TPL1.2

*ITS Wireless Communication Systems in Japan**

Itami, Makoto Tokyo Univ. of Science

Recently, ITS systems are widely being developed and deployed in order to realize a safe and comfortable traffic environment. In ITS systems, wireless communication technology is one of the most important technologies. Dr. Makoto Itami, Professor of Tokyo University of Science, will discuss about the development and deployment of ITS wireless communication systems in Japan such as VICS (Vehicular Information and Communication Service, ETC(Electronic Toll Collection) and ITS spot based on DSRC. In addition, the Japanese standard for inter-vehicle communication using the UHF band and its use in safety applications are also introduced.

TPL2 Alaska

Plenary Session on Tuesday B (Plenary Session)

09:00-09:45 TPL2.1

*Smart Maintenance and Operations Vehicles**

Adams, Ocie Alaska DOT

The Alaska Department of Transportation and Public Facilities partnered with the University of Minnesota to deploy the Smart Maintenance and Operations Vehicles in 2005 in Thompson Pass Alaska. Thompson pass receives an average snow fall of around 250 inches and winds in excess of 122 MPH. The port of Valdes is a primary shipping and resupply line for Eastern Alaska and the termination point of the Alaska Oil Pipeline. Closure of the Richardson Highway can result in emergency services and commercial operators not being able to deliver critical medical services, fuel, groceries, and pipeline maintenance supplies to the Richardson and Alaskan Highways.

With frequent zero visibility conditions in Thompson Pass the department needed a system that could assist the operators with snow removal and Ice control duties. The University of Minnesota offered the best solution to our question. How do we give our operators tools the will help them stay on the road when the visibility would otherwise curtail snow and ice control operations. The University of Minnesota's solution was technology similar to that used in a fighter aircraft. Attend the Smart M&O Vehicles presentation to hear the solution.

09:45-10:30 TPL2.2

*Towards Swarms of Self-Driving Automobiles**

Stiller, Christoph Karlsruhe Inst. of Tech.

This presentation focuses on key technologies for automobiles that perceive their environment and based on this knowledge automatically navigate through everyday traffic in an autonomous and cooperative manner. Methods for 3D machine perception based on lidar, radar, and video sensors are outlined. The possible contribution of prior knowledge from digital maps is elaborated. Beyond classical metrology the recognition and basic understanding of situations must be accomplished for automated decision-making and trajectory planning. When multiple self-driving automobiles are present they are able to communicate their plans and mutually negotiate their trajectories. Inspired by biological swarms it is shown that a coordinated and homogenized traffic flow can be achieved through cooperative yet distributed planning. Results from autonomous vehicles are shown in real world urban and platooning scenarios including AnnieWAY the recent winner of the Grand Cooperative Driving Challenge.

TA1 Chart

Driver Behavior and Safety System (Regular Session)

11:00-11:18 TA1.1

Prediction of Driver Behavior on a Limited Sensory Setting, pp. 638-643

Garcia Ortiz, Michael Bielefeld Univ.
Kummert, Franz Bielefeld Univ.
Schmuedderich, Jens Honda Res. Inst. Europe GmbH

We present a system able to predict the future left cut-in behavior of the ego-vehicle on highway, depending on detected information about the preceding vehicles. Our system learns the mapping between the current perceived scene (information about the ego-vehicle and the preceding vehicles) and the future driving behavior of the ego-vehicle.

The main difference to related contributions comes from the fact that we want to perform behavior prediction with a limited sensory setting. On the one hand, we do not perform driver monitoring, and on the other hand, we only use frontal sensors. However, we show that it is possible to predict accurately the cut-in behavior of the driver.

The system is tested on a real world scenario, using 50 minutes of streams recorded on German highways, and the prediction occurs at a horizon of 2s into the future. The quality of the prediction is measured using frame-based as well as event-based evaluation with a cross-validation approach. We compare a system with only front sensing (vision and radar detection) with a system including a simulated rear sensing.

11:18-11:36 TA1.2

Measuring Driver Awareness Based on Correlation between Gaze Behavior and Risks of Surrounding Vehicles, pp. 644-647

Mori, Masataka Nagoya Univ.
Miyajima, Chiyomi Nagoya Univ.
Angkititrakul, Pongtep Nagoya Univ.
Hirayama, Takatsugu Nagoya Univ.
Li, Yiyang Nagoya Univ.
Kitaoka, Norihide Nagoya Univ.
Takeda, Kazuya Nagoya Univ.

We investigated a method to estimate the degree of driver awareness of surrounding vehicles based on the correlation between driver gaze direction and the positions of and risks posed by surrounding vehicles. The risks posed by surrounding vehicles were represented by their time to collision (TTC) from the driver's vehicle. We recorded driving data from five expert and five non-expert drivers while passing other vehicles on expressways, using an instrumented vehicle. We manually labeled the drivers' gaze directions using video of the drivers' faces, and detected the positions of surrounding vehicles and calculated TTC using laser scanners mounted on the front and back of the vehicle. We focused on driver's gaze behavior for five seconds before the driver began moving into the right hand lane at the beginning of the passing maneuver and calculated the correlation index between vectors representing the distribution of gaze resources and risk levels of surrounding vehicles for eight zones around the vehicle. We found that there were individual differences in gaze behaviors, and that expert drivers showed a higher degree of awareness than non-expert drivers.

11:36-11:54 TA1.3

Modeling the Steering Behavior of Intoxicated Drivers, pp. 648-653

M. Shirazi, Mehran Simon Fraser Univ.
B. Rad, Ahmad Simon Fraser Univ.

Driver assistance systems and vehicle safety systems are meant to improve the driving performance of a driver. Despite increased efforts in educating public at large on the danger of impaired driving in recent years, the problem is not alleviated and drunk driving is still one of the major causes of fatal accidents. Although different models of sober drivers are available in literature, mathematical modeling of humans under the influence of alcohol / drugs in steering control of a vehicle is open. Using system identification techniques, four different linear models for these drivers are presented here. The parameters and characteristics of these models are compared with the respective models for sober drivers. Larger delay (reaction time), reduced ability of maintaining the car in the center of lane, and aggressive driving style are some of the important features of intoxicated drivers identified here. The proposed models are validated using the data collected from 50 minute driving sessions for both sober and drunk drivers. The parametric uncertainties of the model parameters are also shown.

11:54-12:12 TA1.4

Towards Collision Alarming Based on Visual Motion, pp. 654-659

Kilicarslan, Mehmet IUPUI
Zheng, Jiang Yu IUPUI

This work models various collision situations that may happen to a driving vehicle on road in probability, and map such events to the visual field of the camera. The identification of dangerous events thus can be carried out based on the

location-specific motion information modeled in the likelihood probability distributions. Depending on the motion flows detected in the camera, our algorithm will identify the potential dangers and compute the time to collision for alarming. With the location dependent motion based on the knowledge of road environment and behaviors of other vehicles, this approach will detect the motion of potential dangers directly for accident avoidance. The mechanism to link visual motion to the dangerous events avoids the complex shape recognition of vehicles so that the system can response without delay.

12:12-12:30 TA1.5

Leveraging Sensor Information from Portable Devices towards Automatic Driving Maneuver Recognition, pp. 660-665

Sathyanarayana, Amardeep	The Univ. of Texas at Dallas
Sadjadi, Seyed Omid	The Univ. of Texas at Dallas
Hansen, John	The Univ. of Texas at Dallas

With the proliferation of smart portable devices, more people have started using them within the vehicular environment while driving. Although these smart devices provide a variety of useful information, using them while driving significantly affects the driver's attention towards the road. This can in turn cause driver distraction and lead to increased risk of crashes. On the positive side, these devices are equipped with powerful sensors which can be effectively utilized towards driver behavior analysis and safety. This study evaluates the effectiveness of portable sensor information in driver assistance systems. Available signals from the CAN-bus are compared with those extracted from an off-the-shelf portable device for recognizing patterns in driving sub-tasks and maneuvers. Through our analysis, a qualitative feature set is identified with which portable devices could be employed to prune the search space in recognizing driving maneuvers and possible instances of driver distraction. An absolute improvement of 15% is achieved with portable sensor information compared to CAN-bus signals, which motivates further study of portable devices to build driver behavior models for driver assistance systems.

TA2 Denali

Communication Technologies and Protocols 4 (Regular Session)

11:00-11:18 TA2.1

Ipass: Intelligent Pavement Signaling System, pp. 666-671

Claussen, Heiko	Siemens Corp. Res. and Tech.
Aparicio, Juan	Siemens Corp. Res. and Tech.
Rosca, Justinian	Siemens Corp. Res. and Tech.
Tas, Nazif	Siemens Corp. Res. and Tech.

Traditional radio frequency based wireless communication/localization suffers from environmental effects such as multipath propagation. We introduce a robust wireless communication methodology which utilizes the physical world itself to convey information. Our proposed intelligent pavement signaling system (iPASS) can intelligently place irregularities on pavement in order to encode different messages that can be deciphered in real time by an application running on e.g., a phone. iPASS utilizes available accelerometers, e.g., in today's smartphones, that can detect even small vibrations from the inside of a car that are produced by driving over irregularities on the road. Our feasibility study illustrates that iPASS can successfully decode a 5 bit message using a conventional smartphone when cruising at various speeds.

11:18-11:36 TA2.2

Increasing the Probability of Timely and Correct Message Delivery in Road Side Unit Based Vehicular Communication, pp. 672-679

Jonsson, Magnus	Halmstad Univ.
Kunert, Kristina	Halmstad Univ.
Böhm, Annette	Halmstad Univ.

Intelligent transport systems provide a multitude of possibilities when it comes to increasing traffic safety on our roads. Many of the proactive traffic safety applications under development today demand timely and reliable treatment of deadline dependent data traffic. Unfortunately it is not possible to provide any timing guarantees when using the current IEEE 802.11p standard for wireless access in vehicular environments. Additionally, a difficult wireless channel environment makes successful data transmissions very challenging. We suggest adding a real-time layer, comprising a deterministic medium access control protocol and transport layer retransmissions, on top of IEEE 802.11p in order to enable guaranteed real-time behaviour and to improve reliability. In a simulation study we show that the packet error rate can be decreased by several orders of magnitude while being able to guarantee timely treatment of both ordinary transmissions and retransmissions by the help of a real-time schedulability analysis.

11:36-11:54 TA2.3

Person-To-Infrastructure (P2I) Wireless Communication for Work Zone Safety Enhancement, pp. 680-684

Qiao, Yijun	The Univ. of Texas at Austin
Qiao, Fengxiang	Texas Southern Univ.

There are serious concerns about the injuries and fatalities of highway maintenance and construction workers around work-zone area. One portion of such incidents is directly related to the vehicles approaching work zones. The advance warning of the potential conflicts between vehicles and workers to both vehicle drivers and workers is essential to workers' safety. This paper proposes a Person-to-Infrastructure (P2I) communication framework aiming to enhance the work zone safety level. The Time Difference of Arrival (TDOA) based emitter location algorithm is identified to constantly monitor the location of an emitter attached to a worker. An engineering implementation procedure is proposed with nine practical steps. The on-going work includes further computer simulation and pilot test of such P2I wireless communication system.

11:54-12:12 TA2.4

A Smartphone-Based Traffic Information Service Platform for Pedestrian and Bicycle Systems, pp. 685-690

Du, Jun	Tsinghua Univ.
Zheng, Chenyu	Univ. of Colorado
Zeqi, Zhang	Tsinghua Univ.
Zhongqiang, Zhai	Tsinghua Univ.
Yang, Yu	Tsinghua Univ.
Nengqiang, He	Tsinghua Univ.
Sicker, Douglas	Univ. of Colorado
Ren, Yong	Tsinghua Univ.

Currently, the development of urban slow traffic information services is lagging. Numerous issues, such as the lack of

traffic information and deficient information dissemination, restrict the technical and economic development, of such systems. So it is critical and crucial to develop information services for urban pedestrian and bicycle systems. In this paper, a smartphone-based information platform is proposed to provide customized information services ubiquitously for walking and cycling commuters with various characteristics and demands. The platform can provide value-added services like smart tour by cooperating with mobile operators, or promote national information construction and development of related service industries especially for the countries and areas with big populations. Moreover, through taking advantage of portability, the platform is easy to apply to other information services offered by smartphones.

TA3 Dillingham

Detection of Driving Environment 1 (Regular Session)

11:00-11:18 TA3.1

A Generic Map Based Environment Representation for Driver Assistance Systems Applied to Detect Convoy Tracks, pp. 691-696

Weiherer, Tobias — Tech. Univ. München
Bouzouraa, Mohamed Essayed — AUDI AG
Hofmann, Ulrich — AUDI AG

Future Advanced Driver Assistance Systems (ADAS) require generic map based representations to process environment information measured by different sensors. In contrast to today's widespread grid based maps, such environment representations have to be a compact, scalable and easy-to-interpret. In order to fulfill these requirements, we propose a new generic map representation, the two dimensional interval map. One example of information that can be represented in this data structure are convoy tracks. Convoy tracks describe the common motion of vehicles driving in convoys. These tracks can serve as an additional, independent input parameter for longitudinal and lateral control in highly automated ADAS.

Experimental results show the general ability of the new data structure to provide sufficiently precise results at low computation time and memory consumption. The developed methodology to detect convoy tracks is capable of extracting multiple common convoy attributes even in complex scenarios with lane change maneuvers.

11:18-11:36 TA3.2

Simulation Architecture for the Design of Cooperative Collision Warning Systems, pp. 697-703

Gruyer, Dominique — IFSTTAR
Demmel, Sébastien — QUT & IFSTTAR
D'Andrea-Novel, Brigitte — Mines ParisTech
Lambert, Alain — IFSTTAR
Rakotonirainy, Andry — Queensland Univ. of Tech.

Simulation has been widely used to estimate the benefits of Cooperative Systems (CS) based on Inter-Vehicular Communications (IVC). This paper presents a new architecture built with the SiVIC simulator and the RTMaps™ multisensors prototyping platform. We introduce several improvements from a previous similar architecture, regarding IVC modelisation and vehicles' control. It has been tuned with on-road measurements to improve fidelity. We discuss the results of a freeway emergency braking scenario (EEBL) implemented to validate our architecture's capabilities.

11:36-11:54 TA3.3

Robust Traffic Sign Recognition and Tracking for Advanced Driver Assistance Systems, pp. 704-709

Zheng, Zhihui — Beijing Inst. of Tech.
Zhang, Hanxizi — Beijing Insititute of Tech.
Wang, Bo — Beijing Inst. of Tech.
Gao, Zhifeng — Beijing Inst. of Tech.

In this paper we propose a traffic sign recognition system using an on-board single camera for Advanced Driver Assistance Systems (ADAS), including detection, recognition and tracking. We combine RGB ratios based color segmentation with automatic white balance preprocessing and Douglas-Peucker shape detection to establish ROIs. Scale and rotation invariant BRISK features are applied for recognition, matching the features of the candidates to those of template images that exist in database. Tracking-Learning-Detection (TLD) framework is adopted to track the recognized signs in real time to provide enough information for driver assistance function. This paper presents lots of experiments in real driving conditions and the results demonstrate that our system can achieve a high detection and recognition rate, and handle large scale changes, motion blur, perspective distortion and various illumination conditions as well.

11:54-12:12 TA3.4

Interacting Multiple Model Road Curvature Estimation, pp. 710-715

Shen, Truman — Takata Holdings Inc

Accurate road curvature estimation is essential to many drive assistance systems and active safety systems, such as curve speed warning, lane departure warning, and lane keeping assistance. To improve the overall performance of road curvature estimation and path prediction, we proposed an interacting multiple model (structure) approach in curvature filtering, so that the curvature estimates for straight road and pure arc can be more accurate while the transitional curvature change between straight and constant radius curve can still be followed promptly.

12:12-12:30 TA3.5

Probabilistic Estimation of Temporary Lanes at Road Work Zones, pp. 716-721

Graf, Regine — Univ. of Ulm
Wimmer, Andreas — Univ. of Ulm
Dietmayer, Klaus — Univ. of Ulm

Road work zones pose a great challenge for the environmental perception with sensors and the correct modelling of the scenery. Especially the recognition of the valid lane is of great interest for driver assistance systems. At road work zones temporary lanes invalidate the original lanes while the latter are still present on the road. All lines are detected with a greyscale video camera. In this paper we present an approach which generates different hypotheses for the lanes originated from the two different types of lines. A particle filter is applied for smoothing and filtering while a JIPDA algorithm is used for association and with its existence estimation helps to find the most plausible hypothesis of the currently valid lane.

TA4 Fireweed

Vision Sensing and Image Processing 3 (Regular Session)

11:00-11:18 TA4.1

Real-Time Modeling of Dynamic Environments in Traffic Scenarios Using a Stereo-Vision System, pp. 722-727

Vatavu, Andrei — Tech. Univ. of Cluj-Napoca

Nedevschi, Sergiu — Tech. Univ. of Cluj-Napoca

Real-time modeling of dynamic environments is one of the most demanding research problems in the field of driving assistance systems. The representation module may be affected by several factors such as occlusions, unpredictable nature of the traffic participants, wrong associations or noisy measurements. In this paper we propose two different methods for real-time modeling of dynamic environments. Both motion estimation techniques are vision-based and rely on information provided by a Digital Elevation Map. The first approach consists in determining the differences between the previous and current frames. These differences are then used for computing the speeds of the traffic participants. The second motion estimation technique consists in using a fast pairwise alignment of object delimiters that are extracted by radial scanning of the Elevation Map. The final result is a more compact polygonal map with associated static and dynamic features.

11:18-11:36 TA4.2

Unsupervised Video Leap Segmentation for Fast Detection of Salient Segment Transformations in Mobile Sequences, pp. 728-733

Forsthoefel, Dana — Georgia Inst. of Tech.

Wills, D. Scott — Georgia Inst. of Tech.

Wills, Linda M. — Georga Inst. of Tech.

Multiple-frame segmentation, also referred to as video segmentation, is an important step in many video analysis applications for identifying and tracking specific features as they move through a scene. In a mobile, resource-constrained environment such as an intelligent vehicle system, video segmentation can be utilized in preprocessing to reduce image information and increase processing efficiency for high-level scene understanding applications. We introduce video leap segmentation, a highly efficient multiple-frame segmentation approach for use on embedded and mobile platforms where processing speed is critical. The proposed method is demonstrated to successfully track segments across spatial and temporal bounds, generating fast, stable segmentations of images from captured moving-camera video sequences. Video leap segmentation is applied to the task of rough salient segment transformation detection for alerting potential drivers of critical scene changes that may affect steering decisions. Trial results demonstrate that with little added computation, video leap segmentation can be utilized for salient region detection in traffic scenes with high accuracy, correctly detecting 80% of salient segment transformations in trial scenes with less than 5% false positives. Reducing high-level processing to salient areas using the proposed approach has the potential to significantly improve the processing efficiency of scene interpretation applications in intelligent vehicle systems

11:36-11:54 TA4.3

Performance Evaluation of the Improved Hazard Detection System for the Safety of a Handle Type Electric Wheelchair, pp. 734-739

Kim, Jeyeon — Saitama Univ.

Hasegawa, Takaaki — Saitama Univ.

This paper describes the improvement and the performance evaluation of the hazard detection system to ensure the safety of a handle type electric wheelchair. We investigate the warning timing by Time-To-Incident (TTI) in consideration of the cognition, decision, and action time of elderly people and Japan Industrial Standards (JIS) of a handle type electric wheelchair. And then, the size of the target object (hazard object) to be detected and the measurement of the change in slope of road surface are studied. We carry out the performance evaluation of the improved system through the use of four types of the hazard detection rules. The items of the performance evaluation are TTI of the first time warning and the detection success rate of the true positive and the false negative. Furthermore, the evaluation of four types of the hazard detection rules by using the cost function is performed. The results provide the important knowledge for practical application of the hazard detection system.

11:54-12:12 TA4.4

A Novel Technique for Raindrop Detection on a Car Windshield Using Geometric-Photometric Model, pp. 740-745

Sugimoto, Masanori — Univ. of Tokyo

Kakiuchi, Noriaki — Univ. of Tokyo

Ozaki, Noriyuki — DENSO Corp.

Sugawara, Ryoichi — DENSO Corp.

In this paper, we describe a novel technique for detecting raindrops using in-vehicle camera images. The appearance of raindrops on a car windshield can depend on their background, so it is often difficult to detect them using conventional template matching methods, which are based on image features. Initially, we extract potential raindrop regions from images, before generating a rendered background image using a physical raindrop model based on the refraction of light rays. This rendered image is then used to identify true raindrops based on their similarity to the true background image. We propose a new model that approximates a raindrop shape as a spheroid section. This method can represent different raindrop shapes more adaptively and flexibly than conventional models, which approximate raindrops as a section of a sphere. We also extend the Maximally Stable External Regions algorithm to extract candidate raindrops and we identify three measures of image similarity using a Support Vector Machine algorithm. We conducted experiments that confirmed the effectiveness of the proposed technique.

TA5 Iliamna

Simulation and Modeling 4 (Regular Session)

11:00-11:18 TA5.1

Overtaking and Giving Way: Design and Validation of a Lightweight Extended Cellular Automata Urban Traffic Simulator, pp. 746-751

Sanchez-Medina, Javier J. — ULPGC

Medina-Machin, Elisa — ULPGC, CICEI

Diaz-Cabrera, Moises — ULPGC

Galan-Moreno, Manuel — ULPGC, DMAT, CICEI

Rubio-Royo, Enrique — ULPGC, CICEI

In the present article our purpose is to share the design and some initial validation test results we have developed with a new extended cellular automata simulation model. Such new model is equipped to simulate both overtaking and two basic driving behaviour rough patterns: Some virtual drivers

facilitate others drivers' manoeuvres and some do not do so.

We explain the neighbourhood rules used, that incorporate virtual overtaking and giving way actions. It is achieved by means of a novel two passes per iteration approach which implies no resigning using a linear -- and lightweight -- cellular automata to implement overtaking.

Three different sets of experiments were carried out, using three different traffic network spots, as an initial validation study of the proposed new model. Results are encouraging. For the three situations, the simulated traffic seems to keep quite close to the sampled real traffic.

11:18-11:36 TA5.2

Extended Safety Descriptor Measures for Relative Safety Assessment in Mixed Road Traffic, pp. 752-757

Derbel, Oussama	MIPS - UHA
Mourllion, Benjamin	MIPS EA 2332 UHA
Basset, Michel	Univ. of Haute-Alsace

Mixed traffic denotes the coexistence of two driving styles: human and automated driving. Until now, there has been an ambiguity about the driver's safety in mixed traffic. Traffic safety studies focus on a synthesis of control laws which help drivers to avoid or mitigate collisions. Classic safety descriptors use only the time to collision, a time criterion for safety assessment. Other assess traffic safety through vehicle distance gap. In this paper, the Dwell Time descriptor is extended to evaluate safety from both time and distance criteria. The goal is to assess the impact of automated vehicles on driver safety.

11:36-11:54 TA5.3

Traffic Simulation Using Activity Place Related Information Acquisition from the Web, pp. 758-763

Chen, Songhang	Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences

Activity place related information is critical for traffic simulation based on activity. To replace time-consuming manual acquisition, this paper proposes an information extraction method based on ontology and frequent subtree to acquire place-related information from the Web automatically. A destination selection model based on Nested Logit is established to use this information in traffic simulation. To verify the method and model, information of places within Zhongguancun area is acquired from the Web, and then experiments with uniform design are carried out on artificial transportation systems and regression analysis is done.

11:54-12:12 TA5.4

A Cellular Automata Based Evacuation Model on GPU Platform, pp. 764-768

Miao, Qinghai	Graduate Univ. Chinese Acad. of Sciences
Lv, Yisheng	Chinese Acad. of Sciences
Zhu, Fenghua	Chinese Acad. of Sciences

A simulation model of crowd evacuation based on the cellular automata is introduced. The implementation on GPU is focused in details. This model takes advantage of GPU to complete part of computing by certain allocation. Taking Guangzhou Tianhe stadium as an example, the model shows that the performance of computing has been significantly improved by parallel computing technique of GPU, which obtained nearly 15 times speed-up.

12:12-12:30 TA5.5

Car-Following Model with Multiple Predicting and Controlling Modules Based on Assumptions of Anticipation Behavior, pp. 769-775

Kasai, Makoto	Tokyo Univ. of Science

Anticipation of driver actions may be a key factor in car-following behavior. Although many car-following models have been proposed, most of them are regarded as instantaneous feedback controllers. This paper considers taking anticipatory actions into account, as in feed-forward controllers. This paper retrofits this onto a previously proposed model assuming that drivers adjust acceleration to maximize instantaneous utility, adding predicting and controlling modules associated with different target times. The weight of each predicting module is updated depending on the circumstances of the driver over the last few seconds. This paper verifies that the proposed model improves estimation accuracy in terms of the root mean squared error of headway distance by calibration with observed car-following data from probe cars and video images. The goal of this model is future application in exploration of bottleneck phenomena.

TA6 Katmai

Route Planning and Guidance (Regular Session)

11:00-11:18 TA6.1

Online Map-Matching Based on Hidden Markov Model for Real-Time Traffic Sensing Applications, pp. 776-781

Goh, Chong Yang	Nanyang Tech. Univ.
Dauwels, Justin	Nanyang Tech. Univ.
Mitrovic, Nikola	Nanyang Tech. Univ.
Asif, Muhammad Tayyab	Nanyang Tech. Univ.
Oran, Ali	SMART
Jaillet, Patrick	MIT

In many Intelligent Transportation System (ITS) applications that crowd-source data from probe vehicles, a crucial step is to accurately map the GPS trajectories to the road network in real time. This process, known as map-matching, often needs to account for noise and sparseness of the data because (1) highly precise GPS traces are rarely available, and (2) dense trajectories are costly for live transmission and storage. We propose an online map-matching algorithm based on the Hidden Markov Model (HMM) that is robust to noise and sparseness. We focused on two improvements over existing HMM-based algorithms: (1) the use of an optimal localizing strategy, the variable sliding window (VSW) method, that guarantees the online solution quality under uncertain future inputs, and (2) the novel combination of spatial, temporal and topological information using machine learning. We evaluated the accuracy of our algorithm using field test data collected on bus routes covering urban and rural areas. Furthermore, we also investigated the relationships between accuracy and output delays in processing live input streams. In our tests on field test data, VSW outperformed the traditional localizing method in terms of both accuracy and output delay. Our results suggest that it is viable for low-latency applications such as traffic sensing.

11:18-11:36 TA6.2

Dynamic Optimal Routing Based on a Reverse Stackelberg Game Approach, pp. 782-787

Groot, Noortje	Delft Univ. of Tech.
De Schutter, Bart	Delft Univ. of Tech.

Hellendoorn, Hans	Delft Univ. of Tech.

A game-theoretic approach to dynamic routing is proposed in order to maximize the traffic throughput on a freeway network. While existing methods of informing drivers of the approximate travel times for the alternative routes do not in general yield the system optimum, we can achieve a better performance by introducing a leader-follower game with monetary incentives. In particular, a control strategy is proposed in which the traffic authority (the leader) proposes a function that maps the possible travel times for a certain destination to positive or negative monetary incentives. Based on this function that is communicated via on-board computers, the drivers (followers) will rationally choose those travel times associated with an optimal distribution over the available routes. Finally, in return for the associated monetary value, the drivers are presented with a route that they should follow to the desired destination.

11:36-11:54 TA6.3

Realization of ITS Applications through Mapping Technologies: A Survey of Advanced Traveler Information Systems, pp. 788-795

Campbell, Patrick	Univ. of Oklahoma
Havlicek, Joseph	Univ. of Oklahoma
Stevenson, Alan	Oklahoma Department of Transportation:
Barnes, Ronald	Univ. of Oklahoma

ITS applications throughout the United States use a variety of mapping technologies to efficiently relay traffic information to both traffic agents and the general public. This paper describes the findings of a nationwide survey of the mapping approaches taken by traveler information websites. The technologies used within the Oklahoma ITS architecture are also presented within the context of this survey. The mapping technologies discussed include ArcGIS, MapServer, HTML-based techniques, Google Maps, Bing Maps, and OpenLayers. The tradeoffs that would be considered when evaluating the use of mapping technologies in new or existing ITS applications are presented for comparison.

11:54-12:12 TA6.4

Azimuth Angle of GPS Data and Its Application in Map-Matching, pp. 796-801

Li, Lan	Hitachi (China) Res. & Development Corp.
Liu, Bo	Hitachi (China) Res. & Development Corp.
Lai, Yimin	Hitachi Beijing Tech. Information Systems Co., Ltd.
Tang, Xiaochun	Res. Center of Transport and Logistics, Ministry of Transport

Map-matching is to snap a series of GPS (Global Position System) points onto the road segments in the digital map, so as to estimate the actual trajectory of a moving object. It is an elementary process step for many applications, such as traffic flow analysis, fleet management, and driver assistance. In many existing approaches, the distance between GPS point and roads is a main factor for the position determination. From the year of 2011, a new feature called azimuth angle, which shows the instant driving direction of a vehicle, started to be utilized in our map-matching algorithm. So in this paper, we first studied the feasibility of azimuth angle in accuracy enhancement and then proposed a method to utilize it in candidate filtering. The experiment result shows that the proposed method can improve the efficiency as well as the accuracy of map-matching.

12:12-12:30 TA6.5

Automated Transportation Transfer Detection Using GPS Enabled Smartphones, pp. 802-807

Stenneth, Leon	Univ. of Illinois Chicago
Thompson, Kenville	The Graduate Center CUNY
Stone, Waldin	The Graduate Center CUNY
Alowibdi, Jalal	Univ. of Illinois Chicago

Understanding the mobility of a traveller from mobile sensor data is an important area of work in context aware and ubiquitous computing. Given a multimodal GPS trace, we will identify where in the GPS trace the traveller changed transportation modes. For example, where in the GPS trace the traveller alight a bus and boards a train, or where did the client stop running and start walking. Using data mining schemes to understand mobility data, in conjunction with real world observations, we propose an algorithm to identify mobility transfer points automatically. We compared the proposed algorithm against the state of the art that is used in the previously proposed work. Evaluation on real world data collected from GPS enabled mobile phones indicate that the proposed algorithm is accurate, has a good coverage, and a good asymptotic run time complexity.

TA7 King Salmon

Parallel Transportation Management Systems (Special Session)

Organizer: Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Organizer: Rossetti, Rosaldo	Univ. do Porto - LIACC
Organizer: Kong, Qing-Jie	Shanghai Jiao Tong Univ.
Organizer: Li, Lefei	Tsinghua Univ.
Organizer: Miao, Qinghai	Graduate Univ. Chinese Acad. of Sciences

11:00-11:18 TA7.1

Quadtree-Based Domain Decomposition for Parallel Map-Matching on GPS Data (I), pp. 808-813

Xia, Yingjie	Hangzhou Normal Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.
Ye, Zhoumin	Hangzhou Inst. of Service Engineering, Hangzhou NormalUniver
Wu, Wei	Enjoyor Company
Zhu, Mingzhe	Hangzhou Inst. of Service Engineering, Hangzhou NormalUniver

This paper presents a quadtree-based domain decomposition method for matching Global Positioning System (GPS) data onto the digital map in parallel. The method uses two basic tools, quadtree and interval distance measurement. Quadtree is a structure which can facilitate to decompose massive GPS data in a domain into multiple data pieces in the sub-domains. These data pieces with the underlying boundary-extended maps create the computing tasks, which are assigned to Cyberinfrastructure (CI) resources for parallel map-matching. In the task, each GPS point measures the interval distances between itself and the projected points on the road segments surrounding in its sub-domain, and selects the shortest one to determine the mapped point. The experiments show that this method can achieve efficient speedup in computational time by load balancing, and keep high accuracy on the matching results.

11:18-11:36 TA7.2

Comparison of Urban Traffic Prediction Methods between UTN-Based Spatial Model and Time Series Models (I), pp. 814-819

Xu, Yanyan	Shanghai Jiao Tong Univ.
Kong, Qing-Jie	Shanghai Jiao Tong Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.

A spatial short-term traffic flow prediction method based on the macroscopic urban traffic network (UTN) model is described and compared to the traditional time series forecasting methods. In this paper, a general UTN model is developed by adopting the transfer mechanism of vehicles between road links to represent the future distribution of vehicles in the whole network. Based on the model, we predict the short-term traffic flux without using any historical traffic data, which is completely different from previous approaches. Furthermore, to verify the effectivity of the UTN-based prediction model, we compare it to four classic models including two parametric and two nonparametric methods with the data produced by CORSIM, a commonly used microscopic traffic simulation software. Finally, the comparative results illustrate that the proposed method can reach the level of classic methods and predict the short-term traffic flow timely and accurately both for the steady or suddenly changed traffic states.

