



INTELLIGENT
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IEEE ITS SOCIETY NEWSLETTER

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The IEEE ITS Society Newsletter is published quarterly in January, April, July, and October. The current and all past issues of the Newsletter may be downloaded at no charge from the Society's web site: <http://sites.ieee.org/itss/>.

You may subscribe to or unsubscribe from announcements at the same web site. Announcements are sent to approximately 10,000 ITS professionals from industry, academia, and government.

Information for Contributors

Announcements, feature articles, book and meetings reviews, opinions, letters to the editor, professional activities, Abstracts of reports, and other material of interest to the ITS community are solicited. Please submit electronic material for consideration in any of the following formats: Microsoft Word, OpenOffice, plain ASCII, rich text format (rtf), or portable document format (pdf) to the Editor-in-Chief at yaobinchen@ieee.org.

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SOCIETY NEWS

From the Editor

— Yaobin Chen



In this issue, you will have the chance to read summary reports from several ITSS sponsored conferences that were held in July and September such as ICVES'12, MESA'12, SOLI'12, ITSC'12, etc. Especially, we have held another successful ITS conference Anchorage, Alaska September 17-19. Several ITS Society awards were presented to outstanding researchers and Ph.D. students in ITS research community at the conference.

I am pleased to announce that I have completed my service as the Editor-in-Chief for the Newsletter and will transition this role to Dr. Miguel Sotelo of University of Alcalá de Henares, Spain. My service to the Society will continue as a member of the Executive Committee in a different leadership role in the Society. I'd like to take this opportunity to thank you all for your readership and support. In particular, I'd like to thank my associate editors and all other contributors for their time and dedication to the Newsletter. I am sure Dr. Sotelo and his team will continue our tradition of excellence and serve you even better. Welcome on Board, Miguel!

Message from President:

Evidence-Based ITS

By Dr. Christoph Stiller, President

Recently, during a conversation on advancements in science a friend of mine who is a medical scientist made the point that nowadays solely evidence-based medical treatments had any justification. He argued that approaches based on analytical inference, findings through simulations or from observations had too often led to erroneous methods that have been followed with full conviction and led to questionable results in the past. While any approach is acceptable to create a hypothesis for a new therapy, the human is just too complex to allow analytical inference or trustable simulations. Hence, any hypothesis needs to be strictly backed up by empirical evidence, i.e. it has to be applied in, e.g., a double blind systematic study and yield significant empirical evidence before a therapy can be trusted.



Formally, in the Bayesian paradigm evidence for any finding x given data y is described through the a posteriori probability $P(x|y)$. Following Dempster-Shafer evidence theory the evidence is described through the degree of belief $\text{bel}(x)$ in x knowing y . While differing in some aspects, the underlying ideas of both concepts are quite similar. When sampling the space of data sufficiently dense in a representative way, P or bel can be approximated empirically thus confirming hypothesis on the interrelation of x and y to some significance level.

Looking at the many methods and functions we have developed in Intelligent Transportation Systems evidence-based ITS is an exception rather than the rule in our field. New car models are validated during the homologation process by various experiments. This process yields a high evidence level for many components of the vehicle. E.g. after a mechanical part has lasted various driving profiles the trust in its strength is deemed sufficient. However, for Intelligent Transportation Systems these experiments rarely provide significant evidence. The reason for this is that even for relatively simple systems like an Adaptive Cruise Control the space of possible real world data y includes driving situations and thus its dimensionality is too high to allow a representative coverage in experiments. How many successfully driven kilometers in which countries and by which drivers would be required to guarantee sufficient performance of such an advanced driver assistance system? Clearly, that example is solved as the driver is still kept in the driving loop and has to take on responsibility. But how can we ever gain sufficient evidence to trust a safety-relevant driver assistance function?

While norms like ISO 26262 and project results like the code of practice developed in EU RESPONSE aim to provide some rules for the current state-of-the-art, a truly satisfactory answer to the above question is not yet within sight. Nevertheless, I see several trends that help to enhance evidence in ITS.

The first is a more or less open discussion and comparison of ITS methods. It is considered as a prominent mission of our ITS Society to provide an open forum for such exchange through its conferences, meetings, and journals. Thorough peer reviewing is important for our society's activities in this field as it allows condensing the variety of methods to those that provide some

novel contribution that is backed by preliminary evidence from experiments. The ITS Society requires three independent reviews for every contribution, before it can be accepted.

Some ITS conferences like the IEEE Intelligent Vehicles Symposium have the tradition to include a demonstration day that provides stakeholders a unique opportunity to witness the performance of experimental vehicles presented.

Another important trend is the establishment of benchmarks for components of transportation systems. Open image databases for pedestrian detection or stereoscopic image sequences for 3D geometry reconstruction are but few recent examples that contribute to enhance evidence on the best available methods. Even though, benchmarks on vehicle or traffic level are all but exhaustive so far, I am amazed how much the DARPA Grand Challenges in 2004 and 2005, the Urban Challenge in 2007 and the Grand Cooperative Driving Challenge in 2011 have inspired international teams and led to a crystallization of trustable methods.

It is still a long way before we may ever reach evidence for safe ITS but I am convinced that it worth to proceed on it.

As a note on the side, IEEE ITSS is now dedicating a separate conference to railway systems. The IEEE International Conference on Intelligent Rail Transportation, ICIRT, will be in Beijing, China, in August 30st – September 1st, 2013.

Evidently we should proceed our discussions at our conferences in 2013!

2012 ExCom/BoG Annual Meetings

By Jeffrey Miller, VP for Administration

The ITSS Executive Committee met on September 15, 2012 and the ITSS Board of Governors met on September 16, 2012 in Anchorage, Alaska for its fall meeting in conjunction with ITSC 2012. The ExCom meeting was attended by all 10 members of the ExCom, and the BOG was attended by 17 of the 24 BOG members.



The ExCom meeting took place at the Hilton Anchorage on the top floor overlooking the port of Anchorage with a view of the Chugach Mountains. The 5-hour ExCom meeting ended just after 6:00p.m. The ExCom dinner followed at the Crow's Nest at the top of the Hotel Captain Cook with traditional Alaskan cuisine of salmon, halibut, and Yukon potatoes. The BOG meeting began at 9:00a.m. the next morning and lasted until 5:30p.m. The ITSC welcome reception followed the meeting with heavy appetizers and drinks. Each of the members of the ExCom gave a detailed presentation about all of the activities that have been and will be conducted. Discussion ensued on many topics, and the main points are summarized here.

All three of the ITSS publications (Transactions, Magazine, Newsletter) are continuing to do well. The Magazine needs to try to attract more papers. An impact factor will hopefully be coming sometime in late 2013 or early 2014. The Transactions impact factor is still the highest of all transportation journals.

Conference attendance and publications are doing well. We would like to schedule IV and ITSC at least 3 years in advance. The ITSS web site needs to stay updated with new conferences. Membership in the ITSS is now above 1100. Christoph Stiller would like to develop a strategy to grow the society membership to 2000 members.

There will be a BOG teleconference in April 2013 to approve the society budget and page budget for publications. The following BOG meetings will be on June 23, 2013 in conjunction with IV 2013 in Australia and October 6, 2013 in conjunction with ITSC 2013 in the Netherlands. Here are the upcoming conferences with confirmed locations in ITSS:

ITSC 2013 – The Hague, Netherlands

ITSC 2014 – Qingdao, China

ITSC 2015 – Las Palmas, Canary Islands

ITSC 2016 – Rio de Janeiro, Brazil (approved at September 2012 BOG meeting)

IV 2013 – Brisbane, Australia

IV 2014 – Detroit, Michigan (approved at September 2012 BOG meeting)

ISI 2013 – Seattle, Washington, USA

MESA/SOLI 2012 – Suzhou, China

VNC 2012 – Seoul, Korea

Financially the society is doing well and staying consistent. We are operating close to break-even or slightly profitable for 2012.

The tiered registration structure for ITSS students and ITSS members at ITSC 2012 seemed to have attracted members, so it will be implemented at future ITSS conferences as well.

Urbano Nunes, the VP for Technical Activities, scheduled a technical activities committee meeting on September 19, 2012, immediately following ITSC 2012.

Podcast interviews with experts in the field will move forward with Javier Sanchez Medina taking the lead.

The Transactions is trying to reduce the amount of time that elapses from first submission to final decision. One strategy is to have more AEs so current ones do not get overwhelmed. The Magazine has had a few special issues in 2012 and will have some in 2013 as well. More submissions are still being solicited for the Magazine. The Newsletter mailing list consists of over 14,000 email addresses.

The ITSS Constitution and Bylaws were modified to include the Magazine EiC as a voting member of the BOG, similar to the Transactions EiC. The proposed modifications were passed unanimously by the BOG.

A discussion occurred about the issues and benefits of using Papercept for conference paper submission. The conclusion was for the VP Conferences to investigate other systems and make a recommendation to the BOG at a future meeting. Some of the ITSS conferences already use EasyChair or SPLTrak, so those two could be considered.

There were a few ExCom positions that were elected at this meeting also. The term for the President-Elect is one year followed by two years as President and one year as Past-President. All of the other positions are elected for two year terms.

President-Elect – Matthew Barth

VP Financial Activities – Alberto Broggi

VP Technical Activities – Yaobin Chen

VP Administrative Activities – Daniel Dailey

VP Conference Activities – Wei-Bin Zhang (elected because Matt Barth was VP Conferences and has become President-Elect starting in 2013)

Newsletter Editor-in-Chief – Miguel Angel Sotelo (elected because Yaobin Chen was the Newsletter EiC and has become the VP Technical Activities starting in 2013)

Please help me welcome all of the new ExCom members. In addition, the BOG election is currently taking place, and the new BOG members will be announced in the spring newsletter.

As I will no longer be the VP Administrative Activities starting in 2013 (which was voluntary), this will be my last update of ExCom and BOG meetings in the newsletter. I hope you all have enjoyed reading these updates, and I encourage everyone to become as involved in the society activities as you can.

If you have any questions about anything covered at the meeting, feel free to contact the VP Administrative Activities, Jeffrey Miller, at jeffrey.miller@ieee.org.

IEEE 2012 ITS Award Announcement

IEEE ITS Institutional Lead Award
IEEE ITS Outstanding Research Award
IEEE ITS Outstanding Application Award

Purpose and Selection Criteria of Awards

The IEEE ITS Outstanding Research Award, IEEE ITS Outstanding Application Award, and IEEE ITS Lead Award are given annually for ITS researchers, practitioners, and research/development teams who have made significant contributions to research in ITS related fields (ITS Research Award), developed and deployed successful ITS systems or implementations (ITS Application Award), and demonstrated leadership in promoting ITS technologies (ITS Institutional Lead Award). These awards are established to recognize, promote, and publicize major research contribution, application innovations with real-world impact, and ITS institutional leadership.

Winners of 2012 IEEE ITS Awards

2012 IEEE ITS INSTITUTIONAL LEAD AWARD:

Hermann Winner

Institute of Automotive Engineering

TU Darmstadt

Citation: *For Institutional Leadership in Research and System Engineering for Advanced Driver Assistance and Safety.*

2012 IEEE ITS OUTSTANDING RESEARCH AWARD:

Petros Ioannou

University of Southern California

Citation: *For Research Contributions in Advanced Vehicle Control Systems and Integration with traffic.*

2012 IEEE ITS OUTSTANDING APPLICATION AWARD:

Wei-Bin Zhang

California PATH Program

Institute of Transportation Studies

University of California at Berkeley

Citation: *For Contributions in Applications of Advanced Vehicle Control and Safety Systems and Technologies.*



Prof Petros Ioannou (center) accepted the 2012 IEEE ITS OUTSTANDING RESEARCH AWARD at ITSC 2012 from IEEE ITSS President Christopher Stiller (left) and Vice Present for membership Jason Geng (right)



Dr. Wei-bin Zhang (center) accepted the 2012 IEEE ITS OUTSTANDING APPLICATION AWARD at ITSC 2012 from IEEE ITSS President Christopher Stiller (left) and Vice Present for membership Jason Geng (right)



Prof. Hermann Winner (center) accepted the 2012 IEEE ITS INSTITUTIONAL AWARD at ITSC 2012 from IEEE ITSS President Christopher Stiller (left) and Vice Present for membership Jason Geng (right)

2012 ITSS Best Ph.D. Dissertation Awards Announcement

Purpose and Selection Criteria of Awards

The prestigious IEEE ITSS Best Ph.D. Dissertation Award is given annually for the best dissertation in any ITS area that is innovative and relevant to practice. This award is established to encourage doctoral research that combines theory and practice, makes in-depth technical contributions, or is interdisciplinary in nature, having the potential to contribute to the ITSS and broaden the ITS topic areas from either the methodological or application perspectives.

