INTELLIGENT TRANSPORTATION SYSTEMS

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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 16,000 ITS professionals from industry, academia, and government.

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Brendan Morris brendan.morris@unlve.edu

Associate Editors

IEEE T-ITS and IEEE ITS-Magazine Report and Abstracts
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Conferences, Workshops, and Journals
Massimo Bertozzi and Paolo Grisleri
.....itsconfs@ce.unipr.it

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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 brendan.morris@unlv.edu.

SOCIETY NEWS

From the Editor

Brendan Morris

Summer is in full swing but our society has not gone on vacation. In June, we had a successful Intelligent Vehicles Symposium in Dearborn, Michigan. It was great to see the Motor City is alive an well. June also brought the deadline and record number of submissions for the Intelligent Transportation Systems Conference in China. This will be a great edition of our flagship meeting and I look forward to meeting you all in Qingdao.

This issue contains a review of the ITS Society's activities by the President as well as an invitation to listen to the newest ITS Podcast. In addition, our special feature article gives historic perspective on 25 years of Intelligent Vehicles and recognizes Dr. Ichiro Masaki's efforts to make this community a reality. Here's to another 25 strong years.

From the President

Matthew Barth

ITS Society in "Review"

The IEEE ITS Society is off to a fast start this year: we recently had an ITS society executive committee meeting in early March, a Board of Governors teleconference in April, and we had our Intelligent Vehicle (IV) Symposium on June 8th in Dearborn Michigan. The Intelligent Vehicle Symposium is one of our society's key conferences, highlighting some of the best oral presentations, posters, workshops, and papers that are focused on intelligent vehicles and associated intelligent transportation systems.

When I started my role as president of the ITS society, little did I know that each society gets reviewed every five years by the IEEE, sort of an "audit" to see how well each society is doing. I received an email in March that our ITS society was up for review this year, and that we had to assemble a fairly comprehensive report by May. This report is comprehensive in the sense that it covers all of what we do: our strategic plan, operations, conferences, publications, education, membership, finances, administration, and governance. With the help from our executive committee, we submitted our report and met with the review committee in late June. The review committee praised our society and gave us some great ideas to try in the future. In addition, this was a great way for me to quickly learn every detail of what our society does. It really taught me what a great ITS society we have and its potential for growth. We are still one of the younger and smaller societies, but we are expanding in a number of different areas. Here are just a few of the highlights:

Our "field of interest" has always been in ITS, but there is a lot more focus now on intelligent, connected, and automated vehicles, which is reflected in our most recent strategic plan. Our conferences have never been stronger, with our two flagship conferences: Intelligent Vehicle Symposium (this year in Dearborn, Michigan, June 2014), and the Intelligent Transportation System Conference (in Tsingtao China, October 2014). These conferences keep growing each year, currently ranging from 300 – 600 attendees. There are a number of other specialized conferences that we also support, including the growing International Connected Vehicle Conference and Expo (ICCVE), and the International Electric Vehicle Conference (IEVC). In terms of our publications, we have one of the highest impact factors for transportation journals with our Transactions on ITS, and we expect to get our first impact factor rating for our ITS Magazine later this year. One of the key efforts underway is our society creating a new journal: Transactions on Intelligent Vehicles (T-IV). It is a year-long process to start these transactions, but it certainly makes sense: we already have an "ITS" conference and an "Intelligent Vehicle" symposium, why not have an equal Transactions on ITS and a Transactions on Intelligent Vehicles? Stay tuned, this will be launching soon.

In terms of new educational efforts, we are also launching a "Distinguished Lecture Series" in ITS, where over the next two years, we will see lectures from the top ITS researchers in Japan, the U.S., Europe, and China. Also, we are also planning on starting an ITS "summer school" for graduate students and others that want to learn more about ITS. Our membership continues to grow and our finances and administration are strong. We recently had two new ITS society Chapters get started, one in Tunisia Africa, and another in Nagoya, Japan.

As our program continues to expand, we hope our membership continues to increase. Last year, we had one of the highest membership growth rates in the IEEE, at 14.5%. Let's keep that trend moving forward, and expect to hear a lot more about ITS in the coming months.

Matt Barth
IEEE ITSS President, 2014-2015

ITS Podcast

Javier Sanchez-Medina

Special Episode: IV'14 with Mohan Trivedi

We have prepared a special issue of the ITS Podcast, this time about the recent 2014 IEEE Intelligent Vehicles Symposium, also known as IV'14. We have comments from its organizers, from the Intelligent Transportation Systems Society President, plus a memorable interview recorded to Professor Mohan Trivedi, one of the most prolific authors in our community.

We recorded all of this onsite, in Dearborn, Michigan, last month. We really hope you enjoy it! We also have a News Minisection with a call for a conference that may be of your interest.

Please, check it out and give feedback on the show with your comments at the podcast website or at our social networking accounts: LinkedIn, Twitter (@ITSPodcast), Facebook, Google+ or by email: itsspodcast@gmail.com

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However, if you are more of a Smart Apps fan, you can search for this show at your preferred podcasting application. Search for the keywords "Intelligent Transportation" and you will find us.

http://itsp.cicei.com/?p=484

Coming soon!

We are preparing a fascinating episode including a long interview with Jeff Allen, Executive Director of "Drive Oregon". If you like electric mobility, you cannot miss this one.

We also have a great interview with prof. Young Jae JANG., from Korea's KAIST about OLEV, a really innovative contact-less electric vehicle charging system that seems really promising.

Thanks for your support and help!

Javier Sanchez-Medina
EiC IEEE ITSS ITSPodcast

25 Years of Intelligent Vehicles Symposia

Featured Article

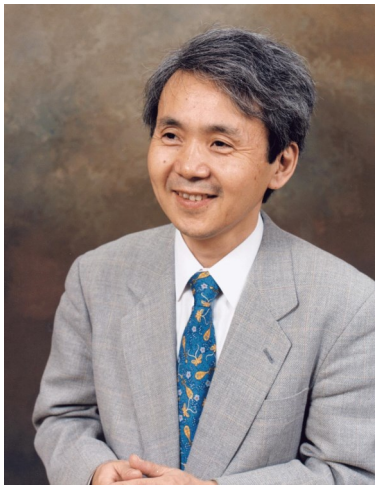
Prof. Alberto Broggi / Prof. Umit Ozguner

This year's IV symposium marked the 25th anniversary of this conference series. It started in 1989 in Japan thanks to the vision of Dr. Ichiro Masaki, the "driving force" who not only initiated this series, but coordinated, planned and led many of the first conferences. The success of the series consolidated over the years and soon became the reference event for academia, industry, and government institution working on any aspect of vehicular intelligence.

Dr. Ichiro Masaki

Founding General Chair of IEEE Intelligent Vehicles Symposia

Massachusetts Institute of Technology, USA



When Dr. Ichiro Masaki started the first conferences, the IEEE Industrial Electronics Society was the home for this series. It was also thanks to the increasing success of this conference that IEEE established the IEEE Intelligent Transportation Systems Council in 1999 and Dr. Masaki worked on including the IV Symposium in the Council. When finally the ITS Council was transformed into the IEEE ITS Society, the Intelligent Vehicles Symposium became one of the two flagship conferences.