11:36-11:54 TA7.3

A Dynamic Network Partition Method for Heterogenous Urban Traffic Networks (I), pp. 820-825

Zhou, Zhao	Shanghai Jiao Tong Univ.
Lin, Shu	Shanghai Jiao Tong Univ.
Xi, Yugeng	Shanghai Jiao Tong Univ.

Recently, it has been shown that Macroscopic Fundamental Diagrams(MFDs) existing in large scale urban traffic networks paly an important role in dynamic traffic management, traffic signal control and mitigation of urban traffic congestion. A well defined MFD can be derived from a homogeneous urban traffic network with similar traffic conditions. In reality, however, most large scale traffic networks are usually heterogeneous networks with various road types and uneven distribution of congestion. In order to use the MFD concept for controlling the large scale urban traffic network through hierarchical or decentralized methods, it is necessary to exploit a network partition method, which should be both effective in extracting homogeneous sub-networks and fast to compute. In this paper, a new approach to calculate the correlation degree, which describes the traffic conditions between two adjacent intersections quantitatively, is first proposed. Then, a fast network division approach by optimizing the modularity, which is a criterion to distinguish the quality of the partition results, is applied to identify the homogeneous sub-networks for large scale urban traffic networks. Finally, an application to a specified urban traffic network is investigated using the proposed algorithm. The results show that it is an effective and efficient method for partitioning heterogeneous urban traffic networks automatically.

11:54-12:12 TA7.4

Reaching Low-Density Urban Areas with the Network-Inspired Transportation System, pp. 826-831

Edwards, Derek	Georgia Inst. of Tech.
Elangovan, Arun Kumar	RideCell, LLC
Watkins, Kari E.	Georgia Inst. of Tech.

Traditional transit is often unable to effectively service areas of low ridership and low population density. To alleviate this problem, a method of combining traditional transit with demand-responsive transportation is proposed. This system, known as the network-inspired transportation sytem (NITS), uses demand-responsive transportation to handle the first and last miles of each passenger's trip. The effectiveness of the NITS is tested in simulations run in a fictional gridded street city as well as the city of Atlanta, GA. Simulation results show that the NITS provides a higher quality of service than transit in low density urban areas where traditional transit is not effective.

12:12-12:30 TA7.5

Exact Solutions to Traffic Density Estimation Problems Involving the Lighthill-Whitham-Richards Traffic Flow Model Using Mixed Integer Programming, pp. 832-839

S Canepa, Edward Esteban	King Abdullah Univ. of Science and Tech.
Claudel, Christian	King Abdullah Univ. of Science and Tech.

This article presents a new mixed integer programming formulation of the traffic density estimation problem in highways modeled by the Lighthill Whitham Richards equation. We first present an equivalent formulation of the problem using an Hamilton-Jacobi equation. Then, using a semi-analytic formula, we show that the model constraints resulting from the Hamilton-Jacobi equation result in linear constraints, albeit with unknown integers. We then pose the problem of estimating the density at the initial time given incomplete and inaccurate traffic data as a Mixed Integer Program. We then present a numerical implementation of the method using experimental flow and probe data obtained during Mobile Century experiment.

TA8 Lupine

Eco Driving and Energy Efficiency (Regular Session)

11:00-11:18 TA8.1

Agent-Based Modeling of Eco-Cooperative Adaptive Cruise Control Systems in the Vicinity of Intersections, pp. 840-845

Kamalanathsharma, Raj Kishore	Virginia Tech. Transportation Inst.
Rakha, Hesham A.	Virginia Tech.

Eco-Cooperative Adaptive Cruise Control (ECACC) systems are a type of Cooperative Adaptive Cruise Control (CACC) that compute the most fuel-efficient (or near-fuel efficient) vehicle trajectory using available information regarding roadway characteristics, set-speed, upcoming signal changes and interaction with other vehicles. ECACC leverages information transfer between vehicles and infrastructure to predict future fuel consumption for alternate vehicle trajectories and selects the fuel optimal trajectory for implementation. ECACC is vehicle-dependent and hence can be modeled using adaptive agents. The ECACC algorithm defined in this paper is vehicle-sensitive and is hence emulated using agent-based models. Simulations to measure the effectiveness of the proposed system using a state-of-the-art fuel-consumption model shows reductions in fuel consumption levels of up to 30 percent in proximity of signalized intersections.

11:18-11:36 TA8.2

Fuel Consumption and Emission Models Development and Application for Advanced Traffic Management Strategies, pp. 846-851

Liao, Tsai-Yun National Chiayi Univ.
Ho, Wei-Ming National Cheng Kung Univ.
Hu, Ta-Yin National Cheng Kung Univ.

Due to the development of industry and commerce, the percentage of fuel consumptions and emissions of the transport sector is increasing in recent years. As a result, the levels of CO2 and other emissions have worsened the environment, and thus global-warming and air-pollution issues need to be incorporated within the planning and operation of transportation system. This research proposes two energy consumption and emission models for mixed traffic flows under a wide variety of advanced traffic management strategies. These two models are defined as the link-based and the trip-based fuel consumption and emission model. The link-based model is developed based on link characteristics, including static and dynamic attributes of the link, such as link length, number of vehicles, and average speed on links. The trip-based model calculates fuel consumption and emission based on trip characteristics, such as vehicle movement trajectory. These two models are integrated with a simulation-assignment model, DynaTAIWAN. Numerical experiments are conducted to illustrate the proposed models. Traffic management strategies, including real-time information and advanced traffic control systems, are evaluated based on the performance of fuel consumption and emission. The experiment results show the models are robust and advanced traffic management strategies can indeed reduce fuel consumption and CO2 emission.

11:36-11:54 TA8.3

Development of Deceleration Intention Indicating System of Forward Vehicle: Effect of the System, pp. 852-857

Saito, Yuichi Univ. of Tsukuba, Japan
Hashimoto, Naohisa National Inst. of AIST
Kato, Shin National Inst. of AIST
Tsugawa, Sadayuki Meijo Univ.

This paper proposes a deceleration intention indicating system, which indicates the shift to braking behavior of the leading vehicle before the brake maneuver is actually started. It aims to improve predictions and expectations by arousing attention for a following driver for a potential risk, and to reduce the risk of a rear-end collision by promoting early decelerating maneuvers. The method with Cover Brake pedal was designed in order to estimate deceleration intention with high certainty. Next, we performed the experiment to clarify effect of the system. The experimental results showed that the system was effective in improving accelerator release time (ART) and brake onset time (BOT) of the following driver.

11:54-12:12 TA8.4

Research on Soft-Switching Circuit of Contactless Power Transmission System of Autonomous Underwater Vehicle, pp. 858-862

Wang, Hongjian 409 Department, Automation Coll. Harbin Engineering Univ.
Yu, Le 409 Department, Automation Coll. Harbin, Harbin Engineering U
Li, Juan Automation Coll. Engineering Univ.
Liu, Xiangbo 409 Department, Automation Coll. Harbin, Harbin Engineering U
Tang, Zhaodong 409 Department, Automation Coll. Harbin, Harbin Engineering U

In order to improve autonomous underwater vehicle's activity and expand the scope of its navigation, contactless power transmission technology has been widely spread in recent years. The contactless power transmission system is loosely coupled coupler connection, making the transmission efficiency of the system is greatly reduced. In this paper, we use soft-switching circuit to improve the transmission efficiency of system. By investigating the passive lossless snubber circuit with non-minimum voltage stress, this paper designs a novel passive lossless snubber circuit based on Buck converter. The experiment results show that the designed circuit can reduce the switching losses effectively and return the energy stored in the buffering process to power supply.

12:12-12:30 TA8.5

Electric Load Forecasting: A Multi-Agent Systems Approach, pp. 863-869

Nejat, Ali Texas Tech. Univ.
Mohsenian-Rad, Hamed Univ. of California at Riverside

While electrification of the transportation system will help reduce greenhouse gas emissions and our dependency on imported oil, the growing number of PHEVs can also impose a significant volume of new load on electric grids. In this paper, we develop an agent-based behavioral transportation-model of Plug-in Hybrid Electric Vehicles (PHEVs) for the purpose of electric load forecasting in large urban areas. This model is intended to simulate the temporospatial dynamics of PHEVs' behavior due to the changes in a multitude of internal PHEV-related transportation attributes. The results from simulations highlighted the inverse correlation between PHEVs' charging time and electric load consumption. The proposed model did not attempt to fully explain the very complex behavior of PHEV agents within the transportation infrastructure, but was rather developed to provide a theoretical foundation to investigate any emergent temporospatial outcomes. The developed model is capable of incorporating external attributes such as collisions, and weather conditions for any future research.

TB1 Chart

Driver Behavior and Safety Systems 2 (Regular Session)

14:00-14:18 TB1.1

Detection of Driver Distraction Based on Temporal Relationship between Eye-Gaze and Peripheral Vehicle Behavior, pp. 870-875

Hirayama, Takatsugu Nagoya Univ.
Mase, Kenji Nagoya Univ.
Takeda, Kazuya Nagoya Univ.

One's state of mind is subconsciously exposed as a reaction reflecting it by external stimuli. In this work, we focus on a car driver's cognitive distraction, specifically by analyzing a driver's internal state induced during a music-retrieval task using an automatic speech-recognition system. A visual event that occurs in front of the driver when a peripheral vehicle overtakes the driver's vehicle is regarded as the external stimulus. The analysis result showed that the temporal relationship between the driver's eye gaze and the peripheral vehicle behavior depends on the driver's state. Specifically, we confirmed that the timing of the gaze toward the stimulus under the distracted state is later than under the neutral state without the secondary cognitive task. This temporal feature can contribute to the detection of the cognitive distraction automatically. A detector based on a Bayesian framework using this feature achieves better accuracy than one based on the percentage road center method.

14:18-14:36 TB1.2

An Intelligent Driver Model with Trajectory Planning, pp. 876-881

Zhang, Sumin	Jilin Univ.
Deng, Weiwen	Jilin Univ.
Zhao, Qingrong	General Motors Company
Sun, Hao	Jilin Univ.

This paper tries to present an overall concept and framework on a driver model with the intent to generate realistic traffic flow and motion while reflect the nature of driving characteristics. The proposed driver model is to simulate a driver's driving on the road with proper trajectory planning mechanism that takes into account of the surrounding environment, including lane and road geometry, surrounding obstacles, and traffic infrastructure; and a decision making process that “mentally” assess the situation for potential hazard or threat; “obey” traffic rules, and determine an optimum trajectory to follow safely and comfortably. Some simulation was conducted to demonstrate the concept and framework presented in this paper.

14:36-14:54 TB1.3

Optical Flow Based Head Movement and Gesture Analysis in Automotive Environment, pp. 882-887

Martin, Sujitha	Univ. of California at San Diego
Tran, Cuong	Univ. of California at San Diego
Tawari, Ashish	Univ. of California at San Diego
Kwan, Jade	Univ. of California at San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

Head gesture detection and analysis is a vital part of of looking inside a vehicle when designing intelligent driver assistance systems. In this paper, we introduce an approach termed Optical flow based Head Movement and Gesture Analyzer (OHMeGA) which is user-independent, robust to occlusions from eyewear or large spatial head turns and lighting conditions, simple to implement and set-up, real-time and accurate. The intuitiveness behind OHMeGA is that it segments head gestures into head motion states and no-head motion states. This segmentation allows higher level semantic information such as fixation time and rate of head motion to be readily obtained. Performance evaluation of this approach is conducted under two settings: controlled in laboratory experiment and uncontrolled on-road experiment. Results show an average of 91.5% accuracy for in laboratory experiment and an average of 86.7% accuracy in on-road experiment.

14:54-15:12 TB1.4

Deciding What to Inspect First: Incremental Situation Assessment Based on Information Gain, pp. 888-893

Platho, Matthias	Univ. of Ilmenau
Eggert, Julian	Honda Res. Inst. Europe GmbH

In order to offer even more sophisticated functionality, future driver assistance systems need the ability to robustly recognize and understand driving situations. Especially in inner-city scenarios the high complexity and variability of situations encountered make their assessment a challenging task. We propose to tackle these challenges by decomposing situations into smaller, more manageable parts. We define such a part as a set consisting of a road user and all entities (e.g. cars, traffic lights) currently affecting its behavior. Though the decomposition alleviates the assessment already, for higher numbers of present entities the recognition of interrelated entities is still computationally expensive if performed in a brute-force fashion. Therefore we employ sensitivity analysis on Bayesian Networks for sensibly controlling the recognition process on the basis of information gain. This leads to an active measurement process in which a situation is perceived incrementally, concentrating first on the most meaningful sensor measurements. The proposed method is evaluated on a simulated inner-city scenario where it reliably recognizes the affecting entities of each road user. We show that a recognition process based on information gain can save more than 50% of measurements without significantly impairing the recognition rate.

15:12-15:30 TB1.5

Driver Behavior Classification Model Based on an Intelligent Driving Diagnosis System, pp. 894-899

Quintero M., Christian G.	Univ. del Norte
Oñate López, José	Univ. del Norte
Cuervo Pinilla, Andres C.	Univ. del Norte

This paper considers the problem of characterize the way people drive applied to driver assistance systems and integrated safety systems without using direct driver signals. To make this, is proposed the design of a driver behaviors classifier based on a previous intelligent driving diagnosis system development by us [1]. This, take into account signals that can be acquired by a GPS data logging system: position, velocity, accelerations and steering angle. The proposed classifier presents the structure of an intelligent driver behaviors model based on neural networks and using as inputs statistical transformations of the driving diagnosis time signals: steering profiles, pedals uses, speeding and getting out of the lane and road. The validation of this classifier is developed in two applications: driver identification for security systems and to classify a driver into one of two categories, aggressive and moderate. The proposed approach has been implemented in real environment and its performance tested in simulation runs. Experimental results presented in this paper shows that our intelligent driving diagnosis system is able to classify different kinds of drivers with a high degree of reliability.

TB2 Denali

Connected Vehicle Technology and Applications (Regular Session)

14:00-14:18 TB2.1

On-Ramp Traffic Merging Using Cooperative Intelligent Vehicles: A Slot-Based Approach, pp. 900-906

Marinescu, Dan	Trinity Coll. Dublin
Čurn, Jan	Trinity Coll. Dublin
Bouroche, Mélanie	Trinity Coll. Dublin
Cahill, Vinny	Trinity Coll. Dublin

The merging of main road and on-ramp traffic is known to lead to congestion under heavy traffic conditions. This is mainly due to the underutilization of the road infrastructure and the lack of efficiency in the way the in which the merging manoeuvre is performed by human drivers. We propose a merging algorithm based on our previous work on slot-based driving which employs cooperation between vehicles within the main motorway as well as between motorway and on-ramp vehicles to achieve a highly efficient merging. The results of the evaluation show that our algorithm achieves a very high throughput and low delay on the on-ramp and

clearly outperforms the merging performed by VISSIM's human driver model.

Attachment. The video is showing the VISSIM simulation of on-ramp merging performed by the proposed slot-based algorithm (main video) versus human drivers as emulated by VISSIM (small video appearing after 10 seconds, shown as picture-in-picture on the top right corner). In both cases, a main road flow of 4700 vehicles/hour and on-ramp flow of 2000 vehicles/hour were used. Note that in the human drivers case, a car waiting in the merging queue for more than 30 seconds is dissolved by VISSIM in an attempt to better simulate the overall impact of the merging.

14:18-14:36 TB2.2

Inter-Vehicle Sensor Fusion for Accurate Vehicle Localization Supported by V2V and V2I Communications, pp. 907-914

Conde Bento, Luis Manuel	Inst. de Sistemas e Robotica
Nunes, Urbano	Inst. de Sistemas e Robotica
Parafita, Ricardo Jorge Pedrosa	Inst. de Sistemas e Robótica - Univ. de Coimbra

Cooperative driving system techniques aim to minimize accidents, traffic congestion and consequently the environmental costs of road traffic. An accurate vehicle's pose is of extreme importance for the inner working of the traffic management systems. A agent based traffic simulator was developed integrating typical automotive sensors, vehicle-tovehicle (V2V) and vehicle-to-infrastructure (V2I) communications, vehicle agents and infrastructure agent. In this paper, we propose to further enhance a multi-sensor localization algorithm in environments where V2V and V2I communication is possible. This paper describes a inter-vehicle sensor fusion for an accurate vehicle positioning, where each vehicle is modeled by an agent, and each agent provides information depending on its vehicle sensors. A broad range of sensor were simulated: GNSS, wheel and steering wheel encoders, laser range finder and magnetic markers sensor. In the first fusion stage, data from four wheel encoders and one steering encoder are fused by means of an EKF, providing robust odometric information, namely in face of undesirable effects of wheels slippage. Next, a second fusion stage is processed for integrating odometric and inter-vehicle absolute positioning data. The sensor fusion methodology presented is constrained to an a limited zone on a intersection range.

Attachment. This video shows the simulation of a inter-vehicle sensor fusion algorithm using the ISR-Traffic Simulator (ISR-TFS). A platoon of two vehicles is simulated, to illustrate the algorithm used by the preceding vehicle, to improve its own estimated position. To compute an accurate pose the following vehicle will use its own wheel and steering wheel encoders and detected magnets, in addition to the LIDAR detected preceding vehicle's accurate position, given by the preceding RTK-GPS and preceding detected magnets. The preceding vehicle information is shared with the following vehicle using V2V. Author contact information:L.C. Bento, R. Parafita and U. Nunes are with the ISR-Institute ofSystems and Robotics, University of Coimbra, Portugal.L.C. Bento is also with the Electrical Department, Polytechnic Instituteof Leiria, Portugal. email: conde, parafita, urbano@isr.uc.pt.

14:36-14:54 TB2.3

Urban Vehicle-To-Infrastructure Wireless Communications Range Evaluation, pp. 915-920

Hyncica, Ondrej	Brno Univ. of Tech.
Honzik, Petr	Brno Univ. of Tech.
Kucera, Pavel	Brno Univ. of Tech.
Pavlata, Karel	Brno Univ. of Tech.

We consider the problem of information propagation for traffic management applications of Intelligent Transportation Systems in urban areas. In this paper is described a system for measurement of communication range of vehicular wireless communications, method for processing and interpreting the measured data and the initial results. The measurement system is designed to provide an estimate on radio propagation and coverage in vehicular applications in urban areas and the focus is on evaluation of the communication coverage for IEEE 802.11 and IEEE 802.15.4 standards based wireless communication systems. The data collected with the described test system are made available online at http://project-bay.eu/v2x-dataset.

14:54-15:12 TB2.4

Mobility-Assisted Fast Handover for Proxy Mobile IPv6 in Vehicle-To-Infrastructure Communications, pp. 921-926

Lu, Henghui	Tsinghua Univ.
Zhang, Sheng	Tsinghua Univ.
Lin, Xiaokang	Tsinghua Univ.

Vehicle-to-infrastructure (V2I) communications en- able various applications for transportation, help improve road safety, transportation efficiency and comfort of travel. As vehicles change their point of attachment frequently, seamless handover becomes one of the most challenging research issues for sup- porting these applications. In this paper, we propose a fast handover for Proxy Mobile IPv6 (PMIPv6) to provide seamless mobility of vehicles. The proposed scheme tackles the spatial and temporal prediction issue in Fast Handover for Proxy Mobile IPv6 (FPMIPv6) with the aid of mobility information, pre-stored access point (AP) placement information and received signal strength (RSS). It also uses a pre-established backup binding and a tunnel between previous mobile access gateway (PMAG) and new mobile access gateway (NMAG) to reduce handover latency and packet loss. Analytical and simulation results show that the overall handover latency and packet loss can be significantly reduced in the proposed scheme compared with other related schemes.

TB3 Dillingham

Detection of Driving Environment 2 (Regular Session)

14:00-14:18 TB3.1

Can Priors Be Trusted? Learning to Anticipate Roadworks, pp. 927-932

Mathibela, Bonolo	Univ. of Oxford
Osborne, Michael A.	Oxford Univ.
Posner, Ingmar	Oxford Univ.
Newman, Paul	Univ. of Oxford

This paper addresses the question of how much a previously obtained map of a road environment should be trusted for vehicle localisation during autonomous driving by assessing the probability that roadworks are being traversed. We compare two formulations of a roadwork prior: one based on Gaussian Process (GP) classification and the other on a more conventional Hidden Markov Model (HMM) in order to model correlations between nearby parts of a vehicle trajectory. Importantly, our formulation allows this prior to be updated efficiently and repeatedly to gain an ever more accurate model of the environment over time. In the absence of, or in

addition to, any in-situ observations, information from dedicated web resources can readily be incorporated into the framework. We evaluate our model using real data from an autonomous car and show that although the GP and HMM are roughly commensurate in terms of mapping roadworks, the GP provides a more powerful representation and lower prediction error.

14:18-14:36 TB3.2

Generator of Road Marking Textures and Associated Ground Truth.Applied to the Evaluation of Road Marking Detection, pp. 933-938

Revilloud, Marc	IFSTTAR
Gruyer, Dominique	IFSTTAR
Pollard, Evangeline	Inria-Rocquencourt

To increase driving safety, many researcher works on Advanced Driving Assistance Systems (ADAS) have been developed and embedded in real prototypes during the last decades. For some of these applications like Lane Keeping System (LKS), lane perception is an essential task. For others applications like Emergency Brake Assist (EBA), lane perception modules provide useful information helping the system to select only the most dangerous obstacles. Proposed solutions to perform lane detection become more and more elaborated, however no generic solution has been proposed to calculate performances of these algorithms. Lots of solutions have been proposed to perform this lane detection. However, no generic solution has actually been proposed to quantify the quality of such applications. It is appearing that this evaluation task is now very important and critical. Most of the existing evaluation stages can be classified in two main parts. In the first case, evaluation is based on natural images databases with ground truth of road marking and/or geometrical truth of lanes. In the second case, evaluation uses virtual data and simulated images. The first one is relatively hard to perform because it is based on manual labeling of natural images. The second one has automatic labeling clustering but a realistic virtual environment is required and more precisely both realistic road bitumen and road marking textures. This paper presents an efficient solution in order to simulate roads enviro

14:36-14:54 TB3.3

Automated Lane Identification Using Precise Point Positioning: An Affordable and Accurate GPS Technique, pp. 939-944

Knoop, Victor L.	Delft Univ. of Tech.
Buist, Peter J.	Delft Univ. of Tech.
Tiberius, Christiaan C.J.M.	Delft Univ. of Tech.
van Arem, Bart	Delft Univ. of Tech.

Nowadays, many vehicles are equipped with GPS navigation systems, that are accurate to approximately 10 meters. This is insufficient to determine the lane a vehicle is driving in. We introduce a new technique, Precise Point Positioning, which is able to get the accuracy of measurement down to approximately half a meter, without having to resort to expensive high-end GPS receivers. This accuracy is possible with a single measurement of position in real-time. We confirm this accuracy in a real-life test with a vehicle driving at motorway speeds. However, even when the vehicle position is known, the driving lane is not known since there are generally no maps with detailed lane information. Therefore, this paper also presents a self-learning method, using this Precise Point Positioning information, to create maps which include the position of lanes. This method is tested using an artificially created dataset, using the accuracies from the real-world test. This shows that the method can get the position of a lane at an accuracy of 20 cm. The combination of accurate information of the position of a vehicle and information about the position of the lane, can be used to give lane-specific advice for drivers, and can even be a step towards automated driving.

14:54-15:12 TB3.4

Model Based Vehicle Localization for Urban Traffic Surveillance Using Image Gradient Based Matching, pp. 945-950

Zheng, Yuan	Inst. of Automation, Chinese Acad. of Sciences
Peng, Silong	Inst. of Automation, Chinese Acad. of Sciences

The matching between 3D model projection and 2D image data is a key technique for model based localization, recognition and tracking problems. Firstly, we propose a fitness function to evaluate the matching degree that uses image gradient information in the neighborhood of model projection. The weighting adjustment and the normalization for visible model projection are involved, which improves the correctness and robustness of fitness function. The fitness function is used for vehicle localization and the 3D pose is reduced to location and orientation. Then, we present a direct search optimization method with 3X3 search kernel for location estimation. The ``disturbed particles" is used to avoid falling into local optimum and the coarse-to-fine optimization strategy is adopted to greatly reduce computational cost. Finally, we propose a 3D pose estimator to find location and orientation by optimizing the fitness function within orientation range. Experiments on real traffic surveillance videos reveal that the proposed optimization algorithm is effective and both fitness function and 3D pose estimator are correct and robust against clutter and occlusion.

TB4 Fireweed

Imaging and Image Analysis (Regular Session)

14:00-14:18 TB4.1

Vehicle Detection, Tracking and Classification in Urban Traffic, pp. 951-956

Chen, Zezhi	Kingston Univ.
Ellis, Tim	Kingston Univ.
Velastin, Sergio A	Kingston Univ.

This paper presents a system for vehicle detection, tracking and classification from roadside CCTV. The system counts vehicles and separates them into four categories: car, van, bus and motorcycle (including bicycles). A new background Gaussian Mixture Model (GMM) and shadow removal method have been used to deal with sudden illumination changes and camera vibration. A Kalman filter tracks a vehicle to enable classification by majority voting over several consecutive frames, and a level set method has been used to refine the foreground blob. Extensive experiments with real world data have been undertaken to evaluate system performance. The best performance results from training a SVM (Support Vector Machine) using a combination of a vehicle silhouette and intensity-based pyramid HOG features extracted following background subtraction, classifying foreground blobs with majority voting. The evaluation results from the videos are encouraging: for a detection rate of 96.39%, the false positive rate is only 1.36% and false negative rate 4.97%. Even including challenging weather conditions, classification accuracy is 94.69%.

14:18-14:36 TB4.2

Detection of Scene Obstructions and Persistent View Changes in Transportation Camera Systems, pp. 957-962

Raghavan, Ajay	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Price, Robert	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Liu, Juan	Palo Alto Res. Center Inc. (PARC, A Xerox Company)

Unattended camera devices are increasingly being used in various intelligent transportation systems (ITS) for applications such as surveillance, toll collection, and photo enforcement. In these fielded systems, a variety of factors can cause camera obstructions and persistent view changes that may adversely affect their performance. Examples include camera misalignment, intentional blockage resulting from vandalism, and natural elements causing obstruction, such as foliage growing into the scene and ice forming on the porthole. In addition, other persistent view changes resulting from new scene elements of interest being captured, such as stalled cars, suspicious packages, etc. might warrant alarms. Since these systems are often unattended, it is often important to automatically detect such incidents early. In this paper, we describe innovative algorithms to address these problems. A novel approach that uses the image edge map to detect near-field obstructions without a reference image of the unobstructed scene is presented. A second algorithm that can be used to detect more generic obstructions and persistent view changes using a learned scene element cluster map is then discussed. Lastly, an approach to detect and distinguish persistent view changes from changes in the orientation of the fixed camera system is explained. Together, these algorithms can be useful in a variety of camera-based ITS.

14:36-14:54 TB4.3

Reference Image-Independent Fault Detection in Transportation Camera Systems for Nighttime Scenes, pp. 963-968

Raghavan, Ajay	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Liu, Juan	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Saha, Bhaskar	Palo Alto Res. Center Inc. (PARC, A Xerox Company)
Price, Robert	Palo Alto Res. Center Inc. (PARC, A Xerox Company)

Automated, unattended camera systems used for various transportation applications such as toll collection and photo enforcement need to capture high quality images in a variety of outdoor scenarios. In particular, they need to remain functional in low ambient illumination conditions (nighttime and cloudy day situations) to enable identification of objects or persons involved in incidents being monitored or extracting relevant information. Over time, for installed camera systems in the field, several problems can develop, such as external flash unit failures, focus drifts, and exposure issues. Thus, it is important to periodically monitor the nighttime images/videos taken by the camera system to ensure nominal functionality. However, due to constantly changing scene elements, it is not practical to compare a historical reference image with an identical scene against current camera output to detect problems. To address this, we present image quality metrics that can be extracted without a nominal reference image and can be used to characterize these problems. These can be incorporated into algorithms that can enable automated camera diagnostics for intelligent transportation systems.

14:54-15:12 TB4.4

Subsign Detection with Region-Growing from Contrasted Seeds, pp. 969-974

Puthon, Anne-Sophie	Ec. des Mines de Paris
Moutarde, Fabien	Mines ParisTech
Nashashibi, Fawzi	INRIA

Speed limit determination systems for cars based on vision are more and more developed. Roadsign detection is nowadays a well managed problem. However, in some situations this information is not sufficient to know the speed limitation. Restrictions are sometimes applicable and specified by subsigns. These small rectangles often provide essential information about the applicability scope (vehicle type, condition, lane, etc.) of speed limits. We present an approach of subsign localization based on region growing with an initial step of seed selection using morphological reconstruction. A comparison is also performed with three other techniques based on edge, color and graph on four databases gathering French and German subsigns. The obtained subsign correct detection is above 65%.

15:12-15:30 TB4.5

A System for Real-Time Detection and Tracking of Vehicles from a Single Car-Mounted Camera, pp. 975-982

Caraffi, Claudio	Toyota Motor Europe
Vojir, Tomas	Czech Tech. Univ. in Prague
Trefný, Jiří	Czech Tech. Univ. in Prague
Sochman, Jan	Center for Machine Perception, Faculty of Elec. Eng., CzechTechn
Matas, George	Czech Tech. Univ.

A novel system for detection and tracking of vehicles from a single car-mounted camera is presented. The core of the system is high-performance vision algorithms: the WaldBoost detector and the TLD tracker that are scheduled so that a real-time performance is achieved.

The vehicle monitoring system is evaluated on a new dataset collected on Italian motorways which is provided with approximate ground truth GT' obtained from laser scans. For a wide range of distances, the recall and precision of detection for cars are excellent. Statistics for trucks are also reported. The dataset with the ground truth is made public.

Attachment. Persistent vehicle detection and tracking from a single camera in motorway scenario,in different traffic and varying lighting condition.Results are compared with a "Ground Truth" automatically generated from laserscanner data.See Readme file for full explanation.

TB5 Iliamna

Simulation and Modeling 6 (Regular Session)

14:00-14:18 TB5.1

Unsupervised Learning Based Performance Analysis of N-Support Vector Regression for Speed Prediction of a Large Road Network, pp. 983-988

Asif, Muhammad Tayyab	Nanyang Tech. Univ.
Dauwels, Justin	Nanyang Tech. Univ.
Goh, Chong Yang	Nanyang Tech. Univ.
Oran, Ali	SMART
Fathi Loshani, Esmail	Nanyang Tech. Univ.

Xu, Muye — Nanyang Tech. Univ.
Menoth, Dhanya — Nanyang Tech. Univ.
Mitrovic, Nikola — Nanyang Tech. Univ.
Jaillet, Patrick — MIT

Abstract—Many intelligent transportation systems (ITS) applications require accurate prediction of traffic parameters. Previous studies have shown that data driven machine learning methods like support vector regression (SVR) can effectively and accurately perform this task. However, these studies focus on highways, or a few road segments. We propose a robust and scalable method using n-SVR to tackle the problem of speed prediction of a large heterogeneous road network. The traditional performance measures such as mean absolute percentage error (MAPE) and root mean square error (RMSE) provide little insight into spatial and temporal characteristics of prediction methods for a large network. This inadequacy can be a serious hurdle in effective implementation of prediction models for route guidance, congestion avoidance, dynamic traffic assignment and other ITS applications. We propose unsupervised learning techniques by employing k-means clustering, principal component analysis (PCA), and self organizing maps (SOM) to overcome this insufficiency. We establish the effectiveness of the developed methods by evaluation of spatial and temporal characteristics of prediction performance of the proposed variable window n-SVR method.

14:18-14:36 — TB5.2

A System for Storing and Retrieving Huge Amount of Trajectory Data, Allowing Spatio-Temporal Dynamic Queries, pp. 989-994

d'Acierno, Antonio — ISA - CNR
Leone, Marco — Univ. of Salerno
Saggese, Alessia — Univ. of Salerno
Vento, Mario — Univ. of Salerno

In the framework of intelligent traffic surveillance, we propose a system for efficiently storing and retrieving moving objects' trajectories extracted from surveillance cameras. We index spatio-temporal data by using a method based on off-the-shelf (widely available) bi-dimensional indexes and enhanced by a segmentation stage. The proposed system does not restrict the choice of the parameters of range queries at query time, unlike clustering and similarity-based methods do. The experimental results, obtained on a standard PC-based system both on a well known real-world trajectory dataset and on synthetic data, confirm the efficiency of the proposed approach.