Winners of 2012 ITSS Best Ph.D. Dissertation Awards

First Place:

MarkusENZweiler
Univ. of Heidelberg
Title: Compound Models for Vision-Based Pedestrian Recognition
Advisor: Prof. Christoph Schnorr, Univ. of Heidelberg, and
Prof. Dr. Dariu Gavrilă, Universitat von Amsterdam

Tied second place winner:

Anna Petrovskaya
Stanford University, USA
Title: Towards Dependable Robotic Perception
Advisor: Prof. Oussama Khatib

Tied second place winner:

Anastasios Kouvelas
Technical University of Crete, Greece
Title: Adaptive Fine-Tuning for Large-Scale Nonlinear Traffic Control Systems
Advisor: Prof. Markos Papageorgiou

For further information, please contact Dr. Jason Geng, VP for Membership Activities, IEEE ITSS.



Markus Enzweiler (center) accepted the 2012 ITSS Best Ph.D. Dissertation Award (First place) at ITSC 2012 from IEEE ITSS President Christopher Stiller (left) and Vice Present for membership Jason Geng (right)



Anna Petrovskaya (center) accepted the 2012 ITSS Best Ph.D. Dissertation Award (tied second place) at ITSC 2012 from IEEE ITSS President Christopher Stiller (left) and Vice Present for membership Jason Geng (right)



Anastasios Kouvelas (center) accepted the 2012 ITSS Best Ph.D. Dissertation Award (tied second place) at ITSC 2012 from IEEE ITSS President Christopher Stiller (left) and Vice Present for membership Jason Geng (right)

2012 IEEE Intelligent Transportation Systems Conference

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

The 2012 IEEE Intelligent Transportation Systems Conference, sponsored by the IEEE ITS Society, was held in Anchorage, Alaska on September 16-19, 2012. Attracting researchers from all around the world, the conference was immensely successful both in information dissemination, networking, great social events, and learning about the local culture of Alaska. One thing I learned when I moved to Alaska was not to let the weather deter you from doing what you want. I'm not sure if the conference attendees abided by that same principle during our rainy September days or if everyone just really wanted to attend all of the great talks that our program chairs lined up. We had over 350 pre-registrants and 340 people attend!

The conference had four great workshops on Sunday, September 16 – emerging technologies for pedestrian/bicycle detection, probe data analysis, challenges, and opportunities, transportation applications of unmanned aerial vehicles, and transportation data management and sharing. The workshops were attended by nearly 150 people, with some people being forced to stand because of the tremendous participation.

Sunday evening saw the beginning of the networking portion of the conference with the reception at the top of the Hilton Anchorage. The turnout was incredible, from what I can only think is attributable to the great Alaskan music provided by Hobo Jim (seen in the picture below with me and my daughter).



The conference opened on Monday morning with keynote speeches by Dr. Joseph Peters of the US Federal Highway Administration's (FHWA) Office of Operations Research and Development and John Horsley of the American Association of State Highway and Transportation Officials (AASHTO). All of the keynote speeches are posted on the ITSC 2012 web site if you would like to watch them. The technical sessions the rest of the day went off flawlessly with many thought-provoking presentations and discussions.

Tuesday opened with two different plenary sessions – one from Dr. Bin Ning of Beijing Jiaotong University and Dr. Makoto Itami of Tokyo University of Science, and the other from Ocie Adams of the Statewide Maintenance and Operations Intelligent Transportation Systems for the Alaska Department of Transportation and Dr. Christoph Stiller of Karlsruhe University in Germany. Both of the sessions were very well-attended and had extremely positive feedback from attendees. I'm glad that we were able to

have a local plenary talk from the Alaska DOT about the snow plow intelligent systems that are installed in some areas of the state that receive more snowfall daily than many cities receive annually.

The technical sessions on Tuesday proved just as valuable as Monday's, concluding with a banquet that many people will never forget. Starting off with the great Alaskan cuisine provided by the Hilton, the Tsimshian dancers followed by giving us a look at the culture of native Alaskans. After that, veteran dog musher Vern Halter gave demonstrations and talked about running the Iditarod, which is the most famous and difficult dog sled race in the world, taking people nearly two weeks to complete in the dead of winter. If that wasn't enough, seeing a bald eagle and snowy owl from the Bird Treatment and Learning Center up close definitely was a highlight. People may have been torn between the birds and getting to sit on an 8 foot tall moose! Hank the Moose was a hit for five straight hours! Pictures of the attendees with Hank can be found on our web site at <http://www.itsc2012.org>. And last but definitely not least, I held up my promise to everyone that I would guarantee seeing a live moose while in Alaska. Teddy the Moose from the Alaska Wildlife and Conservation Center gave everyone the ability to see a moose within nothing but a pole in between. What a great evening this was!



Tsimshian Native Alaskan Dancers



Bald Eagle and Snowy Owl



Iditarod Dog Musher Vern Halter



Prof. Jeffrey Miller and his ITSC 2012 student volunteers with Hank the Moose



Teddy the Moose (5 months old)



Prof. Bart van Arem and the ITSC 2013 organizing committee on Hank the Moose

The conference wrapped up on Wednesday with more technical sessions, and I have to say that I was impressed that over 200 people were still attending sessions on the last day of the conference. I would like to give a great thank you to my entire organizing committee who helped to put on one of the best ITSCs ever! Wei-Bin Zhang, Yin Hai Wang, James Krogmeier, Heng Wei, Zhiheng Li, Javier Sanchez-Medina, Brendan Morris, Urbano Nunes, Fei-Yue Wang, and Matthew Barth definitely made the conference the great success it was. And of course I must also thank the tremendous efforts by the 65 members of the International Technical Program Committee and the 688 reviewers. Without the effort of those volunteers, the technical program would not have been as tremendous as it was.

I want to thank the ITS Society for allowing me to run ITSC 2012 in Anchorage, Alaska, and I hope everyone enjoyed their time in our great state. I look forward to seeing you all at other conferences!

If you have any questions or comments, please email me at jeffrey.miller@ieee.org.

Jeffrey Miller
General Chair
IEEE 15th Intelligent Transportation Systems Conference

2012 IEEE International Conference on Vehicular Electronics and Safety Report

The 2012 IEEE International Conference on Vehicular Electronics and Safety (ICVES'12) which is an annual forum sponsored by the IEEE Intelligent Transportation Systems Society was organized in Istanbul, Turkey during July 24-27, 2012. The technical program was a 3 day conference bringing together researchers and practitioners to discuss vehicle electronics, and safety systems research and practice. The technical presentations were enriched with plenary speakers from three continents: Prof. Ümit Özgüner from USA, Prof. Claude Lurgeau from France, Prof. Christoph Stiller from Germany and Prof. Makoto Itami from Japan gave plenary speeches on the very motivating themes such as roadway safety, electro-mobility, e-mobility, cooperative automobiles and ITS wireless communication systems. Furthermore, a panel session was dedicated to the research and development efforts on the theme of vehicular electronics and safety in Turkey. Managers and engineers from major automotive manufacturers and industrial companies related to automotive technologies in Turkey were attended as the panelists.

Overall, 101 contributions were submitted for possible publication in the ICVES'12 proceedings. The submitted papers were reviewed by the international program committee members (the Associate Editors and the reviewers) and 81 contributions were selected for presentation in the conference and publication in the proceedings. The international nature of the conference was demonstrated by the wide range of countries/regions of origin for the technical contributions, including Australia, Canada, China, Colombia, France, Germany, Greece, India, Iran, Iraq, Italy, Japan, Jordan, North Korea, South Korea, Lebanon, Macedonia, Portugal, Romania, Spain, Taiwan, Thailand, Tunisia, Turkey, United Kingdom, and USA. Overall 233 author's name appears in the ICVES'12 proceedings, 36 authors were from Turkey, 29 authors from China, 27 authors from Germany, 24 authors from Japan, 21 authors from Iran, 17 authors from USA, 12 authors from Taiwan, 9 authors from South Korea, and 5 authors are each from France, Spain and United Kingdom. And as final interesting information, the total of 251 keywords was entered by the corresponding authors at the paper submission. The most hit keywords were Driver Assistance Driving Systems, Active and Passive Safety Systems, and Navigation and Localization Systems.

Overall, the conference program was run very successfully and smoothly and social activities created an atmosphere to enjoy historical and natural beauty of the metropolitan city Istanbul.

Assoc. Prof. Tankut Acarman
Program Chair, IEEE ICVES'12

A Brief Report on 2012 IEEE/ASME MESA and IEEE/INFORMS SOLI Conferences

From July 8 to 10, both the 2012 IEEE/ASME International Conference on Mechatronic/Embedded Systems and Applications (MESA) and IEEE/INFORMS International Conference on Services, Operations, Logistics, and Informatics (SOLI) were held successfully in Suzhou, China.

MESA Conference

Since 2005, the MESA conferences have been sponsored by ASME in odd years and IEEE in even years. The objectives of the MESA conferences are to bring together experts from the fields of mechatronic and embedded systems, disseminate the recent advances made in the area, discuss the future research directions, and exchange application experience. The mechanical engineering is increasing integrated with electronics, control systems, and computer sciences. This integration results in systems that are called mechatronic systems. The development of mechatronic systems requires finding an optimal balance between the basic mechanical structure, sensors, actuators, automatic digital information processing, and controls. The embedded systems play a key role in mechatronic systems.



There are 59 accepted papers from 15 countries attended the conference 10 Technical Sessions.

The invited keynote speaker, Prof. Hwei Peng from Department of Mechanical Engineering, the University of Michigan, addressed issues in "Design and Control of Hybrid Electric Vehicles" in his speech during the conference. The plenary speaker, Professor XiaoQi CHEN from the Department of Mechanical Engineering, University of Canterbury, Christchurch, New Zealand, presented a talk on "Mobile Robots: A Journey of Walk, Claw and Climb" .

General Chair, Prof. Martin Horauer, Program Chair Prof. Bo Chen and Steering Committee Chair, Primo Zingaretti jointly hosted awards session, the 2012 MESA Achievement Award was presented to Prof. Fei-Yue Wang, Chinese Academy of Sciences, for his career achievements and significant contributions in research and applications of mechatronic design of flexible robotic systems and application specific real-time embedded systems.



Mahdi Agheli and Stephen Nestinger received the Best Paper Award in Theory; Xu Zhong and Yu Zhou received the Best Paper Award in Computational Methods and Software; John Wang, G.P. Penamalli, and Lei Zuo received Best Paper Award in Applications.

Best Student Paper awarded to Christoph Ledermann, Jan Hergenhan, Oliver Weede, and Heinz Wörn; Poowanart Poramapojana and Bo Chen; Huang Xiao, Yutian Ma, and Changpin Li respectively.

SOLI Conference

The goal of the IEEE/INFORMS SOLI is to bring together researchers from the fields of Services, Operations, Logistics, and Informatics to develop and nurture a community for the scholars, researchers and practitioners from academic institutions, universities and industrial companies all over the world. This year, 180 papers were submitted to the conference, and



90 papers were accepted after a strict peer review process. In addition to the well-organized technical program, IEEE/INFORMS SOLI 2012 included a distinguished keynote speech by Dr. Stacy F. Hobson from the IBM T. J. Watson Research Center on the topic of "The Role of Data and Analytics in Advancing Services Research".



This event and program would not have been possible without the tremendous efforts of the program and organizing committees. We are grateful to the Program Committee for their outstanding efforts in assembling such an excellent program, and to the authors who submitted the high quality papers for the conference. We also gratefully acknowledge the IEEE ITSS and INFORMS for sponsoring the conference. A special acknowledgement is due to the Institute of Automation, Chinese Academy of Sciences, and Suzhou University, who were the co-hosts of the conference.

Program Chairs, Dr. Xiwei Liu from Chinese Academy of Sciences and Prof. Xueguan Liu from Soochow University hosted 2012 SOLI awards session.

Axel Hochstein, Ying Tat Leung, and Matthew Denesuk; Giovanna Lella, Anthonio Fischetto, Vittorio Cesarotti, James Spohrer, Guangji Ren, and Y. T. Leung received the Best Conference Paper Awards;

Feng Li, RongZeng Cao, ShaoChun Li, ChangJie Guo and XinYu Zhao; Muawia Ramadan, Zelong Wang, and Bernd Noche received Best Application Paper Awards;

Nelson Lee, Pranav Gupta, and Bharat Joshi; Yixiao Huang, Chunyang Shi, Lei Zhao, and Tom Van Woensel received Best Student Paper Awards.