History of the Intelligent Vehicles Symposia

1989 – Tsukuba, Japan
1990 – Tokyo, Japan
1991 – Tokyo, Japan
1992 – Detroit, MI, USA
1993 – Tokyo, Japan
1994 – Paris, France
1995 – Detroit, MI, USA
1996 – Tokyo, Japan
1998 – Stuttgart, Germany
1999 – Tokyo, Japan
2000 – Dearborn, MI, USA
2001 – Tokyo, Japan
2002 – Versailles, France
2003 – Columbus, OH, USA
2004 – Parma, Italy
2005 – Las Vegas, NV, USA
2006 – Tokyo, Japan
2007 – Istanbul, Turkey
2008 – Eindhoven, The Netherlands
2009 – Xi'an, China
2010 – San Diego, CA, USA
2011 – Baden Baden, Germany
2012 – Alcalá de Henares, Spain
2013 – Gold Coast, Australia
2014 – Dearborn, MI, USA

Dr. Masaki's long term engagement was celebrated at the IV 2014 event by Prof. Umit Ozguner, the General Chair of the conference. A token of appreciation was provided to Dr. Masaki in recognition of his leadership and vision in starting and conducting the IV Symposium, which is now the home of many scientists, engineers, and practitioners working for the progress of vehicular science.

Dr. Masaki is still involved in progressing science, with a special interest in ITS related subjects. He recently initiated a new conference series to explore systematic methodologies for improving the quality of life by advancing the technology of the "Universal Village" and its major subsystems, including intelligent health care, intelligent transportation, intelligent environment, intelligent energy management and protection of the environment. During the 2014 Universal Village conference, Prof. Alberto Broggi presented to Dr. Masaki a IV2014 T-Shirt in recognition of his leadership.

Dr. Ichiro Masaki receives a token of appreciation and the official IV 2014 T-Shirt from Prof. Alberto Broggi

IEEE Call for Papers

2015 IEEE Intelligent Vehicles Symposium

June 28 – July 1, 2015, COEX, Seoul, Korea

Sponsored by the IEEE Intelligent Transportation Systems Society

ORGANIZING COMMITTEE

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External Affairs Chair
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International Chair
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THE INTELLIGENT VEHICLES SYMPOSIUM (IV2015) is a premier annual forum sponsored by the **IEEE INTELLIGENT TRANSPORTATION SYSTEMS SOCIETY (ITSS)**. Researchers, practitioners, and students from universities, industry, and government agencies are invited to present their latest works and to discuss research and applications for Intelligent Vehicles and Vehicle-Infrastructure Cooperation. The technical presentations are characterized by a single oral session and multiple poster sessions where all attendees can exchange ideas in an informal atmosphere. Tutorials will be offered on the first day followed by three days of presentations and a vehicle demonstration day. An exhibition area will be available for the presentation of products and projects.

PROGRAM TOPICS INCLUDE BUT ARE NOT LIMITED TO :

- Advanced Driver Assistance Systems
- Automated Vehicles
- Active and Passive Vehicle Safety
- Vehicle Environment Perception
- Driver State and Intent Recognition
- Eco-driving and Energy-efficient Vehicles
- Impact on Traffic Flows
- Cooperative Vehicle-infrastructure Systems
- Collision Avoidance
- Pedestrian Protection
- V2X Communication
- Proximity Detection Technology
- Assistive Mobility Systems
- Proximity Awareness Technology
- Intelligent Ground, Air and Space Vehicles
- Autonomous / Intelligent Robotic Vehicles
- Image, Radar, Lidar Signal Processing
- Information Fusion
- Vehicle Control
- Telematics
- Human Factors and Human Machine Interaction
- Electric and Hybrid Technologies
- Novel Interfaces and Displays
- Intelligent Vehicle Software Infrastructure

SPECIAL and TUTORIAL SESSIONS are encouraged. Organizers should submit a session proposal through the IV2015 webpage (http://www.iv2015.org). For more information, please visit the webpage or contact the conference secretariat (sec@iv2015.org).

PAPER SUBMISSION

Manuscripts must be electronically submitted through the conference website. Submitted manuscripts should be at most six (6) pages in IEEE two-column format, including figures, tables, and references. Please use the templates at Manuscript Templates for Conference Proceedings available from the conference website to prepare your manuscript. All submissions MUST be in PDF format.

IMPORTANT DATES

Paper Submission Deadline	January 9, 2015
Special/Tutorial Sessions, Workshop Proposal Deadline	January 9, 2015
Notification of Acceptance	March 13, 2015
Final Paper Submission	April 10, 2015

CONTACT

For proposal of a special session, demonstration, and exhibition, contact the organization committee at sec@iv2015.org.

http://www.iv2015.org

ICVES 2014

IEEE Conference on Vehicular Electronics and Safety

Hyderabad, India. December 16th to 18th - 2014

The International Conference on Vehicular Electronics and Safety (ICVES) is an annual meeting sponsored by the IEEE Intelligent Transportation Systems (ITS) Society as a forum for researchers from industry and academia to discuss research and applications. We solicit papers that are relevant to intelligent vehicular systems that deal with all aspects of vehicle electronics and vehicle safety.

Organizing Committee

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* **Murthy Gummada,** *AASHTO, USA*
* **Raghav Gulur,** *Continental Corporation*
* **Pannir Selvam,** *Delphi*
* **Siva S,** *Analog Devices*
* **CSRK Prasad,** *NIT Warangal*
* **Greg Nagler**, *FLIR, USA*
* **TI**, Freescale, *ADI (Hardware for vehicular electronics)*

Scope

The 2014 IEEE International Conference on Vehicular Electronics and Safety (ICVES'14), an annual forum sponsored by IEEE Intelligent Transportation Systems Society, will take place in Hyderabad, India during Dec 16-18. It brings together researchers and practitioners to discuss vehicle electronics, and research and application aspects of safety systems. ICVES'14 welcomes papers dealing with any aspects of vehicular electronics and safety systems.

Topics

Original contributions are solicited in all areas pertinent to Vehicular Electronics and Safety research and applications. Contributions for industry and applications sessions are also solicited. Topics include, but are not limited to:

- Active and Passive Safety Systems
- Telematics
- Vehicular Power Networks
- X-By Wire Technology
- System-On-a-Chip
- Vehicular Sensors
- Vehicle Bus Systems
- On-Vehicle Sensor Networks
- Embedded Operating Systems
- Electro Magnetic Compatibility
- Inter-Vehicular Communication
- Vehicle Testing
- Navigation and Localization Systems
- Vehicular Measurement Technology
- Vehicular Signal Processing
- Micro-electromechanical Systems
- Image Sensors
- Vehicle/Engine Control
- Driver Assistance and Warning Systems
- Adaptive Cruise Control Systems
- Pattern Recognition for Vehicles

Paper Submission

Prospective authors must submit their manuscripts electronically through the conference website http://www.ieeeves.org/. Submitted manuscripts should be at most six (6) pages in IEEE two-column format, including figures, tables, and references. Please use the templates at Manuscript Templates for Conference Proceedings available from the conference website to prepare your manuscript. All submissions MUST be in PDF format.