14:36-14:54 — TB5.3

Multi-Objective Traffic Light Control System Based on Bayesian Probability Interpretation, pp. 995-1000

Khamis, Mohamed A. — Egypt-Japan Univ. of Science and Tech. (E-JUST)
Gomaa, Walid — Egypt-Japan Univ. of Science and Tech. (E-JUST)
El-Shishiny, Hisham — IBM Center for Advanced Studies in Cairo

Abstract—Traffic light control is a challenging problem in modern societies. This is due to the huge number of vehicles and the high dynamics of the traffic system. Poor traffic management causes a high rate of accidents, time losses, and negative impact on the economy as well as the environment. In this paper, we develop a multiagent traffic light control system based on a multi-objective sequential decision making framework. In order to respond effectively to the changing environment and the non-stationarity of the road network, the proposed traffic light controller is based on the Bayesian interpretation of probability. We use the open source Green Light District (GLD) vehicle traffic simulator as a testbed framework. The change in road conditions is modeled by varying the vehicles generation probability distributions and adapting the Intelligent Driver Model (IDM) parameters to the adverse weather conditions. We have added a set of new performance indices in GLD based on collaborative learning to better evaluate the performance of the proposed multi-objective traffic light controller. The results show that the proposed multi-objective controller outperforms the single-objective controller. Index Terms—Multi-objective traffic light controller, Multiagent reinforcement learning system, Intelligent Driver Model, Bayesian probability interpretation, Adverse weather conditions

14:54-15:12 — TB5.4

Assessing Traffic Performance Using Position Density of Sparse FCD, pp. 1001-1005

Graser, Anita — Austrian Inst. of Tech.
Ponweiser, Wolfgang — Austrian Inst. of Tech.
Dragaschnig, Melitta — Austrian Inst. of Tech.
Brändle, Norbert — Austrian Inst. of Tech.
Widhalm, Peter — Austrian Inst. of Tech.

We present an approach for evaluating traffic performance along corridors and its variation based on floating car data (FCD). In contrast to existing work, our approach can cope with long and irregular FCD reporting intervals. Resampling of sparse FCD in time and interpolation increases spatial resolution of FCD positions along the corridors. FCD position density is computed with a uniform kernel, which leads to traffic performance expressed as average travel time per meter and average speed. Experimental results based on real-world FCD for a freeway section and arterial roads in Vienna illustrate the plausibility of the approach, and an example illustrating our approach before and after a traffic influencing measure shows its advantage over using dedicated probe vehicle runs, temporary sensor installations or human observers. A sensitivity analysis provides guidelines for the important parameters.

TB6 — Katmai

Route Guidance and Demand Analysis Using Taxi Data (Regular Session)

14:00-14:18 — TB6.1

Congestion-Aware Traffic Routing System Using Sensor Data, pp. 1006-1013

Aslam, Javed — Northeastern Univ.
Lim, Sejoon — MIT
Rus, Daniela — MIT

In this paper, we present a congestion-aware route planning system. First we learn the congestion model based on real data from a fleet of taxis and loop detectors. Using the learned street-level congestion model, we develop a congestion-aware traffic planning system that operates in one of two modes: (1) to achieve the social optimum with respect to travel time over all the drivers in the system or (2) to optimize individual travel times. We evaluate the performance of this system using 10,000+ taxis trips and show that on average our approach improves the total travel time by 15%.

14:18-14:36 TB6.2

A Predictive Model for the Passenger Demand on a Taxi Network, pp. 1014-1019

Moreira-Matias, Luís	LIAAD - INESC TEC
Gama, João	Faculdade de Ec. Univ. do Porto
Ferreira, Michel	Inst. de Telecomunicações
Damas, Luis	Geolink

In the last decade, the real-time vehicle location systems attracted everyone attention for the new kind of rich spatio-temporal information. The fast processing of this large amount of information is a growing and explosive challenge. Taxi companies are already exploring such information in efficient taxi dispatching and time-saving route finding. In this paper, we propose a novel methodology to produce online short term predictions on the passenger demand spatial distribution over 63 taxi stands in the city of Porto, Portugal. We did so using time series forecasting techniques to the processed events constantly communicated for 441 taxi vehicles. Our tests - using 4 months of real data - demonstrated that this model is a true major contribution to the driver mobility intelligence: 76% of the 86411 demanded taxi services were accurately forecasted in a 30 minutes time horizon.

14:36-14:54 TB6.3

Exploring the Relationship between Mobile Phone Call Intensity and Taxi Volume in Urban Area, pp. 1020-1025

Veloso, Marco	Univ. of Coimbra
Phithakkitnukoon, Santi	Culture Lab. School of Computing Science, NewcastleUniversity
Bento, Carlos	Univ. of Coimbra

As urbanization increases rapidly, there is a need for better understanding of the city and how it functions. Increasing digital data produced by the city's inhabitants holds great potential for doing so. In this work, an analysis of mobile phone call intensity and taxi volume in Lisbon, Portugal was carried out. With one source of data describes how city operates socially over mobile phone network and the other characterizes urban dynamic in traffic network, we discovered the inter-predictability between them. Based on one month of observation, we found that the variation in the amount of mobile phone calls was strongly correlated with the taxi volume of the previous two hours. Hence taxi volume can be used to predict mobile phone call intensity of the next two hours. In addition, we found that the level of inter-predictability varied across different time of the day; taxi was a predictor during PM hours while mobile phone call intensity became a predictor for taxi volume in AM hours. Strong correlations between these two urban signals were observed during active hours of the day and active days of the week.

14:54-15:12 TB6.4

Framework of Experienced Route Planning Based on Taxis' GPS Data, pp. 1026-1031

Zhuang, Lijian	Res. Center of ITS,Sun Yat-sen Univ.
Gong, Junfeng	Res. Center of ITS,Sun Yat-sen Univ.
He, Zhaocheng	Res. Center of ITS,Sun Yat-sen Univ.
Xu, Feifei	Res. Center of ITS,Sun Yat-sen Univ.

Route planning is a core part of the traffic information system. Conventional route planning models rely heavily on an improved weighted shortest path algorithm, while this paper proposes a route planning methodology based on taxis' experienced travels. Taking advantage of the data from floating cars, the framework explores drivers' experience in route choices, extracts taxis' operating behaviors to establish the database of experienced routes, and repairs incomplete and abnormal routes to update the database. Given the starting and ending segments, alternative experienced route choice set can be obtained by traversing the database. Taking the road network and taxis' GPS data of Guangzhou city for instance, we make comparisons of the shortest paths and experienced ones, and focus on their differences in factors like length, turning frequency, frequency of signalized intersections, travel time, etc. Various numerical results are documented to show that experienced routes appear better considering all the factors than shortest-distance or shortest-time routes.

TB7 King Salmon

Lane Level Traffic Management (Regular Session)

14:00-14:18 TB7.1

Dynamic Lane Separation to Prevent Blocking Back - a Comparison of Two Dynamic Lane Separation Controllers, pp. 1032-1037

Soekroella, Aroen	TU Delft
Hegyi, Andreas	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.
van Kooten, Jaap	Arane

Blocking back is one of the major causes of degradation of freeway network performance. When at a freeway diverge one of the outgoing links is jammed, the traffic heading to the other outgoing link will often also be delayed due to the back-propagation of the jam tail into the common area upstream of the diverge. Most approaches consider this as a secondary effect of the real bottleneck on the congested link, and use this as a motivation to try to resolve the bottleneck. While this is a valid approach, in some cases this is not possible, and the traffic heading to the non-congested outgoing link will suffer from a bottleneck that is not even on their route. Here we solve the blocking back problem by separating the traffic toward the two outgoing links by dynamic lane allocation. We analyze the jam propagation and traffic state evolution for the cases with and without dynamic lane separation. Next we develop two control approaches, one based on the queue tail location and the other based on the shock wave theoretic considerations. The two controllers are evaluated by microscopic simulations for their resulting performance in terms of total travel time. The simulation results indicate that the queue tail location based controller is superior to the shock wave theory based controller.

14:18-14:36 TB7.2

Simulation-Based Benefit Evaluation of Dynamic Lane Grouping Strategies at Isolated Intersections, pp. 1038-1043

Wu, Guoyuan	Univ. of California-Riverside
Boriboonsomsin, Kanok	Univ. of California-Riverside
Zhang, Liping	Univ. of California, Berkeley
Barth, Matthew	Univ. of California-Riverside

Unlike conventional traffic signal control strategies, which assume that an intersection's geometric configuration is given as an exogenous input, dynamic lane grouping (DLG) strategies aim to further improve roadway capacity utilization under significant traffic demand variation. This is accomplished by dynamically adjusting the turning movement assignments for each lane. Previous numerical analyses have demonstrated that such a DLG strategy is effective in balancing lane flow ratios and reducing intersection delays.

This paper presents an evaluation of a DLG strategy's benefits at an isolated intersection using microscopic traffic simulation. It is demonstrated that such a DLG strategy can provide significant mobility and sustainability benefits over conventional strategies.

14:36-14:54 TB7.3

A Genetic Fuzzy System for Modeling Mandatory Lane Changing, pp. 1044-1048

Hou, Yi	Univ. of Missouri-Columbia
Edara, Praveen	Univ. of Missouri-Columbia
Sun, Carlos	Univ. of Missouri-Columbia

A Fuzzy Logic-based lane changing model was developed for mandatory lane changes at lane drops. Genetic Algorithm was used for optimizing the widths of membership functions. The Next Generation Simulation (NGSIM) dataset of vehicle trajectories was used for model development and validation. The model performed better than a comparable binary Logit model in terms of predicting the merge and non-merge events. The model has applications in traffic simulation and driver assistance systems.

14:54-15:12 TB7.4

Using a Centralized Controller to Optimize the Traffic of Intelligent Vehicles in a Single Lane Highway Provided with a Suicide Lane, pp. 1049-1054

Reghelin, Ricardo	Univ. Tecnológica Federal do Paraná
Arruda, Lúcia Valéria Ramos	Univ. Tecnológica Federal do Paraná (UTFPR)

This paper presents a mathematical solution to optimize the microscopic centralized traffic management of intelligent vehicles in a single lane highway provided with a suicide lane. Therefore an optimization model that uses the travel time as criteria is proposed. The model considers important elements of a highway system such as capacity of acceleration of each vehicle, traffic rules and topography of the lane. It deals with traffic situations such as overtaking, slopes, obstacles, and speed reducers. As the model takes time to run, a simulation algorithm is also proposed. The results of the algorithm provide also references to solve the problem of overtaking priority. Moreover, new indexes for microscopic traffic assessment are proposed. Experimental results are presented to evaluate both the model and the algorithm.

TB8 Lupine

Electric and Hybrid Vehicles (Regular Session)

14:00-14:18 TB8.1

System Architecture and Mathematical Model of Public Transportation System Utilizing Wireless Charging Electric Vehicles, pp. 1055-1060

Jang, Young Jae	Korea Advanced Inst. of Science and Tech.
Ko, Young Dae	Korea Advanced Inst. of Science and Tech.

In this paper the recent progress of the wireless charging electric transportation system developed at Korea Advanced Institute of Technology (KAIST) called On-Line Electric Vehicle (OLEV) is introduced. The system architecture and mathematical model describing the cost issue of the OLEV based public transportation system are presented. The OLEV is the vehicle and road integrated transportation system. The vehicle operates with an electric motor and battery. However, unlike conventional electric vehicles, the battery in the OLEV is charged remotely from the power transmitters installed in the road. The innovative wireless power transfer mechanism equipped in the OLEV system enables the vehicle to be charged while it is moving. Therefore, the long re-charging vehicle down time, which is the major problem of the conventional electric vehicle, is eliminated. The first commercial version of OLEV was deployed at the Seoul Grand Park. Moreover, activities to apply the OLEV technology to the public mass transportation system are being progressed. In this paper, we conceptually illustrate the design architecture of the wireless power transportation system. Also we discuss the economical design issue for applying the OLEV to the mass transportation system. In particular, with the mathematical model, we explain the cost trade off between the battery size and the power transmission allocation in the road for the OLEV based transportation system.

14:18-14:36 TB8.2

Analysis of Impact Factors for Plug-In Hybrid Electric Vehicles Energy Management, pp. 1061-1066

Khayyer, Pardis	The Ohio State Univ.
Wollaeger, James	The Ohio State Univ.
Onori, Simona	The Ohio State Univ.
Marano, Vincenzo	The Ohio State Univ.
Ozguner, Umit	The Ohio State Univ.
Rizzoni, Giorgio	The Ohio State Univ.

Energy management strategies play a critical role in the fuel consumption of hybrid and Plug-in Hybrid Electric Vehicles (PHEV). Most advanced energy management techniques may be further optimized by help of information obtained from Intelligent Transportation Systems (ITS). Following the previously studied impact factors on PHEV energy consumption, in this paper new impact factors are studied. Energy consumption associated with these factors is investigated for subsequent development of energy management strategies in optimizing fuel economy.

14:36-14:54 TB8.3

Research on Shift Schedule of Hybrid Bus Based on Dynamic Programming Algorithm, pp. 1067-1071

Yu, Huilong	Beijing Insitute of Tech.
Xi, Junqiang	Beijing Insitute of Tech.
Chen, Yongdan	Beijing Insitute of Tech..

In this paper, shift schedule of a hybrid bus equipped with Automated Mechanical Transmission (AMT) is researched. Although the one-parameter or two-parameter shift schedule is usually used for hybrid buses, this approach cannot make full use of the advantage of hybrid driving. A new shift schedule, which is based on Dynamic Programming algorithm, is proposed for hybrid buses, a solving algorithm is also presented. The best shifting points for the hybrid buses are obtained via the proposed shift schedule when they work in the typical urban driving-cycle conditions in China. After comparing with the traditional two-parameter shift schedule and the best fuel economy shift schedule, the best shifting points are proved to significantly improve the fuel economy of the hybrid buses and the frequent shifting situation is obviously reduced.

14:54-15:12 TB8.4

Deviations in Markov Chain Modeled Electric Vehicle Charging Patterns from Real World Data, pp. 1072-1077

Hill, Graeme NEWCASTLE Univ.
Blythe, Phil NEWCASTLE Univ.

Within this paper a Markov chain is used to simulate the charging and driving behavior of a cohort of electric vehicles. The probability transition matrix is constructed by analyzing the real world data from an ongoing Electric Vehicle (EV) trial, Switch EV. The vehicles are split into a combination of drive, park and charge states as well as low, mid and high state of charge. The Markov chain is formed from the probability of transitioning between each state for a specified time period. The Markov chain produced results from both work and home based charging regimes that correlate well with the real world results with modeled results showing the features present in real world data. From comparisons of fresh sample runs to the ideal modeled charging distribution it can be seen that the Markov chain has little systematic difference between the ideal distribution and the newly generated distribution within a short period of time. The Markov chain was used to investigate the effect on the charging pattern from a large perturbation of the vehicle state population. It is found that despite initial fluctuations to the charging pattern, which qualitatively correspond with expectations, the population distribution settles down into the typical pattern within 1-2 days.

15:12-15:30 TB8.5

Map-Based Driving Profile Simulation for Energy Consumption Estimation of Electric Vehicles, pp. 1078-1084

Adam, Christian Chemnitz Univ. of Tech.
Wanielik, Gerd Chemnitz Univ. of Tech.

Estimating the energy consumption of electric vehicles accurately along a given route is an important prerequisite for increasing their acceptance. In this paper, an algorithmic framework for interpolating a track described by a set of waypoints using sub-splines is presented. Furthermore, the velocity and acceleration a driver would choose is simulated along the course. The results are evaluated by comparing them to real consumption measurements of an electric vehicle during a test drive.

TC1 Chart

Driver Assistance Systems - Speed Control (Regular Session)

16:00-16:18 TC1.1

Speeding Prediction with a Mathematical Model and Its Validation, pp. 1085-1090

Zhao, Guozhen Inst. of Psychology, Chinese Acad. of Sciences
Wu, Changxu Inst. of Psychology, Chinese Acad. of Sciences

Speeding is one of the most prevalent contributing factors in traffic crashes. The prediction of speeding is important for reducing excessive speeds and preventing speeding-related traffic accidents and injuries. Speeding (either intentional or unintentional) is a consequence of inappropriate speed control. This work extends a previous mathematical model of driver speed control to provide quantitative predictions of intentional and unintentional speeding. These predictions consist of the time at which the driver exceeds the speed limit and the magnitude of speeding. Based on these modeling predictions, this work develops an intelligent speeding prediction system (ISPS) to prevent the occurrence of speeding. An experimental study using a driving simulator is conducted to evaluate ISPS. We find no significant difference between modeled predictions and experimental results in terms of the time and magnitude of intentional speeding. Also, ISPS can successfully predict the majority of unintentional speeding instances, with only a small portion of unnecessary speeding warnings (false alarms). Applications of the ISPS to reducing driving speed, and preventing the real-time occurrence of speeding and speeding-related traffic accidents are discussed.

16:18-16:36 TC1.2

A Context Aware Intelligent Speed Adaptation System: A Field Operational Test, pp. 1091-1096

Hoogendoorn, Raymond G. Delft Univ. of Tech.
Breukink, Johan Delft Univ. of Tech.
van Arem, Bart Delft Univ. of Tech.

Speed is one of the main contributors to the occurrence and to the impact of road accidents. Intelligent Transport Systems can play a significant role in the improve- ment of traffic safety as well as the reduction of greenhouse gas emissions. Combining Intelligent Speed Assistance with limitation of the number of engine revolutions was expected to have positive effects. It was however unclear to what extent such a Context Aware Intelligent Speed Adaptation system influences acceleration and speed in relation with the prevailing maximum speed limit, fuel consumption as well as to what extent users accept the system. Furthermore, it was not clear what the subjective estimate of the impact of this system on driving behavior and safety is. Therefore, an extensive Field Operational Test in the Dutch city of Leiden and neighboring cities was performed with a repeated measures design. Eighteen taxies participated in this FOT, consisting of a control condition (no device) and two experimental conditions. We show that the system has a substantial influence on acceleration and speeding behavior. However some unanticipated results with regard to fuel consumption were established. Furthermore, acceptance of the system is generally low. A substantial influence on the subjective estimates of the impact of the system on driving behavior and safety was found. Finally in this contribution a discussion section and recommendations for future research are provided.

16:36-16:54 TC1.3

Game Theory Algorithm for Intersection-Based Cooperative Adaptive Cruise Control (CACC) Systems, pp. 1097-1102

Zohdy, Ismail Virginia Tech.
Rakha, Hesham A. Virginia Tech.

The paper develops a heuristic optimization algorithm for automated vehicles (equipped with cooperative adaptive cruise control CACC systems) at uncontrolled intersections using a game theory framework. The proposed system models the automated vehicles as reactive agents interacting and collaborating with the intersection controller (manager agent) to minimize the total delay. The system is evaluated using a case study considering two different intersection control scenarios: a four-way stop control and the proposed intersection controller framework. In both scenarios, four automated vehicles (a single vehicle per approach) was simulated using a Monte Carlo simulation that was repeated 1000 times. The results show that the proposed system reduces the total delay relative to a traditional stop control by 35 seconds on average, which corresponds to an approximately 70 percent reduction in the total delay.

16:54-17:12 TC1.4

A New Braking and Warning Scoring System for Vehicle Forward Collision Imminent Braking Systems, pp. 1103-1108

Chien, Stanley	Indiana Univ. Univ. Indianapolis
Li, Lingxi	Indiana Univ. Univ. Indianapolis
Chen, Yaobin	Purdue School of Engineering and Tech. IUPUI

Vehicle forward collision imminent braking (CIB) systems have been equipped in high-end passenger vehicles by many auto manufactures. Due to the complex nature of the CIB technology, the features and performance of various CIB systems differ significantly. As to date, there are no standards to evaluate and compare different CIB systems. This paper describes a systematic methodology for the evaluation of CIB systems which include both braking and warning. The percentage kinetic energy reduction is used as a common unit to allow the evaluation of the performance of both CIB braking and CIB warning. The information collected from some ongoing vehicle active safety testing projects will be used to validate the proposed methodology.

17:12-17:30 TC1.5

Intersection Management for Autonomous Vehicles Using Icacc, pp. 1109-1114

Zohdy, Ismail	Virginia Tech.
Kamalanathsharma, Raj Kishore	Virginia Tech. Transportation Inst.
Rakha, Hesham A.	Virginia Tech.

Recently several artificial intelligence labs have suggested the use of fully equipped vehicles with the capability of sensing the surrounding environment to enhance roadway safety. As a result, it is anticipated in the future that many vehicles will be autonomous and thus there is a need to optimize the movement of these vehicles. This paper presents a new tool for optimizing the movements of autonomous vehicles through intersections: iCACC. The main concept of the proposed tool is to control vehicle trajectories using Cooperative Adaptive Cruise Control (CACC) systems to avoid collisions and minimize intersection delay. Simulations were executed to compare conventional signal control with iCACC considering two measures of effectiveness - delay and fuel consumption. Savings in delay and fuel consumption in the range of 91 and 82 percent relative to conventional signal control were demonstrated, respectively.

TC2 Denali

Safety Analysis and Technologies (Regular Session)

16:00-16:18 TC2.1

Speed Reduction Impact of Dynamic Speed Feedback Signs on High Crash Curves, pp. 1115-1120

Hallmark, Shauna	Iowa State Univ.
Hawkins, Neal	Iowa State Univ.
Smadi, Omar	Iowa State Univ.

Lane departure crashes are a significant safety concern and a disproportionate number occur on horizontal curves. A large number of run-off-road fatal crashes on curves are speed related. Dynamic Speed Feedback Sign systems are one method to reduce vehicle speeds, and consequently crashes, on curves. These systems show promise but they have not been fully evaluated. CTRE conducted a national demonstration project to evaluate the effectiveness of 2 different DSFS signs in reducing speed on curves at 22 total sites in 7 on rural 2-lane roadways.

This paper compares vehicle speeds before and at 12-months after DSFS installation. Overall the signs were effective in reducing mean and 85th percentile speeds. The evaluation also showed that the signs produced a significant reduction in the percent of vehicles traveling over the posted or advisory speed.

The utility of this particular ITS application is that these systems specifically target drivers who are speeding rather than all drivers. In this way, the system “interacts” with an individual driver and may lead to better compliance since the message appears more personalized.

16:18-16:36 TC2.2

Computation of Driver Safety Rating Using In-Vehicle Data Recorders: Case Study of Bangkok Public Transportation, pp. 1121-1126

Saiprasert, Chalermpol	National Electronics and Computer Tech. Center
Pattara-atikom, Wasan	National Electronics and Computer Tech. Center

This paper proposes a novel algorithm for the computation of Driver Safety Rating. The Driver Safety Rating is evaluated by detecting dangerous driving patterns based on vehicles data collected via in-vehicle data recorder. Dangerous driving patterns include rapid acceleration, harsh braking and driving over the speed limit and four triggering events are used in the proposed algorithm. A case study using real world data from public mini vans operating throughout Bangkok is deployed in this work. In addition to the proposed algorithm, a fine tuning technique to adjust the calculation process is introduced. An online survey is used to collect passengers feedback in the form of a score to reflect how they actually feel about the safety aspect of the journey. The proposed algorithm is then finely tuned in order to optimise for the scores derived from passengers feedback. Experimental results reveal that only two of the four triggering events have a significant impact on the overall computation of the Driver Safety Rating for this given set of data.

16:36-16:54 TC2.3

GIS-Based Road Safety Evaluation Model for Cyclist in Campus of Higher Education Mega Center, pp. 1127-1131

Hu, Jihua	Sun Yat-sen Univ.
Zhong, Guangpeng	Sun Yat-sen Univ.
Cheng, Zhifeng	Sun Yat-sen Univ.
Wang, Dalei	Beijing Jiaotong Univ.

In China, many cities construct Higher Education Mega Centers (HEMC) in large-scale, but HEMC's construction is finished in a short period, many problems have no time to discuss and be left unsolved, especially in road traffic. For example, in these years, there are many road accidental injuries to the students in HEMC; most of them are cyclists, for bicycle is the main traffic vehicle of campus students. This paper summarizes four main factors that influence the cyclist safety in campus: slope gradient, road curvature, the distance approaches to the intersections and other special factors (like rainy day) that contribute to the road risk. By using of S-type function in Fuzzy Mathematics, the forward three main risk factors are quantified and normalized, and a comprehensive safety evaluation model for cyclist is established. The east campus of Sun Yat-sen University in GZ HEMC has been used as an application of the road risk distribution model. With the help of GIS software, all risk values of points in road are interpolated through sample points by DTM function, and the risk DTM is overlaid on the remote sensing image of the same

area. Finally a risk distribution map along road for cyclists of campus in sunny days is created, so does in rainy days. Through field based interviews, we can prove that risk distribution map is in accord with realistic bicycle crash locations, it can serve as a basis reference for improving cyclist safety in campus of HEMC, as well as a safety inf

16:54-17:12 TC2.4

Rail Extraction Technique Using Gradient Information and a Priori Shape Model, pp. 1132-1136

Corsino Espino, Jorge	Mines Paris-Tech.
Stanciulescu, Bogdan	Ec. des Mines de Paris (ParisTech)

This paper presents a comparative study of different rail detection techniques as well as a new method based on an efficient algorithm without any empirical thresholds. The main problem with rail detection is that both the track-bed and the exterior conditions (weather/light conditions) vary along the path. On the other hand, there are properties that can be exploited to improve the conventional lane detection. We present an edge detection based on the estimated position of the rails that follows the rail edges upwards in the image, determining a free-from-obstacles space. The existing techniques are also analyzed and compared.

17:12-17:30 TC2.5

Investigating Pedal Errors and Multi-Modal Effects: Driving Testbed Development and Experimental Analysis, pp. 1137-1142

Tran, Cuong	Univ. of California, San Diego
Doshi, Anup	Univ. of California, San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

These days, Intelligent Driver Assistance Systems (IDAS) for driving safety enhancement have an increasingly important role. Although there have been a large amount of related research studies in this area, developing an efficient assistance system, which can perceive and assist the driver in a non-intrusive and naturalistic manner, is still an open question. Due to the diverse characteristics and safety issue of driving, one initial and major difficulty in studying and developing such systems is to have adequate infrastructure testbeds with multi-modal sensing and displays. In this paper, we introduce two multi-modal driving testbeds (including both a real-world vehicle and a driving simulator) that we have been developing for years in our laboratory. Based on these testbeds, we describe two novel joint audio visual driving experiments and databases that we have built for investigating driver pedal misapplication error phenomenon in traffic accident prevention. We will then discuss our analysis towards understanding some factors influencing driver pedal errors including driver workload, sequential effect, and cue modality (i.e. audio visual stimuli) as well as a possibility to predict and mitigate pedal errors to some extent using our approach for modeling and prediction of driver foot behavior.

TC3 Dillingham

Advanced Technologies and Innovative Concepts for Promoting Traffic Safety and Mobility (Special Session)

Organizer: Wei, Heng	Univ. of Cincinnati
Organizer: Li, Zhixia	Univ. of Wisconsin-Madison

16:00-16:18 TC3.1

Effectiveness of Arterial Traffic Status Monitoring Using System Detector Data Based on a V-Plus-O Approach (I), pp. 1143-1148

Li, Zhixia	Univ. of Wisconsin-Madison
Yang, Qingyan	Iteris Inc.
Wei, Heng	Univ. of Cincinnati

Considering the fact that more than 40 percent of US vehicle traveled miles are on the arterial roads, how to cost-effectively monitor and estimate the arterial congestion levels using data from existing ITS facilities is highly demanded by government agencies. This paper aims at evaluating the effectiveness in traffic status estimation of an alternative approach which uses a combination of volume and occupancy data obtained from existing system detectors placed on the arterial corridor. In doing so, the concept of V-Plus-O (%V plus Occupancy) is used in the paper. This concept combines the volume data and the occupancy data collected from the system detector into a single measure of effectiveness (MOE) for arterial traffic status estimation. To evaluate the effectiveness of this alternative approach, a case study has been conducted at a major corridor in downtown Detroit, Michigan. A simulation model has been developed and calibrated as a test bed to compare the traffic status estimated using the proposed alternative approach to the traffic status computed based on speed threshold specified in the Highway Capacity Manual 2010. It has been finally concluded that the V-Plus-O approach can effectively estimate the arterial traffic status, and is promising to serve as a cost-effective alternative to expensive radar and video based methods for real-time arterial traffic status monitoring without any necessities for new equipment installation.

16:18-16:36 TC3.2

Simplified, Data-Driven, Errorable Car-Following Model to Predict the Safety Effects of Distracted Driving (I), pp. 1149-1154

Przybyla, Jay	Univ. of Utah
Taylor, Jeff	Univ. of Utah
Jupe, Jason	Armstrong Forensic Engineers
Zhou, Xuesong	Univ. of Utah

An errorable car-following model is presented in this paper. The model was developed to predict the situational risk associated with distracted driving. To obtain longitudinal driving patterns, this paper analyzed and synthesized the NGSIM naturalistic driver and traffic database to identify essential driver behavior and characteristics. NGSIM data was modified according to data from cognitive psychology concepts to examine the probabilistic nature of distracted driving due to internal vehicle distractions. The errorable microscopic car-following model was developed and validated, which can be fully integrated with the naturalistic data and incorporate the probabilities of driver distraction. The proposed model predicts that distracted driving in congested conditions can result in crash rates 3.25 times that of normal driving conditions.

16:36-16:54 TC3.3

Parts-Based Object Recognition Seeded by Frequency-Tuned Saliency for Child Detection in Active Safety, pp. 1155-1160

Cheng, Shinko	Hrl Lab. LLC
Molineros, Jose	HRL Lab. LLC
Owechko, Yuri	HRL Lab. LLC
Levi, Dan	General Motors, Advanced Tech. Center, Israel
Zhang, Wende	General Motors, Res. and Development

This paper proposes a novel system for automatically detecting children from a color monocular back-up camera, as part of a back-up warning device in passenger vehicles. We presented the use of an attentional mechanism that focuses compute-intensive bounding-box classifiers on a subset of all possible bounding-box solutions to enable real-time performance of 248ms per frame with negligible reduction in performance. The attentional mechanism called Attention to Children which consists of a window generation and verification cascade of based on Frequency-Tuned Saliency, Variational-Optical-Flow Obstacle Detection and finally a parts-based classifier. We also presented a method of reducing much of the cascade classifier evaluations by judicious sampling of the bounding-box solution space. The result is a reduction in the number of windows evaluated down to 439 from more than 12K windows in traditional sliding window techniques, a 97% reduction in the number of windows. The verification stages leading up to the parts-based classifier further reduces the number of windows to half. Together with a parallel processing and pipelining, the final processing time was 248ms per frame.

16:54-17:12 TC3.4

Level of Service for Parking Facilities (I), pp. 1161-1165

He, Yulong	Beijing Univ. of Tech.
Sun, Xiaoduan	Univ. of Louisiana
Du, Lizhen	Beijing Univ. of Tech.
Ruan, Jinmei	Beijing Municipal Inst. of City Planning & Design
Das, Subasish	Univ. of Louisiana

With the number of motor vehicles rapidly increasing, urban parking has become an intolerable problem in major cities in China. Parking facility service evaluations play an important role in urban transportation planning and operation. This paper introduces a level of service (LOS) concept based on a comprehensive parking study in Beijing, China. The LOS methodology developed by an integrated evaluation model reflects the user's perception of the quality of service. The method combines four important service variables, namely the ratio of peak-hour demand to capacity, average parking space occupying rate, parking cost, and circulation time, into one single index to quantitatively evaluate a parking facility's performance.

17:12-17:30 TC3.5

Driving Motion Capture Based Driver Behavior Analysis (I), pp. 1166-1171

Shi, Jianjun	Beijing Univ. of Tech.
Wei, Heng	Univ. of Cincinnati
Shi, Shengqing	Beijing Univ. of Tech.

In this paper a study is presented to use a driving motion capture system to capture and interpret driving motion for a better understanding of driver behaviors which is crucial to highway traffic safety. The impetus to do this research is triggered by the prevalent success of a motion capture system in other areas such as computer 3D animation, bio-mechanics and athletic sports analysis. Driving motion capturing is a process to record and track drivers' body movements and obtains their motion parameters in a three-dimensional space. The established driving motion database through the capturing system can be used to analyze the impacts of human fatigue and alcohol on their driving performance under varying traffic conditions.

TC4 Fireweed

Intersection Detection and Safety (Regular Session)

16:00-16:18 TC4.1

Multi-Object Tracking at Intersections Using the Cardinalized Probability Hypothesis Density Filter, pp. 1172-1177

Reuter, Stephan	Univ. of Ulm
Meissner, Daniel	Univ. of Ulm
Dietmayer, Klaus	Univ. of Ulm

A high fraction of accidents with body injuries in urban areas occur at intersections. Thus, improving safety at intersections using infrastructure based perception systems is desirable. In order to recognize and track the moving objects, a network of laserscanners is used to observe the intersection. In this contribution, a robust object recognition algorithm for vehicles and pedestrians is proposed. Further, the Cardinalized Probability Hypothesis Density with integrated estimation of the clutter density is applied to tracking vehicles and pedestrians at an intersection. The performance of the system is evaluated using real world sensor data of an intersection.