16th International IEEE Conference on Intelligent Transportation Systems **Intelligent Transportation Systems for All Transportation 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 tests.

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.

Organizing committee

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Regional Program Chairs

Matthew Barth (America)

Shunsuke Kamijo (Asia/ Australia)

Miguel Ángel Sotelo (Europe)

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 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 an MSc or PhD 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



Gemeente Den Haag

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

Special Session Proposals	06 January 2013
Paper Submission	06 January 2013
Notification of Acceptance	11 March 2013
Early Registration	28 March 2013
Final paper Submission	11 April 2013

Proposals

For workshop & tutorial sessions, demonstrations, and exhibition proposals please contact respective chair.



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ICIRT 2013 Call for Papers

2013 IEEE International Conference on Intelligent Rail Transportation

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Registration Chairs:

Shigen Gao, China
Xiaoxia Yang, China

**Sponsors: IEEE Intelligent Transportation Systems Society,
Chinese Association of Automation, China Railway Society**
Aug.30-Sept.1, 2013, Beijing, China

THEME

2013 IEEE International Conference on Intelligent Rail Transportation (IEEE ICIRT 2013) will be held on Aug.30-Sept.1, 2013 at the Beijing Friendship Hotel. The conference is sponsored by the IEEE Intelligent Transportation Systems Society, Chinese Association of Automation and China Railway Society. And it is organized by Beijing Jiaotong University and Institute of Automation Chinese Academy of Sciences.

The theme of IEEE ICIRT 2013 is "Security, Efficiency and Intelligence". Experts will be invited to give frontier lectures, make speeches in group and discuss ideas freely. The aim is to provide an open platform for the scholars in the technologies, theories and engineering applications of rail transit to carry out academic exchanges. All accepted papers will be published by IEEE, which will be indexed by EI and ISTP. Welcome experts and scholars both domestic and abroad to contribute to the conference.

TOPICS OF INTEREST (BUT NOT LIMITED TO)

- Rail transit system modeling method
- Train protection control
- Energy saving and environment protecting control technology
- Safe reliability
- Communication technology and its application
- Parallel control and management for rail transit system
- Systems operation organization and dispatching
- Train control system simulation and testing
- Multi-objective optimization control of rail transit
- Computer simulation
- Fault detection and diagnosis
- Multi-agent theory and application
- Automatic operation
- Human factors in rail transit system

PAPER SUBMISSION

Regular paper submission: Complete manuscripts in PDF must be submitted through website <http://icirt.bjtu.edu.cn> electronically. Manuscripts should be at most six pages in the IEEE two-column format including figures, tables, and references.

Invited paper submission: Proposals for invited sessions should be submitted to the Program Chair. Full manuscripts should be submitted in the same manner as regular papers after the proposal has been accepted. The proposal should include a one-page summary of the proposed session with authors' name, affiliation, title of the abstract with five extended abstracts (no more than 1000 words) attached. Please contact us at icirt.ieee@gmail.com.

IMPORTANT DATES

Proposal submission deadline for invited sessions:	January 30, 2013
Full paper submission deadline:	March 30, 2013
Notification of acceptance:	April 15, 2013
Camera-ready copy due:	May 15, 2013



October 2012

IEEE Intelligence and Security Informatics (ISI) 2013

First Call for Papers and Workshop Proposals

September 2012

June 4-7, 2013, Seattle, WA, USA

THEME: Big Data, Emergent Threats and Decision-Making in Security Informatics

HOST: Pacific Northwest National Laboratory

Conference website: <http://ISIconference2013.org>

Intelligence and Security Informatics (ISI) research is an interdisciplinary research field involving academic researchers in information technologies, computer science, public policy, bioinformatics, and social and behavior studies as well as local, state, and federal law enforcement and intelligence experts, and information technology industry consultants and practitioners to support counterterrorism and homeland security missions of anticipation, interdiction, prevention, preparedness and response to terrorist acts. The annual IEEE International ISI Conference series was started in 2003. Meeting have been held in Tucson, AZ (twice); Atlanta, GA; San Diego, CA; New Brunswick, NJ; Taipei, Taiwan; Dallas, TX; Vancouver, Canada; and Beijing, China, and Washington D.C. Proceedings of these ISI meetings and workshops have been published by the IEEE Press and in the Springer Lecture Notes in Computer Science (LNCS) series.

IMPORTANT DATES

- Paper submission due date: *February 15, 2013*
- Notification of acceptance: *March 18, 2013*
- Due date for Workshop proposals: *February 18, 2013.*

ISI 2013 will be organized in three main streams focusing on

- Big Data in Security Informatics
- Emergent Threats
- Decision-Making in Security Informatics.

Submissions may include systems, methodology, test-bed, modeling, evaluation, and policy papers. Research should be relevant to informatics, organization, or public policy in applications of counterterrorism or protection of local/national/international security in the physical world or cyberspace. Topics include but are not limited to:

Big Data in Security Informatics

- Information Sharing and Data/Text Mining Intelligence-related knowledge discovery
- Computer or cybercrime investigations and digital forensics
- Criminal investigative criteria and standard of procedure on Computer crime
- Criminal data mining and network analysis
- Forecasting crime and the impact of crime
- Criminal/intelligence information sharing and visualization
- Crime pattern recognition and modeling tools
- Web-based intelligence monitoring and analysis
- Spatial-temporal data analysis/GIS for crime analysis and security informatics
- Deception and intent detection
- Cyber-crime detection and analysis
- Authorship analysis and identification
- Applications of digital library technologies in intelligence data processing, preservation, sharing, and analysis
- Agents and collaborative systems for intelligence sharing
- HCI and user interfaces of relevance to intelligence and security
- Information sharing policy and governance
- Privacy, security, and civil liberties issues
- Intelligence-computerized community security and surveillance system

Emergent Threats

- Infrastructure Protection and Emergency Responses
- Cyber-Physical-Social system security and incident management
- Cyber-infrastructure design and protection
- Intrusion detection
- Bio-terrorism tracking, alerting, and analysis
- Bio-terrorism information infrastructure

- Transportation and communication infrastructure protection
- Border/transportation safety
- Law Enforcement decision support systems
- Emergency response and management
- Disaster prevention, detection, and management
- Communication and decision support for search and rescue
- Assisting citizens' responses to terrorism and catastrophic events
- Computer forensics and crime lead discovery
- Anti-fraud information technology
- Terrorism Informatics
- Terrorism related analytical methodologies and software tools
- Terrorism knowledge portals and databases
- Terrorist incident chronology databases
- Terrorism root cause analysis
- Social network analysis (radicalization, recruitment, conducting operations), visualization, and simulation
- Forecasting terrorism
- Countering terrorism
- Measuring the impact of terrorism on society
- Measuring the effectiveness of counter-terrorism campaigns
- Crime intelligence and cyberspace crime investigation
- Immigration and security

Decision-Making in Security Informatics

- Enterprise Risk Management and Information Systems Security
- Information security management standards
- Information systems security policies
- Behavior issues in information systems security
- Fraud detection
- Cybercrime and social impacts
- Corporate going concerns and risks
- Accounting and IT auditing
- Corporate governance and monitoring
- Board activism and influence
- Corporate sentiment surveillance
- Market influence analytics and media intelligence
- Consumer-generated media and social media analytics

PAPER SUBMISSION

Submission file formats are PDF and Microsoft Word. Required Word/LaTeX templates (IEEE two-column format) can be found at the conference Web site. Long (6,000 words, 6 pages max) and short (3000 words, 3 pages max.) Papers in English must be submitted electronically via the conference Web site. The accepted papers from ISI 2013 and its affiliated workshops will be published by the IEEE Press in formal Proceedings. IEEE ISI Proceedings are EI-indexed. Authors who wish to present a poster and/or demo may submit a 1-page extended abstract, which, if selected, will appear in Proceedings. The selected IEEE ISI 2013 best papers will be invited for contribution to the Springer Security Informatics journal. The deadline for paper submissions is February 15, 2013. Paper submission instructions and template information can be found at on the submissions page at <https://www.easychair.org/conferences/?conf=ieeesi2013>.

Best papers awards will be given in three categories:

- Best paper
- Runner-up paper
- Best student paper
- Runner-up student paper.

WORKSHOPS

In conjunction with ISI 2013, several workshops will be held on June 4, 2013. Special-topic workshops in any areas of Intelligence and Security Informatics research and practice are welcome. Such events will be an integral part of the ISI-2013 conference program. Proposals in PDF or Microsoft Word not exceeding 3 pages should be emailed to the conference organizing committee at antonio@pnnl.gov by February 18, 2012 and contain the following information.

- Title of tutorial/workshop
- Preferred duration (half day vs. full day)
- Brief bios of proposed instructor(s)/organizer(s)
- Objectives to be achieved
- Scope of topics to be covered
- Target audience and the list of potential

Conference Organizing Committee

General Co-Chairs:

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- Kristin Glass, New Mexico Tech, USA

CALL for PAPERS:

The First International Conference on Universal Village, Jan. 16-17, 2013, Beijing, China

The conference is to explore systematic methodologies to improve the life quality by advancing Universal Village and major subsystems, including, intelligent health care, intelligent transportation, intelligent environment, and intelligent energy management and environment protection. The conference will first discuss the system of Universal Village and how it will be affected by its subsystems, the interaction and mutual impact among its interrelated and coordinated subsystems, as well as their design, development, implementation and engineering. Furthermore, the conference will address regional development paths and key technologies of subsystem integration and system design appropriate for different countries and regions. Besides technical aspects, the conference covers human and social aspects of Universal Village, including its impact on life style, economics, and future society. The conference is expected to benefit governments, companies, and universities on topics as well as practical solutions related to Universal Village. Subjects and general categories include but not limited to the following topics.

Systems, Applications & Regional Factors	Components & System Integration
<ul style="list-style-type: none">■ Subsystems of Universal Village<ul style="list-style-type: none">➤ Intelligent Environment Smart commercial and residential complexes, smart village, smart community, etc., focusing on:<ul style="list-style-type: none">○ Intelligent security monitoring○ Intelligent information distribution & services➤ Intelligent Transportation Systems<ul style="list-style-type: none">○ Intelligent technologies to enhance safety, efficiency & convenience○ Environmental friendly vehicles and other new emerging vehicles➤ Intelligent Healthcare Intelligent & distributed hospitals, recuperation centers, intelligent senior houses, focusing on:<ul style="list-style-type: none">○ Intelligent hospital administration & management technologies○ Intelligent healthcare monitoring & prediction○ Tele-medicine & assistive technologies○ Mobile-health and intelligent ambulance technologies➤ Intelligent Energy Management & Environment Protection Intelligent adaptation based on human activities, health status, and weather conditions for buildings, community, or environment■ Subsystems Interaction and Integration<ul style="list-style-type: none">○ Interaction & mutual impact between whole system and its subsystems○ Interaction & mutual impact among subsystems○ Subsystem integration and system design■ Regional Factors and Future Directions<ul style="list-style-type: none">○ Impact of regional factors on system design○ Future research directions based on the demand of the whole system	<ul style="list-style-type: none">■ Hierarchical Layers & Components<ul style="list-style-type: none">➤ Infrastructure Layer<ul style="list-style-type: none">○ Intelligent sensor & communication network○ Cloud and mobile computing○ Event-driven data compression & storage○ New material, device & components➤ Informational Layer<ul style="list-style-type: none">○ Multi-platform information retrieval & visualization, data sharing & data integration, data fusion & data mining (across TV net, mobile net, Internet)○ Smart response systems for emergency and accidents■ System Implementation<ul style="list-style-type: none">➤ Technical<ul style="list-style-type: none">○ Dynamic impact of subsystem implementation○ Large complex system theories➤ Social<ul style="list-style-type: none">○ Cultural and political factors○ Impact on future life style and society○ Inter-entity & international collaboration such as, collaboration among different government organizations, different companies, and different universities

For any questions, send email to universal.village.conf@gmail.com.

Please submit papers to universal.village.submit@gmail.com by **Oct. 31st, 2012**.

For more details, please refer to www.universal-village.org.



Conference Calendar

Massimo Bertozzi / Paolo Grisleri

Conference Calendar

This section lists upcoming ITS-related conferences, workshops, or exhibits. Contributions are welcome; please send announcements to itsconfs@ce.unipr.it.