Important Dates:

Submission deadline: Aug 1 (sharp), 2014
Notification of acceptance: Sep 15, 2014
Final manuscript due: Oct 1, 2014

For details and most updated information,
Please visit the conference web site at:
http://www.ieeeves.org
Email address: ieeeicves2014@gmail.com

The 3rd IEEE International Conference on Connected Vehicles and Expo (ICCVE 2014)

November 3-7, 2014 | Vienna, Austria

"The future of mobility enabled by Connected Automated Vehicles"

Conference website: http://www.iccve.org/2014

Connected Vehicles is an emerging technical field which crosses multiple disciplines and industries including automotive, travel & transportation, information technology, communications, consumer electronics, industrial electronics, media & entertainment, energy & utilities, insurance, etc. By connecting vehicles with various devices, services and participants, we are able to make our mobility more enjoyable, sustainable and safe.

Co-sponsored by over 20 societies and organizations, ICCVE 2014 is the world's top 1 Connected Vehicles conference that gathers all the relevant communities together. During the 5-day conference, experts, practitioners and policy makers from all around the world will present the latest innovations and advances on connected vehicles, share the experience and insights, forecast the trends and opportunities, and discuss the policy, economics and social implications. We are proudly and excitedly inviting you to participate in and enjoy this world-class event.

The conference program will feature paper sessions and workshops, summits and industry forums, demos, exhibits, tutorials, and tours. Topics of interest include, but are not limited to:

1. Wireless Communications and Vehicular Networking
2. Mobile Internet, Mobility Internet and Internet of Things
3. Cooperative Driving, Intelligent and Autonomous Vehicles
4. Automotive Electronics and Automatic Control
5. Transportation and Connected Vehicles
6. Electric Vehicle and Transportation Electrification
7. Geographic, Spatial and Social Information Systems
8. Manufacturing and Product Safety Engineering in Connected Vehicles
9. Practices, Recommendations and Standards in Connected Vehicles
10. Policy, Economics and Social Implications of Connected Vehicles

*** CALL FOR PAPERS ***

Prospective authors are invited to submit full papers (6 pages) or digest papers (2 pages) for presentation at the conference and publication in the Proceedings.

Full Papers:
Prospective authors are invited to submit full papers (IEEE standard format, double column, 10-point font, US letter, 6 pages maximum with 2 additional pages allowed but at an extra charge) for presentation at the conference and publication in the Proceedings.

Digest Papers:
Authors are also invited to submit digest papers (IEEE standard format, double column, 10-point font, US letter, 2 pages) to showcase results recently obtained in industry or academia. Accepted digest papers will be presented at the conference and published in the Proceedings.

Accepted and presented papers will be published in the ICCVE 2014 Conference Proceedings and submitted to IEEE Xplore®. The ICCVE 2014 Conference Proceedings will also be submitted for indexing through INSPEC, and EI's Engineering Information

Index, Compendex, and ISI Thomson's Scientific and Technical Proceedings, ISTP/ISI Proceedings, and Current Contents on Diskette, and Scopus.

Substantially extended versions of top quality papers will also be considered for publication in special issues or special sections of the following IEEE journals:
- IEEE Transactions on Industrial Electronics (Current IF: 5.165)
- IEEE Transactions on Industrial Informatics (Current IF: 3.381)
- IEEE Intelligent Transportation Systems Magazine (Current IF: 3.064)
- IEEE Consumer Electronics Magazine
- IEEE Transactions on Transportation Electrification
- IEEE Transportation Electrification Magazine
- IEEE Systems Journal (Current IF: 1.27)

Paper Submission Deadline: Jul 31, 2014 (Extended)
Notification of Acceptance: Aug 31, 2014
Final Manuscript Due: Sep 15, 2014

*** INDUSTRY FORUMS - CALL FOR SPEECH PROPOSALS ***

The ICCVE 2014 will hold Industry Forums designed to facilitate broad discussions on various aspects of Connected Vehicles. Speeches about technologies, practices, markets, policy, and social implications are all welcome. If you are interested in speaking at the ICCVE 2014 Industry Forums, please submit a simple proposal to our industry forums committee. Based on the submitted proposals, the committee will schedule forum sessions consisting of speeches and panel discussions. Each speech will be 20-30 min, depending on how full the agenda of a session would be.

Simple submission. Too busy to write a detailed proposal? Don't worry. At this stage, you only need to send a simple email as your proposal to our industry forums committee (forums@iccve.org). Just include the following items in the plain-text proposal:
- Title for the speech;
- An abstract of the speech (no more than 200 words);
- Name, affiliation, and email address of the speaker;
- A short biography of the speaker.
You will get a notification of acceptance in 10 working days, then you can start preparing your slides.

No copyright transfer. You keep the copyright of your slides, so you can feel free to reuse them in part or in whole for other occasions.

Do not take the "Industry Forums" too literally. You are not an industry person? It doesn't matter at all. Speakers from academia, industry and government are all welcome.

Proposal Submission Deadline: Jul 31, 2014 (Extended)
Notification of Acceptance: 10 working days after your submission
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* PATRONAGE AND EXHIBITION OPPORTUNITIES *

The conference will bring together government, academia, companies, organizations and customers to discuss an emerging technical field which crosses multiple disciplines and industries including automotive, travel & transportation, information technology, communications, consumer electronics, industrial electronics, media & entertainment, energy & utilities, insurance, etc. Patrons and exhibitors will become a part of the business network that is being built to develop / deploy products and services across cars, trucks, equipment, trains, ships, airplanes and the Intelligent Highway.

We want to help you meet potential customers from around the world that will be interested in your products and services. By becoming a part of the ICCVE Business Network, we will ensure that you will have access to the leaders of the new Connected Vehicles world during the conference and long afterwards.

A limited number of patronage opportunities and exhibition packages are available. Please inquire of our exhibits committee (exhibits@iccve.org).

For more information, visit http://www.iccve.org/2014

Steering Committee:
George Bebis, Univ of Nevada, Reno, USA (Chair)
Bahram Parvin, Berkeley National Lab, USA
Richard Boyle, NASA Ames Research Center, USA
Darko Koracin, Desert Research Institute, USA

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Computer Graphics Chairs:
Deng Zhigang, University of Houston, USA
Mark Carlson, DreamWorks Animation, USA

Virtual Reality Chairs:
Ryan McMahan, University of Texas at Dallas, USA
Jason Jerald, NextGen Interactions, USA

Visualization Chairs:
Zhang Hui, Indiana University, USA
Steven Drucker, Microsoft, USA

Keynote Speakers:
Arun Ross, Michigan State University, USA
Gopi Meenakshisundaram, Univ of California at Irvine, USA
Melanie Tory, Univ of Victoria, Canada
Rama Chellapa, Univ of Maryland, USA
Bernd Frohlich, Bauhaus Univ, Weimar, Germany
Luc Vincent, Google, USA

International Program Committee:
http://www.isvc.net/committee.html

Sponsors

CALL FOR PAPERS & SPECIAL TRACKS

10th International Symposium on Visual Computing

ISVC'14
December 8-10, 2014
Monte Carlo Resort & Casino
Las Vegas, Nevada, USA
http://www.isvc.net/

Scope

The purpose of the International Symposium on Visual Computing (ISVC) is to provide a common forum for researchers, scientists, engineers and practitioners throughout the world to present their latest research findings, ideas, developments and applications in the broader area of visual computing. ISVC'14 will consist of invited and contributed presentations dealing with all aspects of visual computing. The symposium will include several keynote speakers, special tracks, and a poster session.