16:18-16:36 TC4.2

Cooperative Multi Sensor Network for Traffic Safety Applications at Intersections, pp. 1178-1183

Goldhammer, Michael	Univ. of Applied Sciences Aschaffenburg
Strigel, Elias	Univ. of Ulm
Meissner, Daniel	Univ. of Ulm
Brunsmann, Ulrich	Univ. of Applied Sciences Aschaffenburg
Doll, Konrad	Univ. of Applied Sciences Aschaffenburg
Dietmayer, Klaus	Univ. of Ulm

To significantly reduce injury and fatal accidents, smart intersections equipped with sensors and communication infrastructures have been proposed. In this publication a novel multi sensor network to perceive the intersection environment is presented. Based on an intensive analysis of accident scenarios in Germany the system was designed to address 75 % of all severe and lethal accidents. 14 laserscanners, 10 cameras, signal phase tapping and an I2V communication unit have been installed at a public intersection in Aschaffenburg, Germany. By using computer based field of view modelling the sensor positions are carefully selected to avoid occlusions. Thus, the infrastructure perception system provides a bird's eye view. Our experiments show that spatial and temporal alignment of sensor data is achieved. We also demonstrate that a part of the sensor network, a calibrated stereo system, allows 3D coordinates in the field of view region of the cameras to be determined with an accuracy of 30 mm.

16:36-16:54 TC4.3

Iicas: Intelligent Intersection Collision Avoidance System, pp. 1184-1190

Kaadan, Asaad	Univ. of Oklahoma
Refai, Hazem	Univ. of Oklahoma

The number of vehicle collisions, especially at intersections, continues to rise despite recent advancements in vehicular technologies. Innovative design solutions for collision avoidance systems and transportation infrastructure are needed. In this paper we introduce iICAS, a novel Intelligent Intersection Collision Avoidance System that utilizes various

components and advanced features to detect and identify vehicles, predict collisions, and issue appropriate warning signals. Inherent intelligent features such as self-calibration, power management, auto mesh forming, and Over-The-Air (OTA) upgrade increase system reliability and functionality at a price point much less than comparable systems.

16:54-17:12 TC4.4

VeloRegistration Based Intersection Detection for Autonomous Driving in Challenging Urban Scenarios, pp. 1191-1196

Zhu, Quanwen	Wuhan Univ.
Mao, Qingzhou	Wuhan Univ.
Chen, Long	Wuhan Univ.
Li, Ming	Wuhan Univ.
Li, Qingquan	Wuhan Univ.

In this paper, an improved intersection detection method is proposed by applying the VCS-based algorithm on the registered scans instead of the single scan. Both the registration and intersection detection approach are independent on Global Positioning System (GPS), Geographic Information System (GIS), Inertial Navigation System (INS) or other auxiliaries which have been extensively used in autonomous navigation. The novel registration method named VeloRegistration addresses the data registration problem and moving object detection simultaneously by introducing a tracking-classification operator into iterative matching process. The accurate and massive information gener-ated by VeloRegistration enables us to cope with much more com-plicated intersection scenarios, especially there are dead zones caused by severe occlusion. Experimental validation, including three real world data sets acquired in Wuhan, China substantiate the effectiveness and robustness of our approach in challenging urban scenarios.

17:12-17:30 TC4.5

A Feasibility Study on a Cooperative Safety Application for Cyclists Crossing Intersections, pp. 1197-1204

Thielen, Daniel	German Aerospace Center (DLR)
Lorenz, Tobias	German Aerospace Center (DLR)
Hannibal, Marco	German Aerospace Center (DLR)
Köster, Frank	German Aerospace Center (DLR)
Plättner, Jens	German Aerospace Center (DLR)

Introduction of wireless vehicular communications enables a variety of new ITS use-cases, allowing for cooperation between vehicles and infrastructure services. However the cooperation between vehicles and vulnerable road users (VRU) is not considered in these use cases. Currently there are already efforts to investigate the feasibility and the impact of systems to protect VRU. Due to the continously increasing number of traffic participants in urban environments this paper focuses on protecting cyclists in intersection scenarios. Therefore this paper provides a feasibility study on a cooperative safety application for vehicles and bicycles using a vehicle equipped with Vehicle-to-X communication (ETSI ITS G5) technology and a commercial mobile device using consumer WLAN (IEEE 802.11g) at the bicycle. Within a demonstration it is proven that the set up and the deployment of such a system is feasible. Thus it could help to decrease the number of accidents between vehicles and bicycles or at least mitigate the impact of an accident.

TC5 Iliamna

Simulation and Modeling 5 (Regular Session)

16:00-16:18 TC5.1

Determinants of Powered Two-Wheelers Virtual Lane Width in Urban Arterials, pp. 1205-1210

Nikias, Vasileios	National Tech. Univ. of Athens
Vlahogianni, Eleni	School of Civil Engineering, National Tech. Athe
Lee, Tzu-Chang	National Cheng Kung Univ.
Golias, John	National Tech. Univ. of Athens

The present paper aims at modeling the dynamic width of the virtual lane of the Powered Two-Wheelers (PTWs) and revealing the critical factors that may influence it, such as the speed of the motorcycles, the existence of a heavy vehicle and so on. All possible manners of PTW maneuvering in an urban arterial (2 lanes per direction of travel) were identified and then data were collected from real measurements using advanced video analysis techniques. Further, statistical models were developed in order to reveal the relation between the virtual lane's width and several determinants such as PTW speeds, lane headways, traffic mix and so on. Results showed that the virtual lane width depended on the speed of the PTW, the existence of a platoon, the existence of a heavy vehicle and the headways in both lanes. Moreover, results revealed the need to address the human behavior and the cognitive aspects of driving during the modeling.

16:18-16:36 TC5.2

Investigation on Traffic Flow Competition between Main Road and On-Ramp on Urban Freeway, pp. 1211-1214

He, Shuyan	Beijing Jiaotong Univ.
Guan, Wei	Beijing Jiaotong Univ. Beijing P.R.C

Bottlenecks at highway or urban freeway are one of origins of traffic congestion. Based on empirical investigation on traffic data collected from Beijing urban freeway, we find that when traffic is dense, upstream flow and ramp flow are correlated significantly. Competitions between the two flows at vicinities of several on-ramps during a morning peak are studied. Based on these empirical observations, a flow competition model as an extension of CTM (cell transmission model) is developed. The proposed model focuses on reproducing correlated upstream flow and ramp flow in dense traffic. Both empirical data and simulation results point out that several traffic phenomena, such as capacity drop and spontaneous traffic breakdown, can be explained as results of such a competition.

16:36-16:54 TC5.3

Estimating Flexible Route Choice Models Using Sparse Data, pp. 1215-1220

Fadaei Oshyani, Masoud	KTH Royal Inst. of Tech.
Sundberg, Marcus	KTH Royal Inst. of Tech.
Karlstrom, Anders	KTH Royal Inst. of Tech.

GPS and nomad devices are increasingly used to provide data from individuals in urban traffic networks. In many different applications, it is important to predict the continuation of an observed path, and also, given sparse data, predict where the individual (or vehicle) has been. Estimating the perceived cost functions is a difficult statistical estimation problem, for different reasons. First, the choice set is typically very large. Second, it may be important to take into account the correlation between the (generalized) costs of different

routes, and thus allow for realistic substitution patterns. Third, due to technical or privacy considerations, the data may be temporally and spatially sparse, with only partially observed paths. Finally, the position of vehicles may have measurement errors. We address all these problems using a indirect inference approach. We demonstrate the feasibility of the proposed estimator in a model with random link costs, allowing for a natural correlation structure across paths, where the full choice set is considered.

16:54-17:12 TC5.4

Analysis and Prediction of Deceleration During Car Following Using Stochastic Driver-Behavior Model, pp. 1221-1226

Angkititrakul, Pongtep	Nagoya Univ.
Miyajima, Chiyomi	Nagoya Univ.
Takeda, Kazuya	Nagoya Univ.

Driver deceleration behavior contains large amount of information regarding individual driving characteristics, driving environment, and situations perceived as potentially hazardous by a driver. This paper focuses on deceleration behavior involving both release of the gas pedal and depression of the brake pedal during on-the-road car following. A Bayesian framework was employed to calculate the probability of a driver decelerating at a given point in time, using only low-level driving signals. A stochastic driver-behavior model based on a Dirichlet process mixture model was employed to capture distinct characteristics of different driver's driving behavior. In addition, this framework exploits estimated time-to-collision (TTC) information, using both negative and positive values as a criticality indicator of driving situations perceived by the driver. Experimental validation was conducted using the on-the-road car-following behavior of sixty-four drivers. The results showed the promise of this framework for estimating deceleration probability during car following.

17:12-17:30 TC5.5

Predicting Arrival Times of Buses Using Real-Time GPS Measurements, pp. 1227-1232

Sinn, Mathieu	IBM Res.
Yoon, Ji Won	IBM Res.
Calabrese, Francesco	IBM Res.
Bouillet, Eric	IBM Res.

Predicting arrival times of buses is a key challenge in the context of building intelligent public transportation systems. In this paper, we describe an efficient non-parametric algorithm which provides highly accurate predictions based on real-time GPS measurements. The key idea is to use a Kernel Regression model to represent the dependencies between position updates and the arrival times at bus stops. The performance of the proposed algorithm is evaluated on real data from the public bus transportation system in Dublin, Ireland. For a time horizon of 50 minutes, the prediction error of the algorithm is less than 10 percent on average. It clearly outperforms parametric methods which use a Linear Regression model, predictions based on the K-Nearest Neighbor algorithm, and a system which computes predictions of arrival times based on the current delay of buses. A study investigating the selection of interpolation points to reduce the size of the training set concludes the paper.

TC6 Katmai

Emergency and Freight Operation (Regular Session)

16:00-16:18 TC6.1

Modeling Monetary Costs of Multi-Class Traffic Flow – Application to the Dynamic Management of Truck Lanes, pp. 1233-1238

Schreiter, Thomas	Delft Univ. of Tech.
Pel, Adam	Delft Univ. of Tech.
van Lint, Hans	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.

Traffic is composed of different vehicle classes, each characterized by the vehicle length, the value of time (VOT) and other class-specific properties. Multi-class traffic flow models aim to capture these class-specific differences. In this paper, a multi-class model is appended with a monetary cost framework accounting for the value of time of each vehicle class, thereby enabling the computation of the total network costs. Subsequently, the framework is analytically applied to show the conditions under which it is justified to prioritize certain traffic classes in order to maximize the monetary flow (which is equivalent to minimizing the total monetary network costs). An illustrative example is given in which the framework is used to find the conditions (bottleneck capacity, traffic demand, pce, VOT) under which activating a dedicated lane for trucks is beneficial.

16:18-16:36 TC6.2

Freight Origin-Destination Estimation Based on Multiple Data Sources, pp. 1239-1244

Ma, Yinyi	Erasmus Univ.
Van Zuylen, H.J.	Delft Univ. of Tech.
Kuik, Roelof	Erasmus Univ. Rotterdam

Freight origin-destination (OD) information is increasingly important for understanding the influence of transportation on network congestion. Traditional OD estimation methods based on a single data source, usually loop detectors, are not easily transferred to freight OD estimation. However, alternative data capture technologies are nowadays available to gather traffic information. Examples are automatic number plate recognition (ANPR), Bluetooth scanners, and Weigh-in-Motion systems. This paper aims to develop feasible approaches based on Entropy Maximization and Bayesian Networks to estimate freight OD matrix using multiple sources of captured data. In the case of the A15 motorway in the Netherlands, we illustrate how the captured data is informative about transport behavior in the area and how the proposed methods lead to an estimation of the freight OD matrix.

16:36-16:54 TC6.3

GPS Tracking of Freight Vehicles to Identify and Classify Bottlenecks, pp. 1245-1249

Dailey, Daniel J.	Univ. of Washington
McCormack, Ed	Univ. of Washington
Zhao, Wenjuan	Washington State Department of Transportation

This paper presents a systematic methodology for identifying and ranking bottlenecks using probe data collected by commercial GPS fleet management devices. This methodology is based on the hypotheses that truck speed distributions can be represented by either a unimodal or bimodal probability density function, and it proposes a new reliability measure for evaluating roadway performance.

16:54-17:12 TC6.4

The Multi-Modal Evacuation System (MES) for Baltimore Metropolitan Region, pp. 1250-1257

Zhang, Xin	Univ. of Maryland
Chang, Gang-Len	Univ. of Maryland

Evacuating large metropolitan areas during emergencies in an efficient manner is one of the critical concerns of most responsible agencies. Previous studies focused mainly on strategic evacuation plans or controls for passenger cars, giving inadequate attention to those pedestrians relying on transit systems or other modes. This study has developed a multimodal evacuation system for Baltimore city. The proposed system can generate evacuation plans to guide people to the parking lots or pick-up points, dispatch shuttles to pick up evacuees, and provide route guidance to vehicles. The system uses a hybrid method to simulate traffic conditions, allowing users to evaluate the effectiveness of the proposed plan. An evacuation planning for Baltimore downtown is used as an illustration case in this study.

TC7 King Salmon

Emergency Operation and Management (Regular Session)

16:00-16:18 TC7.1

Multi-Objective Optimization Model Based on Heuristic Ant Colony Algorithm for Emergency Evacuation, pp. 1258-1262

Duan, Pengfei	Wuhan Univ. of Tech.
Xiong, Shengwu	Wuhan Univ. of Tech.
Jiang, Hongxin	Wuhan Univ. of Tech.

It is important to evacuate pedestrians properly in large public buildings under emergency conditions. A multi-objective optimization model based on Heuristic ant colony algorithm for emergency evacuation is proposed in this paper. The two objectives of this model are to minimize the evacuation clearance time and to minimize the total path crowding degree. The Heuristic ant colony algorithm takes into account the distances between the evacuees and the dangerous or safe targets. In addition, this model is applied to a large stadium to simulate the whole evacuation process. In order to make the results realistic, experiments that consider the evacuees' real responses to the instructions are conducted. By simulating the process of pedestrian evacuation with this model, the results show the feasibility of the algorithm, so as to provide a scientific basis for guiding the real evacuation process.

16:18-16:36 TC7.2

Sensitivity Analysis of Driver Behavior under Emergency Conditions (I), pp. 1263-1268

Prionisti, Elena	National Tech. Univ. of Athens
Antoniou, Constantinos	National Tech. Univ. of Athens

Under emergency situations, citizens are often forced to evacuate an inhabited area for their own safety. During this process, drivers' behavior becomes a very important factor determining vehicle movements in the affected area. In this research, the impact of driver aggressiveness on traffic flow properties related to evacuation, such as travel time to the safe zones, is modeled through microscopic simulation and the use of detailed driver behavior models. A sensitivity analysis examining the impact of each individual model on the network is first performed, followed by an analysis of the interaction of the most influential models. The findings of this research can be useful in developing realistic evacuation strategies and plans, in which the expected impact of the drivers' behavior due to their stress is explicitly taken into consideration.

16:36-16:54 TC7.3

Emergency Traffic Evacuation Control Based on the Orthogonal Experimental Design Method (I), pp. 1269-1273

Lv, Yisheng	Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of sciences
Miao, Qinghai	Graduate Univ. Chinese Acad. of Sciences
Ye, Peijun	Inst. of Automation, Chinese Acad. of Sciences
Chen, Songhang	Chinese Acad. of Sciences

Evacuees' behaviors have a significant impact on evacuation efficiency. Evacuation clearance time is one of the key indicators in the evacuation planning and management. Evacuees' departure time choice, destination choice and route choice behavior based on real-time traffic information are three crucial factors used to estimate evacuation clearance time. In this paper, we use the orthogonal experimental design method to determine values of these three factors simultaneously, which can reduce evacuation clearance time significantly. Once we obtain these values, we can guide evacuees' departure time choice, destination choice and route choice behavior to approximate these values and evacuation efficiency will improve greatly. The dynamic traffic evacuation process is modeled using a rule-based multi-agent microscopic traffic simulation system called TransWorld. The simulation experiment results illustrate the effectiveness and reliability of the proposed method. The proposed methodology, computational results and discussions can be used for future emergency evacuation planning and management.

16:54-17:12 TC7.4

An RFID-Based Inventory Management Framework for Efficient Emergency Relief Operations, pp. 1274-1279

Ozguven, Eren Erman	Rutgers Univ.
Ozbay, Kaan	Rutgers Univ.

Emergency disaster management has emerged as a vital tool to reduce the harm and alleviate the suffering the disasters can cause to their victims. A significant task of planners involved in the emergency disaster management is the ability to plan for and satisfy the vital needs of the people located in the emergency shelters, such as the Superdome shelter at New Orleans. As clearly stated by Whybark [1], the management of the stored vital commodities can be improved within the emergency disaster management if there were more effective tracking and monitoring systems. This study proposes a comprehensive framework for the development of a humanitarian emergency inventory management system based on the real-time tracking of emergency supplies and demands through the integration of emerging technologies such as Radio Frequency Identification Devices (RFID). The proposed approach combines an offline planning strategy with online control techniques in a unified framework that is robust with respect to disruptions to the transportation system and unexpected peaks in consumption of vital commodities in the aftermath of a disaster.

TC8 Lupine

Parking Technologies (Regular Session)

16:00-16:18 TC8.1

Detection of Parking Spots Using 2D Range Data, pp. 1280-1287

Zhou, Jifu — Carnegie Mellon Univ.
Navarro-Serment, Luis — Carnegie Mellon Univ.
Hebert, Martial — Carnegie Mellon Univ.

This paper addresses the problem of reliably detecting parking spots in semi-filled parking lots using on-board laser line scanners. In order to identify parking spots, one needs to detect parked vehicles and interpret the parking environment. Our approach uses a supervised learning technique to achieve vehicle detection by identifying vehicle bumpers from laser range scans. In particular, we use AdaBoost to train a classifier based on relevant geometric features of data segments that correspond to car bumpers. Using the detected bumpers as landmarks of vehicle hypotheses, our algorithm constructs a topological graph representing the structure of the parking space. Spatial analysis is then performed on the topological graph to identify potential parking spots. Algorithm performance is evaluated through a series of experimental tests.

16:18-16:36 TC8.2

A New Base Stations Placement Approach for Enhanced Vehcile Position Estimation in Parking Lot, pp. 1288-1293

Kiwan, H. — Univ. of Regina
Bais, A. — Univ. of Regina
Morgan, Y. L. — Univ. of Regina

In the recent decades, short-range wireless has become of great importance in the applications of Intelligent Transportation Systems (ITS); especially, that serve traffic management and safety. Various approaches are concerned with optimal positioning of a vehicle and Base-Stations (BSs) placement within a specific area. The optimization problem stands as an exhaustive challenge. This paper discuses different approaches for short-range BSs placement with respect to maximizing signal coverage and minimizing error in positioning within a parking lot. An implementation of a number of sample patterns is illustrated. A comparison based on the utilization of the patterns, shows coverage in percentage, average, standard deviation and maximum value of error in estimated positions of vehicles. We propose a new approach which results in improved accuracy and highest performance in positioning and then enhanced tracking of vehicles.

16:36-16:54 TC8.3

Fully-Automatic Recognition of Various Parking Slot Markings in Around View Monitor (AVM) Image Sequences, pp. 1294-1299

Suhr, Jae Kyu — Hanyang Univ.
Jung, Ho Gi — Hanyang Univ.

This paper proposes a novel fully-automatic method for recognizing various parking slot markings in image sequences acquired by an Around View Monitor (AVM) system which is gaining popularity as a parking-aid product. The proposed method utilizes an approach which finds parking slots in AVM image sequences using a simple detector and combines sequentially acquired slots rather than using a sophisticated heavy detector in order to achieve the robustness against diverse practical situations. Parking slots are first detected in the current image using the hierarchical tree structure based approach presented in our previous paper [1]. Then, the current positions of previously detected parking slots are predicted using a transformation between consecutive images, and the parking slots detected in the current image and predicted from previous images are combined. The resulting parking slots are clustered according to their types and orientations, and the clusters which contain more than a predetermined number of slots are selected as final parking slots. The proposed method was evaluated using 10 AVM image sequences that include 134 parking slots, and demonstrated a detection rate of 95% with only three false detections.

16:54-17:12 TC8.4

Computationally Inexpensive Parallel Parking Supervisor Based on Video Processing, pp. 1300-1305

Espejo, Caterina — Pontificia Univ. Catolica del Peru
Rodriguez, Paul — Pontificia Univ. Catolica del Peru

Parallel parking, in general, is a moderate difficulty maneuver. Moreover, for inexperienced drivers, it can be a stressful situation that can lead to mistakes such as being far from the sidewalk or damage another vehicle resulting in traffic tickets that range from simple parking violation to crash-related violations.

In this paper we propose a computationally effective approach to perform a collision-free parallel parking. The method will calculate the minimum parking space needed and then the minimum possible path for the parallel parking. This method is computationally inexpensive in comparison with the state of art. Moreover, it could be used by any car because the parameters needed to perform all computations are taken from published datasheets.

Technical Program for Wednesday September 19, 2012

WA1 Chart

Driver Assist Systems - Traffic Signal/Sign Recognition (Regular Session)

09:00-09:18 WA1.1

Impact of Introducing Signal Recognition Enhancement System on Traffic Flow at Signalized Intersection, pp. 1306-1309

Nakazawa, Masatoshi — City of Yokohama
Fukuda, Atsushi — Nihon Univ.
Suzuki, Hironori — Nippon Inst. of Tech.
Okamura, Makoto — Almec Corp.

The Signal Recognition Enhancement System or SRES is one of practical ITS which is expected to avoid rear-end collisions at a signalized intersection by providing signal information to a

vehicle and/or a driver before reaching an intersection. This system is also expected to suppress the unnecessary fuel consumption and reduce CO2 emissions. The purpose of this paper is to evaluate the impact of the SRES which will be installed at signalized intersections. To estimate the impact, we develop the micro traffic simulation model which includes the behavior of a driver with/without SRES. We employed the time integral of difference of space distance and stopping distance or TIDSS as the indicator for measurement of safety, while we employed the equations to calculate fuel consumption and CO2 based on an average velocity. As the result of simulations, it was confirmed that SRES might help to reduce collision, fuel consumption and CO2 emissions at signalized intersections.

09:18-09:36 WA1.2

Traffic Sign Detection and Analysis: Recent Studies and Emerging Trends, pp. 1310-1314

Møgelmose, Andreas	Aalborg Univ.
Trivedi, Mohan M.	Univ. of California at San Diego
Moeslund, Thomas	Aalborg Univ.

Traffic sign recognition (TSR) is a research field that has seen much activity in the recent decade. This paper introduces the problem and presents 4 recent papers on traffic sign detection and 4 recent papers on traffic sign classification. It attempts to extract recent trends in the field and touch upon unexplored areas, especially the lack of research into integrating TSR with a driver-in-the-loop system and some of the problems that presents. TSR is an exciting field with great promises for integration in driver assistance systems and that particular area deserves to be explored further.

09:36-09:54 WA1.3

Suspended Traffic Lights Detection and Distance Estimation Using Color Features, pp. 1315-1320

Diaz-Cabrera, Moises	Univ. of Las Palmas de Gran Canaria
Cerri, Pietro	Univ. of Parma
Sanchez-Medina, Javier J.	Univ. of Las Palmas de Gran Canaria

Traffic Light Detection is a problem differently approached by many research groups around the world. The present work exhibits a novel technique to detect suspended traffic lights, based on colors and features such as black area of traffic lights or area of lighting lamps. Additionally, the traffic light distance is estimated aiming at slowing down and stopping in the correct position, in case of red light. Some preliminary test results are presented to assess both the detection rate and the distance estimation.

09:54-10:12 WA1.4

Visibility Estimation of Traffic Signals under Rainy Weather Conditions for Smart Driving Support, pp. 1321-1326

Sato, Ryuhei	Nagoya Univ.
Doman, Keisuke	Nagoya Univ.
Deguchi, Daisuke	Nagoya Univ.
Mekada, Yoshito	Chukyo Univ.
Ide, Ichiro	Nagoya Univ.
Murase, Hiroshi	Nagoya Univ.
Tamatsu, Yukimasa	DENSO Corp.

The aim of this work is to support a driver by notifying the information of traffic signals in accordance with their visibility. To avoid traffic accidents, the driver should detect and recognize surrounding objects, especially traffic signals. However, when driving a vehicle under rainy weather conditions, it is difficult for drivers to detect or to recognize objects existing in the road environment in comparison with fine weather conditions. Therefore, this paper proposes a method for estimating the visibility of traffic signals for drivers by image processing under rainy weather conditions. The proposed method is based on the concept of visual noise known in the field of cognitive science, and extracts two types of visual noise features which affect the visibility of traffic signals. We expect to improve the accuracy of visibility estimation by combining the visual noise features with the texture feature introduced in the previous work. Experimental results showed that the proposed method could estimate the visibility of traffic signals accurately under rainy weather conditions.

WA2 Denali

Advanced Vehicle Technologies 1 (Regular Session)

09:00-09:18 WA2.1

Vehicle Control Based on a LPV Control and a Nonlinear Control to Detect Critical Driving Situation Due to High Dynamic Loads, pp. 1327-1332

Menhour, Lghani	Mathématiques et Systèmes CAOR
Charara, Ali	HEUDIASYC UMR UTC/CNRS 6599
Lechner, Daniel	INRETS-MA

This paper presents two control laws dedicated to the vehicle control and gives a comparison between them. The first control law is designed to control the vehicle from steering angle and is based on the LPV control strategy, the solution for this problem is achieved using the LMI framework and the interpolation gains method. The second strategy controls the longitudinal and lateral motion of the vehicle via wheel torque traction and steering torque respectively. It is based on a second order sliding mode control. These control laws are used to perform closed-loop simulations with a non linear vehicle model, under high dynamic loads to detect critical driving situations such as physical limitation of the vehicle in a bend. These laws are tested using the experimental data acquired by four wheeled vehicle Peugeot 307 from IFSTTAR.

09:18-09:36 WA2.2

Nonlinear Observers of Tire Forces and Sideslip Angle Estimation Applied to Road Safety: Simulation and Experimental Validation, pp. 1333-1338

Wang, Bin	HEUDIASYC UMR UTC/CNRS 7253
Cheng, Qi	Heudiasyc
Victorino, Alessandro	Univ. de Tech. de Compiegne, Departement deGenieInfor
Charara, Ali	HEUDIASYC UMR UTC/CNRS 6599

Extensive research is focus on the stability control in the modern industrial auto-mobile society. Some active safety systems, such as Electronic Stability Program (ESP) and Traction Control System (TCS) have been widely used as safety option in our quotidian cars. These systems are based on the information which contains the motion characteristic of vehicle. Nevertheless, some complex safety system needs more information which can preferable describe the precise motion features, such as sideslip angle and tire forces. This article will principally present two non-linear observers: EKF (Extended Kalman filter) and PF (Particle filter) to estimate

these variables, respectively. These observers are designed based on the non-linear double track model. The Dugoff model is used to elaborate the relation between tire forces and sideslip angle. Performances of these observers are tested by using the experimental data in real driving test, using our laboratory vehicle equipped with a real-time sampling and processing system. Particularly, the estimation process with EKF has been developed as a real-time application for the onboard test. Furthermore, a simulator is involved in the critical driving test which is hazardous in real driving condition.

09:36-09:54 WA2.3

Traffic Situation Assessment by Recognizing Interrelated Road Users, pp. 1339-1344

Platho, Matthias	Univ. of Ilmenau
Gross, Horst-Michael	Ilmenau Univ. of Tech.
Eggert, Julian	Honda Res. Inst. Europe GmbH

With the trend to highly automated driving, future driver assistance systems are required to correctly assess even complex traffic situations and to predict their progress. As soon as other road users are present the number of possible situations becomes infinite, rendering their assessment based on learned situation types impossible. In this paper we propose to break the situation down into sets of interrelated entities by estimating for each road user the entities that affect its behavior most. The decomposition offers numerous advantages: Attention can be focused on relevant entities only and predictions can be performed with a smaller set of considered entities. As the high variability among situations requires a large amount of data for learning and testing, we implemented a simulation environment, that gives access to the causes for the behavior of each road user. In a simulated intersection scenario we show that we can reliably infer the affecting entities for each road user only utilizing features that can be obtained by common sensors.

09:54-10:12 WA2.4

Genesis of Booster Curves in Electric Power Assistance Steering Systems, pp. 1345-1350

Ciarla, Valentina	GipsaLab
Cahouet, Violaine	Univ. Joseph Fourier GipsaLab
Canudas de Wit, Carlos	Grenoble
Quaine, Franck	Univ. Joseph Fourier GipsaLab

The typical architecture of an Electric Power Assistance Steering (EPAS) system includes a static map to provide the correct amplification to the driver's exerted torque. In literature, it is generally known as booster curve. This paper concerns the study of the amplification criteria, that are commonly used to these booster curves. The basic concepts of the Electric Power Steering (EPS) systems with a realistic model for the friction contact, that acts on the wheels are discussed. A relation between the assistance and the driver's torque is provided, under the hypothesis of a position-oriented control of the movement and the Stevens' power law. Finally, the simulation results proposed at the end of this paper validate the shape of the booster curves and are in accord with the initial hypothesis.

10:12-10:30 WA2.5

Temporal Association Rule Mining for the Preventive Diagnosis of Onboard Subsystems within Floating Train Data Framework, pp. 1351-1356

Sammouri, Wissam	UPE, IFSTTAR, GRETTIA
Come, Etienne	UPE, IFSTTAR, GRETTIA
Oukhellou, Latifa	UPE, IFSTTAR,GRETTIA
Aknin, Patrice	UPE, IFSTTAR,GRETTIA
Fonlladosa, Charles-Eric	Alstom Transport
Prendergast, Kevin	Alstom Transport

The increasing interest in preventive maintenance strategies for railway transportation systems as well as the emergence of telecommunication technologies have both led to the development of floating train data (FTD) systems. Commercial trains are being equipped with both positioning and communications systems as well as onboard intelligent sensors monitoring various subsystems all over the train. The collected sizable amounts of real-time spatio-temporal data can be used to leverage the development of innovative diagnosis methodologies based on temporal and sequential data mining. This paper presents a temporal association rule mining approach named T-patterns, applied on highly challenging floating train data. The aim is to discover temporal associations between pairs of timestamped alarms, called events, that can predict the occurrence of severe failures within a complex bursty environment. Experiments carried out on Alstom's TrainTracerTM data show promising results.

WA3 Dillingham

Vehicle Localization and Autonomous Navigation 1 (Regular Session)

09:00-09:18 WA3.1

Real Time Localization, Path Planning and Motion Control for Autonomous Parking in Cluttered Environment with Narrow Passages, pp. 1357-1364

Tehrani Nik Nejad, Hossein	DENSO Corp.
Do, Quoc Huy	Toyota Tech. Inst.
Sakai, Ryohei	Toyota Tech. Inst.
Han, Long	Toyota Tech. Inst.
Mita, Seiichi	Toyota Tech. Inst.

This paper propose a novel practical method for autonomous parking in cluttered environment with narrow passages. We present a modified FastSLAM algorithm for environment mapping to reduce the map entropy and increase the localization accuracy for autonomous parking. The proposed path planning method is based on predefined arc paths for real time generation of smooth paths to avoid obstacles. The corresponding control commands are generated to minimize the steering angle control error which executed by the vehicle actuators. The proposed parking method is implemented on an autonomous vehicle platform and evaluated in the different environments with narrow passages.

Attachment. This video shows an autonomous parking experiment inside the building. As shown in the movie, the experiment place has narrow passages and makes it difficult for parking. The steering, acceleration and brake are controlled by the computer and the student in the car is just for safety issue. The research can be extended for developing practical application of autonomous parking in multi level parking area at supermarket.

09:18-09:36 WA3.2

Multi-Sensor Localization – Visual Odometry As a Low Cost Proprioceptive Sensor, pp. 1365-1370

Bak, Adrien	DxO Lab.
Gruyer, Dominique	IFSTTAR
Bouchafa, Samia	Univ. Paris Sud XI

Aubert, Didier IFSTTAR

Ego-localization is a key issue for most autonomous robots and vehicles. Indeed, the ability to take a proper decision (avoidance, path-finding, etc.) relies on the knowledge of one's particular environment on one hand and on its relative positioning in this environment on the other hand. As such, this issue has been addressed multiple times in the past few years. This work extends a multi-sensor fusion framework in order to take advantage of Visual Odometry (VO), as a low cost proprioceptive sensor with the same result than an expensive INS sensor. In particular, it is shown that VO helps to determine the course of the vehicle and to limit the overall drift of the system with a similar behavior than with a classical but expensive localization filter.