2012

Dec 12-16, 2012
International Conference on Connected Vehicles and Expos
Beijing, China
Submission due by: August 15, 2012
<http://www.ICCVE.org>

2013

February 2-3, 2013
2nd International Conference on Traffic and Transportation Engineering
Male, Maldives
Submissions due by: November 25, 2012
<http://www.iccte.org>

February 20-21, 2013
V2X for Auto Safety and Mobility Europe 2013
Frankfurt, Germany
<http://www.telematicsupdate.com/vehicle-to-vehicle-conference-europe/index.php>

Feb 21-23, 2013
VISIGRAPP Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications
Barcelona, Spain
<http://www.visigrapp.org/>

April 16-18, 2013
SAE 2013 World Congress
Detroit, Michigan, USA
Submissions due by: September 1st
<http://www.sae.org/congress/techprogram/cfp.pdf>

April 22-24, 2013
ITS America Annual Meeting and Exposition
Nashville, TN, USA
Submission due by: November 1
<http://itswc.confex.com/itswc/AM2013/cfp.cgi>

May 6-10, 2013
2013 IEEE International Conference on Robotics and Automation (ICRA 2013)
Karlsruhe - Germany
Submissions due by September 17, 2012
<http://www.icra2013.org/>

May 27-31, 2013
IEEE International Symposium on Industrial Electronics (ISIE 2013)
Submission of Full Papers November 30, 2012
Special Session Proposals November 10, 2012
<http://www.isie2013.org/>

June 2-5, 2013
IEEE Vehicular Technology Conference: VTC2013-Spring
Dresden, Germany
Submissions due by: September 30
<http://www.ieeevtc.org/vtc2013spring/index.php>

June 23-26, 2013
The 2013 IEEE Intelligent Vehicles Symposium
Workshop and Tutorial Proposals: 01 November 2012
Special Session Proposals: 01 November 2012
Paper Submission: 01 November 2012
Gold Coast, Australia
<http://www.iv2013.org/>

June 27-28, 2013
ICIAP 2013 : International Conference on Image Analysis and Processing
Paris, France
Submissions due by: January 31, 2013

June 26-28, 2013
IFAC Intelligent Autonomous Vehicles Conference IAV'13
Gold Coast, Australia
<http://www.iav2013.org>

Jun 23-28, 2013
26th IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2013)
Portland OR, USA
Submissions due by Nov 4, 2012

<http://www.pamitc.org/cvpr13/>

July 15-16, 2013

International Conference on Vehicular Electronics and Safety (ICVES 2013)

Stockholm, Sweden

Submissions due by: January 31, 2013

<http://www.waset.org/conferences/2013/stockholm/icves/>

August 24-27, 2013

National Rural ITS Conference

St. Cloud, MN, USA

http://archive.itsmn.org/files/downloads/events/flyer_nrits_2013.pdf

Aug 28-30, 2013

2013 IEEE Multi-Conference on Systems and Control (MSC)

Hyderabad, India

September 1-4, 2013

IEEE Vehicular Technology Conference: VTC2013-Fall

Submission due by: March 2013

Las Vegas, NV, USA

http://www.ieee.org/conferences_events/conferences/conferencedetails/index.html?Conf_ID=20447

September 6-9, 2013

IEEE Intelligent Transportation Systems Conference

Submission due by: March 15, 2013

The Hague, The Netherlands

September 25-27, 2013

International Conference on Sustainable Automotive Technologies

Ingolstadt, Germany

Submissions due after: August 1st

<http://www.icsat2013.com>

October 14-18, 2013

20th World Congress on ITS

Tokyo, Japan

<http://www.itsworldcongress.jp>

November 3-7, 2013

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2013)

Tokyo Big Sight, Tokyo, Japan

<http://www.iros2013.org/>

Abstracts of forthcoming papers on IEEE Transactions on ITS

PEDESTRIAN SAFETY ANALYSIS IN MIXED TRAFFIC CONDITION USING VIDEO DATA

ZHANG, YINGYING; YAO, DANYA (DANIEL); QIU, TONY; PENG, LIHUI; ZHANG, YI

With dramatic development of image processing technology, a growing number of traffic flow detection and analysis have been conducted by using video data. Time to Collision (TTC) and Post-Encroachment Time (PET) are two major parameters to indicate the potential collision's severity and to capture imminent vehicular accident. However, micro-level pedestrian involved collisions are less studied because they are hard to observe or record. This paper tries to extract the traffic object locations from video data, define the Time Difference to Collision (TDTC) parameter as a variation from TTC and PET to fit the pedestrian involved potential collisions/conflicts, analyze the interaction behavior between pedestrian and vehicle, and validate the TDTC parameter in indicating pedestrian safety performance by using 100 groups of interaction data. The result shows that the interaction cases with larger TDTC values are safer, while the cases with continuously closer to zero TDTC values are more dangerous. About 80% of the cases classified by the TDTC parameter have the same result with the independent observation; if TDTC is combined with vehicle speed, the classification result can be improved. More mixed traffic scenes will be conducted based on this research in the future.

DEVELOPMENT OF A SMALL-SCALE RESEARCH PLATFORM FOR INTELLIGENT TRANSPORTATION SYSTEMS

SHENG, WEIHUA; LA, HUNG; LIM, RONNY; DU, JIANHAO; ZHANG, SIJIAN; YAN, GANGFENG

In this paper, we propose and develop a small-scale research platform for intelligent transportation systems. Our platform has four main parts: an arena; an indoor localization system; automated radio controlled (RC) cars; and roadside monitoring facilities. First, to mimic traffic environments we build an arena with a wooden floor, mock buildings and streets. Second, to facilitate feedback control for trajectory following, an indoor localization system is set up to track the RC cars. Third, both autonomous driving RC cars and human driving RC cars are developed, based on an automated RC car design. The automated RC cars can receive control signals from a computer through an Xbee RF module and control the front and rear wheels through motors. A new control algorithm is developed to allow the RC cars to track predefined trajectories. Finally, we implement an example of roadside monitoring which uses a fish-eye camera associated with advanced video processing for image segmentation, object identification and tracking. Experiments are performed to demonstrate the effectiveness of the designed platform. We also discuss possible ITS research problems which can be studied in this testbed.

A TASK ASSIGNMENT ALGORITHM FOR MULTIPLE AERIAL VEHICLES TO ATTACK TARGETS WITH DYNAMIC VALUE

ZHONG, LIU; LUO, QUAN; WEN, DING; QIAO, SHIDONG; SHI, JIANMAI; ZHANG, WEIMING

A good task assignment is an important guarantee to achieve great combat effectiveness. This paper investigates the task assignment problem where the value of the targets is time-changing in battlefield, and presents a solution approach which is a combination of two algorithms: the multi-destination route planning algorithm based on dynamic programming and the multi-subgroup ant colony algorithm (MSACO). The two algorithms coordinately solve the task assignment problem. The route planning algorithm can obtain available routes between any two targets and provide reasonable routing information for MSACO. Then ant colony algorithm is applied to solve the task assignment problem. To solve the task assignment problem in the battlefield environment, several key technologies are introduced to improve the traditional ant colony algorithm, which include subgroup selection strategy, dynamic candidate aggregate policy, state transferring policy and information element updating mechanism. Simulations results show that the proposed approach can produce reasonable and available plan for all the test cases in short computational time.

DISTRIBUTED CLASSIFICATION OF TRAFFIC ANOMALIES USING MICROSCOPIC TRAFFIC VARIABLES

THAJCHAYAPONG, SUTTIPONG; GARCIA TREVIÑO, EDGAR; BARRIA, JAVIER

This paper proposes a novel anomaly classification algorithm that can be deployed in a distributed manner and utilizes microscopic traffic variables shared by neighbouring vehicles to detect and classify traffic anomalies under different traffic conditions. The algorithm which incorporates multi-resolution concepts is based on the likelihood estimation of a neural network output and a bisection-based decision threshold. We show that when applied to real-world traffic scenarios, the proposed algorithm can detect all the traffic anomalies of the reference test data set; this represents a significant improvement over our previously proposed algorithm. We also show that the proposed algorithm can effectively detect and classify traffic anomalies even when i) the microscopic traffic variables are available from only a fraction of the vehicle population and ii) some microscopic traffic variables are lost due to degradation in V2V and/or V2I communications.

SPATIO-TEMPORAL TRAFFIC SCENE MODELING FOR OBJECT MOTION DETECTION

HAO, JIUYUE; LI, CHAO; KIM, ZUWHAN; XIONG, ZHANG

Moving object detection is an important component of a traffic surveillance system. Usual background subtraction approaches often perform poorly on a long outdoor traffic video due to vehicles waiting at an intersection and gradual changes of illumination and background shadow position. We present a fast and robust background subtraction algorithm based on unified spatio-temporal background and foreground modeling. The correlation between neighboring pixels provides high levels of detection accuracy in the dynamic background scene. Our Bayesian fusion method, which establishes the traffic scene model, combines both background and foreground models, and considers prior probabilities to adapt changes of background in each frame. We explicitly model both temporal and spatial information based the Kernel Density Estimation (KDE) formulation for background modeling. Then, we use a Gaussian formulation to describe spatial correlation of moving objects for foreground modeling. In the Updating Step, a fusion background frame is generated and reasonable updating rates are also proposed for the traffic scene. The

experimental results show that the proposed method outperforms the previous work with less computation, and is better suited for the traffic scenes.

VEHICLE POSITIONING USING GSM AND CASCADE-CONNECTED ANN STRUCTURES

BORENOVIC, MILOS; NESKOVIC, ALEKSANDAR; NESKOVIC, NATASA

Procuring the location information for intelligent transportation systems is a popular topic amongst researchers. This paper investigates the vehicle location algorithm based upon the received signal strengths from the available GSM networks. The performances of positioning models, consisted of cascade-connected Artificial Neural Network (ANN) multilayer feedforward structures, employing space-partitioning principle, are compared to the single ANN multilayer feedforward model in terms of accuracy, number of subspaces and other positioning relevant parameters. Cascade-connected ANN structures make use of the fact that a vehicle can be found only in a subspace of the entire environment (roads) to improve the positioning accuracy. The best performing cascade-connected ANN structure achieved an average error of 26m, and a median error of less than 5m, which is accurate enough for most of the vehicle location services. Using the same received signal strength database obtained by measurements it was shown that the proposed model outperforms kNN and EKF trained ANN positioning algorithms. Moreover, the presented ANN structures replace not only the positioning algorithms, but also the overloaded map-matching process.

CLASSIFICATION AND COUNTING OF COMPOSITE OBJECTS IN TRAFFIC SCENES USING GLOBAL AND LOCAL IMAGE ANALYSIS

SOMASUNDARAM, GURUPRASAD; SIVALINGAM, RAVISHANKAR; MORELLAS, VASSILIOS; PAPANIKOLOPOULOS, NIKOLAOS

Object recognition algorithms often focus on determining the class of a detected object in a scene. There are usually two significant phases involved in object recognition. The first phase is the object representation phase in which the most suitable features that provide the best discriminative power under constraints such as lighting, resolution, scale and view variations are chosen to describe the objects. The second phase is to use this representation space to develop models for each object class using discriminative classifiers. In this paper we focus on composite objects, i.e. objects which have two or more simpler classes interconnected in a complicated manner. A classic example of such a scenario is a bicyclist. A bicyclist consists of a bicycle and a human riding it. When we are faced with the task of classifying bicyclists and pedestrians, it is counter-intuitive and often hard to come up with a discriminative classifier to distinguish the two classes. We explore global image analysis based on bag of visual words compare the results with local image analysis in which we attempt to distinguish the individual parts of the composite object. We also propose a unified Naive Bayes framework as well as a combined histogram feature method for combining the individual classifiers for enhanced performance.

MODEL-INDEPENDENT ADAPTIVE FAULT-TOLERANT OUTPUT TRACKING CONTROL OF 4WS4WD ROAD VEHICLES

LI, DANYONG; SONG, YONGDUAN; HUANG, DONG; CHEN, HENAN

This paper investigates the path tracking control problem of four-wheel-steering and four-wheel-driving (4WS4WD) road vehicles. Of particular interest is the development of an adaptive and fault-tolerant tracking control scheme

capable of compensating vehicle uncertain dynamics/disturbances as well as actuation failures simultaneously. Control algorithms are derived without requiring detail system dynamic information. The control scheme is shown to be effective in coping with unexpected actuation faults without the need for analytically estimating bound on actuator failure variables. The proposed method is validated and demonstrated through its application to a wheeled vehicle with four steering wheels and four driving wheels, where high precision path tracking is achieved in the face of steering faults.