Topics

ISCV seeks papers describing contributions to the state of the art and state of the practice in the field of visual computing. The symposium is structured around the four central areas of visual computing: (1) **computer vision**, (2) **computer graphics**, (3) **virtual reality**, and (4) **visualization**. In particular, we are interested in papers that combine technologies from two or more of these areas.

Computer Vision: Early and Biologically-Inspired Vision; Color and Texture; Illumination and Reflectance Modeling; Segmentation and Grouping; Object Recognition/Detection/Categorization; Motion and Tracking; Video Analysis and Event Recognition; Biometrics (Face, Fingerprint, Hand, Iris); Pattern Recognition; Statistical Methods and Learning; Document Analysis; Medical Image Analysis; Image and Video Retrieval; 3D Reconstruction; Shape from X; Physics-based Modeling; Image-Based Modeling; Computational Photography; Human-Computer Interfaces; Vision for Graphics; Vision for Robotics; Performance Evaluation; Sensors and Systems; Secure Image/Video Communication; Image/Video Encoding/Compression; Applications

Computer Graphics: Geometric Modeling; Physically Based Modeling; Geometric Computing; Shape and Surface Modeling; Graphics Algorithms; Web Based Graphics; Perceptual Aspects of Computer Graphics; Computer Animation; Special Effects; Multimedia and Digital Media; Computational Photography; Image-Based Computer Graphics; Rendering Techniques; Stylized Rendering; Global Illumination, Photo-Realistic Computer Graphics; Volume Graphics, Semi-Transparent Media; Graphics System Architectures; Graphics Hardware and Hardware-Related Techniques (GPU); Data Compression for Graphics; Computer Graphics for Small/Large Displays; Parallelism in Computer Graphics; Graphic Toolkits; Interaction and HCI; Simulation for Computer Graphics; Applications.

Virtual Reality: Augmented Reality; Mixed Reality; Artificial Reality; Real-Time Rendering; Collision detection in VR; 3D Interaction for VR; Modeling and Simulation; Virtual Humans and Artificial Life; VR Systems and Toolkits; Collaborative Virtual Environments; Tele-collaboration; VR System Architecture; Multimodal displays; Projection and Display Systems; Human Computer Interaction; Presence and Cognition; Integration of VR and Multimedia; Immersive Gaming; Multi-user and Distributed VR and Gaming; Serious Games; Haptics, Audio, and Other Non-Visual Interfaces; Tracking and Sensing; Human Factors; User Studies and Evaluation; Hardware Devices; Applications

Visualization: Visualization Taxonomies and Models; Information Visualization; Scalar, Vector, and Tensor Visualization; Multi-dimensional and Multi-resolution Data Visualization; Time Series Data Visualization; Medical Data Visualization; Molecular Data Visualization; Geographic Data Visualization; Volume Visualization; Flow Visualization; Large Scale Data Set Visualization; Collaborative and Distributive Visualization; Isosurfaces; Rendering Techniques; Visualization Systems; Visual Analytics, Visual Data Mining and Knowledge Discovery; Display and Interaction Technology; Human Perception and Cognition; Human Factors; Haptics for Visualization; Evaluation and User Studies; Hardware for Visualization; Mesh Techniques and Compression; Applications.

Submission Procedure

Papers submitted to ISVC must not have been previously published and must not be currently under consideration for publication elsewhere. All papers accepted will appear in the symposium proceedings which will be published by **Springer-Verlag** in **Lecture Notes in Computer Science (LNCS)**.

Other Information

Special tracks are intended to stimulate in-depth discussions in special areas relevant to the symposium theme. Significantly extended and revised versions of selected papers will be considered for publication in a special issue of the *International Journal on Artificial Intelligence Tools (IJAIT)* (ISI/SCIE indexed). Also, a "best paper" award ($500) will be sponsored by MERL.

Important Dates:

Special Track Proposals:	April 1, 2014
Paper submissions:	August 23, 2014
Notification of acceptance:	October 7, 2014
Final camera ready paper:	October 31, 2014
Advance Registration:	October 31, 2014
ISVC'14 Symposium:	December 8-10, 2014

Intelligent Transportation System

A Special Track of the

10th International Symposium on Visual Computing

(ISVC14) http://www.isvc.net

December 8-10, 2014

Las Vegas, Nevada, USA

Scope:

The scope of Intelligent Transportation System (ITS) has been enlarging from reducing traffic accidents and casualties on the road, to integrating energy, mobility, and information communication technology so that we can improve the overall transportation experience. It also has applications in surveillance scenarios and security applications such as restricting access of vehicles. It can also encompass scenarios that help users to do geographic recognition from the dashboard camera.

As such, advances in computer vision are the key to unlocking the full potential of many of the relevant technologies related to ITS. As industry starts looking at the viable proposals for self-driving cars and changing mindset for greater acceptance of such technology, it is important to push the envelope for scientific research to support such efforts. The purpose of this track is to advance the current state of the art of ITS and its wide range of applications with respect to visual processing technologies.

Topics:

The topics of interest include but are not limited to the following areas:

Video Surveillance
Traffic Monitoring
Autonomous or Semi-Autonomous vehicles
Visual assist technologies for drivers
Vehicle detection, classification, and tracking
Pedestrian detection, tracking
Driver intent detection
Traffic pattern analysis
Mobility services and applications

License plate recognition
Road sign detection and classification

Paper Submission Procedure:

Papers submitted to ISVC 2014 Special Track must not have been previously published and must not be currently under consideration for publication elsewhere. Manuscripts should be submitted in camera-ready format and should not exceed **12 pages**, including figures and tables (see http://www.isvc.net for details). All papers accepted will appear in the symposium proceedings which will be published by **Springer-Verlag** in the **Lecture Notes in Computer Science (LNCS)** series.

Important Dates:

Paper submissions	August 23, 2014
Notification of acceptance	October 7, 2014
Final camera ready paper	October 31, 2014
Advance Registration	October 31, 2014
ISVC14 Symposium	December 8-10, 2014

Organizers:

Amol Ambardekar, Microsoft, Bellevue, WA, USA, amolamb@microsoft.com
Brendan Morris, University of Nevada, Las Vegas, Las Vegas, NV, USA, brendan.morris@unlv.edu

Job Advertisement for ERA Chair Holder Position

The University of Zilina according to Act No. 131/2002 Coll. on Universities (Universities Act) and internal regulations of the University of Zilina invites applications for the following job position:

EUROPEAN RESEARCH AREA (ERA) CHAIR

in Intelligent Transport Systems (ITS)

Excellent scientists are invited to apply for the ERA Chair position established at the University Science Park of the University of Zilina within the prestigious European grant awarded to only 11 European research institutions within the Seventh Framework Programme. The project aims to enhance research and innovation aspects of the park in the field of Intelligent Transport Systems (ITS). The University of Zilina plays a leading role in the ITS research and development in Slovakia and it is equipped with state-of-the-art ITS and ICT infrastructure.