09:36-09:54 WA3.3

Continually Improving Large Scale Long Term Visual Navigation of a Vehicle in Dynamic Urban Environments, pp. 1371-1376

Churchill, Winston Oxford Univ.
Newman, Paul Univ. of Oxford

This paper is about long term navigation in dynamic environments. In previous work we introduced a framework which stored distinct visual appearances of a workspace, known as experiences. These are used to improve localisation on future visits. In this work we introduce a new introspective process, executed between sorties, thats aims by careful discovery of the relationships between experiences, to further improve the performance of our system. We evaluate our new approach on 37km of stereo data captured over a three month period.

09:54-10:12 WA3.4

A Sequential Test for Autonomous Localisation of Map Errors for Driving Assistance Systems, pp. 1377-1382

Zinoune, Clément Univ. of Tech. of Compiègne, Renault SAS
Bonnifait, Philippe Univ. of Tech. of Compiegne
Ibanez Guzman, Javier Renault S.A.S,

Driving assistance systems are progressively introduced to enhance safety and comfort in passenger vehicles. They increasingly rely on information stored in digital navigation maps. However maps can be obsolete or contain errors, resulting in malfunctions of context based driving assistance systems and possibly generating hazardous situations. This paper aims at making the vehicle able to detect and localise map errors in an autonomous manner using its embedded sensors. The proposed approach relies on the sequential generation and monitoring of residuals. The vehicle estimated trajectory is compared statistically with the geometric data in the map. The approach allows driving assistance functions to know if they can rely on the map in real-time and to store this information for future journeys. The method is very efficient in terms of computational load which makes embedded applications possible. Performance is assessed using vehicle data acquired in real traffic conditions, which is then compared with an outdated navigation map.

WA4 Fireweed

ITS Implementations 2 (Regular Session)

09:00-09:18 WA4.1

Motion Stereo-Based Collision Avoidance for an Intelligent Smart Car Door System, pp. 1383-1389

Scharfenberger, Christian Univ. of Waterloo
Chakraborty, Samarjit Tech. Univ. München
Zelek, John Univ. of Waterloo, Systems Design Engineering, Canada
Clausi, David Univ. of Waterloo, Systems Design Engineering, Canada

Driver assistance systems in today's cars assist drivers when the car is in motion. However, there is relatively less, to almost no work on assistance systems when the car is stationary. This paper focuses on such a system, and describes the design and realization of a collision avoidance system for a novel car door assistance system, the smart car door. An omnidirectional camera is attached to each side-view mirror of a car, and the fold-in fold-out movement of the mirror is used to generate 3D information about static obstacles next to the car based on a motion stereo approach. The car door controller uses the sensor data to compute collision-free door opening paths, and the two-hinge kinematic system of the smart car door enables to move the door around static obstacles. The latter increases the door entrance area in tight parking lots, which drastically improves the ingress/egress to/from a vehicle. These are enhancements to currently available systems that only indicate the presence of obstacles next to the car. Experiments on a fully realized prototype demonstrated a robust generation of 3D information about obstacles next to the car. A study with 20 test users showed that our system strongly supports the users to avoid collisions when operating the door.

09:18-09:36 WA4.2

Mobile Based Event-Activated Vehicle Tracking in Urban Environments, pp. 1390-1395

Srinivasa, Ramakrishna Intel Tech.
Agnihotri, Samar The Chinese Univ. of Hong Kong
Jadhupathi, Prem Mphasis
Namballa, Revathipathi Mphasis

The ubiquitous nature of present wireless networks makes the real-time and accurate location-tracking of mobile assets a realizable possibility. However, the existing solutions with their high infrastructure and operational costs, and technical implementation difficulties are not attractive for practical event-activated asset tracking, control, and diagnostics. In this paper, we provide complete system architecture and a description of fully-functional prototype implementation of a mobile based and event-activated solution for low-cost and real-time asset-tracking in urban environments. The accuracy and stability of the proposed solution is established via rigorous field-trials.

09:36-09:54 WA4.3

Hybridization of Appearance and Symmetry for Vehicle-Logo Localization, pp. 1396-1401

Zhou, Kai Automation and Control Inst. Vienna Univ.
Varadarajan, Karthik Mahesh ACIN, TU Vienna
Vincze, Markus ACIN, TU Vienna
Liu, Fuqiang Tongji Univ.

Vehicle logo detection is of great importance in intelligent transportation system (ITS) applications since it augments the traditional license plate recognition (LPR) based vehicle identification solutions. An algorithm based on the combinational consideration of appearance and symmetrical

information is proposed to locate the vehicle logo in a digital image. Air-intake grille, as the most evident visual aspect in the front view of the vehicle, can be efficiently detected and recognized thereby providing information about related position of vehicle logos. Symmetry as another widely used feature for analyzing vehicle's front-view image has also been taken into consideration along with grille detection in this paper. This hybridization facilitates more accurate vehicle logo detection rate comparing using isolated symmetry (faces challenge on complex background) or edge statistic (can not handle non/small-grille vehicle). Experimental results on a large number of images validate the robustness and efficiency of the proposed algorithm.

09:54-10:12 WA4.4

Research on Compressed EKF Based SLAM Algorithm for Unmanned Underwater Vehicle, pp. 1402-1406

Wang, Hongjian	Automation Coll. Harbin Engineering Univ. Harbin,HeiLon
Li, Cun	409 Department,automation Coll.
Lv, Hongli	409 Department,automation Coll.
Chen, Xinghua	automation Coll. engineeringuniversity

The Extend Kalman Filter based algorithm for simultaneous localization and mapping cannot satisfy the requirement of real time map updating because of the increasing number of landmarks and the heavy calculating cost while AUV working for long time endurance . The Compressed EKF based SLAM is introduced in this paper. And the method of map management and the local map switch strategy are addressed, which divide the AUV navigating area into several local sub-maps. The navigation error calculating based on landmarks in sub-map is completed in local area by using Extend Kalman filter, and the global map updating is done only when the condition satisfied the switch rule of the sub-map. Finally the CEKF-SLAM based navigating method is tested with the trial data, and by comparing with the dead reckoning navigating result, the test results show that the navigation error of CEKF-SLAM algorithm is less than that of dead reckoning algorithm, and on the same time, the former reduces the calculation cost for AUV navigation.

WA5 Iliamna

Simulation and Modeling 1 (Regular Session)

09:00-09:18 WA5.1

Link Observability without Path Enumeration: A Revisit, pp. 1407-1410

Ng, ManWo	Old Dominion Univ.

In this paper we revisit the following link observability problem: Determine the smallest subset of links in a traffic network for counting sensor installation, in such a way that it becomes possible to infer the flows on all remaining links. While a solution methodology has already been proposed in the literature, unfortunately, path enumeration was required which is infeasible for large-scale networks. In this work, we present a reformulation of the link observability problem, requiring only node enumeration. Using this node-based approach, we prove a conjecture made in the literature by deriving an explicit relationship between the number of nodes and links in a transportation network, and the minimum number of sensors to install in order to be able to infer all link flows. Numerical results are reported and discussed.

09:18-09:36 WA5.2

Measurement of Heavy Traffic Using Temporal Template, pp. 1411-1416

Tsukanome, Takuma	Hirosaki Univ.
Onoguchi, Kazunori	Hirosaki Univ.

This paper presents the method which can measure traffic situation in heavy congestion. The proposed method calculates average speed of passing vehicles from Temporal Template well used in the field of gesture recognition. It is created by accumulating motion areas detected in an image sequence by the frame differential method, changing intensity of them for every frame. The proposed method is robust to overlap of vehicles because it estimates speed of vehicles without detecting and tracking vehicles individually. At first, Temporal Template is created from accumulating frame differential results. Next, median intensity is calculated on each horizontal scan line of Temporal Template. And then, the relation between the vertical axis of Temporal Template and median intensity is approximated as straight lines. Average speed of passing vehicles is obtained from the inclination of these straight lines. Temporal Template contains no motion area if there is no passing vehicle or all vehicles almost stops on the road. Therefore, if Temporal Template has no motion area and the background subtraction image has no foreground area, our method judges that no passing vehicle exists on the road. On the other hand, if Temporal Template has no motion area and the background subtraction image has some foreground areas, it judges that all vehicles almost stops on the road. Experimental results including the scene of heavy congestion show the effectiveness of the proposed method.

09:36-09:54 WA5.3

Calibration of CORSIM Models Considering All Model Parameters Simultaneously, pp. 1417-1422

Paz, Alexander	Univ. of Nevada, Las Vegas
Molano, Victor	Univ. of Nevada, Las Vegas
Gaviria, Carlos	Univ. of Cauca

This study proposes a calibration methodology for microscopic traffic flow simulation models that has the capability to simultaneously consider all model parameters and also to calibrate time-dependent aspects of the model, such as link counts. The Simultaneous Perturbation Stochastic Approximation algorithm provides the optimization engine that determines the calibrated set of model parameters. In this study, experiments were conducted using two different CORSIM models; the results illustrate the effectiveness of the proposed calibration methodology. Current research focuses on expanding the proposed methodology to enable the simultaneous calibration of link counts, speeds, and associated bottlenecks.

09:54-10:12 WA5.4

Traffic Jam Modeling and Simulation (I), pp. 1423-1428

Yin, Derek	Univ. of Alberta
Qiu, Tony	Univ. of Alberta

In this paper various theories on traffic jams and stop-and-go wave modeling were reviewed and discussed. These include traditional microscopic car-following model, asymmetric traffic theory, first-order and second-order macroscopic models, traffic disturbance model, phase transition model as well as macroscopic simulation. The mechanism of stop-and-go waves, causes, generation, propagation, and absorption was discussed. A macroscopic simulation model was developed which suits for both free flow and stop-and-go traffic conditions. Ten hours of macroscopic simulation was performed on a section of freeway in California. The model

predicted traffic speed and density were compared with field measured data. It was concluded that by applying proper boundary conditions for each roadway segment and incorporating capacity drop in the model, the macroscopic simulation model can reasonably predict the stop-and-go traffic states.

10:12-10:30 WA5.5

Dynamic Model Development of Performance Indices for Planning of Sustainable Transportation Systems, pp. 1924-1930.

Maheshwari, Pankaj	Univ. of Nevada, Las Vegas
Khaddar, Romesh	Univ. of Nevada, Las Vegas
Kachroo, Pushkin	Univ. of Nevada, Las Vegas
Paz, Alexander	Univ. of Nevada, Las Vegas
Shlayan, Neveen	Univ. of Nevada, Las Vegas

Sustainability has recently become a very important research area in transportation because of the dependencies between transportation, economic and environmental system. A lot of research is taking place in various aspects that try to understand the interdependencies. However, there is a need to capture the behavior of such systems over time. The research presented in this paper is the first attempt to build dynamic models that try to capture the interdependent behavior of these systems. The research is influenced and motivated by the predator-prey models developed by renowned researchers Lotka and Volterra. The current study is performed to capture the interaction between interdependent systems i.e. transportation system, activity system, and environmental system. To study the interactions from a macro-scale, this research emphasizes non-linear modeling techniques to capture the nominal behavior of all the three systems. The results indicate that the performance of transportation system and the activity system follow a periodic behavior with phase lag, while the performance of environment system decreases with time. The modeling approach proposed in this research will be helpful to other researchers so that they can modify and enhance such models for proper analysis of sustainable systems.

WA6 Katmai

Intelligent Solutions for Air Transportation and Air Space – (ISATAS) (Special Session)

Organizer: Castro, António — LIACC, Univ. of Porto

09:00-09:18 WA6.1

Towards an Autonomous and Intelligent Airline Operations Control (I), pp. 1429-1434

Castro, António J. M.	LIACC, Univ. of Porto
Rocha, Ana Paula	Faculty of Engineering of Porto (Portugal)
Oliveira, Eugénio	Faculty of Engineering, Univ. of Porto

Studies have estimated that irregular operations (flights affected by a disruption) can cost between 2% and 3% of the airline annual revenue and that a better recovery process could result in cost reductions of at least 20%. Even for small airlines this can represent millions of Euros. In this paper we propose a multi-agent system (MAS) whose members represent the roles, functionalities and competences existing in a typical Airline Operations Control Centre (AOCC), the airline entity responsible for managing the impact of irregular events on planned operations. This multiagent based system produces intelligent solutions in the sense that its outcomes are the result of an autonomous reaction and adaption to changes in the environment, solving partial problems simultaneously. We tested our MAS using real data from TAP Portuguese airline company and experimentally compared our system with solutions found by the human operators on TAP Portugal AOCC. A comparison was also made with a more traditional sequential approach that is the typical method followed by AOCCs when solving disruptions. Results from those comparisons show that it is possible to reduce costs and have a better integrated solution with the proposed system.

09:18-09:36 WA6.2

Revisit the Fairness Issues in Flight Landing Scheduling, pp. 1435-1440

Wang, Yong	National Univ. of Defense Tech.
Wang, Feng	The Univ. of Mississippi
Wang, Dan	The Hong Kong Pol. Univ.
Gong, Zhenghu	National Univ. of Defense Tech.
Liu, Jiangchuan	Simon Fraser Univ.

Flight landing optimization at the terminal area is an ongoing challenge for air traffic controllers. The current schedule scheme is first-come-first-served (FCFS). There are studies focusing on how to minimize the total cost or maximize the throughput. These schemes are short of fairness consideration. In this paper, we start from a real recent example to show that a lack of consideration of long-term fairness may cause significant problems in certain emergency situations. We propose new definitions of fairness between different airlines which consider the history fairness information. We then study the fairness in flight landing problem (FFLP). We show that the problem is NP-hard to solve. Therefore, we develop a fast heuristic. Our experiment results show that our algorithm achieves a 50.4% gain on long-term fairness.

09:36-09:54 WA6.3

Analysis of Aircraft Trajectories Using Fourier Descriptors and Kernel Density Estimation, pp. 1441-1446

Annoni Jr., Ronald	Inst. Tecnologico de Aeronautica
Forster, Carlos H. Q.	Inst. Tecnologico de Aeronautica

Handling the large amount of information from aircraft trajectories that are produced daily from air traffic control radar systems requires models for representing trajectories in a compact, easy to calculate, representative and distinctive form. These models should permit to perform clustering and classification operations efficiently and effectively. The Fourier descriptors have these characteristics and this article presents the results obtained on actual aircraft trajectories including approach and takeoff operations over a terminal area. Clustering and classification techniques in the feature space of Fourier descriptors were able to correctly separate the various types of operations. Additionally, based on the results of the clusters obtained, a method is presented for the classification of trajectories in progress based on kernel density estimation. An interesting result from the point of view of air traffic control for the detection of anomalous traffic is demonstrated.

09:54-10:12 WA6.4

Optimal Configuration for Intersecting Flows of Aircraft, pp. 1447-1452

Huang, Shimeng	Univ. of Pittsburgh

Feron, Eric	Georgia Inst. of Tech.
Mao, Zhi-Hong	Univ. of Pittsburgh

This paper studies the configuration for intersecting flows of aircraft. Intersections of aircraft flows can be considered as basic building blocks for air traffic networks, and traffic networks can be designed through finding optimal arrangements of intersections whose conflict zones do not overlap. A conflict zone is defined as a minimal circular area centered at the intersection of two flows which allows aircraft approaching the intersections to resolve conflict completely within the conflict zone. This paper derives the relationship between the size of a conflict zone and the intersection angle of the two flows. Such a relationship guides to find an optimal configuration for intersecting aircraft flows. An example involving n converging flows of aircraft demonstrates the efficiency of the proposed configuration of intersections: the result of conflict resolution shows a greatly reduced traffic complexity compared with the solution derived from our previous study. the complexity metric is reduced from O(n^4) to O(n^2).

WA7 King Salmon

Weather Response Systems (Regular Session)

09:00-09:18 WA7.1

907-Plow - Anchorage's Approach to Real-Time Snowplow Tracking, pp. 1453-1458

Menard, Timothy	Univ. of Alaska, Anchorage
Lund, John	Univ. of Alaska Anchorage
Miller, Jeffrey	Univ. of Alaska Anchorage
Petersen, Todd	Univ. of Alaska Anchorage

We present a novel approach to tracking heavy machinery used as snowplows for the improvement of commuter safety. We have developed hardware designed for universal installation in snowplows that relay location and plow position data without human interaction over a cellular network to the real-time traffic simulator FreeSim [1-3]. FreeSim analyzes the data and overlays it onto Google Maps [4] by color-coded lines displaying the time elapsed since the roadway was last plowed. The plow position is determined utilizing magnetic fields between the plow blade and a stationary mount on the snowplow. By publicly displaying this information we aim to educate the end user with the current reported road conditions.

09:18-09:36 WA7.2

Impact Assessment of Network Reliability with Route Information under Severe Weather, pp. 1459-1464

Ho, Wei-Ming	National Cheng Kung Univ.
Chen, Li-Wen	Chung Hua Univ.
Hu, Ta-Yin	National Cheng Kung Univ.

Climate change and severe weather impacts on transportation and infrastructure have become global and environmental issues in the whole world. All human and transportation infrastructure systems are affected by climate change. Taiwan was hit by Typhoon Morakot and it caused a flood disaster in August 2009. This research focuses on the network reliability assessment with route information under severe weather. Two indexes are proposed to examine network reliability under route information, including: connectivity reliability and travel time reliability. Numerical experiments are conducted based on a real traffic network, the Jiaxian network, to illustrate the impact assessment of network reliability.

09:36-09:54 WA7.3

A Prototype for a Real-Time Weather Responsive System, pp. 1465-1470

Krings, Axel	Univ. of Idaho
Serageldin, Ahmed	Univ. of Idaho
Abdel-Rahim, Ahmed	Univ. of Idaho

This paper presents a prototype of a secure, dependable, real-time weather-responsive system. The prototype performs two operations: 1) it accesses weather information that provides near-real-time atmospheric and pavement observations and 2) it adapts signal timing in response to inclement weather. Since this real-time control system operates in a critical infrastructure, it must be designed with built-in security and survivability mechanisms. For this purpose a software architecture is presented that uses real-time monitoring to detect precedence violations and off-nominal system execution in order to provide effective contingency management. The focus of these systems is the autonomous recognition and reaction to execution patterns that have not been previously observed and thus fall outside of the known behavior. Because the described system has very similar requirements to other traffic control applications, it serves as a milestone in the development of secure and dependable real-time traffic control systems.

09:54-10:12 WA7.4

Simulation Analysis of Longitudinal Ventilation System with Jet Fan Speed Control for MPC Strategy in a Road Tunnel, pp. 1471-1476

Tan, Zhen	Zhejiang Univ.
Huang, Zhiyi	Zhejiang Univ.
Wu, Ke	Zhejiang Univ.
Xu, Leiting	Hang Zhou Urban Infrastructure Construction and Development Cent

To make the longitudinal ventilation systems more efficient and energy saving in road tunnels, it is being combined with typical model predictive control (MPC) strategies. Good application of such method is based on a comprehensive understanding of the system characteristics. Using CFD (Computational Fluid Dynamics) simulation, step response model is chosen to describe the dynamic behaviors of the system in a road tunnel with comprehensive health-related indexes which is difficult to obtain by field measurement. The results show that the “Fan Model”, which characterizes the effect of jet speed on CO (carbon monoxide) concentration, is approximately bilinear within fan's economical working range and system settling time is longer when jet speed decreases than it increases. The “Tunnel tube model”, which characterizes the effect of traffic intensity on CO concentration, links to traffic flow features, and has a similar settling time in normal operation and a traffic-speed-related delay time when maximum CO concentration is considered. This can provide guidance or index to control the tunnel ventilation system economically and useful data to implement MPC strategy in the system.

WA8 Lupine

Traffic Data Fusion (Regular Session)

09:00-09:18 WA8.1

Traffic State Estimation Based on Data Fusion Techniques (I), pp. 1477-1482

Cipriani, Ernesto	Univ. di Roma Tre.

Gori, Stefano	Univ. di Roma Tre.
Mannini, Livia	Univ. di Roma Tre.

The capability to detect and/or forecast traffic condition is of utmost importance. Recent advances in technology have made available numerous new monitoring systems, such as probe vehicles. Together with traditional volume and time mean speed measurements relative to a local section monitored continuously in time, probe vehicles provide additional type of data, such as space mean speed and travel time, relative to road segments monitored in specific time intervals. Therefore, the aim of this paper is to study how to exploit available information detected by new monitoring devices in the estimation of traffic flow conditions. Different data fusion techniques have been analyzed, such as measurement data fusion and state vector fusion. Several simulations have been carried out in a test network, traveled by probe vehicles and constituted of 9 cells with an on ramp and an off ramp and with two fixed traffic sensors located in two different cells. More promising results have been obtained in the case of measurement data fusion rather than state vector fusion.

09:18-09:36 WA8.2

Current State and Future Outlook of Traffic Data Fusion in London, pp. 1483-1488

Hu, Jun	Imperial Coll. London
Kaparias, Ioannis	City Univ. London
Bell, Michaeal Geoffrey Harrison	Imperial Coll. London

Metropolitan areas today have become more than ever saturated with various types and sources of real-time data. Yet, the unsolved practical challenge how to most effectively combine data sources currently prevents the wide use of this data as a powerful tool to both improve the quality of the transport supply and to influence travel demand. Focusing on London, this paper investigates the current state and attempts to give an outlook into the future of traffic data fusion in dense urban network environments. Successes and gaps in the current state are identified, and extensions are proposed, along with respective deployment scenarios and impacts assessment.

09:36-09:54 WA8.3

First Order Velocity Based Travel Time Model, pp. 1489-1494

Farokhi Sadabadi, Kaveh	Univ. of Maryland
Haghani, Ali	Univ. of Maryland

A general first-order model relating directional derivatives of travel time with speed at each point in the time-space domain is used in speed based travel time estimation. Due to its partial differential equation (PDE) form, this model makes it possible to estimate travel times without the need for trajectory construction based on speeds which is a cumbersome integration operation. A forward time backward space (FTBS) finite difference scheme is presented to approximate the general model. While the general model and its corresponding FTBS solution scheme are designed for smooth situations, the traffic stream is replete with discontinuities especially as congestion increases. For these situations an equivalent conservative model based on the first order continuum traffic flow model with Greenshields flux is proposed. A Godunov scheme is proposed to approximate the conservative model. US-101 dataset from NGSIM project is used to illustrate the performance of the proposed models. Three factors impacting the performance of the proposed schemes that is underlying speed estimate accuracy, traffic congestion level and discretization level are considered.

09:54-10:12 WA8.4

Road Intersection Intelligent Traffic Management Supported by Inter-Vehicle Sensor Fusion, pp. 1495-1502

Conde Bento, Luis Manuel	Inst. de Sistemas e Robotica
Nunes, Urbano	Inst. de Sistemas e Robotica
Parafita, Ricardo Jorge Pedrosa	Inst. de Sistemas e Robótica - Univ. de Coimbra

This paper describes a traffic management system applied to road intersections, namely roundabout and crossroads. A microscopic traffic simulator was developed to study traffic management techniques and evaluate their performance. The intelligent management techniques are aimed to minimize accidents, traffic congestion and consequently the environmental costs of road traffic. Each vehicle is modeled by an agent and each agent provides information depending on its vehicle sensors. The envisioned traffic management algorithm is supported by V2V and V2I communication, allowing the exchange of information, such as vehicle's pose, between vehicles and the intersection traffic management system. An accurate vehicle's pose is of extreme importance for the traffic management system, to achieve this accuracy various sensors are simulated and fusion algorithms presented, namely satellite navigation systems, wheel and steering wheel encoders. The sensorial fusion uses as well other auxiliary sources of information such as laser range finders and magnetic markers.

Attachment. This video shows the simulation of an Intelligent Traffic Management System (ITSM) in two types of intersections, roundabout and crossroads. In this video the proposed ITSM performance is compared to not using a Traffic Management System in three traffic fluxes density (low, medium and high). Additionally lengthy vehicle platoons arriving from one direction at either the roundabout and crossroads is also show in this video.Author contact information: L.C. Bento, R. Parafita and U. Nunes are with the ISR-Institute ofSystems and Robotics, University of Coimbra, Portugal.L.C. Bento is also with the Electrical Department, Polytechnic Instituteof Leiria, Portugal. email: conde, parafita, urbano@isr.uc.pt.

WB1 Chart

Driver Assistance Systems 1 (Regular Session)

11:00-11:18 WB1.1

Comparison of Model Reference and Map Based Control Method for Vehicle Stability Enhancement, pp. 1503-1508

Baek, Seunghwan	Inje Univ.
Son, Minhyuk	TNO Automotive Korea
Boo, Kwangsuk	Inje Univ.
Kim, Heungseob	Inje Univ.
Song, Jeonghoon	Tongmyong Univ.

A map based controller method to improve a vehicle lateral stability is proposed in this study and compared with the conventional method, a model referenced controller. A model referenced controller to determine compensated yaw moment uses the sliding mode method, but the proposed map based controller uses compensated yaw moment map acquired by vehicle stability analysis. Vehicle stability region is calculated by topological method based on trajectory reversal method. A two degree-of-freedom vehicle model and Pacejka's tire model used to evaluate the proposed map based controller.

The control performance of two methods are compared under various road conditions and driving inputs. Model referenced control method needs control input to satisfies linear reference model, and then generates unnecessary tire lateral forces, it may lead to worse performance than uncontrolled vehicle with step steer input in low friction road. As the results of simulation, map based controller seems to be better than model referenced in the viewpoint of stability.

11:18-11:36 WB1.2

Using Grid Maps to Reduce the Number of False Positive Measurements in Advanced Driver Assistance Systems, pp. 1509-1514

Nuss, Dominik	Univ. of Ulm
Reuter, Stephan	Univ. of Ulm
Konrad, Marcus	EvoBus GmbH - Daimler Buses
Munz, Michael	-
Dietmayer, Klaus	Univ. of Ulm

In Advanced Driver Assistance Systems (ADAS), object tracking is a crucial method to foresee dangerous situations. The Joint Integrated Probabilistic Data Association (JIPDA) offers the advantage, that existence and association uncertainties are considered in multi-target tracking. Recently, real-time capable implementations have been presented. However, the real-time capability is only given, if a certain number of tracked objects is not exceeded. Thus, so called false positive object detections yield a problem. To mitigate this issue, additional information about the vehicle's environment is used to identify measurements that are not relevant. The idea is to focus on moving objects for tracking. As an example, an Occupancy Grid Map is used to distinguish between stationary and non-stationary objects. The approach is evaluated using real-world data of a research vehicle.

11:36-11:54 WB1.3

Are Drivers Aware of Their Behavior Changes When Using In-Vehicle Systems, pp. 1515-1518

Yang, Yan	Univ. of Southampton
McDonald, Mike	Univ. of Southampton
Bryan, Reimer	Massachusetts Inst. of Tech.
Bruce, Mehler	Massachusetts Inst. of Tech.

The growing use of In-Vehicle Information Systems (IVISs) has become a safety concern due to the higher workload caused to drivers, which in turn affects their driving performance and visual behavior. This paper studied both drivers' self-perception of their behavior and the associated direct measurements while performing a set of In-Vehicle tasks in addition to driving. An experiment was conducted to compare these self-perceptions with their actual performance and visual behavior in real traffic conditions to improve the understanding of the associations and any gaps. The results suggest drivers are largely aware of the negative impacts of performing additional mental tasks whilst driving, although these tend to be over- estimated. More importantly, they under-estimate the effects of performing In-Vehicle tasks on their visual searching range, which reduced significantly. This has important safety implications, as driving requires intensive visual information processing, although the effects of different In-Vehicles tasks on various driver characteristics groups can be investigated using this objective and subjective comparison method.

11:54-12:12 WB1.4

Real-Time Vehicle Detection by Parts for Urban Driver Assistance, pp. 1519-1524

Sivaraman, Sayanan	Univ. of California at San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

In this study, we propose a novel, lightweight approach to real-time detection of vehicles using parts at intersections. Intersections feature oncoming, preceding, and cross traffic, which presents challenges for vision-based vehicle detection. Ubiquitous partial occlusions further complicate the vehicle detection task, and occur when vehicles enter and leave the camera's field of view. To confront these issues, we independently detect vehicle parts using strong classifiers trained with active learning. We match part responses using a learned matching classification. The learning process for part configurations leverages user input regarding full vehicle configurations. Part configurations are evaluated using Support Vector Machine classification. We present a comparison of detection results using geometric image features and appearance-based features. The full vehicle detection by parts has been evaluated on real-world data, runs in real time, and shows promise for future work in urban driver assistance.

WB2 Denali

Driver Assistance Systems 2 (Regular Session)

11:00-11:18 WB2.1

An Analysis on Users' Evaluation for Self-Balancing Two-Wheeled Personal Mobility Vehicles, pp. 1525-1530

Ando, Ryosuke	TTRI (Toyota Transportation Res. Inst.
Li, Ang	Urban Transport Center, Ministry of Housing and Urban-RuralDevel

In order to promote the personal mobility vehicles including the self-balancing two-wheeled one and the three wheeled one in Japan, the authors organized an event for experiencing them. This paper focuses on the self-balancing two-wheeled personal mobility vehicles. We aim to discuss about the operability, acceptability and effectiveness in terms of an analysis on the users' evaluation obtained by a questionnaire which were conducted after their experiencing.

11:18-11:36 WB2.2

Fault-Tolerant Controller Design for Automated Guided Vehicle Systems Based on Petri Nets, pp. 1531-1536

Yan, Jiaxiang	Indiana Univ. Univ. Indianapolis (IUPUI)
Li, Lingxi	Indiana Univ. Univ. Indianapolis (IUPUI)

In this paper, we propose an approach for the design of fault-tolerant controllers for automated guided vehicle systems (AGVs) that are modeled by Petri nets. In particular, we consider multiple faults detection and identification in Petri nets that have state machine structures (i.e., every transition in the net has only one input place and one output place). We develop an approximation algorithm to design the fault-tolerant Petri net controller so as to minimize the sum of the arc weights in the (input and output) incident matrices of the redundant controller. A design example for an AGV system is also provided to illustrate our approach.

11:36-11:54 WB2.3

Reachability Analysis of Cooperative Adaptive Cruise Controller, pp. 1537-1542

Kianfar, Roozbeh	Chalmers Univ. of Tech.
Falcone, Paolo	Chalmers Univ. of Tech.
Fredriksson, Jonas	Chalmers Univ. of Tech.

In this paper, a set based approach to safety analysis of Adaptive Cruise Control (ACC) and Cooperative Adaptive Cruise Control (CACC) is presented. Reachability anal- ysis techniques are used to compare the minimum safe inter-vehicle distances which can be achieved with ACC and CACC controllers. Not surprisingly, the results indicate that a shorter inter-vehicle distance can be achieved with a CACC controller. The presented method can also be used to design the required inter-vehicle distance for a given controller. Furthermore, we show how backward reachability analysis and invariant set theory can be used to find the Maximal Asymptotic Safe Set. This is defined as a set of position error, relative speeds and acceleration, which a given controller is guaranteed to control to the desired speed and inter-vehicle distance, while fulfilling vehicle physical constraints and avoiding rear-end collisions with the preceding vehicle. The calculation of the Maximal Asymptotic Safe Set is demonstrated for ACC and CACC controller designed based on mixed H2/∞ state feedback. Finally, the calculation of the Maximal Asymptotic Safe Set is extended to the case of vehicle model uncertainties.

11:54-12:12 WB2.4

Driver Assistance Systems Modeling by Model Predictive Control, pp. 1543-1548

Wang, Meng	Delft Univ. of Tech.
Daamen, Winnie	Delft Univ. of Tech.
Hoogendoorn, Serge	Delft Univ. of Tech.
van Arem, Bart	Delft Univ. of Tech.

Recently, an optimal control framework has been put forward to model human driver behavior and Advanced Driver Assistance Systems (ADAS). Although the models are shown to be face valid, applications are limited to the open-loop optimal control problem, which are based on the assumption that a driver expects a certain dynamic speed profile of his predecessor. While human drivers are assumed to be good in anticipating traffic, ADAS are poor at predicting the dynamics of other vehicles, due to a limited looking-ahead range and errors of sensors and actuators. This contribution furthers the optimal control framework to model automatic ADAS vehicles by relaxing the assumption that ADAS vehicles can predict the dynamics of other vehicle and solving the optimal control problem in a receding horizon way. This work assumes that within a prediction horizon, other vehicles are driving at stationary conditions (zero accelerations). An ADAS vehicle predicts system dynamics based on this assumption and makes control decisions to optimize its cost. The modeling framework is applied to design ACC systems and EcoACC systems, where multiple control objectives including safety, efficiency and sustainability are taken into account. The prediction horizon is tuned by face validating the behavior of a controlled vehicle. Simulation comparisons show that EcoACC systems result in higher fuel efficiency and a smoother vehicular behavior compared to ACC systems.