SHORT-RUN ROUTE DIVERSION: AN EMPIRICAL INVESTIGATION INTO VARIABLE MESSAGE SIGN DESIGN AND POLICY EXPERIMENTS

JINDAHRA, PAVITRA; CHOOCHARUKUL, KASEM

Variable message signs (VMS) can convey several traffic and roadway information to motorists. Using empirical state preference (SP) data from road users in Bangkok, we demonstrate that short-run route diversion can be estimated and forecasted based on different VMS message content attributes via mixed logit and logit models in which the motorist's stated route diversion is the dependent variable. The findings reveal that different message contents lead to different levels of route-changing propensity. Route diversion in Bangkok is likely when a VMS displays a suggested route and qualitative information. The framing effect on route choice decision explains the finding of qualitative delay information preference to its quantitative counterpart. To determine the policy implications, we further investigate the developed models by estimating changes in the probability of the stated route choice due to changes in the message content. Three VMS message policy experiments are conducted using the model: enforcing quantitative delay content, enforcing qualitative delay content, and enforcing suggested route content. The results show that qualitative delay information and suggested route reduce the ambiguity of the message quality. The optimal VMS designs for short-run traffic management to encourage/discourage route diversion are discussed.

A FIXED SENSOR-BASED INTERSECTION COLLISION WARNING SYSTEM IN VULNERABLE LINE-OF-SIGHT AND/OR TRAFFIC VIOLATION PRONE ENVIRONMENT

JANG, JEONGAH; CHOI, KEECHOO; CHO, HANBYEONG

This paper proposes a Cooperative Intersection Collision Warning System (CICWS) model which uses fixed traffic sensors to provide warning information to drivers at unsignalized intersections in a real-time manner. The CICWS model is useful for vulnerable line-of-sight and/or traffic violation prone environment since it determines whether the situation is really dangerous one or not. More specifically, the model is for unsignalized intersections without STOP/YIELD signs where drivers don't tend to stop. The situation forecast model uses vehicle location, speed, and time data obtained from multiple sensors located at intersection approaches together with obstacle position and sight distance relationship. More specifically, the model has a real-time sight-distance triangle module and a collision-time prediction module. Using a micro traffic simulator called VISSIM, the validation and evaluation of the model are performed based on different scenarios with different parameters, like inflow volume, locations of traffic sensor, design speed, and obstacle placement. The results show that the model successfully forecasts dangerous situations up to 94.3%, which may imply the deployment of the model in such an environment where vehicle to infrastructure or vehicle to vehicle communication are possible. Some limitations and future research agenda have also been discussed.

ACCURATE GLOBAL LOCALIZATION USING VISUAL ODOMETRY AND DIGITAL MAPS ON URBAN ENVIRONMENTS

PARRA ALONSO, IGNACIO; FERNANDEZ-LLORCA, DAVID; GAVILÁN, MIGUEL; ALVAREZ, SERGIO; GARCÍA-GARRIDO, MIGUEL ANGEL; VLACIC, LJUBO; SOTELO VÁZQUEZ, MIGUEL ÁNGEL

In the last years, Advanced Driver Assistance Systems (ADAS) have become a key element in the research and development of intelligent transportation systems and particularly, of intelligent vehicles. Many of these systems require accurate global localisation information, which has been traditionally performed by GPS's, despite its well-known failings, particularly in urban environments. Different solutions have been attempted to bridge the gaps of GPS positioning errors, but they usually require additional expensive sensors. Vision-based algorithms have proved to be capable of tracking the position of a vehicle over long distances using only a sequence of images as input and with no prior knowledge of the environment. This paper describes a full solution to the estimation of the global position of a vehicle in a digital road map by means of visual information alone. Our solution is based on a stereo platform used to estimate the motion trajectory of the ego vehicle and a map matching algorithm which will correct the cumulative errors of the vision-based motion information and estimate the global position of the vehicle in a digital road map. We demonstrate our system in large scale urban experiments reaching high accuracy in the estimation of the global position and allowing for longer GPS blackouts thanks to both the high accuracy of our visual odometry estimation and the correction of the cumulative error of the map matching algorithm. Typically challenging situations in urban environments such as non-static objects or illumination exceeding the dynamic range of the cameras are shown and discussed.

RELIABLE CLASSIFICATION OF VEHICLE TYPES BASED ON CASCADE CLASSIFIER ENSEMBLES

ZHANG, BAILING

Vehicle type recognition based on images is a challenging task. This paper comparatively studied two feature extraction methods for image description, i.e., the Gabor wavelet transform and the Pyramid Histogram of Oriented Gradients (PHOG). Gabor transform has been widely adopted to extract image features for various vision tasks. PHOG has the superiority in its description of more discriminating information. A highly reliable classification scheme was proposed by cascade classifier ensembles with reject option to accommodate the situations where no decision should be made if there exists adequate ambiguity. The first ensemble is heterogeneous, consisting of several classifiers, including k-nearest neighbor (kNN), multiple layer perceptron (MLP), support vector machine (SVM), and Random Forest. The classification reliability is further enhanced by second classifier ensemble, composing of a set of base MLPs coordinated by an ensemble meta-learning method called Rotation Forest (RF). For both of the ensembles, rejection option is accomplished by relating the consensus degree from majority voting to a confidence measure and abstaining to classify ambiguous samples if the consensus degree is lower than a threshold. The final class label is assigned by dual majority voting from the two ensembles. Experimental results using more than 600 images from a variety of 21 makes of cars and vans demonstrated the effectiveness of the proposed approach. The cascade ensembles produce consistently reliable results. With a moderate ensemble size of 25 in the second ensemble, the two-staged classification scheme offers 98.65% accuracy with a rejection rate of 2.5%, exhibiting promising potentials for real-world applications.

A PARALLEL COMPUTING FRAMEWORK FOR LARGE-SCALE AIR TRAFFIC FLOW OPTIMIZATION

CAO, YI; SUN, DENG FENG

Optimizing the nationwide air traffic flow entails computational difficulty as the traffic is generally modeled as a multi-commodity network which involves a huge number of variables. This paper presents a framework which speeds up the optimization. The nationwide air traffic is modeled using a Link Transmission Model, to which a dual decomposition method is applied. The large-scale problem is decomposed into a master problem and a number of independent subproblems which are easy to solve. As a result, the execution of solving the subproblem is parallelizable. A parallel computing framework is based on multiprocessing technology. The master problem is updated on a server, and a client cluster is deployed to finish the subproblems such that the most computationally intensive part of the optimization can be executed in parallel. The server and the clients communicate via TCP/UDP. An adaptive job allocation method is developed to balance the workload among each client, resulting in maximized utilization of the computing resources. Experiment results show that, compared to an earlier single process solution, the proposed framework considerably increases the computational efficiency. The optimization of a 2-hour nationwide traffic problem involving 2326 subproblems takes six minutes using 10 Dell workstations. The increased computation workload due to increased number of subproblems can be mitigated by extension of computer deployment.

AIRCRAFT GROUND TAXIING MODEL FOR CONGESTED AIRPORT USING CELLULAR AUTOMATA

MORI, RYOTA

Efficient airport surface operation is considered a key to the successful implementation of 4D trajectories. Here, an airport surface aircraft model is developed to improve the simulation accuracy. The new simulation method is developed based on the Nagel-Schreckenberg model which is a car congestion model, and it considers the taxiing speed and the time histories of taxiing especially for heavy traffic environment. To validate the model, airport surface surveillance data at Tokyo International airport is used, and it is proved that the congestion phenomenon is modeled well with an average accuracy of about 30 seconds.

SECURITY CHALLENGES IN VEHICULAR CLOUD COMPUTING

YAN, GONGJUN; WEN, DING; OLARIU, STEPHAN; WEIGLE, MICHELE

Recently, Olariu and his coworkers [1,2,3] have promoted the vision of Vehicular Clouds (VCs), a non-trivial extension, along several dimensions, of conventional cloud computing. In a VC, the under-utilized vehicular resources including computing power, storage and Internet connectivity can be shared between drivers or rented out over the Internet to various customers. Clearly, if the VC concept is to see a wide adoption and to have significant societal impact, security and privacy issues need to be addressed. The main contribution of this work is to identify and analyze a number of security challenges and potential privacy threats in VCs. Although security issues have received attention in cloud computing and vehicular networks, we identify security challenges that are specific to VCs, e.g. challenges of authentication of high-mobility vehicles, scalability and single interface, tangled identities-locations, and the complexity of establishing trust relationships among multiple players caused by intermittent short-range communications. Additionally, we provide a security scheme that addresses several of the challenges discussed.

REAL-TIME VIDEO-BASED TRAFFIC MEASUREMENT AND VISUALIZATION SYSTEM FOR ENERGY/EMISSIONS

MORRIS, BRENDAN; TRAN, CUONG; SCORA, GEORGE; TRIVEDI, MOHAN; BARTH, MATTHEW

It has become increasingly important to monitor the state of roadways in order to better manage traffic congestion. Sophisticated traffic management systems are in development to process both the static and mobile sensor data that provide traffic information for the roadway network. In addition to typical traffic data such as flow, density, and average traffic speed, there is now strong interest in environmental factors such as greenhouse gases, pollutant emissions, and fuel consumption from traffic. It is now possible to combine high resolution real-time traffic data with instantaneous emission models to estimate these environmental measures in real-time. In this paper, a system is described that estimates average traffic fuel economy, CO₂, CO, HC, and NO_x emissions using a computer vision-based methodology in combination with vehicle specific power based energy and emission models. The CalSentry system provides not only the typical traffic measures, but also gives individual vehicle trajectories (instantaneous dynamics) and recognizes vehicle categories which are used in the emission models to predict environmental parameters. This estimation process provides far more dynamic and accurate environmental information compared to static emission inventory estimation models.

GNSS/CELLULAR HYBRID POSITIONING SYSTEM FOR MOBILE USERS IN URBAN SCENARIOS

DE ANGELIS, GUIDO; BARUFFA, GIUSEPPE; CACOPARDI, SAVERIO

This paper proposes a hybrid scheme for user positioning in an urban scenario using both a Global Navigation Satellite System (GNSS) and a mobile cellular network. In order to maintain receiver complexity (and costs) at a minimum, the location scheme combines the Time Difference Of Arrival (TDOA) technique measurements obtained from the cellular network with GNSS pseudorange measurements. The extended Kalman filter algorithm is used as data integration system over the time axis. Simulated results, obtained starting from real measurements, demonstrate that the use of cellular network data may provide increased location accuracy when the number of visible satellites is not adequate. In every case, the obtained accuracy is within the limits required by emergency location services, e.g., Enhanced 911 (E911).

AUTOMATIC ROAD CRACK DETECTION AND CHARACTERIZATION

OLIVEIRA, HENRIQUE; CORREIA, PAULO

A fully integrated system for the automatic detection and characterization of cracks in road flexible pavement surfaces which does not require manually labeled samples is proposed, notably to minimize the human subjectivity resulting from traditional visual surveys. The first task addressed, crack detection, is based on a learning from samples paradigm, where a subset of the available image database is automatically selected and used for unsupervised training of the system. The system classifies non-overlapping image blocks as either containing crack pixels or not. The second task deals with crack type characterization, for which another classification system is constructed, now to characterize the detected cracks' connect components. Cracks are labeled according to the types defined in the Portuguese Distress Catalog, with each different crack present in a given image receiving the appropriate label. Also a novel methodology for the assignment of crack severity levels is introduced, computing an estimate for the width of each detected crack. Experimental crack detection and characterization results are presented based on images captured during a visual road pavement surface survey over Portuguese roads, with promising results. This is shown

by the quantitative evaluation methodology introduced for evaluation of this type of systems, including a comparison to human experts' manual labeling results.

THE DEVELOPMENT OF VEHICLE POSITION ESTIMATION ALGORITHMS BASED ON THE USE OF AMR SENSORS

TAGHVAEEYAN, SABER; RAJAMANI, RAJESH

This paper focuses on the use of anisotropic magnetoresistive (AMR) sensors for imminent crash detection in cars. The AMR sensors are used to measure the magnetic field from another vehicle in close proximity, so as to estimate relative position and velocity from the measurement. An analytical formulation for the relationship between magnetic field and vehicle position is developed. The challenges in the use of the AMR sensors include their nonlinear behavior, limited range and magnetic signature levels that vary with each type of car. An adaptive filter based on the iterated extended Kalman filter is developed to automatically tune filter parameters for each encountered car and reliably estimate relative car position. The utilization of an additional sonar sensor during the initial detection of the encountered vehicle is shown to highly speed up the parameter convergence of the filter. Experimental results are presented from a number of tests with various vehicles to show that the proposed sensor system is viable.