The ERA Chair holder is expected to represent research excellence in the field of Intelligent Transport Systems, specifically in the area of ICT, transport and services development towards advanced ITS. He/She should be “Leading Researcher” (R4) according to the European Framework for Research Careers. Previous experiences with development and implementation of ITS will be evaluated during the selection process. Additionally, the ERA Chair holder will have an opportunity to influence the scientific development as the scientific advisor to the rector of the University of Zilina.

ERA Chair candidate is expected to:

- **Have international reputation based on research excellence in the field of ITS;**
- **Demonstrate critical judgment in the identification and execution of research activities;**
- **Make a substantial contribution to the research field;**
- **Recognize the broader implications and applications of his/her research;**
- **Have a proven record in securing significant research funding / budgets / resources;**
- **Be an expert in managing and leading international research projects;**
- **Develop and implement strategic vision on the future of the research field;**
- **Have at least 10 years of experiences in relevant fields.**

The candidate’s international reputation and research excellence will be assessed by considering his/her influential publications in high impact international journals and books, memberships in conference organizing committees and invited talks in area of ICT, transport, ITS. He/She is also expected to have a proven record in securing international projects and the ability to form motivating, innovative and creative environment for research and innovations.

The selected candidate will be offered the following:

- **Tenure track with initial appointment for 4.5 years;**

- **Internationally competitive salary commensurate with the candidate's qualifications and experience in conformity with section 7a) of the Act No.553/2003 Coll.;**
- **Budget for establishing ERA Chair Team (5 full-time and 5 part-time members);**
- **Start-up package for instrumentation;**
- **Consumables;**
- **Office space for the ERA Chair research team;**
- **Access to existing state-of-the-art research infrastructure;**
- **Extra bonus package depending on negotiations.**

Applications should include Curriculum Vitae with a special focus on high-impact publications and research funding management, a statement of research interest, three professional references and motivation letter.

Applications should be sent by e-mail to erachair@uniza.sk or alternatively mailed to:

ERA Chair, University of Zilina; Univerzitna 8215/1, 010 26 Zilina, Slovakia.

Applications should be submitted by **31st August, 2014.**

Review of applications will commence immediately after the deadline. Short-listed candidates complying with the mentioned requirements will be invited to Zilina, Slovakia for an interview and public presentation within one month of the application deadline. The selected candidate is obliged to demonstrate his/her blamelessness before signing the employment contract with the University of Zilina. Expected start date of working in-situ is November 2014.

Information and updates regarding the ERA Chair Holder position are available at:

http://www.erachair.uniza.sk/

Conference Calendar

Massimo Bertozzi / Paolo Grisleri

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

Upcoming Deadlines

ICCVE 2014 : July 31, 2014
ICVES 2014 : August 1, 2014
ISVC 2014 : August 23, 2014
VISGRAPP 2015 : October 7, 2014

2014

August, 24-27
NRITS National Rural ITS Conference
Branson, MO, USA
http://www.nritsconference.org/

September 7-11
ITS World Congress 2014 - Detroit
Detroit, MI, USA
http://itsworldcongress.org

September 10-12
International Conference on Mechatronic and Embedded Systems and Applications (MESA2014)
Mechatronic and Embedded Technologies in Intelligent Transportation Systems (METITS)
Senigallia, Italy
http://mesa2014.org/
http://mesa2014.org/it/symposia-mesa-13/

September 14-18
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2014)
Chicago, IL, USA
http://www.iros2014.org

September 14-17
IEEE Vehicular Technology Conference: VTC2014-Fall
Vancouver, Canada
http://www.ieeevtc.org/vtc2014fall/

October 7-10
2014 IEEE Multi-Conference on Systems and Control
Antibes Congress Center, Nice/Antibes, France
http://www.msc2014.org/

October 8-11
ITSC2014: The 17th International IEEE Conference on Intelligent Transportation Systems
Qingdao, Shandong, China
http://www.itsc2014.org/

October 22-25
14th International Conference on Transport Systems Telematics
Kraków, Ustron, Poland
http://tst-conference.org/

November 14-15
ICTTE 2014 : International Conference on Traffic and Transportation Engineering
Italy, Venice
https://www.waset.org/conferences/2014/italy/ictte/index.php

November 3-7
ICCVE 2014 : International Conference on Connected Vehicles and Expo
Vienna, Austria
Submission due by: July 31, 2014
http://www.iccve.org/

November 20-21
VISIGRAPP 2015: 10th International Joint Conference on Computer Vision, Imaging and Computer Graphic Applications
Berlin, Germany
Submission due by: October 7, 2014
http://www.visigrapp.org/

November 20-21
ICIAP 2014: International Conference on Image Analysis and Processing
Capetown, South Africa
https://www.waset.org/conferences/2014/capetown/iciap/

December 8-10
ISVC 2014: International Symposium on Visual Computing
- Special Track on Intelligent Transportation Systems
Las Vegas, NV
Submission due by: August 23, 2014
http://www.isvc.net/

December 16-18
ICVES 2014: IEEE Conference on Vehicular Electronics and Safety
Hyderabad, India
Submission due by: August 1, 2014
http://www.uurmi.com/icves2014/

Abstracts of forthcoming papers on IEEE Transactions on ITS

A BRAIN-COMPUTER INTERFACE-BASED VEHICLE DESTINATION SELECTION SYSTEM USING P300 AND SSVEP SIGNALS

FAN, XIN-AN; BI, LUZHENG; TENG, TENG; DING, HONGSHENG; LIU, YILI

In this paper, we propose a novel driver-vehicle interface for individuals with severe neuromuscular disabilities to use intelligent vehicles by using P300 and Steady State Visual Evoked Potential (SSVEP) brain-computer interfaces (BCI) to select a destination, and test its performance in the laboratory and real driving conditions. The proposed interface consists of two components: the selection component based on a P300 BCI and the confirmation component based on an SSVEP BCI. Furthermore, the accuracy and selection time models of the interface are built to help analyze the performance of the entire system. Experimental results from 16 participants collected in the laboratory and real driving scenarios show that the average accuracy of the system in the real driving conditions is about 99% with an average selection time of about 26 seconds. More importantly, the proposed system improves the accuracy of destination selection compared to a single P300 BCI-based selection system, especially for those participants with relatively low level of accuracy in using the P300 BCI. This study can not only provide individuals with severe motor disabilities with an interface to use intelligent vehicles and thus improve their mobility, but also facilitate the research on driver-vehicle interface, multi-modal interaction, and intelligent vehicles. Furthermore, it opens an avenue on how cognitive neuroscience may be applied to intelligent vehicles.

A BULK QUEUE MODEL FOR EVALUATION OF IMPACT OF HEADWAY VARIATIONS AND PASSENGER WAITING BEHAVIOR ON PUBLIC TRANSIT PERFORMANCE

ISLAM, MD KAMRUL; VANDEBONA, UPALI; DIXIT, VINAYAK; SHARMA, ASHISH

This paper demonstrates a model developed using the Markov chain technique, to ascertain the performance of public transit systems and examine the effects of stochastic variations in passenger arrival, waiting, boarding and alighting behavior on the regularity of headway along the route. The model addresses situations where passengers abandon the system after consuming a certain amount of waiting time. This accounts for the existence of a finite allowance of waiting time from the view point of the passengers. Numerical examples included offer insights into factors that affect the reliability of public transit systems and presents analysis of the system performance measures such as mean counts of passengers served by transit systems, baulked passengers and unused space on vehicles. The impact of variability of departure headway on the utilization of public transit systems is illustrated. This investigation provides a better understanding about the determinants of reliability of public transit systems. This model can be used as an analysis tool by transit planners to evaluate selection of system attributes.