WB3 Dillingham

Vehicle Localization and Autonomous Navigation 2 (Regular Session)

11:00-11:18 WB3.1

Positioning Accuracy Improvement Via Distributed Location Estimate in Cooperative Vehicular Networks, pp. 1549-1554

Liu, Kai	Nanyang Tech. Univ.
Lim, Hock Beng	Intelligent Systems Centre, Nanyang Tech. Univ.

The development of cooperative vehicle safety (CVS) applications, such as collision warnings, turning assistants, and speed advisories, etc., has received great attention in the past few years. Accurate vehicular localization is essential to enable these applications. In this study, motivated by the proliferation of the Global Positioning System (GPS) devices, and the increasing sophistication of wireless communication technologies in vehicular networks, we propose a distributed location estimate algorithm to improve the positioning accuracy via cooperative inter-vehicle distance measurement. In particular, we compute the inter-vehicle distance based on raw GPS pseudorange measurements, instead of depending on traditional radio-based ranging techniques, which usually either suffer from high hardware cost or have inadequate positioning accuracy. In addition, we improve the estimation of the vehicles' locations only based on the inaccurate GPS fixes, without using any anchors with known exact locations. The algorithm is decentralized, which enhances its practicability in highly dynamic vehicular networks. We have developed a simulation model to evaluate the performance of the proposed algorithm, and the results demonstrate that the algorithm can significantly improve the positioning accuracy.

11:18-11:36 WB3.2

Communicationless Navigation through Robust Visual Odometry, pp. 1555-1560

Van Hamme, David	Univ. Coll. Ghent
Veelaert, Peter	Ghent Univ. - Univ. Coll. Ghent
Philips, Wilfried	Ghent Univ. IBBT

GPS navigation is often found undependable in urban situations where tall structures occlude large parts of the sky. To keep accurate position in these situations, we need an alternative method. We propose a novel visual odometry method that is shown to provide reliable relative motion estimation in typical urban road driving using a single camera. While the short-term accuracy is good, relative motion estimation by itself is susceptible to drift and therefore insufficient to provide good long-term absolute position estimates. To overcome this drift, we propose to warp the visual odometry output to a stored map. This warping must be able to cope with temporary discrepancies between visual odometry and map data. The proposed mapping does not make a hard decision about road position, but instead entertains all plausible hypotheses about the followed trajectory and their associated warping costs. Evaluation on real test sequences proves that the method succesfully eliminates drift, and on average stays within 7 metres of simultaneously recorded GPS data. This proves that the combined visual odometry and mapping are sufficient to provide positioning with comparable accuracy to GPS in those situations when GPS is unavailable.

11:36-11:54 WB3.3

Lightweight Lane Positioning of Vehicles Using a Smartphone GPS by Monitoring the Distance from the Center Line, pp. 1561-1565

Sekimoto, Yoshihide	Univ. of Tokyo
Matsubayashi, Yutaka	Kokusai Kogyo Co., Ltd.
Yamada, Harutoshi	Center for Spatial Information Science, Univ. of Tokyo
Imai, Ryuichi	National Inst. of Land and Infrastructure Management, MLIT
Usui, Tomotaka	Center for Spatial Information Science, Univ. of Tokyo
Kanasugi, Hiroshi	Inst. of Industrial Science, Univ. of

Tokyo

This paper presents a simple method for using the separation distance (offset) between a smartphone GPS and the center line on a digital road map to determine the lane position of a car. The method was verified.

11:54-12:12 WB3.4

Illumination Robust Road Detection Using Geometric Information, pp. 1566-1571

Oh, Changbeom Yonsei Univ.
Son, Jongin Yonsei Univ.
Sohn, Kwanghoon Yonsei Univ.

Road detection is an important task in intelligent transportation system (ITS). Over the past few decades, several vision-based approaches for road detection have been proposed and most of them are based on color information. However, color information may result in false road detection under variation of illumination conditions. To deal with illumination problems, we propose an illumination invariant road detection method using geometric information. By incorporating geometric information with a color-based road probability map, the proposed method robustly detect road regions on real scene containing variation of illumination such as shadow and mixed artificial lights. Experimental results show that the proposed method outperforms the conventional methods.

WB4 Fireweed

ITS Implementations 1 (Regular Session)

11:00-11:18 WB4.1

A Distributed Algorithm for Adaptive Traffic Lights Control, pp. 1572-1577

Faye, Sébastien Telecom ParisTech
Chaudet, Claude Telecom ParisTech
Demeure, Isabelle Télécom ParisTech

In this paper, we address the problem of controlling traffic lights at an intersection with a spatially distributed sensor network. We propose a sensor network architecture that does not depend on a centralized coordinator and we separate logically it into 4 levels of hierarchy. On this architecture, we define and evaluate through simulations an adaptive traffic light control algorithm. Based on two main objectives, this algorithm decides dynamically of the green lights sequences by selecting the movements composing each phase and its duration. Simulation results show that this algorithm, if properly tuned, has the capacity to reduce average waiting time at an intersection, while avoiding starvation.

11:18-11:36 WB4.2

DVS: A Distributed Virtual Signboard for Information Dissemination and Preservation in Vehicular Networks, pp. 1578-1583

Hu, Zhengqing Nanyang Pol.
Motani, Mehul National Univ. of Singapore

With increasing affluence and growing urban populations, traffic congestion is a world-wide problem and affects almost everybody. One way to mitigate this problem is to provide real-time traffic information to drivers. This will allow them to make better travel and navigation decisions, such as avoiding congested areas or getting out of blocked lanes. In this paper, we consider a fully distributed information access, dissemination and preservation protocol for road traffic conditions called the Distributed Virtual Signboard (DVS). The DVS disseminates real time local traffic information to drivers to alert them of possible disruptions, and keeps the information alive in the relevant area, in a fully distributed fashion. It provides a low cost and widely applicable solution because it does not require any dedicated roadside infrastructure. The DVS uses traffic in both directions on the road, to form a virtual information loop. Specifically, a double token ring is implemented to increase the information delivery ratio and to increase the robustness of the whole scheme. Analysis shows that, when congestion happens, which is normally associated with a situation of high car density, the probability of token handover failure is close to zero. We have also shown that, almost all cars passing through the virtual loop can get the traffic alert under DVS.

11:36-11:54 WB4.3

Vehicle Mass Estimation Using a Total Least-Squares Approach, pp. 1584-1589

Rhode, Stephan Karlsruhe Inst. of Tech.
Gauterin, Frank Karlsruhe Inst. of Tech.

We introduce an incremental total least-squares vehicle mass estimation algorithm, based on a vehicle longitudinal dynamics model. Available control area network signals are used as model inputs and output. In contrast to common vehicle mass estimation schemes, where noise is only considered at the model output, our algorithm uses an errors-in-variables formulation and considers noise at the model inputs as well. A robust outlier treatment is realized as batch total least-squares routine and hence, the proposed algorithm works in a superior way on a broad range of vehicle acceleration. The results of six test runs on various vehicle masses show highly accurate mass estimation results on high and low dynamics of vehicular operation.

11:54-12:12 WB4.4

Application of Reinforcement Learning with Continuous State Space to Ramp Metering in Real-World Conditions, pp. 1590-1595

Rezaee, Kasra Univ. of Toronto
Abdulhai, Baher Univ. of Toronto
Abdelgawad, Hossam Univ. of Toronto

In this paper we introduce a new approach to Freeway Ramp Metering (RM) based on Reinforcement Learning (RL) with focus on real-life experiments in a case study in the City of Toronto. Typical RL methods consider discrete state representation that lead to slow convergence in complex problems. Continuous representation of state space has the potential to significantly improve the learning speed and therefore enables tackling large-scale complex problems. A robust approach based on local regression, named k nearest neighbors temporal difference (kNN-TD), is employed to represent state space continuously in the RL environment. The performance of the new algorithm is compared against the ALINEA controller and typical RL methods using a micro-simulation testbed in Paramics. The results show that RM using the kNN-TD method can reduce total network travel time by 44% compared to the do-nothing case (without RM) and by 17% compared to ALINEA.

WB5 Iliamna

Simulation and Modeling 3 (Regular Session)

11:00-11:18 WB5.1

A K-Nearest Neighbor Locally Weighted Regression Method for Short-Term Traffic Flow Forecasting, pp. 1596-1601

Li, Shuangshuang	Inst. of Automation, Chinese Acad. of Sciences
Shen, Zhen	Inst. of Automation, Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of Sciences
Xiong, Gang	Inst. of Automation, Chinese Acad. of Sciences

In this paper, a k-nearest neighbor locally weighted regression method (k-LWR) is proposed to forecast the short-term traffic flow. Inspired by k-nearest neighbor (k-NN) method, the traffic flows which have the same clock time with the current traffic flow are viewed as neighbors. The traffic flows which have the same clock time with the predicted traffic flow are viewed as the outputs of the neighbors. The neighbors most similar to the current traffic flow are viewed as nearest neighbors. It is observed that each nearest neighbor has different similarity with the current traffic flow, and the similarity is relevant to the contribution of the nearest neighbor's output to predicted traffic flow. The greater the similarity is, the greater the contribution is. These contributions of the nearest neighbors' outputs are obtained by the locally weighted regression (LWR) method. In this way, k-LWR uses less data, but uses it more effectively. We use the root mean square error (RMSE) between the actual traffic flow and the predicted traffic flow as the measurement. The proposed method is tested on the actual data from Xingye intersection and Feihu intersection in Jiangsu Province in China. The experimental results show that k-LWR has 20% and 24% improvement over the pattern recognition algorithm (PRA), 26% and 30% improvement over k-NN, for the two intersections, respectively.

11:18-11:36 WB5.2

Scalability in Urban Autonomy through Overlapping Decompositions of Hybrid-State Systems, pp. 1602-1607

Kurt, Arda	The Ohio State Univ.
Ozguner, Umit	The Ohio State Univ.

This study investigates the issue of scalability for autonomous vehicles and systems in urban environments. As the number of agents such as infrastructure elements and communication-capable vehicles increases, the systems that are designed to sense/track/control these agents get burdened under the increased number of tracks/measurements. By employing the concept of overlapping decompositions, it is possible to divide and parallelize the workload, with limited degradation of overall system performance. The paper demonstrates this methodology on simple urban scenarios, involving autonomy of infrastructure elements and autonomous vehicle interactions.

11:36-11:54 WB5.3

Networked Driving Simulator Based on SIGVerse and Lane-Change Analysis According to Frequency of Driving, pp. 1608-1613

Bando, Takashi	DENSO Corp.
Shibata, Tomohiro	Nara Inst. of Science and Tech.

Driving includes many social factors, such as interaction with other vehicles. In this study, we attempted to examine the social interactions in driving through developing a novel driver assistance system; this system is intended to aid nonexpert drivers in assessing such interactions. We first present a novel networked driving simulator based on SIGVerse which is a software platform for research that adopts a constructive or computational approach. We investigated the differences in driving behaviors when changing lanes, which is a basic type of driving behavior that includes traffic interaction. We employed 30 subjects and each subject took part in tests under four different conditions to examine driving behavior in terms of driving experience. Our results show that frequent drivers achieved smoother lane changes by appropriately controlling the timing of lane changing than drivers who rarely drive or who lack a driving license.

11:54-12:12 WB5.4

Parameter Sensitivity Analysis of a Cooperative System by Means of Microscopic Traffic Simulation, pp. 1614-1619

Riemann, Raffaela	TUM CREATE - Centre for Electromobility
Baur, Mathias	Tech. Univ. München
Fullerton, Matthew	Tech. Univ. München

The scope of the research study is to evaluate the parameter sensitivity of certain cooperative systems' parameters within microsimulation scenarios. A methodology and testing framework for the evaluation of the parameter sensitivity is developed. The parameter sensitivity of cooperative of a Broken Down Vehicle Warning function is tested and analyzed. Within this research, it was shown that certain parameter variations have significant effects on the overall traffic, showing that the effects of parameter variations shall be taken into consideration when performing microsimulation of cooperative systems. The sensitivity analysis showed that the proportion of C2X vehicles and the communication range are generally sensitive to variations. These results are especially interesting for electric vehicles as cooperative system can be enablers for the electric vehicles. Furthermore electric vehicles will benefit from an increased driving efficiency.

WB6 Katmai

Travel Time Estimation and Its Applications (Regular Session)

11:00-11:18 WB6.1

Towards an Uncertainty Aware Short-Term Travel Time Prediction Using GPS Bus Data: Case Study in Dublin, pp. 1620-1625

Trigueiro Baptista, Arthur	Royal Inst. of Tech. KTH, Sweden
Bouillet, Eric	IBM Res.
Pompey, Pascal	IBM Res.

In this paper we propose and study the performances of a bus travel times prediction model using real bus location data from the city of Dublin. The proposed prediction model uses a modified version of the K-Nearest Neighbors algorithm, KNN, algorithm and exhibits a significant improvement over the baseline KNN. We also investigate the benefits of decomposing travel times in three components: running time, dwell time at bus stops and time stopped at traffic lights. We discuss that most of the uncertainty on the travel times comes from time spent at bus stops and traffic lights, and prediction of running time only is much improved due to the reduced uncertainty at bus stops and traffic lights. Finally we show the need of a prediction algorithm for time spent at bus stops and

traffic lights that added to the prediction of running time would allow for an uncertainty aware travel time predictor.

11:18-11:36 WB6.2

Reliability in Stochastic Time-Dependent Traffic Networks with Correlated Link Travel Times, pp. 1626-1631

Dong, Wei	Swinburne Univ. of Tech.
Li, Minyi	Swinburne Univ. of Tech.
Vo, Quoc Bao	Swinburne Univ. of Tech.
Vu, Hai L.	Swinburne Univ. of Tech.

Optimal route selection with reliable expected travel time has been a focus of research in transportation networks where the reliability is subject to many uncertainty factors such as traffic incidents or recurring traffic congestions. In this paper we develop an approximation method to obtain the reliability of a route travel time in a stochastic time-dependent traffic network. The proposed method takes into consideration the probabilistic nature of the travel time on individual links and their spatial correlation between adjacent links of a selected route. Reliability calculations and the accuracy of our approximation are discussed via a simple illustrative example and a larger network.

11:36-11:54 WB6.3

Unscented Kalman Filter for Urban Link Travel Time Estimation with Mid-Link Sinks and Sources, pp. 1632-1637

Hage, Ré-mi	IFSTTAR
Bétaille, David	IFSTTAR
Peyret, Francois	IFSTTAR
Meizel, Dominique	ENSIL
Smal, Jean-christophe	IFSTTAR

To estimate the link travel time, the classical analytical procedure uses cumulative plots at upstream and downstream locations. This procedure is vulnerable in urban networks mainly due to significant flow to and from mid-link sinks and sources. One of the important developments recently done on this topic has yielded to the CUPRITE methodology. This method is derived from the classical analytical procedure. It integrates probe vehicle data to correct deterministically the upstream cumulative plot to match the information of probe vehicles travel times, whilst the downstream cumulative plot is kept unchanged. The algorithm proposed and validated in this research estimates urban links travel times based on an unscented Kalman filter (UKF). This algorithm integrates stochastically the vehicle count data from underground loop detectors at the end of every link and the experienced travel time from probe vehicles. The proposed methodology, which can be used for travel time estimation in real-time, is compared to the classical analytical procedure and to the CUPRITE method in case of mid-link perturbation. Along to its lower sensitivity than CUPRITE, the UKF algorithm makes it possible detection and exclusion of outliers from both data sources.

11:54-12:12 WB6.4

Practical Time-Dependent and Stochastic Routing with Historical Measurements of Travel Times, pp. 1638-1643

Demeyer, Sofie	Ghent Univ.
Audenaert, Pieter	Ghent Univ.
Logghe, Steven	Be-Mobile
Pickavet, Mario	Ghent Univ.
Demeester, Piet	Ghent Univ.

We present a case study of an industrial-strength time-dependent and stochastic routing system, which makes use of predicted travel times for road networks. Next to a short theoretical consideration, the major focus of this research was on the practical implementation of the system, which aims at efficiently routing in a road network making use of stochastic travel time information. Using historical measurements collected by cell phone and GPS tracking techniques, we derive time-dependent travel time probability distributions for all links in our network. Making use of these distributions, one can accurately determine the travel time distributions for whole routes. In this way, the chance of arriving in time at the destination can be optimized. Moreover, a number of suggestions, not yet implemented due to various causes, for extending and improving the platform are presented. The results of this work are deployed by the industrial partners involved in this research.

12:12-12:30 WB6.5

Evaluation of Travel Time Estimation Based on LWR-V and CTM-V: A Case Study in Stockholm, pp. 1644-1649

Allström, Andreas	Linköping Univ.
Gundlegård, David	Linköping Univ.
Rydergren, Clas	Linköping Univ.

Real-time estimations of current and future traffic states are an essential part of traffic management and traffic information systems. Within the Mobile Millennium project considerable effort has been invested in the research and development of a real-time estimation system that can fuse several sources of data collected in California. During the past year this system has been adapted to also handle traffic data collected in Stockholm. This paper provides an overview of the model used for highways and presents results from an initial evaluation of the system. As part of the evaluation process, GPS data collected in an earlier field-test and estimations generated by the existing system used by the TMC in Stockholm, are compared with the estimations generated by the Mobile Millennium system. Given that the Mobile Millennium Stockholm system has not undergone any calibration, the results from the evaluation are considered promising. The estimated travel times correspond well to those measured in the field test. Furthermore, the estimations generated by the Mobile Millennium system can be regarded as superior to those of existing traffic management system in Stockholm. The highway model was found to perform well even with a reduction in the number of sensors providing data. The findings of this study indicate the robustness of the Mobile Millennium system and demonstrate how the system can be migrated to other geographical areas with similar sources of available data.

WB7 King Salmon

Traffic Flow Management (Regular Session)

11:00-11:18 WB7.1

Compare Linear Interpolation and Adaptive Smoothing Methods on Traffic Flow Information Reconstruction, pp. 1650-1655

Guo, Wei	Tsinghua Univ.
Wang, Qi	Tsinghua Univ.
Li, Zhiheng	Tsinghua Univ.
Zhang, Yi	Tsinghua Univ.
Li, Li	Tsinghua Univ.
Zhang, Zuo	Tsinghua Univ.

With rapid development of transportation system, traffic information collection, which provides accurate and reliable traffic data, receives more and more attentions. However, under practical conditions, most roads and freeways are equipped with limited amount of loop detectors. Thus, researchers are delving into traffic information reconstruction by utilizing limited information. In this paper, we compare the classical linear interpolation method and a special nonlinear interpolation method, the adaptive smoothing method, on reconstructing the spatial-temporal dynamics of traffic flow rate, density and velocity. Tests on NGSIM dataset show that both methods are effective.

11:18-11:36 WB7.2

The Optimal Discretized Timing Plan for Individual Oversaturated Intersections, pp. 1656-1660

Zou, Bin	Tsinghua Univ.
Hu, Jianming	Tsinghua Univ.
Zhang, Yi	Tsinghua Univ.

The topic of traffic control for individual intersections has been studied for many years. A lot of work has been devoted to designing signal timing plans able to make things better under oversaturated situations. In this paper, we discuss how to discretize Gazis two-stage control strategy that had been introduced in [1] for a single oversaturated intersection. We give an optimal discrete timing plan and prove that it gives the least delay.

11:36-11:54 WB7.3

Towards a Realistic Optimization of Urban Traffic Flows, pp. 1661-1668

Angius, Fabio	Univ. of California
Reineri, Massimo	Pol. di Torino
Chiasserini, Carla Fabiana	Pol. di Torino
Gerla, Mario	Univ. of California
Pau, Giovanni	Univ. of California

In spite of recent advances in Intelligent Transport, vehicular traffic dynamics are still hard to represent and analyze. Most of the previous work on traffic regards highways or single lanes where vehicles interact in one dimension. Models for multi-dimensional vehicle-to-vehicle interactions and models for urban intersections are quite complicated and hardly applicable on a large scale. Nonetheless, urban traffic jams are an actual problem that requires a solution. This paper proposes a method to optimize urban traffic layout using basic heuristics and computationally efficient simulations. Instead of modeling an entire urban map with hundreds of intersections, each typology of intersection is simulated in order to understand how it responds to different traffic patterns and intensities. This knowledge is leveraged to allow the computation of minimal delay route on the complete road map. In order to validate our model, we use the solution obtained with our heuristic to derive the average travel delay through simulation on realistic Manhattan topologies with different intersection types.

11:54-12:12 WB7.4

Traffic Incident Detection by Multiple Kernel Support Vector Machine Ensemble, pp. 1669-1673

Xiao, Jianli	Shanghai Jiao Tong Univ.
Liu, Yuncai	Shanghai Jiao Tong Univ.

In order to further improve the performances and stabilization of multiple kernel support machine (MKL-SVM) in traffic incident detection, this paper presents a new algorithm called MKL-SVM ensemble. The proposed algorithm uses the bagging technique to train different individual MKL-SVM classifiers, then takes the weighted voting way to combine the output of the individual MKL-SVM classifiers. Some experiments have been performed to evaluate the performances of the four algorithms: standard SVM, SVM ensemble, MKL-SVM and the proposed algorithm (MKL-SVM ensemble). The experimental results show that the proposed algorithm has the best comprehensive performances in traffic incident detection. More important, the performances of the proposed algorithm are very stable. Meanwhile, in order to achieve relatively better performances, the proposed algorithm need less individual classifiers to construct the ensemble than SVM ensemble algorithm. Thus, compared to SVM ensemble algorithm, the complexity of the ensemble classifier of the proposed algorithm is reduced greatly. Conveniently, the proposed algorithm also avoids the burden of selecting the appropriate kernel function and parameters.

WB8 Lupine

Analysis Using Probe Vehicle Data (Regular Session)

11:00-11:18 WB8.1

Queue Length Estimation Using Conventional Vehicle Detector and Probe Vehicle Data, pp. 1674-1681

Badillo, Brian E.	Harmonia Holdings Group, LLC
Rakha, Hesham A.	Virginia Tech.
Rioux, Thomas W.	Rioux Engineering & Harmonia Holdings Group
Abrams, Marc	Harmonia Holdings Group, LLC

The paper presents IntelliFusion, an algorithm that fuses inductive loop detector data with real-time vehicle probe data obtained from Connected Vehicles to enhance back of the queue estimates. The work also presents an evaluation of the data fusion algorithm using datasets produced by eTEXAS, a microscopic traffic simulation model for signalized intersections. Results of the evaluation show queue length estimates produced by the IntelliFusion algorithm are accurate to within the length of a single vehicle even at low levels of market penetration (e.g., LMP = 20%).

11:18-11:36 WB8.2

Wide-Area, Web-Based Mobility Analysis Using Probe Data, pp. 1682-1686

Pack, Michael	Univ. of Maryland Center for Advanced Transportation Technology

This paper describes a web-based visual analytics monitoring system for identifying major bottlenecks, reporting on travel time reliability, and displaying other congestion measures using private sector vehicle probe data fused with agency incident/event data where available. This system represents an exponential leap forward in capabilities to report on system performance in terms of speed and ease of access, usability, and overall data availability. This paper demonstrates how states are using the system to justify construction projects, demonstrate the benefits of transportation projects, identify areas for improvement, and analyze travel times using a variety of data sources, with an emphasis on vehicle probe data. The underlying system includes probe data from as early as 2008 through today that is being used to analyze trends from year-to-year, month-to-month, and day-to-day. The resulting suite of tools provide significant new capabilities to researchers and analysts that will likely fuel additional research.

11:36-11:54 WB8.3

Automatic Inference of Map Attributes from Mobile Data, pp. 1687-1692

Hofleitner, Aude	Univ. of California, Berkeley
Come, Etienne	UPE, IFSTTAR, GRETTIA
Oukhellou, Latifa	UPE, IFSTTAR, GRETTIA
Lebacque, Jean-Patrick	UPE, IFSTTAR, GRETTIA
Bayen, Alexandre	Univ. of California, Berkeley

The development and update of reliable Geographic Information Systems (GIS) greatly benefits Intelligent Transportation Systems developments including real-time traffic management platforms and assisted driving technologies. The collection and processing of the data required for the development and update of GIS is a long and expensive process which is prone to errors and inaccuracies, making its automation promising. The article introduces a method which leverages the emergence of sparsely sampled probe vehicle data to update and improve existing GIS. We present an unsupervised classification algorithm which discriminates between signalized road segments (as having a signal at the downstream intersection) and non-signalized road segments. This algorithm uses a statistical model of the probability distribution of vehicle location within a link, derived from hydrodynamic traffic flow theory. The decision of whether the link has a traffic signal or not is taken according to model selection criteria. Numerical results performed with sparsely sampled probe data collected by the Mobile Millennium system in the Bay Area of San Francisco, CA underline the importance of the problem addressed by the article to improve the accuracy and update signal information of GIS. They showcase the ability of the method to detect the presence of traffic signals automatically.

11:54-12:12 WB8.4

Robust Road Link Speed Estimates for Sparse or Missing Probe Vehicle Data, pp. 1693-1697

Widhalm, Peter	Austrian Inst. of Tech.
Piff, Markus	Austrian Inst. of Tech. (AIT)
Brändle, Norbert	Austrian Inst. of Tech.
Koller, Hannes	Austrian Inst. of Tech.
Reinthaler, Martin	Austrian Inst. of Tech.
Ponweiser, Wolfgang	Austrian Inst. of Tech.

Probe vehicles equipped with GPS can be used to permanently collect traffic speed information for an entire road network, and the statistical mean value of link speeds collected over time is often used as an estimator for mid-term predictions. For road links with sparse probe vehicle data, the estimated mean may be too inaccurate due to the low sample size, and speeds for road links with missing probe vehicle data must be imputed from other data. This paper proposes to apply a Gaussian-mixture based technique to increase the robustness of speed estimates. Typical shapes of the diurnal speed curve are learnt from historical data of all links in the road network. The model is able to provide robust estimates of mean speed curves based on only a few available observations and drastically reduces the amount of data needed to store them by 95 %. Experimental results on a comprehensive set of 857527 day speed curves show that the predictions are superior to traditional approaches based on aggregated or disaggregated historical mean values.

12:12-12:30 WB8.5

Path Inference of Low-Frequency GPS Probes for Urban Networks (I), pp. 1698-1701

Rahmani, Mahmood	KTH Royal Inst. of Tech.
Koutsopoulos, Haris N.	KTH Royal Inst. of Tech.

The use of probe vehicles in traffic management is growing rapidly. The reason is that the required data collection infrastructure is increasingly in place in urban areas with significant number of mobile sensors moving around covering expansive areas of the road network. The data is usually sparse in time and location. It usually includes only geo-location and timestamp. Extracting the paths taken by the vehicles is an important step in using this data. Such methods are referred to as map-matching or path inference. This paper introduces a path inference method for low-frequency probes and compares its performance with another recent method.

WC1 Chart

Driver Assistance Systems - Lateral Control (Regular Session)

14:00-14:18 WC1.1

Steering Assisting System for Obstacle Avoidance Based on Personalized Potential Field, pp. 1702-1707

Noto, Noriyasu	Nagoya Univ.
Okuda, Hiroyuki	Nagoya Univ.
Tazaki, Yuichi	Nagoya Univ.
Suzuki, Tatsuya	Nagoya Univ.

This paper presents the identification technique of the personalized potential map to design the obstacle avoidance assisting control. First of all, the personalized potential map, which is considered to represent the driver's risk feeling to environment is learned by using the obstacle avoidance driving data. Next, the reference path is calculated with gradient method considering the vehicle dynamics from identified potential field, and the avoidance assisting system is realized so as to track on the obtained path. Finally, the validity of the proposed assisting system is verified.

14:18-14:36 WC1.2

A New Nonlinear Observer of Sideslip Angle with Unknown Vehicle Parameter Using the Dual Unscented Kalman Filter, pp. 1708-1713

Cheng, Qi	Heudiasyc
Victorino, Alessandro	Univ. de Tech. de Compiegne, Departement de GenieInfor
Charara, Ali	HEUDIASYC UMR UTC/CNRS 6599

To improve the stability control of automotive engineering, the vehicle dynamic information, including vehicle motion states and key parameters of vehicle dynamic, is essential. Especially, the sideslip angle, an important variable of the vehicle state, is difficult to measure directly for technology or economic reason. What's more, some key parameters of vehicle system, such as the mass of vehicle, may vary significantly from one journey to the others, and require real-time estimation. This article is designed to propose a new nonlinear observer which can derive the state and unknown parameter of the vehicle dynamic system. This observer is based on the nonlinear double track model, in which the Dugoff model is used to describe the relation between the tire road force and the sideslip angle. The dual unscented Kalman filter is employed to get the states and the key parameters in the observer. Simulation results indicate that the new nonlinear observer works effectively and has big potential benefit in the real vehicle dynamic system.

14:36-14:54 WC1.3

Integrated Threat Assessment and Control Design for Roadway Departure Avoidance, pp. 1714-1719

Gray, Andrew	Univ. of California, Berkeley
Ali, Mohammad	Volvo Cars
Gao, Yiqi	Univ. of California, Berkeley
Hedrick, J. Karl	Univ. of California, Berkeley
Borrelli, Francesco	Univ. of California, Berkeley

This paper presents the design of an active safety system for prevention of unintended roadway departures. In normal driving conditions, the driver fully commands the vehicle while the safety system corrects the driver's steering and braking action in case there's a risk that the vehicle unintentionally departs the road. A model of the driver's nominal behavior is first estimated based on his observed behavior. A nonlinear model of the vehicle in closed loop with the driver is then used to reformulate the threat assessment and control problems as a combined optimization problem.The resulting predictive controller is always active and mode switching is not necessary. Experimental data collected using human drivers in a driver simulator, demonstrate the capability of the suggested controller to detect and avoid roadway departures while avoiding unnecessary interventions.

14:54-15:12 WC1.4

Model of Collision Avoidance with Lane Departure Warning in Real-World Departure Collisions with Fixed Roadside Objects, pp. 1720-1725

Kusano, Kristofer	Virginia Tech.
Gabler, Hampton Clay	Virginia Tech.

This study developed and presented a computational model of road departure collisions which used data collected from real-world crashes as the basis for simulations of collision avoidance for vehicles equipped with Lane Departure Warning (LDW) systems. Real-world collisions were extracted from a database of 890 serious road departure crashes with detailed reconstructions of the vehicle trajectory and impact locations. The model was developed using the simulation software PreScan (TASS Americas) and simulated driver steering maneuvers following a road departure and LDW. We used the model to simulate a subset of road departure collisions with objects close to the road and with little driver steering after the road departure. In our dataset, these crashes corresponded to approximately 26% of departures with available data and lane markings (47 cases). Between 3% and 5% of hazards were avoided with a LDW delivered at lane crossing. If the LDW was delivered 1 s prior to departure, between 19% and 34% of crashes were avoided. This model is a first step in a larger LDW benefits estimates study. Future models should include simulations of drivers who were steering prior to the crash without LDW, which were excluded from the current study.

15:12-15:30 WC1.5

Self-Defensive Coordinated Maneuvering of an Intelligent Vehicle Platoon in Mixed Traffic, pp. 1726-1733

Guo, Chunzhao	Toyota Tech. Inst.
Wan, Nianfeng	Clemson Univ.
Mita, Seiichi	Toyota Tech. Inst.
Yang, Ming	Shanghai Jiao Tong Univ.

Cooperative driving is a promising technology for reducing traffic jams, limiting CO2 emissions and reducing traffic accidents. With the future mixed traffic, the current platooning concept comes to its limitations when human-driven vehicles interfere with the platoon between the autonomous vehicles without negotiation. In this interfering situation, most of them have to break down into two platoons, which may ensure the safety while lose the efficiency. In this paper, we introduce a self-defensive coordinated maneuvering strategy to generalize platooning to situations with non-automated interfering vehicles in mixed traffic. It allows the vehicles in the platoon to observe the interfering vehicles' behaviors, predict their intentions, and then react by changing their platoon formations so as to keep such vehicles always out of the platoon. In the proposed framework, the platoon can not only "talk" and "listen" for cooperative driving based on the communication system, but also "guessing" and "reacting" to actively defend the completeness based on the on-board sensors. Therefore, higher safety and efficiency can be expected. Simulation results in various typical but challenging interfering situations with mixed traffic show the effectiveness of the proposed approach.

Attachment. This video shows the examples of the proposed self-defensive coordinated maneuvering of an intelligent vehicle platoon in mixed traffic, which provides a better understanding of the dynamic level of the platoon formation change. It also let the reader better understand how the interfering vehicle engage the manuever with the platoon.