MODELING AND ANALYSIS OF DRIVING BEHAVIOR BASED ON PROBABILITY WEIGHTED ARX MODEL

OKUDA, HIROYUKI; IKAMI, NORIMITSU; SUZUKI, TATSUYA; TAZAKI, YUICHI; TAKEDA, KAZUYA

This paper proposes a probability weighted ARX (PrARX) model wherein the multiple ARX models are composed by the probabilistic weighting functions. This model can represent both the motion control and decision making aspects of the driving behavior. As the probabilistic weighting function, a 'softmax' function is introduced. Then, the parameter estimation problem for the proposed model is formulated as a single optimization problem. The 'soft' partition defined by the PrARX model can represent the decision making characteristics of the driver with vagueness. This vagueness can be quantified by introducing the 'decision entropy'. In addition, it can be easily extended to the online estimation scheme thanks to its small computational cost. Finally, the proposed model is applied to the modeling of the vehicle following task, and the usefulness of the model is verified and discussed.

PREDICTIVE PREVENTION OF LOSS OF VEHICLE CONTROL FOR ROADWAY DEPARTURE AVOIDANCE

ALI, MOHAMMAD; FALCONE, PAOLO; OLSSON, CLAES; SJÖBERG, JONAS

In this paper, we investigate predictive approaches to the problem of roadway departure prevention via automated steering and braking. We assume a sensing infrastructure detecting road geometry and consider a two layer accident avoidance framework consisting of a threat assessment and an intervention layer. A novel active safety function for prevention of loss of vehicle control is proposed and implemented using the considered accident avoidance framework. Simulation and experimental results are presented, showing that the proposed approach effectively exploits road preview information in order to prevent the vehicle from operating in regions of the state space where standard Electronic Stability Control (ESC) systems are normally activated.

STOCHASTIC MODELING OF TRAFFIC FLOW BREAKDOWN PHENOMENON: APPLICATION TO PREDICTING TRAVEL TIME RELIABILITY

DONG, JING; MAHMASSANI, HANI

This paper presents a modeling approach to generate random flow breakdowns on congested freeways and capture the subsequent wave propagation among heterogeneous drivers. The approach is intended for predicting travel time variability caused by such stochastic phenomena. It is assumed that breakdown may occur at different flow levels with some probability, and would sustain for a random duration. This is modeled at the microscopic level by considering speed changes that are initiated by a leading vehicle and propagated by the following vehicles with correlated-distributed behavioral parameters. Numerical results from a Monte Carlo simulation demonstrate that the proposed stochastic modeling approach produces realistic macroscopic traffic flow behavior and can be used to generate travel time distributions.

BAHG: BACK-BONE ASSISTED HOP GREEDY ROUTING IN VANET'S CITY ENVIRONMENTS

SAHU, PRATAP KUMAR; WU, HSIAOKUANG; SAHOO, JAGRUTI; GERLA, MARIO

Using advanced WLAN technologies, vehicular ad-hoc networks (VANETs) have become viable and valuable for their wide variety of novel applications such as road-safety, multimedia content sharing, commerce on wheels, etc. Multi-hop information dissemination in VANETs is constrained by high mobility of vehicles, and frequent disconnections. Currently, geographic routing protocols are widely adopted for VANETs as they do not require route construction and route maintenance phases. Again, with connectivity awareness they perform well in terms of reliable delivery. To obtain destination position, some protocols use flooding which can be detrimental in city environments. Further, in case of sparse and void regions, frequent use of recovery strategy elevates hop-count. Some geographic routing protocols adopt minimum weighted algorithm based on distance or connectivity to select the intermediate intersections. However, the shortest path or the path with higher connectivity may include numerous intermediate intersections. As a result, these protocols yield routing paths with higher hop-count. In this paper, we propose a hop-greedy routing scheme which yields a routing path with minimum number of intermediate intersection nodes while taking connectivity into considerations. Besides, we introduce back bone nodes which play a key role in providing connectivity status around an intersection. Apart from this, by tracking the movement of source as well as destination, the back bone nodes enable a packet to be forwarded in the changed direction. Simulation results signify the benefits of the proposed routing strategy in terms of high packet delivery ratio, and shorter end-to-end delay.

PARALLEL TRAFFIC MANAGEMENT SYSTEM AND ITS APPLICATION FOR 2010 ASIAN GAMES

XIONG, GANG; DONG, XISONG; FAN, DONG; ZHU, FENGHUA; WANG, KUNFENG; LV, YISHENG

Fluctuating data is important for the convenient daily travel of urban residents, reducing traffic congestion and accidents, pursuing for low-carbon, environment-friendly, sustainable development strategy, and meeting the extra peak traffic demand of large sports game or large business activities, etc. To meet the fluctuating data demand during 2010 Asian (Para) Games held in Guangzhou China, based on novel ACP approach (Artificial systems, Computational experiments, and Parallel execution), Parallel Traffic Management System (PtMS) were developed. It can successfully help the smoothness, safety, efficiency and reliability of public transport management during the two games, support the public traffic management and decision making, and help to enhance public traffic management level from experience-based policy formulation and manual implementation to scientific computing -based policy formulation

and implementation. PtMS represents another new milestone to solve the management difficulty of real -world complex system.

FRONT SENSOR AND GPS-BASED LATERAL CONTROL OF AUTOMATED VEHICLES

YANG, JING; HOU, EDWIN; ZHOU, MENGCHU

This paper proposes an automated steering control system for passenger cars. Feasibility of a control strategy based on a front sensor and a global positioning system (GPS) has been evaluated using computer simulations. Firstly, the steering angles can be estimated by using the driving data provided by the front sensor and GPS. Secondly, the road curvature estimator for real-time situation is designed based on its relationship with the steering angle. Thirdly, accurate and real-time estimation of the vehicle's lateral displacements with respect to the road is accomplished. Finally, a closed loop controller is used to control the lateral dynamics of the vehicle. The proposed estimation and control algorithms are validated by computer simulation results. They show that this lateral steering control system achieves a good and robust performance for vehicles to follow a reference path.

EFFICIENT TRAFFIC STATE ESTIMATION FOR LARGE-SCALE URBAN ROAD NETWORKS

KONG, QING-JIE; ZHAO, QIANKUN; WEI, CHAO; LIU, YUNCAI

This paper presents a systematic solution to estimate the traffic state of large-scale urban road networks efficiently. We first propose the new approach to construct the exact GIS-T digital map. The exact digital map can lay the solid foundation for the traffic state estimation with the data from GPS probe vehicles. Then, we present two effective methods based on GPS probe vehicles for the traffic state estimation. One is the curve-fitting based method; the other is the vehicle-tracking based method. Finally, we test the proposed solution with a huge number of real data from GPS probe vehicles and the standard digital map of Shanghai. In the experiments, data from thousands of GPS-equipped taxis were taken as the probe vehicles. The estimation accuracy and operation speed of the two different methods were systematically measured and compared. In addition, the coverages of the GPS sampling points were also investigated for the large-scale urban road network in the spatial and temporal domains. For the accuracy experiment, the ground truth was obtained by repeating the videos that were recorded on 24 road sections in Shanghai downtown. The experiment results illustrate that the proposed methods are effective and efficient for monitoring the traffic state of large-scale urban road networks.

GPS LOCALIZATION ACCURACY CLASSIFICATION: A CONTEXT BASED APPROACH

DRAWIL, NABIL; AMAR, HAITHAM; BASIR, OTMAN

GPS localization has been attracting attention recently in various areas, including, Intelligent Transportations Systems, Navigation Systems, Road Tolling, Smart Parking, and Collision Avoidance. Although, various approaches for improving localization accuracy have been reported in the literature, there is still a need for more efficient and more effective measures that can ascribe some level of accuracy to the localization process. These measures will enable localization systems to manage the localization process and resources so as to achieve the highest accuracy possible, and to mitigate the impact of inadequate accuracy on the target application.

The localization accuracy of any GPS system depends heavily on both the technique it uses to compute locations and the measurement conditions in its surroundings. However, while localization techniques have recently started to demonstrate significant improvement in localization performance, they continue to be severely impacted by the measurement conditions in their environment. Indeed, the impact of the measurement conditions on the localization accuracy in itself is an ill conditioned problem due to the incongruent nature of the measurement process. This paper proposes a scheme to address localization accuracy estimation. This scheme involves two steps, namely, measurement condition disambiguation and enhanced location accuracy classification. Real-life comparative experiments are presented to demonstrate the efficacy of the proposed scheme in classifying GPS localization accuracy under various measurement conditions.

AN INTEGRATED 802.11P WAVE DSRC AND VEHICLE TRAFFIC SIMULATOR WITH EXPERIMENTALLY-VALIDATED URBAN (LOS AND NLOS) PROPAGATION MODELS

REDMILL, KEITH; BIDDLESTONE, SCOTT; MIUCIC, RADOVAN; OZGUNER, UMIT

The IEEE 802.11p, 1609.3, and 1609.4 WAVE standards are designed to facilitate inter-vehicle communication and ultimately improve traffic safety. Multiple safety applications and control algorithms have been proposed to use 802.11p Dedicated Short Range Communication (DSRC) radios and message structures. An urban environment provides many challenges for Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication. These include multiple propagation paths and many occlusions, particularly in areas where V2V messages would be most useful such as blind spots, buildings and other obstructions. The dense urban environments and high concentration of vehicles make it difficult to predict how reliable this communication will be. The Ohio State University's Vehicle and Traffic Simulator (VaTSim) is designed as a micro-simulator of traffic. This paper describes the incorporation of V2V communication into VaTSim using Network Simulator 3 (NS3) and physical layer modeling to determine how different road layouts and building configurations will affect 802.11p communication. This paper explains the theory used to define the simulated Line of Sight (LOS) propagation, Non-Line of Sight (NLOS) propagation calculations, and channel switching congestion as well as the experiments performed to validate the models and the simulation.

ANALYTICAL PREDICTION OF SELF-ORGANIZED TRAFFIC JAMS AS A FUNCTION OF INCREASING ACC PENETRATION

JERATH, KSHITIJ; BRENNAN, SEAN

Self-organizing traffic jams are known to occur in medium-to-high density traffic flows and it is suspected that Adaptive Cruise Control (ACC) may affect their onset in mixed human-ACC traffic. Unfortunately, closed-form solutions that predict the occurrence of these jams in mixed human-ACC traffic do not exist. In this paper, both human and ACC driving behaviors are modeled using the General Motors' fourth car-following model and are distinguished by using different model parameter values. A closed-form solution that explains the impact of ACC on congestion due to the formation of self-organized traffic jams (or "phantom" jams) is presented. The solution approach utilizes the master equation for modeling the self-organizing behavior of traffic flow at a mesoscopic scale, and the General Motors' fourth car-following model for describing the driver behavior at the microscopic scale. It is found that while introduction of ACC-enabled vehicles into the traffic stream may produce higher traffic flows, it also results in disproportionately higher susceptibility of the traffic flow to congestion.

REAL TIME DETECTION AND RECOGNITION OF ROAD TRAFFIC SIGNS

GREENHALGH, JACK; MIRMEHDI, MAJID

We propose a novel system for the automatic detection and recognition of traffic signs. The proposed system detects candidate regions as maximally stable extremal regions (MSERs), which offers robustness to variations in lighting conditions. Recognition is based on a cascade of SVM classifiers trained using HOG features. The training data is generated from synthetic template images freely available from an online database, thus real footage road signs are not required as training data. The proposed system is accurate at high vehicle speeds, operates under a range of weather conditions, runs at an average speed of 20 fps, and recognises all classes of ideogram based (non-text) traffic symbol from an online road sign database. We present comprehensive comparative results to illustrate the performance of the system.

SPARSE REPRESENTATION BASED GRAPH EMBEDDING FOR TRAFFIC SIGN RECOGNITION

LU, KE; DING, ZHENGMING; GE, SAM

Researchers have proposed various machine learning algorithms for traffic sign recognition, which is a supervised, multi-category classification problem with unbalanced class frequencies and various appearances. We present a novel graph embedding algorithm that strikes a balance between local manifold structures and global discriminative information. A novel graph structure is designed to explicitly depict the local manifold structures of traffic signs with various appearances, and intuitively model between-class discriminative information. Through this graph structure, our algorithm effectively learns a compact and discriminative subspace. Moreover, by using L_{2,1}-norm, the proposed algorithm can preserve the sparse representation property in the original space after graph embedding, thereby generating a more accurate projection matrix. Experiments demonstrate that the proposed algorithm exhibits better performance than the recent state-of-the-art methods.