A COOPERATIVE TRAIN CONTROL MODEL FOR ENERGY-SAVING

SU, SHUAI; TANG (GUEST EDITOR ICIRT 2013), TAO; ROBERTS (GUEST EDITOR ICIRT2013), CLIVE

Increasing attention is being paid to energy efficiency in subway systems in order to reduce the operational cost as well as the carbon emissions. Optimization of the driving strategy and efficient utilization of the regenerative energy

are two effective methods to reduce the energy consumption for electric subway systems. Based on a common scenario that an accelerating train can reuse the regenerative energy from a braking train on the opposite track, this paper proposes a cooperative train control model to minimize the practical energy consumption, i.e., the difference between the traction energy and the reused regenerative energy. Firstly, we design a numerical algorithm to calculate the optimal driving strategy with the given trip time, in which the variable traction force, braking force, speed limits, and gradients are considered. Then a cooperative train control model is formulated to adjust the departure time of the accelerating train for reducing the practical energy consumption during the trip by efficiently using the regenerative energy of the braking train. Furthermore, a bisection method is presented to solve the optimal departure time for an accelerating train. Finally, the optimal driving strategy is obtained for the accelerating train with the optimal departure time. Case studies based on the Beijing Yizhuang subway line are presented to illustrate the effectiveness of the proposed approach on energy-saving.

A DISTRIBUTED FRAMEWORK FOR COORDINATED HEAVY-DUTY VEHICLE PLATOONING

LARSON, JEFFREY; LIANG, KUO-YUN; JOHANSSON, KARL

Heavy-duty vehicles traveling in a single file with small intervehicle distances experience a reduced aerodynamic drag and therefore have an improved fuel economy. In this paper, we attempt to maximize the amount of fuel saved by coordinating platoon formation using a distributed network of controllers. These virtual controllers, placed at major intersections in a road network, help coordinate the velocity of approaching vehicles so they arrive at the junction simultaneously and can therefore platoon. This control is initiated only if the cost of forming the platoon is smaller than the savings incurred from platooning. In a large-scale simulation of the German autobahn network, we observe savings surpassing 5\% when only few thousand vehicles participate in the system. These results are corroborated by an analysis of real-world heavy-duty vehicle data that shows significant platooning opportunities currently exist, suggesting a slightly invasive network of distributed controllers, such as the one proposed in this paper, can yield considerable savings.

A GENETIC ALGORITHM-BASED APPROACH TO SOLVE CARPOOL SERVICE PROBLEM IN CLOUD COMPUTING

HUANG, SHIH-CHIA; JIAU, MING-KAI; LIN, CHIH-HSIANG

Traffic congestion has been a serious problem in many urban areas around the world. Carpooling is one of the most effective solutions to traffic congestion. It consists of increasing the occupancy rate of cars by reducing the empty seats in these vehicles effectively. In this paper, an advance carpool system is described in detail, and is called as the intelligent carpool system, which provides the carpoolers use the carpool services via the smart handheld device anywhere and at any time. The carpool service agency in the intelligent carpool system is integrated with the abundant geographical, traffic and societal information, and used to manage requests. For the help of coordinating the ride-matches via the carpool service agency, we apply the genetic algorithm to propose the Genetic-based Carpool Route and Matching algorithm for this multi-objective optimization problem called Carpool Service Problem. The experimental section shows that the proposed Genetic-based Carpool Route and Matching algorithm is compared with two single-point methods: the Random-Assignment Hill Climbing algorithm and the Greedy-Assignment Hill Climbing algorithm on real-world scenarios. Use of the Genetic-based Carpool Route and Matching algorithm was proved to result in the superior results involving the optimization objectives of carpool service problem than other algorithms. Furthermore, our Genetic-based Carpool Route and Matching algorithm operates with significantly a small amount of computational complexity to response the match results in the reasonable time, and the processing time is further reduced by the termination criteria of early stop.

A MEASUREMENT-BASED STOCHASTIC MODEL FOR HIGH-SPEED RAILWAY CHANNELS

HE, RUISI; AI, BO; ZHONG, ZHANGDUI; MOLISCH, ANDY; CHEN, RUIFENG; YANG, YAOQING

The high-speed railway (HSR) propagation channel has a significant impact on the design and performance analysis of wireless railway control systems. This paper derives a stochastic model for the HSR wireless channel at 930 MHz. The model is based on a large number of measurements in 100 cells using a practically deployed and operative communication system. We use the Akaike Information Criterion (AIC) to select the distribution of the parameter distributions, including the variations from cell to cell. The model incorporates the impact of directional base station (BS) antennas, includes several previously investigated HSR deployment scenarios as special cases, and is parameterized for practical HSR cell sizes, which can be several kilometers. The proposed model provides a consistent prediction of the propagation in HSR environments and allows a straightforward and timesaving implementation for simulation.

A MEMORY-EFFICIENT ARCHITECTURE OF FULL HD AROUND VIEW MONITOR SYSTEMS

JEON, BYEONGCHAN; PARK, GYURO; LEE, JUNSEOK; YOO, SUNGJOO; JEONG, HONG

The around view monitor (AVM) is one of the representative features of smart vision systems adopted in various application areas, e.g. advanced driver assistance systems. The design of AVM systems with full HD-level resolution presents significant technical challenges. In particular, a high memory performance is required to process full HD images obtained from multiple cameras. Specifically, a full HD AVM system requires a high memory bandwidth (six times higher than D1 image-based systems), and is characterized by a significant amount of single-writes, which degrades the effective performance of modern DRAM. To address these problems, two methods are proposed in this paper. The first method reduces the required memory bandwidth by storing in the memory only the input pixel data that will be used in the final processing step, and the second improves the single-write performance of a DRAM subsystem by DRAM-aware data mapping. The effectiveness of the proposed methods is proved by designing an AVM system incorporating FPGAs and DDR2-200 SDRAMs. The proposed methods reduce the memory bandwidth requirement by 53%, allowing a full HD AVM system to run at over 24 fps.