WC2 Denali

Advanced Vehicle Technologies 2 (Regular Session)

14:00-14:18 WC2.1

Anti-Trap Protection for an Intelligent Smart Car Door System, pp. 1734-1740

Scharfenberger, Christian	Univ. of Waterloo
Chakraborty, Samarjit	Tech. Univ. München
Zelek, John	Univ. of Waterloo, Systems Design Engineering, Canada
Clausi, David	Univ. of Waterloo, Systems Design Engineering, Canada

A majority of driver assistance systems focuses on assisting the driver when the car is in motion. There is relatively less, to almost no work on assistance systems when the car is stationary. The focus of this paper is on such a system and describes the design and realization of a novel, camera-based anti-trap protection system for smart car doors. Our system uses a single omnidirectional camera that is integrated in each inner door of a vehicle, and detects obstacles such as fingers, hands or legs at the A and B-pillar, door sill and car door without any contact. This is an enhancement to currently available systems that require an active contact between obstacles and sensors in the door area for the detection of trapping. The paper also proposes a scheme for re-calibrating the camera position that may change due to vibrations during the life-time of the car door. Experiments on a fully realized car door prototype show that the proposed schemes prevent trapping by robustly detecting obstacles such as small fingers or hands in critical door regions, and output results in real-time. The latter is important when door users slam the car door. A first study with 20 test users showed that our system strongly supports the door users to prevent trapping.

14:18-14:36 WC2.2

Optimal Braking and Steering Control for Active Safety, pp. 1741-1746

Moshchuk, Nikolai	General Motors Company

Chen, Shih-Ken	General Motors Company
Zagorski, Chad	General Motors Company
Chatterjee, Aamarapali	General Motors Company

The paper summarizes the development of an optimal braking and steering control for collision avoidance maneuver. The goal is to minimize the distance to the target vehicle ahead of the host vehicle subject to vehicle and environment constraints. Comparative study of standalone steering versus braking in a collision avoidance maneuver is given and results are discussed. The collision avoidance steering maneuver is effective only when the forward velocity is above a certain limit dictated by the surface friction coefficient and vehicle/tire characteristics. The algorithms were implemented in Simulink and verified in CarSim. The results indicate that there is an optimal braking and steering control resulting in minimal distance needed for collision avoidance maneuvers.

14:36-14:54 WC2.3

Shared Control System to Safeguard Mobility of Wheeled, Actively Articulated Truck-Trailer Vehicles on Structured and Rough Terrain, pp. 1747-1752

Labenda, Patrick	Ruhr-Univ. Bochum

For transportation tasks predominantly wheeled vehicles are used. This is due to a wheel's easy construction, its simple actuation and control implementation as well as the fact that no energy is wasted to overcome gravitational effects. But wheeled vehicles are best suited for a use on prepared terrain and surfaces. Their mobility on unstructured and rough terrain is significantly limited. These limits can be overcome by the integration of active articulations which enable a vehicle system's reconfiguration and accommodation to various environmental conditions. The paper at hand describes a wheeled, actively articulated transportation system in form of a mobile robot and experimental small-scale model, respectively. The system is equipped with a shared control system to safeguard its efficient mobility with respect to performance indices maneuverability, terrainability and trafficability, both, on structured and rough terrain. The developed shared control system is introduced and first experimental results are presented.

14:54-15:12 WC2.4

In-Vehicle Speaker Recognition Using Independent Vector Analysis, pp. 1753-1758

Yamada, Toshiro	Univ. of California, San Diego
Tawari, Ashish	Univ. of California, San Diego
Trivedi, Mohan M.	Univ. of California at San Diego

As part of human-centered driver assist framework for holistic multimodal sensing, we present an evaluation of independent vector analysis for speaker recognition task inside an automotive vehicle. Independent component analysis-based blind source separation algorithms have attracted attentions in recent years in the application of speech separation and enhancement. Compared to the traditional beamforming technique, the blind source separation method may typically require less number of microphones and perform better under reverberant environment. We recorded two speakers in the driver and front-passenger seats talking simultaneously inside a car and used independent vector analysis to separate the two speech signals. In the speaker recognition task, we show that by training the model with the speech signals from the IVA process, our system is able to achieve 95 % accuracy from a 1-second speech segment.

WC3 Dillingham

Pedestrian Detection (Regular Session)

14:00-14:18 WC3.1

Early Detection of the Pedestrian's Intention to Cross the Street, pp. 1759-1764

Köhler, Sebastian	Univ. of Applied Sciences Aschaffenburg
Goldhammer, Michael	Univ. of Applied Sciences Aschaffenburg
Bauer, Sebastian	Friedrich-Alexander-Univ. Erlangen-Nuremberg
Doll, Konrad	Univ. of Applied Sciences Aschaffenburg
Brunsmann, Ulrich	Univ. of Applied Sciences Aschaffenburg
Dietmayer, Klaus	Univ. of Ulm

This paper focuses on monocular-video-based stationary detection of the pedestrian's intention to enter the traffic lane. We propose a motion contour image based HOG-like descriptor, MCHOG, and a machine learning algorithm that reaches the decision at an accuracy of 99 % within the initial step at the curb of smart infrastructure. MCHOG implicitly comprises the body language of gait initiation, especially the body bending and the spread of legs. In a case study at laboratory conditions we present ROC performance data and an evaluation of the span of time necessary for recognition. While MCHOG in special cases indicates detection of the intention before the whole body moves, on average it allows for detection of the movement within 6 frames at a frame rate of 50 Hz and an accuracy of 80 %. Feasibility of the method in a real world intersection scenario is demonstrated.

Attachment. The following video illustrates results of our work on detecting pedestrian's intention to cross the street.It consists of four sequences where the test persons start walking coming from standstill. Two sequences were capturedin the laboratory and two sequences at a real world intersection. Furthermore two of the sequences correspond to imagesequences in the paper to get a more detailed view.

14:18-14:36 WC3.2

Nighttime Pedestrian Detection by Selecting Strong Near-Infrared Parts and Enhanced Spatially Local Model, pp. 1765-1770

Lee, Yi-shu	National Taiwan Univ.
Chan, Yi-Ming	National Taiwan Univ.
Fu, Li-Chen	National Taiwan Univ.
Hsiao, Pei-Yung	National Univ. of Kaohsiung
Chuang, Li-An	National Taiwan Univ.
Chen, Yi-Hsiang	National Taiwan Univ.
Luo, Ming-Fang	Chung-Shan Inst. of Science and Tech.

We propose a nighttime pedestrian detection method for a moving vehicle equipped with a camera and the near-infrared lighting. The objects in the nighttime environment will reflect the infrared projected. In some cases, however, the clothes absorb most of the infrared and make the pedestrian partially invisible in that part. To deal with this, a part-based pedestrian detection method according to the feature points marked on parts is used. Due to high computation load, selection of effective parts becomes imperative. In this research work, we analyze the relations between the detection rate/processing time and different numbers/types of parts. Besides, traditional training of the part detector normally requires a large number

of occlusion samples. To overcome this problem, we learn the spatial relationship between every pair of two parts. The confidence of the detected parts can be enhanced even if some parts are occluded. While trying to refine pedestrians after detection, we use two filters and segmentation method to verify their bounding boxes. The proposed system is verified by experiments and appealing results have been demonstrated.

14:36-14:54 WC3.3

Video–based Pedestrian Head Pose Estimation for Risk Assessment, pp. 1771-1776

Schulz, Andreas — Robert Bosch GmbH

Stiefelhagen, Rainer — Fraunhofer-Inst. für Optronik, Systemtechnikund Bildauswertung

Pedestrian detection and action recognition is a demanding field in video-based driver assistance systems. Future systems not only try to detect pedestrians but also aim to predict the pedestrian's intention in order to guaranty the best safety for him/her and other traffic participants. Our contribution to that tendency consists of a method to reliably estimate the pedestrians' head pose in low resolution video sequences taken from an on-board camera. Assuming a pre-detected pedestrian, the head pose is initialized using normalized confidence values from a set of head pose detectors. Integrating the head pose predictions over time using particle--filtering will further result in a higher robustness and efficiency. Experiments on public available datasets (CHIL/CLEAR2007, CAVIAR) and real world scenarios show a performance improvement compared to single image based approaches. The developed method can be integrated easily into an overall system and will serve for a better pedestrian path prediction and intension estimation within risk assessment.

14:54-15:12 WC3.4

Comparison of Granules Features for Pedestrian Detection, pp. 1777-1782

Kao, Yu-Fu — National Taiwan Univ.

Chan, Yi-Ming — National Taiwan Univ.

Fu, Li-Chen — National Taiwan Univ.

Hsiao, Pei-Yung — National Univ. of Kaohsiung

Huang, Shih-Shinh — National Kaohsiung First Univ. of Science and Tech.

Wu, Cheng-En — National Taiwan Univ.

Luo, Min-Fang — Chung-Shan Inst. of Science and Tech.

Pedestrian detection is an important part of intelligent transportation systems. In the literature, Histogram of Oriented Gradients (HOG) detector for pedestrian detection is known for its good performance, but there are still some false detections appearing in the cases with flat area or clustered background. To deal with these problems, in this research work we develop a new feature which is based on pairing comparison computations, called Comparison of Granules (CoG). The idea of CoG is to encode the textural information of local area describing how different the pixel intensities are distributed within a region. It is shown that the special characteristics of CoG feature are “small” and “efficiency” relative to HOG. By incorporating this new feature, we propose a HOG-CoG detector which through our validation experiment achieves 38% log-average miss rate in full image evaluation and 90% detection rate at 10^(-4) false positives per window on INRIA Person Dataset. Another contribution of this work is that, we also present a training scheme that can be applied on huge database for training a detector. Such training scheme can reduce the number of hard samples during bootstrap training.

15:12-15:30 WC3.5

Reliable Pedestrian Recognition Combining High-Definition LIDAR and Vision Data, pp. 1783-1788

Kidono, Kiyosumi — Toyota Central R&D Lab. Inc.

Naito, Takashi — Toyota Central R&D Lab. Inc.

Miura, Jun — Toyohashi Univ. of Tech.

Pedestrian recognition is one of the key technologies for advanced driver assistance systems and autonomous driving systems. This paper proposes a fusion system for reliable pedestrian recognition using a high-definition LIDAR and a vision sensor to achieve high performance in various conditions. Pedestrian candidates are extracted from two sensors in parallel by support vector machine based classifiers. In particular, the region of interest in the image processing is set by information about objects derived from the LIDAR processing to reduce false positives as well as computational burden. All candidates are integrated by their likelihood calculated from their classification scores, using multiple thresholds according to the detection condition of the target in two sensors. A quantitative evaluation in a road environment confirms the effectiveness of the proposed system.

WC4 Fireweed

Human Factors Studies (Regular Session)

14:00-14:18 WC4.1

Predicting Cruising Speed through Data-Driven Driver Modeling, pp. 1789-1796

McNew, John-Michael — Toyota Tech. Center

We present a data-driven method for predicting driver behavior of sufficiently low complexity to be implemented in an automotive context. We develop a method to predict the driver's intended cruising speed as they launch from a stopped position. Our goal is to make this prediction in spite of highly modal driving by the driver (i.e. they drive in either an aggressive or relaxed manner). To reduce complexity and improve prediction, we do not try to calculate the hidden variables causing the modal driving or try to predict the vehicle's entire trajectory through filtering. We instead formulate a supervised learning problem to estimate the cruise speed directly. First we segment the trajectories into launch, cruise, and deceleration behavioral segments based on vehicle state and environment. Within each segment, we extract a low dimensional feature set which can be used to learn a model for predicting cruise speed under modal driving. In particular, a dynamical model is fit to the launch sequence data and its coefficients are used as regressors for a Nadaraya-Watson estimator. Results from a real-time implementation show that for a single road type, prediction error is significantly lower than other standard prediction methods. A key point is that our simpler prediction technique can yield good prediction results over long time scales with low complexity by predicting goal states directly rather than predicting the evolution of the vehicle state in time.

14:18-14:36 WC4.2

Driver Head Pose and Gaze Estimation Based on Multi-Template ICP 3D Point Cloud Alignment, pp. 1797-1802

Bär, Tobias — FZI Forschungszentrum Informatik

Reuter, Jan-Felix — FZI Forschungszentrum Informatik

Zöllner, J. Marius FZI Forschungszentrum Informatik

Knowledge of the gaze point of the driver can improve comfort and safety whilst driving in manifold ways. Head movements, combined with the line of gaze, play a fundamental role in predicting the driver's actions and in inferring his intention. However, a gaze tracking system for automotive applications needs to satisfy high demands: It must not disturb the driver in his freedom of movements, it must cover large and fast head turns in yaw and pitch, be resistant to changing illumination conditions, be fast enough to recognize fast mirror checks, which are performed almost exclusively through eye rather than head movements, and be accurate and reliable enough to derive high quality information for driver assistance systems relying on their output.

In this work a multi-template, ICP-based gaze tracking system is introduced. The system determines the head pose and subsequently estimates the driver's line of gaze by analysing the angles of the eyes. Due to a fast search of correspondences, and switching between point to point and point to plane alignment, real-time performance and high accuracy can be achieved. The system is compared with other state of the art head pose estimation systems based on a publicly available benchmark database, where a classification rate of 92% at a tolerance of 10 degrees in yaw could be achieved. We further show in the experiments section, that head rotations up to 4 radians per second can be handled.

Attachment. Getting information of the driver's line of sight can enrich the input of various driver assistance systems.In this work, the head pose is determined using an ICP algorithm matching point clouds gained through a Microsoft Kinect sensor. The correspondence search of the ICP algorithm (nearest neighbour) was implemented by means of a projection into the depth image, making the algorithm fast and keeping real-time conditions at 30 Hz on an off-the-shelf desktop CPU.The accuracy of the head pose was approved to be correct in 92 percent of the frames accepting a tolerance of 10 degrees in yaw.

14:36-14:54 WC4.3

A Generic Concept of a System for Predicting Driving Behaviors, pp. 1803-1808

Bonnin, Sarah bielefeld Univ. Cor-Lab.
Kummert, Franz Bielefeld Univ.
Schmuedderich, Jens Honda Res. Inst. Europe GmbH

Today, many vehicles are equipped with Advanced Driver Assistance Systems (ADAS) to warn the driver about the potential danger of a scene, but in some situations the warning is not early enough to avoid an accident. A solution for preparing the driver and giving him the time to react to such dangerous events is to predict the behavior of other traffic participants. This paper describes a method to predict the behavior of the surrounding vehicles by a classification approach. However, the behavior alternatives strongly depend on the scenario faced by the target vehicle. Where most of the state-of-the-art approaches focus on a single scenario, the concept presented in this paper aims at a generic solution, allowing for behavior prediction for a large amount of different scenes. The idea of the method is to categorize scenes into a hierarchy from the most generic ones in the top nodes to the most specific ones in the leaves. Every node of the hierarchy is a scene containing a set of classifiers to predict the possible behaviors. GPS and digital maps provide the static information about the infrastructure, which is used to determine the nodes fitting to the current situation. As a first step this paper shows accurate prediction of traffic participants behavior in highway entrance situations for a prediction horizon of up to 3 seconds.

14:54-15:12 WC4.4

IC-DEEP: A Serious Games Based Application to Assess the Ergonomics of In-Vehicle Information Systems, pp. 1809-1814

Gonçalves, Joel Univ. do Porto - DEI/FEUP
Rossetti, Rosaldo Univ. do Porto - LIACC
Olaverri Monreal, Cristina Faculty of Mechanical Engineering,Tech.

With the number of in-vehicle information systems and the complexity of their tasks growing at a very high rate in near future, we need a clear understanding of their related distraction or mental workload and its impact on driver performance. Thus, in this paper we introduce these concepts already in the development phase of a product that will be used in an in-vehicle environment. We present the IC-DEEP (In-Car Ergonomics Evaluation Platform), which is an implementation approach in form of a Serious Game (SG) to autonomously assess, under low-time and low-cost conditions, the factors that can jeopardize the driving performance when manipulating or receiving information from in-vehicle information systems (IVISs). We evaluate the feasibility of the proposed approach and draw conclusions on its effects on behavioral changes and IVIS assessment.

15:12-15:30 WC4.5

Coupling Instrumented Vehicles and Driving Simulators: Opportunities from the DRIVE IN2 Project, pp. 1815-1820

Bifulco, Gennaro Nicola Univ. of Naples Federico II
Pariota, Luigi Univ. of Naples Federico II
Galante, Francesco Univ. of Naples Federico II
Fiorentino, Anita Fiat Group Automobile

DRIVE IN^2 is an automotive research project within the field of Intelligent Transportation Systems, especially Advanced Driving Assistance Systems (ADAS). The project originates from the idea that the development of new ADAS and evaluation of their effect have to take drivers into account, as well as their behavior while driving: the benefits of adopting new in-vehicle technologies depend also on their adoption and usage by drivers. To this aim, the project develops a Driver-In-the-Loop framework to position observation of the drivers at the center of the research activities. Observations are carried out by coupling different research tools, namely instrumented vehicle and driving simulators. The premise and methodological framework of the research project are presented and discussed. Some preliminary activities with particular reference to validating the driving simulation environment are also described.

WC5 Iliamna

Simulation and Modeling 7 (Regular Session)

14:00-14:18 WC5.1

Short-Term Traffic Flow Prediction Using EMD-Based Recurrent Hermite Neural Network Approach, pp. 1821-1826

Chen, Syuan-Yi Industrial Tech. Res. Inst.
Wei-Yao, Chou Industrial Tech. Res. Inst.

An empirical mode decomposition based recurrent Hermite neural network (ERHNN) prediction model is proposed to predict short-term traffic flow in this study. First, a recurrent Hermite neural network (RHNN) prediction model with different orthonormal Hermite polynomial basis functions (OHPBFs) as activation functions is introduced. Then, to

further mitigate the influence of noise and improve the accuracy of prediction, an empirical mode decomposition (EMD) method is derived to decompose the original short-term traffic flow data into several intrinsic mode functions (IMFs) and adopt them as the inputs for the RHNNs. Therefore, an ERHNN prediction model, which comprises good predictive ability for the nonlinear and non-stationary signals through the combination of the merits of OHPBFs, EMD and EHNN, is proposed to predict short-term traffic flow more effectively. The validity of the ERHNN prediction model is verified using all day short-term traffic flow data at high way I-80W in California. Simulation results demonstrate that the proposed ERHNN prediction model is with superior performance compared with the pure recurrent neural network (RNN) and RHNN prediction models.

14:18-14:36 WC5.2

A Micro-Simulation Model of Pedestrian-Vehicle Interaction Behavior at Unsignalized Mid-Block Locations, pp. 1827-1833

Wang, Tianjiao — Univ. of Southampton
Wu, Jianping — Tsinghua Univ.
McDonald, Mike — Univ. of Southampton

The frequent interaction between vehicles and jaywalking pedestrians at unsignalized locations is one of the main characteristics of traffic systems in some developing countries such as China, due to less disciplined behavior on urban streets. The inadequate understanding and improper management of the mixed traffic contribute much to traffic congestion and accidents. Existing micro-simulation tools are of limit use for evaluating system performances at unsignalized locations, or comparing operations between unsignalized and signalized scenarios. A project was proposed to study the pedestrian-vehicle interaction behavior in urban street environment by micro-simulation modeling. This paper presents partial results of this project, focusing on the development and validation of the simulation model of the interaction behavior of the two modes at unsignalized mid-block locations. The result can be used as a tool to supplement current guidelines for pedestrian related problems, and also contributes to the knowledge base to incorporate pedestrians into existing micro-simulation models in a more realistic way.

14:36-14:54 WC5.3

Modelling Traffic Dynamics in Motorway Networks, pp. 1834-1839

Fitzgerald, Aidan — Queen's Univ. Belfast
Marshall, Adele H. — Queen's Univ. Belfast
Moutari, Salissou — Queen's Univ. Belfast

Due to the rapid growth of traffic density, the necessity to increase the operational efficiency and capabilities of intelligent transportation systems (ITSs) has led to the development of various traffic modelling theories. The Lighthill- Whithman and Richards (LWR) model [12, 13], uses fluid based partial differential equations to capture traffic dynamics along continuous stretches of road. In contrast to the LWR model, the artificial neural network model [4, 14] utilizes historical observations of traffic flow-rates to forecast flow-rate locally. This paper aims to introduce a new hybrid macroscopic model which combines the complementary features of the LWR and artificial neural network models, to effectively simulate traffic flow in road networks. The model developed in this paper demonstrates the ability to, within a certain degree of accuracy, forecast traffic flow in a road network that includes junctions and continuous stretches of road. Furthermore, the proposed model offers an appropriate trade-off between accuracy and computational complexity, therefore it is suitable for real time applications.

14:54-15:12 WC5.4

Micro-Simulation Study on the Effect of On-Street Parking on Vehicular Flow, pp. 1840-1845

Guo, Hongwei — Department of Transportation Engineering,BeijingInstituteof Tech.
Wang, Wuhong — Department of Transportation Engineering,BeijingInstituteof Tech.
Guo, Weiwei — Department of Transportation Engineering,BeijingInstituteof Tech.

Abstract—On-street parking is an important component of urban parking system. It is an efficient means for providing more parking spaces and balancing the parking demand and supply. However, it is easy to decrease traffic performance and increase the risk of traffic accident. Aiming at evaluate the influence of on-street parking on characteristics of vehicular flow, a cellular automata model is developed for describing the interaction between the on-street parking maneuvers and vehicular flow in the one-way street with on-street parking spaces. The model takes different driving manures into account according to the dynamic features of different vehicles. Numerical simulation is performed using an extensive Monte Carlo procedure. The results show that the driving maneuvers of on-street parking can antedate traffic state transition from free flow to congested flow at low density. The maximum volume and travel speed are also influenced significantly. The finding in this paper has important ramifications for policy in the area of parking management and planning.

WC6 Katmai

Advanced Public Transportation Systems (Regular Session)

14:00-14:18 WC6.1

A Sequential Testing Approach for Change-Point Detection on Bus Door Systems, pp. 1846-1851

Cheifetz, Nicolas — Univ. Paris-Est, IFSTTAR/GRETTIA
Samé, Allou — Univ. Paris-Est, IFSTTAR/GRETTIA
Aknin, Patrice — Univ. Paris-Est, IFSTTAR/GRETTIA

Detecting change-points and anomalies on sequential data is common in various domains such as fraud detection for credit cards, intrusion detection for cyber-security or military surveillance. This study is motivated by the predictive maintenance of pneumatic doors in transit buses. For this purpose, buses are instrumented and data are collected through embedded sensors. Inspired by the CUSUM and GLR approaches, this paper deals with on-line change-point detection on sequential data where each observation consists in a bivariate curve. The system is considered out of control when a change occurs in the curves probability distribution. A specific regression model is used to describe the curves. The unknown parameters of this model are estimated using the maximum likelihood principle. Experimental studies performed on realistic data demonstrate the promising behavior of the proposed method.

14:18-14:36 WC6.2

Sitting, Waiting, Wishing: Waiting Time Perception in Public Transport, pp. 1852-1857

Millonig, Alexandra — Austrian Inst. of Tech.
Sleszynski, Marek — Austrian Inst. of Tech.

Ulm, Michael	Austrian Inst. of Tech.

Waiting for public transport services is one of the most important factors deteriorating public transport customer satisfaction. Although there are several approaches for enhancing the waiting experience for passengers, little consolidated knowledge exists concerning the effects of particular offers under different circumstances such as site characteristics or group preferences. This contribution introduces an approach for measuring the influence of different waiting activities on the perception of waiting times. We analyzed the activities and waiting time perception of 1215 public transport passengers in three types of stations in order to explore the effect of particular entertainment offers on the ability to estimate the duration of waiting times. The results indicate strong influences of station characteristics as well as user characteristics on waiting activities and time perception.

14:36-14:54 WC6.3

A Portable Pedometer Based on Inductive Proximity, pp. 1858-1861

Shajahan, Sheik Mohammed Ali	Indian Inst. of Tech. Madras
George, Boby	Indian Inst. of Tech. Madras

This paper presents a new pedometer which requires, practically, no user depended calibration. This new scheme is based on an inductive proximity sensing principle. The proposed pedometer consists of two modules, to be installed one in each shoe. These modules can be easily integrated, by the user, into commercially available shoes. A prototype unit has been developed and tested. Results are matching well with reference measurements. New sensor is less expensive and does not require frequent calibrations.

14:54-15:12 WC6.4

Making Public Transportation Schedule Information Consumable for Improved Decision Making, pp. 1862-1867

Gupta, Raj	IBM Res.
Srivastava, Biplav	IBM Res.
Tamilselvam, Srikanth	IBM Res.

Traffic chaos is increasing by the day in cities around the world, and especially in developing countries, due to rapid increase in the use of private vehicles. One reason for this trend is the lack of information about commuting choices possible with the existing public transportation network. Although schedules of individual modes may be available, they are not amenable to direct analysis and furthermore, give an integrated view of the services possible in the city. In this paper, we describe an efficient approach to transform readily available schedules into a more consumable standard form, and demonstrate its usage in a decision support tool for commuting choice selection. We have fine-tuned the process to remove common schedule errors and can easily incorporate new cities into the system within days for improved decision support. The approach is complementary to other alternatives that work with real-time data, e.g., GPS on buses, but need longer time, investment and extensive instrumentation to implement.

WC7 King Salmon

Experimental Investigations (Regular Session)

14:00-14:18 WC7.1

BSM Emulator – Advanced Vehicle Safety Application Testbed, pp. 1868-1873

Gupta, Somak Datta	PATH, UC Berkeley
Lin, Chih-Che	Information and CommunicationsResearchLab.,IndustrialTechnology
Chan, Ching-Yao	ITS, Univ. of California at Berkeley

The emerging IEEE 1609/802.11(p) network protocol suite [1][2][3][4][5][6][7] enables a variety of vehicular applications [8]. For example, Applications based on SAE J2735 Basic Safety Messages (BSMs) [9] have been developed to avoid vehicle collisions and enhance driving safety. Evaluation of applications to be deployed is usually conducted with field trials, which are costly and labor intensive.

In this paper, we develop and implement a network emulation platform (called the BSM Emulator) for the new IEEE 802.11p/1609 network. The BSM Emulator can generate SAE J2735 BSMs with different MAC addresses, emulating the existence and the behaviors of multiple OBUs and vehicles. By using this tool, one IEEE 802.11(p)/1609 device can imitate the BSM broadcast behaviors of multiple vehicles around an intersection, greatly facilitating field trials of vehicular networks/applications and reducing the cost of conducting field trials. To the best of the authors' knowledge, this paper is the first work that develops and implements an integrated environment for the emulation of IEEE 802.11p/1609 network and SAE J2735 related vehicular applications.

14:18-14:36 WC7.2

A Robotic Platform to Evalute Autonomous Driving Systems, pp. 1874-1879

Belbachir, Assia	IFSTTAR
Smal, Jean-christophe	IFSTTAR : French Inst. of Science and Tech. for Transport
Blosseville, Jean-marc	IFSTTAR

The paper proposes an assessment framework in which two platforms are used, one is simulation based, the other, Robert, is a robot that carries out the basic control of actuators. Robert platform can be installed on any cars. Authors have completed those basic capabilities in one case with upper level control (path planning, upper control) to assess perception capabilities. Robert basic controllers have also been completed to evaluate full autonomous control capabilities, without the difficulty to maintain low level controllers.

14:36-14:54 WC7.3

A System for Coupled Road Traffic Utility Maximisation and Risk Management Using VANET, pp. 1880-1887

Fitzgerald, Emma	Univ. of Sydney
Landfeldt, Bjorn	Lund Univ.

We propose a system for dynamic, real-time management of traffic accident risk in which vehicles exchange information via a vehicular ad-hoc network and use received information in calculating an estimate of current risk levels. We test the system's effectiveness in increasing the utility of the road network while maintaining the accident rate. We further prove the convergence of our proposed algorithm and investigate the information propagation, convergence rate and bandwidth requirements of the system and find that the system is able to increase the utility at maintained accident rate while operating within the confines of the IEEE 802.11p radio standard.

14:54-15:12 WC7.4

An Experimental Study on Changes of Muscle Fatigue among Utilizing Standing-Type Mobile Vehicles and Walking, pp. 1888-1893

Hashimoto, Naohisa	National Inst. of AIST
Sakurai, Yoshihisa	Japan Inst. of Sports Sciences
Suzuki, Yusuke	AIST
Tomita, Kohji	AIST
Horiuchi, Eichi	AIST
Matsumoto, Osamu	AIST
Yokozuka, Masashi	AIST

Many robotics technologies are being developed. One of the technologies is utilized in a personal vehicle. A personal vehicle, which is high energy efficiency, has been expected as new personal mobility. It is well-known that a personal vehicle is higher energy efficiency, and needs less space than a normal vehicle. On the other hand, with respect to the fatigue, there are less enough experimental data using a personal vehicle, especially a standing-type personal vehicle. Thus, it will be necessary to evaluate the fatigue using standing-type personal vehicle. Two types of standing-type personal vehicles and normal walking were utilized in this study. The changes of muscle hardness on foot were employed in order to measure the amount of fatigue. The amount of fatigue was measured before and after moving about 3 [km] distance in real world on using each vehicle. The experiments and questionnaires after doing experiments were done with 6 subjects. Experimental result shows that there is a difference between two kinds of standing-type personal vehicles. The amount of muscle fatigue by using one small vehicle changes larger than two methods. It assumed that muscle fatigue can be affected by stability, power and space around feet from the results of experiments and questionnaires.

WC8 Lupine

Network Level Traffic Analysis (Regular Session)

14:00-14:18 WC8.1

Network Zoning Based on Community Detection for Urban Traffic Control, pp. 1894-1899

Chen, Cheng	Inst. of Automation, Chinese Acad. of Sciences
Ai, Yunfeng	Inst. of Automation, Chinese Acad. of Sciences
Zhu, Fenghua	Inst. of Automation, Chinese Acad. of Sciences

Network Zoning is a key problem for the coordination in hierarchical control system. In traffic control area, considering the characteristics of road network, like directed and spatial property, we give one appropriate method for network zoning. Inheriting the advantages of several community detection methods, this method takes the distance between intersections and the scale of intersection into account simultaneously. And we also applied it to the parallel transportation management systems (PtMS) in Tianhe area of Guangzhou for network zoning. The results of experiments illustrate its effectiveness.

14:18-14:36 WC8.2

Effects of Traffic Network Dynamics on Hierarchical Community-Based Representations of Large Road Networks, pp. 1900-1905

Movahed Nejad, Mahyar	Wayne State Univ.
Mashayekhy, Lena	Wayne State Univ.
Chinnam, Ratna Babu	Wayne State Univ.

Efficient representation of traffic networks, including congestion states, plays an important role in the effectiveness of routing algorithms incorporating Intelligent Transportation Systems (ITS) data. We employ an emerging concept in analyzing complex networks called “community structure detection” to capture traffic network dynamics in the form of hierarchical community-based representations of road networks. A key strength of these community (structure) detection methods is their computational efficiency. We investigate the impact of traffic dynamics on the hierarchical community-based representations of large road networks. The resulting hierarchical community representations and their evolution over varying traffic conditions with time can aid the computational performance of real-time routing algorithms. We analyze the performance of hierarchical community detection methods on the metropolitan road networks of New York City, Detroit, and San Francisco Bay area.

14:36-14:54 WC8.3

Markov-Based Redistribution Policy Model for Future Urban Mobility Networks, pp. 1906-1911

Volkov, Mikhail	Massachusetts Inst. of Tech.
Rus, Daniela	MIT
Aslam, Javed Alexander	NEU

In this paper we present a Markov-based urban transportation model that captures the operation of a fleet of taxis in response to incident customer arrivals throughout the city. We consider three different evaluation criteria: (1) minimizing the number of transportation resources for urban planning; (2) minimizing fuel consumption for the drivers; and (3) minimizing customer waiting time increase the overall quality of service. We present a practical policy and evaluate it by comparing against the actual observed redistribution of taxi drivers in Singapore. We show through simulation that our proposed policy is stable and improves substantially upon the default unmanaged redistribution of taxi drivers in Singapore with respect to the three evaluation criteria.

14:54-15:12 WC8.4

Modeling ITS Data Sources for Generating Realistic Traffic Operating Parameters for Project-Level Conformity Analysis, pp. 1912-1917

Liu, Hao	Univ. of Cincinnati
Wei, Heng	Univ. of Cincinnati
Yao, Zhuo	Univ. of Cincinnati

The challenge in characterizing on-road traffic source emissions affected by traffic management or control countermeasures is often the lack of the realistic traffic flow data at the microscopic level for the project-level transportation conformity analysis. With the advancement of Intelligent Transportation Systems (ITS) technologies, more and more ITS devices are deployed for monitoring traffic. Those ITS devices provide promising data sources for inputs to the emission models for the project level analysis. Taking advantage of those data sources, this paper presents an integrated framework to facilitate the on-road transportation emission estimation under various traffic operations which are influenced by the traffic management and control measures. The implementation of the framework is demonstrated by applying the three components of the framework, i.e., traffic flow phase identification module, vehicle classification module and MOVES (Motor Vehicle Emission Simulator) analysis module, in a case study where inductive loop data are utilized. The information provided by the framework can help traffic

operation agency improve or develop efficient traffic management or control measures for energy saving and environment protection.