A NEW APPROACH TO VIDEO-BASED TRAFFIC SURVEILLANCE USING FUZZY HYBRID INFORMATION INFERENCE MECHANISM

KAO, CHIH-CHUNG; WU, BING-FEI; JUANG, JHY-HONG; HUANG, YI-SHIUN

This study proposes a new approach to video-based traffic surveillance using a fuzzy hybrid information inference mechanism (FHIIM). The three major contributions of the proposed approach are background updating, vehicle detection with block-based segmentation, and vehicle tracking with error compensation. During background updating, small-range updating is adopted to overcome environmental changes in congested conditions. During vehicle detection, the proposed approach detects the vehicle candidates from the foreground image, and it resolves problems such as headlight effects. Tracking technique is employed to track vehicles in consecutive frames. First, the method detects edge features in congested scenes. Next, FHIIM is employed to determine the tracked vehicles. Finally, a method that compensates for error cases under congested conditions is applied to refine the tracking qualities. In our experiments, we tested scenarios inside and outside the tunnel with three lanes. The results showed that the proposed system exhibits good performance in congested conditions.

PERFORMANCE MODELING OF SAFETY MESSAGES BROADCAST IN VEHICULAR AD HOC NETWORKS

KHABAZIAN, MEHDI; AISSA, SONIA; ALI, MUSTAFA K. MEHMET

In vehicular ad-hoc networks, due to the fact that all vehicles in range are seen as destination nodes and less time will be spent for medium access process; broadcast communication is considered as a highly appropriate technique for the dissemination of safety messages in such networks. However, the lack of RTS/CTS handshaking and packet acknowledgment makes the communication more vulnerable to interferences, thus resulting in lower communication reliability. In this paper, we present an analytical model for the performance evaluation of safety message dissemination in vehicular ad-hoc networks with two priority classes. Specifically, considering IEEE 802.11 broadcast protocol and using two-dimensional Markov modeling, we derive the joint distribution of the numbers of low-priority periodic messages, which are in transmission mode and in back-off process in a highway. Then, the result is used to derive the average dissemination delay of high-priority event-driven messages in the presence of the low-priority traffic in the network. The results are helpful in determining a good trade-off between the network parameters such as vehicles' transmission range, safety traffic generation rate and MAC parameters to satisfy the required delay bounds for the critical high-priority traffic.

LAND-USE CLASSIFICATION USING TAXI GPS TRACES

PAN, GANG; QI, GUANDE; WU, ZHAOHUI; ZHANG, DAQING; LI, SHIJIAN

Land-use is important information for urban planning, which is hard to get in detail. Currently, GPS traces of vehicles are becoming easily available. It conveys human mobility and activity information, which may be closely related to land-use of a region. This paper discusses the potential use of taxi traces for urban land-use classification especially for recognizing social function of urban land by using one year's trace data from 4000 taxis. Firstly, we found that pick-up/set-down dynamics, extracted from taxi traces, exhibited clear patterns corresponding to land-use classes of these regions. Secondly, with six features designed to characterize the pick-up/set-down pattern, land-use classes of regions could be recognized. Classification result using the best combination of the features achieved a recognition accuracy of 95%. Thirdly, the classification result also highlighted regions that changed land-use class from one to another and such land-use class transition dynamics of regions revealed unusual real world social events. Moreover, the pick-up/set-down dynamics could further reflect to what extent each region is used as a certain class.

VISION BASED TRAFFIC SIGN DETECTION AND ANALYSIS FOR INTELLIGENT DRIVER ASSISTANCE SYSTEMS: PERSPECTIVES AND SURVEY

MØGELMOSE, ANDREAS; TRIVEDI, MOHAN; MOESLUND, THOMAS

In this paper, we provide a survey of the traffic sign detection literature, detailing detection systems for Traffic Sign Recognition (TSR) for driver assistance. We separately describe the contributions of recent works to the various stages inherent in traffic sign detection: segmentation, feature extraction, and final sign detection. While TSR is a well-established research area, we highlight open research issues in the literature, including a dearth of use of publicly-available image databases, and the over-representation of European traffic signs. Further, we discuss future directions for TSR research, including integration of context and localization. We also introduce a new public database containing US traffic signs.

ROAD GEOMETRY CLASSIFICATION BY ADAPTIVE SHAPE MODELS

ALVAREZ, JOSÉ M.; GEVERS, THEO; DIEGO, FERRAN; LÓPEZ, ANTONIO M.

Vision-based road detection is important for different applications in transportation such as autonomous driving, vehicle collision warning and pedestrian crossing detection. Common approaches to road detection are based on low-level road appearance (eg, color or texture) and neglecting the scene geometry and context. Hence, using only low level features make these algorithms highly depend for structured roads, road homogeneity and lighting conditions. Therefore, the aim of this paper is to classify road geometries for road detection through the analysis of scene composition and temporal coherence. Road geometry classification is proposed by building corresponding models from training images containing prototypical road geometries. We propose adaptive shape models where spatial pyramids are steered by the inherent spatial structure of road images. To reduce the influence of lighting variations, invariant features are used. Large scale experiments show that the proposed road geometry classifier yields high recognition rate 73,57% +- 13,1 clearly outperforming other state-of-the art methods. Including road shape information improves road detection results over existing appearance-based methods. Finally, it is shown that invariant features and temporal information provide robustness against disturbing imaging conditions.

OPTIMAL PERIMETER CONTROL FOR TWO URBAN REGIONS WITH MACROSCOPIC FUNDAMENTAL DIAGRAMS: A MODEL PREDICTIVE APPROACH

GEROLIMINIS, NIKOLAS; HADDAD, JACK; RAMEZANI, MOHSEN

Recent analysis of empirical data from cities showed that a macroscopic fundamental diagram (MFD) of urban traffic provides for homogenous network regions a unimodal, low-scatter relationship between network vehicle density and network spacemean flow. In this paper, the optimal perimeter control for two region urban cities is formulated with the tool of MFDs. The controllers operate on the border between the two regions, and manipulate the percentages of flows that transfer between the two regions, such that the number of trips reaching their destinations is maximized. The optimal perimeter control problem is solved by model predictive control, where the prediction model and the plant (reality) are formulated by macroscopic fundamental diagrams. Examples are presented for different levels of congestion in the regions of the city and the robustness of the controller is tested for different sizes of error in the MFDs and different levels of noise in the traffic demand. Moreover, two methods for smoothing the control sequences are presented. Comparison results show that the performances of the model predictive control are significantly better than a "greedy" feedback control. The results of this paper can be extended to develop efficient hierarchical control strategies for heterogeneously congested cities.

ESTIMATING REAL-TIME TRAFFIC CARBON DIOXIDE EMISSIONS BASED ON INTELLIGENT TRANSPORTATION SYSTEM TECHNOLOGIES

CHANG, XIAOMENG; CHEN, BI YU; LI, QINGQUAN; CUI, XIAOHUI; TANG, LULIANG; LIU, CHENG

In this paper, a bottom-up vehicle emission model is proposed to estimate real-time CO₂ emissions using intelligent transportation system (ITS) technologies. In the proposed model, traffic data collected by ITS are fully utilized to estimate detailed vehicle technology data (e.g. vehicle type) and driving pattern data (e.g. speed, acceleration and road slope) in the road network. The road network is divided into a set of small road segments, in order to consider the effects of heterogeneous speeds within a road link. A real-world case study in Beijing China is carried out to demonstrate the applicability of the proposed model. The spatiotemporal distributions of CO₂ emissions in Beijing are

analyzed and discussed. The results of case study indicate that ITS technologies can be a useful tool for real-time estimations of CO₂ emissions with a high spatiotemporal resolution.

AUTOMATIC CALIBRATION METHOD FOR DRIVER'S HEAD ORIENTATION IN NATURAL DRIVING ENVIRONMENT

FU, XIANPING; GUAN, XIAO; PELI, ELI; LIU, HONGBO; LUO, GANG

Gaze tracking is crucial for studying driver's attention, detecting fatigue and improving driver assistant systems, but it is difficult in natural driving environments due to non-uniform and highly variable illumination and large head movements. Traditional calibrations that require subjects to follow calibrators are too cumbersome to be implemented in daily driving situations. A new automatic calibration method, based on a single camera for determining head orientation, which utilizes the side mirrors, rear view mirror, instrument board and different zones in windshield as calibration points is presented in this paper. Supported by a self-learning algorithm, the system tracks the head and categorizes head pose in 12 gaze zones based on facial features. Particle filter is used to estimate head pose in order to obtain an accurate gaze zone by updating the calibration parameters. Experimental results show that after several hours of driving the automatic calibration method without driver's corporation can achieve the same accuracy as a manual calibration method. The mean error of estimated eye gazes was less than 5° in day and night driving.

HETEROGENEOUS DELAY EMBEDDINGS FOR TRAVEL TIME AND ENERGY COST PREDICTION VIA REGRESSION ANALYSIS

MU, TINGTING; JIANG, JIANMIN; WANG, YAN

In this paper, we study travel time and energy cost prediction at any future departure time for a targeted road segment and vehicle. These two prediction tasks play an important part in the design of advanced driver assistance systems that can automatically manage battery charging, energy saving and route planning for fully electric vehicles. Compared to the fundamental problem of travel time prediction that usually learns from the historical and current data of travel time itself, energy cost prediction is a more complex problem that involves multiple context conditions and vehicle status measured by various time-invariant and time-variant data. We define a general learning problem based on multiple time-invariant and time-variant inputs to unify these two prediction tasks. To solve the defined learning problem, we propose heterogeneous delay embeddings (HDE) that extracts an informative feature space for regression analysis, aiming at achieving satisfactory prediction for any future departure time. The proposed HDE first categorizes the historical and current data of a time-variant measurement into different types, then incorporates different delay settings for embedding multiple types of time series data, and finally removes redundant information and noise from the generated features using orthogonal locality preserving projection. Experimental results demonstrate the effectiveness of the proposed method for both short-term and long-term prediction of travel time and energy cost.

DISCRETE FOURIER TRANSFORMATION FOR SEASONAL FACTOR PATTERN CLASSIFICATION AND ASSIGNMENT

SHEN, LUOU; LU, CHENXI; ZHAO, FANG; LIU, WEIMING

This paper introduces a data-mining method to investigate the relationship between seasonal factors and land use characteristics for Florida urban areas through Discrete Fourier Transformation (DFT). First, DFT is applied to discover seasonal variation patterns, and two typical patterns were identified. Second, linear regression is then used to determine influential variables, and weighted similarity method derived from the amplitude of each DFT wave is applied for the seasonal factors assignment. The results assisted by DFT demonstrate promising assignment accuracy with a mean absolute percentage error of 4.27% for all data, and 3.96% for the low seasonal household percentage sub-class.

VIRTUAL PROTOTYPING OF AN ELECTRIC POWER STEERING SIMULATOR

NEHAOUA, LAMRI; DJEMAI, MOHAMED; PUDLO, PHILIPPE

This paper presents a simulation tool for an electrical steering system whose aim is twofold: 1) to investigate the possibility of designing a minimum clearance mechatronic platform with sensorless control methods and 2) to evaluate assistance torque control feedback by considering technological specifications and human factors consideration. The choice has been made for a driving simulator having at least a real steering system with its EPS device and an adequate motor to reproduce the rack load force resulting from tire/road contact as in a real driving situation. These components are gathered to form a virtual simulator platform which serves as a basis for a future realization. Our main contributions concern the vehicle's front assembly kinematics modeling and the evaluation of the load rack force resulting from tire/road interaction. Also, a real application of the most recent virtual sensor algorithms, arising from the sliding mode observer theory for states and unknown inputs estimation, is described.

ENHANCING PARKING SIMULATIONS USING PEER DESIGNED AGENTS

CHALAMISH, MICHAL; SARNE, DAVID; LIN, RAZ

In this paper we investigate the usefulness of peer designed agents (PDAs) as a turn-key technology for enhancing parking simulations. The use of PDAs improves the system's ability to capture the dynamics of the interaction between individuals in the system, each theoretically exhibiting a different strategic behavior. Furthermore, since people in general are inherently rational- and computation-bounded, simulating this domain becomes even more challenging. The advantage of PDAs in this context lies in their ability to reliably simulate a large pool of human individuals with diverse strategies and goals. We demonstrate the efficacy of the proposed method by developing a large-scale simulation system for the parking space search domain, which plays an important role in urban transport systems. The system is based on 34 different parking-search strategies. Most of these strategies are substantially different from synthetic strategies that are used in prior literature. A quantitative analysis of the PDAs indicates that they reliably capture their designers' real-life strategies. Finally, we demonstrate the usefulness of PDAs-based parking space search simulation by utilizing it to evaluate four different information technologies that are of increasing use in recent years.