A NOVEL ALGORITHM FOR CRASH DETECTION UNDER GENERAL ROAD SCENES USING CRASH PROBABILITIES AND AN INTERACTIVE MULTIPLE MODEL PARTICLE FILTER

KIM, TAEWUNG; JEONG, HYUN-YONG

Driver inattention causes the majority of vehicular crashes, and these accidents produce extensive economic and social costs as well as injuries and fatalities. Thus, the development of imminent crash detection systems is one of the most important issues in automotive safety. Various crash detection algorithms have been proposed, but the coverage of these algorithms has been limited to one or two crash scenarios. To widen the coverage of crash detection systems to include various crash modes, driver behaviors that are dependent on road scenes and vehicle dynamics should be considered. This study proposed an algorithm for detecting an imminent collision in general road scenes. The proposed algorithm consists of crash probability data generated from Monte Carlo simulations that consider driver behavior and vehicle dynamics, a tracking algorithm that uses an interactive multiple-model particle filter, and a threat assessment algorithm that estimates crash probabilities. To reduce nuisance and false-positive alarms, the algorithm discriminated between normal and dangerous road scenes, and a point-of-no-return was detected using three driver models that addressed different levels of driver input. The performance of the proposed algorithm was evaluated under three scenarios, and it successfully discriminated between collision and near-miss cases and adjusted warning times depending on the road scenes. It is expected that the proposed algorithm would have good driver acceptability based on the results of the near-miss cases. The proposed algorithm can be used as an

integrated crash detection algorithm for crash warning, avoidance, and mitigation purposes while incorporating tracking information from multiple sources.

A NOVEL APPROACH FOR VEHICLE INERTIAL PARAMETER IDENTIFICATION USING A DUAL KALMAN FILTER

HONG, SANGHYUN; LEE, CHANKYU; BORRELLI, FRANCESCO; HEDRICK, KARL

This paper proposes a novel algorithm to identify three inertial parameters: sprung mass, yaw moment of inertia, and longitudinal position of the center of gravity. First, a four-wheel nonlinear vehicle model with roll dynamics is presented. The model is used by a dual unscented Kalman filter to simultaneously identify the inertial parameters and the vehicle state. A local observability analysis on the nonlinear vehicle model is used to activate and de-activate different modes of the proposed algorithm. Extensive CarSim simulations and experimental tests show the performance and robustness of the proposed approach on a flat road with a constant tire-road friction coefficient.

A NOVEL CENTRALIZED TDMA-BASED SCHEDULING PROTOCOL FOR VEHICULAR NETWORKS

ZHANG, RONGQING; CHENG, XIANG; YANG, LIUQING; SHEN, XIA; JIAO, BINGLI

In this paper, we propose a novel centralized TDMAbased scheduling protocol for practical vehicular networks based on a new weight-factor-based scheduler. The RSU, as a centralized controller, collects the channel state information and the individual information of the communication links within its communication coverage and calculates their respective scheduling weight factors, based on which the scheduling decisions are made by the RSU. Our proposed scheduling weight factor mainly consists of three parts, namely the channel quality factor, the speed factor, and the access category (AC) factor. In addition, a resource reusing mode among multiple V2V links is permitted if the distances between every two central-vehicles of these V2V links are larger than a predefined interference interval. Compared with the existing MAC protocols in vehicular networks, the proposed centralized TDMA-based scheduling protocol can significantly improve the network throughput and can be easily incorporated into practical vehicular networks.

A NOVEL ELECTRIC VEHICLE FOR SMART INDOOR MOBILITY

BIANCHESSI, ANDREA; ONGINI, CARLO; BONIOLO, IVO; ALLI, GIOVANNI; SPELTA, CRISTIANO; TANELLI, MARA; SAVARESI, SERGIO

This paper presents the design of the vehicle platform and of the related control system of an innovative electric vehicle tailored to indoor personal mobility. The vehicle is suitable for the transportation of a single passenger or small loads. It has no handlebars: therefore, the rider stands in an upright position and controls the vehicle direction via the combined use of a smartphone and of weight balancing. Specifically, the inertial sensors on-board of the smartphone allow commanding the vehicle motion, and two metal insoles equipped with pressure sensors allow gathering the user's weight distribution in realtime to issue the steering commands. The work presents all the development phases, characterized by a co-design of the vehicle mechanics and electronic systems that makes the motion control problem more easily manageable than that of comparable existing mobility solutions.

A STUDY OF TRUCK PLATOONING INCENTIVES USING A CONGESTION GAME

FAROKHI, FARHAD; JOHANSSON, KARL

We introduce an atomic congestion game with two types of agents, cars and trucks, to model the traffic flow on a road over various time intervals of the day. Cars maximize their utility by finding a trade-off between the time they choose to use the road, the average velocity of the flow at that time, and the dynamic congestion tax that they pay for using the road. In addition to these terms, the trucks have an incentive for using the road at the same time as their peers because they have platooning capabilities, which allow them to save fuel. The dynamics and equilibria of this game-theoretic model for the interaction between car traffic and truck platooning incentives are investigated. We use traffic data from Stockholm to validate parts of the modeling assumptions and extract reasonable parameters for the simulations. We use joint strategy fictitious play and average strategy fictitious play to learn a pure strategy Nash equilibrium of this game. We perform a comprehensive simulation study to understand the influence of various factors, such as the drivers' value of time and the percentage of the trucks that are equipped with platooning devices, on the properties of the Nash equilibrium.

A VALIDATION STUDY ON A SUBJECTIVE DRIVING-WORKLOAD PREDICTION TOOL

HWANG, YOON SOOK; YOON, DAESUB; KIM, HYUNSUK; KIM, KYONG-HO

A variety of methods used to measure a driver’s workload does not include information such as the driver’s characteristics and attitudes. A subjective driving-workload prediction tool (DWPT) was developed to overcome this limitation. The purpose of this study is to validate the DWPT, which is composed of three sub factors: the Situational Inadaptability, Risk-Taking Personality, and the Interpersonal Inadaptability. For this, we conducted the driving-simulator experiment to gather the drivers’ driving behaviors. The driving path scenario was included a various driving tasks. Thirty male drivers participated in this study. The analysis results showed that a driver’s predicted score of subjective driving-workload had a positive or negative relation to their workload-related driving behaviors such as the operation of the indicator/steering/gas pedal and gaze behaviors. In particular, two sub factors, the risk-taking personality and the interpersonal inadaptability, were more closely related to their driving behaviors than the total predicted subjective driving-workload and situational inadaptability sub-factor. These results suggest that a DWPT could be used to predict the drivers’ subjective driving-workload instead of measuring the driving performance or self-reporting questionnaire. And this would be expected to be available on the area of the ADAS (Advanced Driver Assistance System) and drivers’ safety industry.

ACCURATE AND INTERPRETABLE BAYESIAN MARS FOR TRAFFIC FLOW PREDICTION

XU, YANYAN; KONG, QING-JIE; KLETTE, REINHARD; LIU, YUNCAI

Current research on traffic flow prediction mainly concentrates on generating accurate prediction results based on intelligent or combined algorithms but ignores the interpretability of the prediction model. While in practice, the interpretability of the model is equally important for traffic managers to realize which road segment in the road network will affect the future traffic state of the target segment in a specific time interval, and when such an influence is expected to happen. In this paper, an interpretable and adaptable spatio-temporal Bayesian multivariate adaptive-regression splines (ST-BMARS) model is developed to predict short-term freeway traffic flow accurately. The parameters in the model are estimated in the way of Bayesian inference and the optimal models are obtained using a Markov chain Monte Carlo (MCMC) simulation. In order to investigate the spatial relationship of the freeway traffic flow, all of the road segments on the freeway are taken into account for the traffic prediction of the target road segment. In our experiments, actual traffic data collected from a series of observation stations along freeway I-205 in Portland are used to evaluate the performance of the model. Experimental results indicate that the proposed interpretable ST-BMARS model is robust and can generate superior prediction accuracy in contrast with the temporal

MARS model, the parametric model ARIMA, the state-of-the-art seasonal ARIMA model, and the kernel method support vector regression.