15:12-15:30 WC8.5

A Platoon of Vehicles Approaching an Intersection: A Testing Platform for Safe Intersections, pp. 1918-1923

Diab, Hilal	RWTH Aachen Univ.
Ben Makhlouf, Ibtissem	RWTH Aachen Univ.
Kowalewski, Stefan	RWTH Aachen Univ.

Intersections are one of the most complex driving scenarios for an autonomous vehicle. When a platoon of autonomous vehicles following a leader approaches the intersection, the platoon should change its highway mode to other modes in order to cross the intersection safely. Therefore, the position, velocity and acceleration of the vehicles inside the platoon should be available. Furthermore, information about the position and velocity of other vehicles in the intersection area should be known too. The platoon controller should use all these information to decide which mode will be adopted. In fact, the platoon has to decide whether to stop, to pass or to split the platoon while crossing the intersection. This paper proposes a scaled testing platform of four electronically coupled vehicles equipped with a positioning system and an intersection management system. We tested different scenarios related to different crossing modes of the platoon. The experiments showed that we can change the platoon mode from a highway mode to an intersection drive efficiently.

Reviewers

Surname, Given_name
Abbas-Turki, Abdeljalil
Abdel-Rahim, Ahmed
Abdelfatah, Akmal
Abdelghany, Khaled
Abellard, Alexandre
Aboudolas, Konstantinos
Acarman, Tankut
Afonso, João
Agnihotri, Samar
Aguilar Lgartua, Mónica
Ahn, Kyoungho
Ahn, Soyoung
Alimardani, Fatemeh
Allam, Karteek Kumar
Almazán, Javier
Altintas, Onur
Altug, Erdinc
Alvarez, José M.
Alvarez Pardo, Sergio
Ambellouis, Sebastien
Amditis, Angelos
Amorim, José Carlos
Amoroso, Alessandro
Amri, Hanns
Ando, Ryosuke
Antoniou, Constantinos
Apatean, Anca Ioana
Araujo, Helder
Araújo, Rui
Archer, Jeffery
Arhin, Stephen
Arimura, Mikiharu
Armingol Moreno, José María
Aufrere, Romuald
Aved, Alexander
Avineri, Erel
Azimi, Mehdi
Bachmann, Alexander
Balakrishna, Poornima
Balakrishna, Ramachandran
Ban, Jeff
Bang, Karl
Banno, Atsuhiko
Barker, Alan M.
Barnes, Ronald
Barria, Javier
Barth, Matthew
Batista, Katherine
Bauer, Dietmar
Bazzi, Alessandro
Beg, Chris
Belbachir, Assia
Benine-Neto, André
Besbes, Bassem
Bétaille, David
Biddlestone, Scott
Bie, Jing
Biral, Francesco
Bonnabel, Silvère
Boo, Kwangsuk
Borkar, Amol
Boskovich, Scott
Bouchafa, Samia
Bouillet, Eric
Bouroche, Mélanie
Box, Simon
Brackstone, Mark
Breckon, Toby
Brennan, Thomas
Broggi, Alberto
Brunsmann, Ulrich
Brückmann, Dieter
Brändle, Norbert
Bu, Lei
Burghout, Wilco
Busoniu, Lucian
Cabello, Enrique
Campbell, Patrick
Cao, Meng
Cao, XianBin
Cao, Yi
Cappiello, Alessandra
Carrasco, Juan Pablo
Castro, António
Cats, Oded
Cela, Arben
Celikoglu, Hilmi Berk
Cerri, Pietro
Cetin, Mecit
Chan, Ching-Yao
Chan, Yi-Ming
Chang, Chien Yen
Chang, Gang-Len
Chang, Li-Yen
Chang, Mei-Shiang
Chaudhary, Nadeem
Chen, Chao-Hua
Chen, Cheng
Chen, Chenyi
Chen, Duan-Yu
Chen, Hao
Chen, Syuan-Yi
Chen, Xiaoming
Chen, Xiqun
Chen, Yangzhou
Chen, Yaobin
Chen, Yuan-Lin
Cheng, Qi
Cheng, Shinko
Cheng, Yang
Cheng, Zhifeng
Cherfaoui, Véronique
Cheu, Ruey Long
Chien, Stanley
Chilukuri, Bhargava Rama
Chou, Chien-Ming
Chow, Andy
Chow, Joseph
Christofa, Eleni
Cipriani, Ernesto
Claes, Rutger
Cong, Zhe
Corey, Jonathan
Corti, Andrea
Courbon, Jonathan
D'Andréa- Novel, Brigitte
Daamen, Winnie
Dai, Haifeng
Dailey, Daniel J.
Danescu, Radu Gabriel
Dang, ruina
Dang, Thao
Danno, Mikio
Dasigi, Shalini
Day, Christopher
De la Escalera, Arturo
Deguchi, Daisuke
Delgado, Joaquim
Dell'Orco, Mauro
Delling, Daniel
Den Braven, Karen
Dervisoglu, Gunes
Di Gangi, Massimo
Diab, Hilal
Dickmann, Jürgen
Distante, Cosimo
Dixon, Michael
Doll, Konrad
Dong, Honghui
Dong, Jing
Doshi, Anup
Du, Eliza
Du, Jun
Du, Lili
Duan, bobo
Duan, Houli
Dumortier, Yann
Edara, Praveen
Efthymiou, Dimitrios
Eguchi, Junji
Elefteriadou, Lily
Enzweiler, Markus
Ernst, Joseph M.
Fallah, Yaser
Fang, Jie
Fang, Tingjian
Fehr, Duc
Feng, Suwei
Ferreira Leite, Alessandro
Flemisch, Frank
Flötteröd, Gunnar
Fong, A. C. M.
Fredriksson, Jonas
Fries, Ryan
Fritsch, Jannik
Fujii, Masahiro
Fumiaki, Maehara
Fusco, Gaetano
Förster, Georg
Gabler, Hampton Clay
Gallen, Romain
Ganti, Raghu
Gayah, Vikash
Gemou, Maria
Geroliminis, Nikolas
Ghavami, Abouzar
Giglio, Davide
Glaser, Sébastien
Goerick, Christian
Golias, John
Gomes, Gabriel
Gonzalez, Carlos
Gorodetsky, Vladimir
Granosik, Grzegorz
Grimm, Donald
Grinberg, Michael
Groult, Xavier
Gruyer, Dominique
Gu, Xiaojun
Guan, Tianyi
Guan, Wei
Gunaratne, Pujitha
Gundogan, Fatih
Guo, Chunzhao
Guo, Jianhua
Guo, Liya
Gupta, Somak Datta
Gurupackiam, Saravanan
Haddad, Jack
Hadi, Mohammed
Hadjali, Allel
Haj-salem, Habib
Hajiahmadi, Mohammadreza
Han, Dongfeng
Han, Xingguang
Hariharan, Baradwaj
Hasegawa, Mikio
Hasegawa, Takaaki
Hasegawa, Tameharu
Haselhoff, Anselm
Hashimoto, Naohisa
Hatano, Hiroyuki
Hatoyama, Kiichiro
Havlicek, Joseph

Hayes, Monson
He, Qing
He, Zhonghe
Hebert, Martial
Heilmann, Bernhard
Hensel, Stefan
Hernandez, Salvador
Hernandez Parra, Noelia
Hinebaugh, Dennis
Ho, Ivan Wang-Hei
Hodge, Victoria
Homm, Florian
Hong, Jungyeol
Hong, Xiaoyan
Hongfeng, Xu
Hoose, Neil
Horiguchi, Ryota
Hu, Jia
Hu, Jianming
Hu, Jinge
Hu, Peifeng (Patrick)
Hu, Shou-Ren
Hu, Ta-Yin
Huang, Shan
Huang, Shimeng
Ishizaka, Tetsuhiro
Itoh, Tadashi
Jawad, Dima
Jiménez, Felipe
Jin, Jing
Jin, Wen-Long
Jonsson, Magnus
Jorge, Pedro
Jula, Hossein
Jung, Changbae
Jung, Ho Gi
Kahveci, Nazli E.
Kamijo, Shunsuke
Kaparias, Loannis
Karlstrom, Anders
Kepaptsoglou, Konstantinos
Khaddar, Romesh
Khan, Ghazan
Khayyer, Pardis
Khodayari, Alireza
Khraisat, Yahya
Kim, Dongwook
Kim, Jeyeon
Klappstein, Jens
Klunder, Gerdien
Knoop, Victor
Kochenderfer, Mykel
Kondyli, Alexandra
Kong, Qing-Jie
Kosonen, Lisakki
Kourtellis, Achilleas
Koutaki, Gou
Kremo, Haris
Krogmeier, James V.
Kuhn, Kenneth
Kulshrestha, Ashish
Kurt, Arda
Kwigizile, Valerian
Kwon, Daniel
Kyte, Michael
Labayrade, Raphaël
Lahrmann, Harry
Lambert, Alain
Lan, Kun-chan
Lanz, Oswald
Larsson, Tony
Lategahn, Henning
Lauffenburger, Jean-Philippe
Laugier, Christian
Lauren, Verena
Lee, Jin-Woo
Lee, Snow
Lethaus, Firas
Li, Feng
Li, Hao
Li, Huan
Li, Jing
Li, Jing-Quan
Li, Kang
Li, Lan
Li, Li
Li, Lingxi
Li, Man
Li, Pengfei
Li, Ruimin
Li, Shengbo
Li, Shuangshuang
Li, Zhixia
Lin, Chih-Che
Lin, Lei
Lin, Shu
Lin, Wei-Hua
Lin, Yong
Liu, Bo
Liu, Hao
Liu, Haode
Liu, Wei
Liu, Youjun
Liu, Yue
Liu, Yuncai
Liu, Zhiyuan
Loose, Heidi
Lopes, Jorge
Lowry, Mike
Lu, Henghui
Lu, Jianbo
Lu, Yecheng
Lundquist, Christian
Lv, jinpeng
Lv, Wei
Lv, Yisheng
Ma, Guanglin
Ma, Jian
Ma, Wanjing
Ma, Xiaoliang
Macek, Kristijan
Maldonado-Bascón, Saturnino
Malikopoulos, Andreas
Mammar, Said
Marita, Tiberiu
Martens, Marieke
Masini, Barbara Mavi
Masson, Favio
Mathew, Tom
Matsumoto, Shuichi
Matsushima, Kousuke
Maurer, Markus
McBride, James
McCormack, Ed
McGee, Ryan
Meijer, Sebastiaan
Menon, Arvind
Merzouki, Rochdi
Mestre, Daniel R
Meuter, Mirko
Miao, Qing
Miao, Qinghai
Michalke, Thomas Paul
Milanés, Vicente
Miller, Jeffrey
Minoiu Enache, Nicoleta
Miska, Marc Philipp
Misra, Pradeep
Mita, Seiichi
Miyajima, Chiyomi
Mladenovic, Milos
Molano, Victor
Monteiro, Vitor
Morency, Catherine
Morris, Brendan
Mounier, Hugues
Moura, Scott
Mousset, Stéphane
Moutarde, Fabien
Munaretto, Giorgio
Muralidharan, Ajith
Murase, Hiroshi
Muthukumar, Venkatesan
Møgelmose, Andreas
Nagaosa, Tomotaka
Nalmpantis, Dimitrios
Nassu, Bogdan Tomoyuki
Navarro-Serment, Luis
Nezhad-Ahmadi, Mohammad-Reza
Ni, Daiheng
Nie, Yu (Marco)
Nieto, Juan Ignacio
Nishiuchi, Hiroaki
Nozari Zarmehri, Mohammad
Nuevo, Jesus
Nunez, Alfredo
Nur, Khalid
Nwanze, Nnamdi
Ocaña, Manuel
Ogawa, Keiichi
Oh, Jun-Seok
Oh, Junseok
Ohno, Hiroyuki
Ohno, Kohei
Olaverri Monreal, Cristina
Oliveira, Arnaldo
Oliveira, Luciano
Oncu, Sinan
Oniga, Florin Loan
Ono, Shintaro
Ortiz, Jesús
Ottomanelli, Michele
Ou, Dongxiu
Ozbay, Kaan
Ozguven, Eren Erman
Paik, Daehyun
Pan, Cheng
Panou, Maria
Papadimitriou, Eleonora
Papamichail, Loannis
Park, Byungkyu (Brian)
Paruchuri, Vamsi
Patire, Anthony
Paz, Alexander
Pellegrini, Paola
Perallos, Asier
Pereira, Antonio
Pereira, C., Francisco
Perronnet, Florent
Petrov, Plamen
Petry, Marcelo R.
Peyret, Francois
Pham, Minh-Hai
Phegley, Brian
Piao, Jinan
Pink, Oliver
Piza, Ricardo
Platho, Matthias
Ploeg, Jeroen
Prathombutr, Passakon
Prati, Andrea
Prokhorov, Danil
Qi, Yi
Qin, Xiao
Qiu, Tony
Quddus, Mohammed
Quintero Mínguez, Raúl
Ramanandan, Arvind
Ramirez, Maria F.
Ranganathan, Anand
Rathinam, Sivakumar
Rebreyend, Pascal
Redmill, Keith
Reina, Paulina
Remias, Stephen
Ren, Yong
Resende, Paulo
Riemann, Raffaela
Rinaldi, Marco
Rocha, Ana Paula
Rocha, Rui P.

Rodrigues Florez, Sergio Alberto
Rogozan, Alexandrina
Romero Cano, Victor Adolfo
Roppel, Thaddeus
Rosebrock, Dennis
Ross, Ralph Werner
Rossetti, Rosaldo
Saberi K., Meead
Salazar-Aguilar, Maria Angelica
Sanchez, Rene
Sanchez-Medina, Javier J.
Sanders, Peter
Sando, Thobias
Santa, José
Santos, Vitor
Sathyanarayanan, Sudhakar
Satonaka, Takami
Savaresi, Sergio
Scharfenberger, Christian
Schmuedderich, Jens
Schmöcker, Jan-Dirk
Schoenbein, Miriam
Schubert, Robin
Seco-Granados, Gonzalo
Sekimoto, Yoshihide
Sermpis, Dimitris
Sghaier, Manel
Shankar, V
Sharma, Vikas
Shen, Chung-wei
Shi, Wei
Shigeno, hiroshi
Shiiya, Kazuhisa
Shiomi, Yasuhiro
Shiwakoti, Nirajan
Shladover, Steven E.
Shyu, Ming-Bang
Sirandas, Sai
Sittikariya, Sittipan
Sivakumar, Aruna
So, Jaehyun
So, Stella
Somasundaram, Guruprasad
Song, Ziqi
Songchitruksa, Praprut
Spring, Gary
Spyropoulou, Ioanna
Srivastava, Biplav
Stathopoulos, Antony
Stiefelhagen, Rainer
Su, Dongyan
Su, Yuelong
Suganuma, Naoki
Sunwoo, Myoungho
Takatori, Yusuke
Takeda, Kazuya
Talaat, Hoda
Tampere, Chris
Tanaka, Shinji
Tapani, Andreas
Tarel, Jean-Philippe
Tatiana, Levashova
Tawari, Ashish
Tchrakian, Tigran Tigran
Teng, Hualiang
Thai, Jerome
Themans, Michaël
Tian, Bin
Tian, Zong
Toledo, Tomer
Toledo-Moreo, Rafael
Toral-Marín, Sergio
Trigueiro Baptista, Arthur
Trivedi, Mohan M.
Tsekeris, Theodore
Tseng, Finn
Tsugawa, Sadayuki
Tu, Huizhao
Tyrinopoulos, Yannis
Uchida, Kenetsu
Uemura, Takumi
Ulfarsson, Gudmundur
Unnikrishnan, Avinash
Van dan Elzen, Chris
Van den Haak, Paul
Van Lint, Hans
Van Nunen, Ellen
Van Zuylen, H.J.
Velaga, Nagendra
Venkataraman, Narayan
Verma, Ashish
Villagra, Jorge
Vincze, Markus
Vlahogianni, Eleni
Vu, Anh
Wada, Tomotaka
Wadoo, Sabiha
Wang, Donglin
Wang, Haizhong
Wang, Jianqiang
Wang, Jiawei
Wang, Lanjun
Wang, Qian
Wang, shuiying
Wang, Wen
Wang, Wenjia
Wang, Yifei
Wang, Yinhai
Wang, Yizhi
Wang, Yubin
Wang, zhenjun
Wei, Heng
Wei-Yao, Chou
Wender, Stefan
Widhalm, Peter
Widmann, Glenn
Wimmer, Andreas
Wischhof, Lars
Wollaeger, James
Worrall, Stewart
Wu, Bing-Fei
Wu, Di
Wu, Guoyuan
Wu, Tianshu
Wu, Xinkai
Wu, Yao-Jan
Wuhong, wang
Xiao, Jianli
Xiaoguang, Yang
Xie, Chi
Xie, Kunqing
Xie, Yuanchang
Xing, Yao
Xu, Dongwei
Xu, Yanyan
Xuan, Yiguang
Yan, Jiaxiang
Yang, Jun
Yang, Ming
Yang, Ming
Yang, Qichi
Yang, Yan
Yashiro, Tomoyuki
Ye, Peijun
Yebes Torres, José Javier
Yeo, Hwasoo
Yildirimoglu, Mehmet
Yin, Kai
Yin, Yafeng
Yu, Quan
Yuan, Yu
Yung, Nelson H. C.
Yuzbasioglu, Cagri
Zeng, Weiliang
Zhang, Guohui
Zhang, Haiyu
Zhang, Hui
Zhang, Ke
Zhang, Kuilin
Zhang, Liguo
Zhang, Lihui
Zhang, Liping
Zhang, Sumin
Zhang, Wang
Zhang, Wei-Bin
Zhang, Xuedan
Zhang, Yi
Zhang, Zuo
Zhao, dongbin
Zhao, Huijing
Zhao, Kun
Zhao, Li
Zhao, Sheng
Zhao, Yunjie
Zheng, Dongxi
Zheng, Jianyang
Zheng, Nan
Zheng, Pengjun
Zheng, Yichen
Zheng, Zuduo
Zhou, Kai
Zhou, Xuesong
Zhou, Zhao
Zhu, fenghua
Zhu, Liwei
Zhu, Weihua
Zhuang, Jun
Zlatkovic, Milan
Zlocki, Adrian
Zohdy, Lsmail
Zou, Yajie
Zuo, Xingquan
Zöllner, J. Marius

Author Index

D

E

* Session Code
** Page # in the ITSC 2012 Proceedings

Keyword Index

Communication and Controls	
Intelligent Infrastructure	MA3.3, MC3.1, MC7.3, TA2.1, TB1.5, TB4.2, TB4.3, TB7.1, TB7.4, TC4.3, WA8.4, WB4.1, WB5.2, WB8.5
ITS Architecture and Standards	TA6.3, TB2.3, WB4.2
ITS implementation	MA4.2, MA6.1, MB7.5, TA2.4, TA6.5, TB2.3, TB5.2, TB7.2, TC2.2, TC4.3, TC7.4, WA4.2, WA8.1, WB8.2, WC4.5
ITS policy enhancements	MA6.1, WA8.2
L	
Lane Detection and Lane Keeping	MB3.1, MB3.2, MB3.3, MB3.4, MB3.5, MC4.1, TA3.5, TB3.2, TB3.3, WB3.3, WC1.3
Large Scale Traffic Management Simulation	MA5.3, MA5.4, MB5.3, MC5.4, TB6.1, WA5.2, WA7.1, WC7.3, WC8.3
Lidar, Vision and Radar Sensing	MA3.5, MA4.3, MB1.2, MB3.1, MB4.2, MC2.2, MC4.2, TA4.3, TA4.4, TB1.1, TB4.1, TB4.5, TC4.2, TC4.4, TC8.1, WA1.3, WA3.3, WA4.3, WB1.2, WB1.4, WC3.5
M	
Motion Planning in Dynamic Environments	MC1.3, MC1.4, TA4.1, TB7.4, TC3.1, TC7.1, WA3.1, WC1.1
Multi-Autonomous Vehicle: Models, Techniques and Simulations	MB6.1, TB2.1, TPL2.2, WA6.4, WB5.2, WC1.5, WC7.2, WC8.5
Multi-Sensor Fusion	MA4.1, MA4.3, MA4.4, MB1.1, MB3.3, TA1.5, TA2.3, TA3.1, TB1.1, TB2.2, TC4.1, TC4.2, WA3.2, WA8.2, WA8.3, WA8.4, WB8.1, WC3.5
N	
New findings through simulations using existing protocols	MA2.2, MA8.3, MB7.1, TC3.5, WB8.1
New theoretical foundations	MC2.4, TC1.3, TC1.5, WC8.2
Novel Technologies	MA3.2, TB1.4, TC1.4, WC2.3
O	
Optimization and Control: Theory and Modeling	MA4.2, MA5.2, MA8.5, MB5.1, MB6.2, MB7.3, MC1.1, MC7.1, MC7.2, MC8.4, TA6.2, TA7.3, TA7.5, TB5.3, TB6.1, TB7.1, TB7.4, TB8.3, TC6.1, TC6.4, TC7.4, WA2.1, WA2.2, WA5.1, WA6.2, WB2.2, WB2.4, WB7.2, WB7.3, WC1.2, WC1.5, WC2.2, WC6.1
Other research topics	MA6.5, MB6.5, MB7.5, TA1.3, TB1.2, TB4.2, TC3.4, TC5.1, WA6.1, WA6.2, WA7.4
P	
Passenger Cars and Public Transportation	WC7.4
Pedestrian Detection, Vehicle Detection	MA3.1, MA3.2, MA3.3, MA3.4, MA3.5, MB4.4, MC1.2, MC1.3, MC3.4, MC4.3, TB3.4, TB4.1, TB4.5, TC3.3, TC4.1, TC8.1, WA4.3, WB1.2, WB1.4, WC3.1, WC3.2, WC3.3, WC3.4, WC3.5
Pedestrian support	MC7.4, TA2.4, TC4.5, WC3.3, WC7.4
Personalized Public Transit	TA7.4, WB2.1, WC6.2, WC6.4
R	
Reliability and Safety	MA5.5, MA7.2, MC3.1, TC2.1, TC2.2, TC3.2, TC7.4, WA2.5, WB2.1, WB6.2, WB6.4
Ride Matching and Reservation	MA6.2, MB6.2, TA7.4
S	
Safety systems	MA8.3, MA8.4, TA2.3, TB7.3, TC1.3, TC2.1, TC2.4, TC3.5, WA1.1, WA2.1, WC7.3
Safety, comfort	TA1.2, TA2.3, TA2.4, TA5.2, TB1.2, TC1.2, TC2.2, TC2.3, TC3.2, WA7.4, WB1.3, WB2.3, WC7.2
Simulation and Modeling	MA1.3, MA1.4, MA5.2, MA5.4, MA7.1, MA8.1, MA8.2, MB1.2, MB5.4, MB6.1, MB6.4, MB7.1, MB7.2, MB7.4, MB7.5, MB8.4, MC1.1, MC2.1, MC2.2, MC5.3, MC5.4, MC5.5, MC6.3, MC7.4, MC8.2, MC8.3, TA3.2, TA5.1, TA5.2, TA5.3, TA5.4, TA5.5, TA6.1, TA7.2, TA7.5, TA8.2, TB5.3, TB6.1, TB7.2, TB7.3, TB8.3, TB8.4, TB8.5, TC3.2, TC3.5, TC5.2, TC5.3, TC6.2, TC6.4, TC7.2, TC7.3, WA5.1, WA5.3, WA5.4, WA7.2, WA8.1, WA8.3, WB1.1, WB2.2, WB4.2, WB4.3, WB5.2, WB5.3, WB5.4, WB6.3, WB7.1, WB7.3, WC2.2, WC4.4, WC5.1, WC5.2, WC5.3, WC5.4
Special Purpose Vehicles for Aged and Handicapped People	MB8.5, WC7.4
Statistical Modeling	MA5.4, MA7.4, MC2.4, MC5.1, MC5.2, MC5.3, MC6.3, MC6.4, MC8.3, MC8.4, TA5.1, TA6.1, TB3.1, TB8.4, TC5.1, TC5.3, TC5.4, TC5.5, TC6.2, WB6.1, WB6.3, WB7.3, WB8.3, WB8.4, WC5.3, WC6.1
T	
Traffic Control	MA2.4, MA5.5, MA6.3, MB4.1, MB5.1, MB5.2, MB7.1, MB7.2, MB7.3, MB7.4, MB8.2, MC3.3, MC7.1, MC7.2, MC7.3, MC7.4, TB2.1, TB5.2, TB7.1, TB7.2, TC2.1, TC6.1, WA6.4, WA8.4, WB4.4, WB7.2, WB8.1, WC8.1
Traffic Theory for ITS	MA5.2, MA7.3, MC6.1, TA5.5, TA7.3, TA7.5, TC5.2, TC6.1, WA5.1, WA5.2, WA5.4, WA8.3, WB5.1, WB6.3, WB6.5, WB7.1, WC5.3, WC5.4, WC8.2, WC8.4
Transportation Security	TC2.4, WB7.4
Travel Behaviour Under ITS	MA6.3, MB8.5, TA5.1, TB6.4, WC6.2
Travel Demand Management	MA5.3, MA6.1, MA6.4, MB6.2, TB6.2, TC3.4, TC6.2, WB8.2
Travel Information and Guidance	MA6.3, MA8.5, MB6.4, MB6.5, MC5.1, MC6.1, MC6.2, MC6.3, MC6.4, TA6.4, TB6.4, TC3.1, TC6.3, WA8.1, WB6.4
Traveller Services Information	MB6.3, MB6.5, MC6.2, MC6.4, TA6.3, TA6.4, TA7.2, TB6.4, WB6.1, WB6.4
V	
Vehicle Localization and Autonomous Navigation	MA7.3, MB4.1, MB8.1, TA2.1, TA6.4, TB3.3, TB3.4, TB4.3, TC4.4, TC8.2, WA3.1, WA3.2, WA3.3, WA3.4, WA4.4, WB3.1, WB3.2, WB3.4

Conference Announcement

16th International IEEE Conference on Intelligent Transportation Systems

October 6-9, 2013, The Hague, The Netherlands

Intelligent Transportation Systems for All Transport Modes

The IEEE Conference on Intelligent Transportation Systems is the annual flagship conference of the IEEE Intelligent Transportation Systems Society. IEEE-ITSC2013 welcomes articles in the field of Intelligent Transportation Systems, conveying new developments in theory, analytical and numerical simulation and modeling, experimentation, advanced deployment and case studies, results of laboratory or field operational test.

The theme of the IEEE-ITSC2013 conference is Intelligent Transportation Systems for All Transportation Modes. Major advances in information and communication technology are enabling a vast array of new possibilities in transportation.

ITS are emerging worldwide to make transportation more efficient, reliable, cleaner and safer. ITS are used in road, water, rail and air transportation to collect information about transportation flows from a multitude of sources and manage them effectively, shifting collective traffic and transportation management paradigms towards end user orientation.

Program Topics

The technical areas include but are not limited to the following:

- Multi-modal ITS
- Advanced Public Transportation Management
- Ports, Waterways, Inland navigation, and Vessel Traffic Management
- Modeling, Simulation, and Control of Pedestrians and Cyclists
- Air, Road, and Rail Traffic Management
- ITS User services
- Emergency Management
- Transportation Networks
- Emissions, Noise, Environment
- Management of Exceptional Events: Incidents, Evacuation, Emergency Management
- Security Systems
- Safety Systems
- Driver and Traveler Support Systems
- Commercial Vehicle Operations
- Intelligent logistics
- Sensing and Intervening, Detectors and Actuators
- Data Management Systems
- Communication in ITS
- Cooperative Techniques and Systems
- Intelligent Vehicles
- Vision, and Environment Perception
- Electric Vehicle Transportation Systems
- Electronic Payment Systems
- Intelligent Techniques in ITS
- Traffic Theory for ITS
- Modeling, Control and Simulation
- Human Factors, Travel Behavior
- ITS Field Tests and Implementation

Paper submission

Complete manuscripts in PDF format must be electronically submitted for peer-review in IEEE standard format. Detailed submission instructions can be found through the conference website.

Special Sessions, Tutorials, and Workshops

Special session organization is encouraged. Proposals for workshops, tutorials, and special sessions should be submitted via the conference submission website.

Best Paper Award and Best Student Paper Award

A "Best Paper Award" and a "Best Student Paper Award" will be conferred to the author(s) of a full paper presented at the conference, selected by the Awards Committee. The "Best Student Paper Award" will be given to a paper of which the first author is a student.

Journal and Magazine Publication of Selected Papers

Selected papers of exceptional quality will be invited for submission to a special issue of the IEEE Transactions on Intelligent Transportation Systems or the IEEE Intelligent Transportation Systems Magazine. Authors will be asked to revise their papers according to the standards of the Transactions or the Magazine. The papers will be subject to the Transactions' and Magazine's review process.

Important Dates

Special session proposal submission deadline: February 25, 2013

Full paper submission deadline: March 15, 2013

Workshop/tutorial proposal submission deadline: May 1, 2013
Notification of acceptance: June 1, 2013
Final paper submission deadline: July 1, 2013

Organizing committee

General Chair - Bart van Arem
General Co-Chair - Hans van Lint
Program Chair - Andreas Hegyi
Program Co-Chair - Bart De Schutter
Special Sessions Chair - Alfredo Núñez
Special Sessions Co-Chair - Hans van Lint
Finance Chair - Felicita Viglietti
Publications, Publicity, and Sponsoring Chair - Vincent Marchau
Local Arrangements and Registration Chair - Nicole Fontein



Conference website: http://ieee-itsc13.org/

IEEE Intelligent Vehicles Symposium – IV'13
23-26 June 2013, Gold Coast, Australia

http://www.iv2013.org







Call for Papers

THE INTELLIGENT VEHICLES SYMPOSIUM (IV'13) is the premier annual forum sponsored by the IEEE INTELLIGENT TRANSPORTATION SYSTEMS SOCIETY (ITSS). Researchers, academics, practitioners, and students from universities, industry, and government agencies are invited to discuss research and applications for Intelligent Vehicles and Cooperative Vehicle Systems. The technical presentations are characterized by a single session format so that all attendees remain in a single room for multilateral communications in an informal atmosphere. Tutorials will be offered on the first day followed by three days of presentations. An exhibition area will be available for the presentation of products and projects.

The IFAC – INTELLIGENT AUTONOMOUS VEHICLES CONFERENCE IAV'13 will also be held at Gold Coast, from 26 June to 28 June 2013. It is the very first time, since their inception, that these two premier conferences will be held back-to-back. A special reduced conference fee will thus be on offer to intelligent autonomous vehicles researchers and practitioners towards encouraging them to attend both events and explore underpinning synergies. For details please visit www.iav2013.org

The IV'13 Program topics include but are not limited to:

Advanced Driver Assistance Systems	Assistive Mobility Systems
Automated Vehicles	Proximity Awareness Technology
Vehicular Safety, Active and Passive	Intelligent Ground, Air and Space Vehicles
Vehicle Environment Perception	Autonomous/Driverless Vehicles
Driver State and Intent Recognition	Image, Radar and Lidar Signal Processing
Eco-driving and Energy-Efficient Vehicles	Information Fusion
Impact on Traffic Flows	Vehicle Control
Cooperative Vehicle – Infrastructure Systems	Telematics
Collision Avoidance	Human Factors and HMI
Pedestrian Protection	Electric and Hybrid Vehicle Technologies
V2I/V2V Communication	Novel Interfaces and Displays
Proximity Detection Technology	Intelligent Vehicle Software Architecture

For detailed submission instructions visit the conference website at www.iv2013.org

Important Dates

Workshop, Special Session and Tutorial Proposals	01 November 2012
Paper Submission	01 November 2012
Notification of Acceptance	15 January 2013
Early Registration	15 February 2013
Final paper Submission	28 February 2013

Proposals

For special sessions, demonstrations, and exhibition proposals please contact respective chair.



General Chair	IPC Co-Chairs	Publication Chair	Tutorial Chair	Industry Chair
Ljubo Vlacic	Miguel Ángel Sotelo	Hussein Dia	Eduardo Nebot	Gary White
l.vlacic@griffith.edu.au	miguel.sotelo@uah.es	Hussein.Dia@aecom.com	nebot@acfr.usyd.edu.au	gary.white@autocrc.com
	Zoran Duric			
	zduric@cs.gmu.edu			

Notes

Notes