A COOPERATIVE SCHEDULING MODEL FOR TIMETABLE OPTIMIZATION IN SUBWAY SYSTEMS

YANG, XIN; LI, XIANG; GAO, ZIYOU; WANG, HONGWEI; TANG, TAO

In subway systems, the energy put into accelerating trains can be reconverted into electric energy by using the motors as generators during braking phase. Generally speaking, except that a small part is used for on-board purposes, most of the recovery energy is transmitted backwards along the conversion chain and fed back into the overhead contact line. In order to improve the utilization of recovery energy, this paper proposes a cooperative scheduling approach to optimize the timetable so that the recovery energy generated by braking train can be directly used by accelerating train. The recovery generated by braking train is less than the required energy for accelerating train, therefore, only the synchronization between successive trains is considered. Firstly, we propose the cooperative scheduling rules and define the overlapping time between the accelerating trains and braking trains for peak hours scenario and off-peak hours scenario, respectively. Secondly, we formulate an integer programming model to maximize the overlapping time with headway time and dwell time control. Furthermore, we design a genetic algorithm with binary encoding to solve the optimal timetable. Finally, we present six numerical examples based on the operation data from Beijing Yizhuang subway line of China. The results illustrate that the proposed model can significantly improve the overlapping time by 22.06% at peak hours and 15.19% at off-peak hours.

NEW PARADIGMS FOR THE INTEGRATION OF YAW STABILITY AND ROLLOVER PREVENTION FUNCTIONS IN VEHICLE STABILITY CONTROL

RAJAMANI, RAJESH; PIYABONGKARN, DAMRONGRIT

The integration of rollover prevention and yaw stability control objectives in electronic stability control has traditionally been done based on a priority calculation. This paper focuses on an integrated electronic stability control system wherein the objectives of yaw stability and rollover prevention are addressed simultaneously, rather than one at a time. First, we show that staying on a desired planar trajectory at a specified speed results in an invariant rollover index. This implies that rollover prevention can be achieved whenever there is a danger of rollover only by reducing vehicle speed, since changing the desired vehicle trajectory is not a desirable option. In this regard, it is shown that a vehicle which reduces its speed before entering a sharp curve performs significantly better than a vehicle that uses differential braking during the turn for yaw stability control. Second, the paper explores how the use of steer-by-wire technology can address the trade-off between yaw stability, speed and rollover prevention performance. It is shown that the use of traditional steer-by-wire simply as an additional actuator cannot by itself ameliorate the trade-off. However, this trade-off can be eliminated if steer-by-wire is used to invert the direction of the roll angle of the vehicle. A new steer-by-wire algorithm that uses transient counter steering is shown to change the location of the rollover dynamics from the neighborhood of an unstable to a stable equilibrium. A desired trajectory can then be achieved by the vehicle at the same speed with a much smaller danger of rollover.

A STUDY OF DESTINATION SELECTION MODEL BASED ON LINK FLOWS

YE, PEIJUN; WEN, DING

Generating travel behavior based on artificial population and activity plan is a conventional method for traffic simulation. As a complicated and important constituent of travel behavior, destination selection is a decision-making process for the space transfer and has been studied extensively in the disaggregate model. However, existing selection models only focus on the psychology or custom of individuals from a microscopic perspective and rarely take account of the actual traffic state. This causes a large deviation in simulation results and thus brings some obstacles for

application. In this paper, a new destination selection model based on link flows is proposed. Further, a searching algorithm for observed link set is given and compressed sensing is used in the model solution. Experiments demonstrate that this model can predict the actual traffic state in rush hours quite well. Therefore, it contributes to the credible simulation and computational experiments.

GENERALIZING LAPLACIAN OF GAUSSIAN FILTERS FOR VANISHING POINT DETECTION

KONG, HUI; SARMA, SANJAY; TANG, FENG

We propose a framework for road vanishing point detection based on a new generalized Laplacian of Gaussian (gLoG) filter. In the first part, the gLoG filter can be applied to estimate the texture orientation at each pixel of an image, and the road vanishing point can be detected based on the estimated texture orientations. However, such a texture based road vanishing point detection scheme suffers from high computational complexity. In the second part, an efficient gLoG-based method is proposed by only using the dominant texture orientations estimated at a sparse set of salient micro-blob road regions, where the gLoG filter is used to detect these salient micro-blob areas and simultaneously estimate their dominant texture orientations. Experimental results on 1003 general road images show that the efficient gLoG-based method is significantly faster than the Gabor-filter based method, while the detection accuracy is comparable. The non-efficient gLoG-based method is more accurate in detecting vanishing point than the Gabor-based approach.

A STUDY ON THE METHOD FOR CLEANING AND REPAIRING THE PROBE VEHICLE DATA

ZHANG, ZHAOSHENG; YANG, DIANGE; ZHANG, TAO; HE, QIAOCHU; LIAN, XIAOMIN

Probe vehicle data are being increasingly applied in urban dynamic traffic data collection. However, the mobility and scale limit of probe vehicles may lead to incomplete or inaccurate data and thus influence the measurement of the state of traffic. At present, probe vehicle data are usually repaired by linear interpolation or a historical average method, but the repair accuracy is relatively low. To address the above problems, the Multi Threshold Control Repair Method (MTCRM) was proposed to clean and repair the probe vehicle data. MTCRM adopts threshold control and a rule based on approximate normalization transform to clean abnormal traffic data, and fill the missing data by a weighted average method and an exponential smoothing method. In this approach, we combine topological road network characteristics to fill in the missing data from data for neighboring road sections, and repair noisy data by reconstructing the principle components. This study mainly focuses on analyzing the component of probe vehicle data recurring pattern which can provide guides for the subsequent traffic forecasts. The findings of data repair for different grades of road in Beijing demonstrate that the mean repair error may meet the requirements of traffic state measurement, demonstrating that MTCRM can effectively clean probe vehicle data.

COMPUTATIONAL TRAFFIC EXPERIMENTS BASED ON ARTIFICIAL TRANSPORTATION SYSTEMS: AN APPLICATION OF ACP APPROACH

ZHU, FENGHUA; WEN, DING; CHEN, SONGHANG

The Artificial societies, Computational experiments, and Parallel execution (ACP) approach provides us an opportunity to look into new methods that address transportation problems from new perspectives. In this paper, we present our work and results of applying the ACP approach on modeling and analyzing transportation systems, particularly carrying out computational experiments based on artificial transportation systems (ATs). Two aspects in the

modeling process are analyzed. The first is growing an ATS from the bottom up using agent-based technologies. The second is modeling environmental impacts under the principle of “simple is consistent.” Finally, three computational experiments are carried out on one specific ATS, i.e., Jinan-ATS, and numerical results are presented to illustrate the applications of our method.

Abstracts of forthcoming papers on IEEE ITS Magazine

A NEW CONFIDENCE ESTIMATOR FOR VEHICLE TRACKING BASED ON A GENERALIZATION OF BAYES FILTERING

ALTENDORFER, RICHARD; MATZKA, STEPHAN

In safety-critical driver assistance systems such as automatic emergency braking that require the estimation of the vehicle’s environment usually a measure of confidence or probability of existence for tracked objects is required. Its purpose is to distinguish real objects from spurious objects based on artifacts within the measurement or tracking process in order to reduce the number of erroneous deployments (false alarms). We review and assess existing approaches of obtaining such measures. We propose a new method of computing a probability of existence by relaxing the underlying assumption of a Bayes filter which leads to a novel estimation algorithm for a probability of existence. The benefits of this approach compared to a standard Bayes filter are illustrated and corroborated by a numerical study using experimental data.

AN EMBEDDED MULTI-MODAL SYSTEM FOR OBJECT LOCALIZATION AND TRACKING

RODRIGUEZ FLOREZ, SERGIO; FREMONT, VINCENT; BONNIFAIT, PHILIPPE; CHERFAOUI, VERONIQUE

Reliable obstacle detection and localization is a key issue for driver assistance systems, particularly in urban environments. In this study a multi-modal perception approach is investigated, the objective being to enhance vehicle localization and dynamic object tracking in a world-centric map. A 3D ego-localization is achieved by merging information from a stereo vision system and data obtained from vehicle sensors. Mobile objects are detected using a multi-layer lidar that is also used to identify a constrained search space within the multiple target tracking process. Object localization and tracking is then performed in the fixed frame, which facilitates analysis and understanding of the scene. Experimental results using real world data are performed to evaluate the performance of the multi-modal system, and these are presented to show the effectiveness of the approach.

NOTICE: AN ARCHITECTURE FOR THE NOTIFICATION OF TRAFFIC INCIDENTS

YAN, GONGJUN; OLARIU, STEPHAN; POPESCU, DIMITRIE

The past decade has witnessed the confluence of Intelligent Transportation Systems and Vehicular Networks that is expected to change drastically incident detection and to provide timely dissemination of traffic-related information to the traveling public. As a first step in this direction we introduce NOTICE, a secure and privacy-aware architecture for the notification of traffic incidents. Using sensor belts embedded in the roadway, traffic-related messages and advisories are carried between belts by passing cars. NOTICE moves the responsibility for making decisions about traffic-related information dissemination to the infrastructure rather than leaving those decisions with the drivers, which may have incomplete or incorrect knowledge. Extensive simulation have confirmed that NOTICE can provide "up-to-the-minute" notification of traffic-related incidents to the various participants in the traffic.

A NEW SCORING MECHANISM FOR VEHICLE CRASH IMMINENT BRAKING SYSTEMS

CHIEN, STANLEY; MOURY, MICHAEL; WIDMANN, GLENN; LI, LINGXI; MAINA ARI, ADAM; MEADOWS, ALEX; BANVAIT, HARPREETSINGH; CHEN, YAOBIN

As Crash Imminent Braking (CIB) systems have been introduced to the passenger vehicle market segment, there is an immediate need to develop a standardized performance scoring system which enables an objective comparison of similar CIB systems implemented across various vehicle platforms. It is desirable that this standard is adopted by the entire automotive industry to further advance CIB technologies. It is also a valuable reference for consumers to compare the safety of different vehicles. This paper describes an approach for the establishment of such a standard to evaluate and compare the performance of CIB systems. A set of testing scenarios is proposed for the performance evaluation of CIB systems. Subjective and arguable test scenarios are avoided as much as possible. The applicability of the proposed scoring system is demonstrated with the data collected from some proposed testing scenarios in the evaluation of a 2011 model-year passenger vehicle equipped with a CIB system.

DRIVING BEHAVIOR AND SIMULATOR SICKNESS WHILE DRIVING THE VEHICLE IN THE LOOP: VALIDATION OF LONGITUDINAL DRIVING BEHAVIOR

KARL, INES; BERG, GUY; RUEGER, FABIAN; FAERBER, BERTHOLD

The Vehicle in the Loop (VIL) is a simulator, which combines real driving experience with the replicability and safety of simulators. In the VIL test setup a real test vehicle is combined with a virtual testing environment which is displayed to the user via a head-mounted display (HMD). In theory, this simulation concept renders the VIL uniquely suited to the development and evaluation of numerous automotive applications, including driver assistance systems. Aiming to assess the extent to which the VIL elicits realistic driving responses, a validation study was performed. In this first validation study the focus was on longitudinal driving behavior. 44 participants performed five common traffic maneuvers in reality and the VIL setup. Simulator sickness was assessed with the simulator sickness questionnaire (SSQ). Descriptive and inferential analyses of the data showed that the VIL achieves relative validity concerning brake pressure and reaction times and absolute validity concerning the steering angle. However, subjects showed longer reaction times and accelerated more smoothly while driving the VIL. One possible explanation for these results could be the presence of simulator sickness. Overall, the study indicates that the VIL represents a suitable testing method for the evaluation and development of driver assistance systems. The study also provided clear indications for the future development of the VIL.

A 13.000 KM INTERCONTINENTAL TRIP WITH DRIVERLESS VEHICLES: THE VIAC EXPERIMENT

BERTOZZI, MASSIMO; BROGGI, ALBERTO; COATI, ALESSANDRO; FEDRIGA, REAN

In recent years the interest in autonomous vehicles has incrementally increased. After the DARPA Challenges new fields of application as agricultural, construction, mining, and also nautical are continuously opening up. In this paper a huge test is presented, the first of this kind in the history of vehicular robotics. A trip from Italy to China with four electric autonomous vehicles will be described focusing on all aspects of the challenge, from the managing issues to the most technical ones. A vehicle-following application (or virtual towing) is the system under test for a three consecutive months and 13,000 km long unique experience.

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