AN EFFICIENT VISIBILITY ENHANCEMENT ALGORITHM FOR ROAD SCENES CAPTURED BY INTELLIGENT TRANSPORTATION SYSTEMS

HUANG, SHIH-CHIA; CHEN, BO-HAO; CHENG, YI-JUI

The visibility of images of outdoor road scenes will generally become degraded when captured during inclement weather conditions. Drivers often turn on the headlights of their vehicles, and streetlights are often activated, resulting in localized light sources in images capturing road scenes in these conditions. Additionally, sandstorms are also weather events that are commonly encountered when driving. In sandstorms, atmospheric sand has a propensity to irregularly absorb specific portions of spectrum, thereby causing color-shift problems in the captured image. Traditional state-of-the-art restoration techniques are unable to effectively cope with these hazy road images that feature localized light sources or color-shifts problems. In response, we present a novel and effective haze removal approach to remedy problems caused by localized light sources and color-shifts, which thereby achieves superior restoration results for single hazy images. The performance of the proposed method has been proved through quantitative and qualitative evaluation. Experimental results demonstrate that the proposed haze removal technique can recover scene radiance more effectively while demanding less computational cost than can traditional state-of-the-art haze removal techniques.

AN INTEGRATED VEHICLE NAVIGATION SYSTEM UTILIZING LANE DETECTION AND LATERAL POSITION ESTIMATION SYSTEMS IN DIFFICULT ENVIRONMENTS FOR GPS

ROSE, CHRISTOPHER; BRITT, JORDAN; ALLEN, JOHN; BEVLY, DAVID

A navigation filter combines measurements from sensors currently available on vehicles - Global Positioning System (GPS), an inertial measurement unit (IMU), camera, and light detection and ranging (lidar) - for achieving lane level positioning in environments where standalone GPS can suffer or fail. Measurements from the camera and lidar are used in two lane detection systems, and the calculated lateral distance (to the lane markings) estimates of both lane detection systems are compared with centimeter level truth to show decimeter level accuracy. The navigation filter uses the lateral distance measurements from the lidar and camera-based systems with a known waypoint-based map to provide global measurements for use in a GPS/INS system. Experimental results show that the inclusion of lateral distance measurements and a height constraint from the map creates a fully observable system even with only two satellite observations and as such greatly enhances the robustness of the integrated system over GPS/INS alone. Various scenarios are presented which affect the navigation filter including satellite geometry, number of satellites, and loss of lateral distance measurements from the camera and lidar systems.

AN OFF-LINE FRAMEWORK FOR HANDLING AUTOMATIC PASSENGER COUNTING RAW DATA

BARABINO, BENEDETTO; DI FRANCESCO, MASSIMO; MOZZONI, SARA

Knowledge of ridership data on bus routes is pivotal for the quality and the efficient operational planning of public transport companies. Automatic Passenger Counting can represent a powerful resource for supporting this activity, because it can provide a databank of accurate counts. However, relevant challenges, such as the matching of data to the bus stop, data validation, tackling anomalies, and building intelligible performance reports, must be faced in order to make Automatic Passenger Counting data a mainstream source of information. This paper proposes an off-line

framework for addressing these challenges. In order to illustrate a possible application of the framework, its use for setting bus frequencies is investigated. The results are represented by easy-to-read control dashboards made up with tables and graphs. The methodology is tested experimentally with data records provided by the bus operator CTM in Cagliari (Italy). Finally, we discuss the implications on service rearrangement.

AN OPTIMAL VELOCITY PLANNING SCHEME FOR VEHICLE ENERGY EFFICIENCY THROUGH PROBABILISTIC PREDICTION OF TRAFFIC SIGNAL TIMING

MAHLER, GRANT; VAHIDI, ARDALAN

The main contribution of this paper is the formulation of a predictive optimal velocity planning algorithm that uses probabilistic traffic Signal Phase And Timing (SPAT) information to increase a vehicle's energy efficiency. We introduce a signal phase prediction model which uses historically-averaged timing data and real-time phase data to determine the probability of green for upcoming traffic lights. In an optimal control framework, we then calculate the best velocity trajectory that maximizes the chance of going through greens. Case study results from a multi-signal simulation indicate that energy efficiency can be increased with probabilistic timing data and real-time phase data. Monte-Carlo simulations are used to confirm that the case study results are valid, on average. Finally, simulated vehicles are driven through a series of traffic signals, using recorded data from a real-world set of traffic-adaptive signals, to determine the applicability of these predictive models to various types of traffic signals.

ARTIFICIAL CO-DRIVERS AS A UNIVERSAL ENABLING TECHNOLOGY FOR FUTURE INTELLIGENT VEHICLES AND TRANSPORTATION SYSTEMS

DA LIO, MAURO; BIRAL, FRANCESCO; BERTOLAZZI, ENRICO; GALVANI, MARCO; BOSETTI, PAOLO; WINDRIDGE, DAVID; SAROLDI, ANDREA; TANGO, FABIO

This position paper introduces the concept of artificial "co-drivers" as an enabling technology for future intelligent transportation systems. In the first section, the design principles of co-drivers are in-troduced and framed within general human-robot interactions. Several contributing theories and technologies are reviewed, specifically those relating to relevant cognitive architectures, human-like sensory-motor strategies and the emulation theory of cognition. In the second section we present the co-driver developed for the EU project interactIVe as an example instantiation of this notion, demonstrating how it conforms to the above guidelines. We also present substantive experimental results and clarify the limitations and performance of the current implementation. In the last section we analyze the impact of the co-driver technology. In particular, we identify a range of application fields, showing how it constitutes a universal enabling technology for both smart vehicles and cooperative systems, and naturally sets-out a program of future research.

AUTOMATED ROAD INFORMATION EXTRACTION FROM MOBILE LASER SCANNING DATA

GUAN, HAIYAN; LI, JONATHAN; YU, YONGTAO; CHAPMAN, MICHAEL; WANG, CHENG

This paper presents a survey of literature about road-feature extraction, giving a detailed description of a mobile laser scanning (MLS) system (RIEGL VMX-450) for transportation-related applications. The paper describes the development of automated algorithms for extracting road features (road surfaces, road markings, and pavement cracks) from MLS point cloud data. The proposed road-surface extraction algorithm detects road curbs from a set of profiles that are sliced along vehicle trajectory data. Based on segmented road-surface points, we create geo-referenced feature (GRF) images and develop two algorithms, respectively, for extracting (1) road markings with high retro-reflectivity and (2)

cracks containing low contrast with their surroundings, low signal-noise-ratio, and poor continuity. A comprehensive comparison illustrates satisfactory performance of the proposed algorithms and concludes that MLS is a reliable and cost effective alternative for rapid road inspection.

AUTOMATED TEST APPROACH BASED ON ALL PATHS COVERED OPTIMAL ALGORITHM AND SEQUENCE PRIORITY SELECTED ALGORITHM

ZHENG, WEI; LIANG, CI; WANG, RUI; KONG, WEIJIE

A timely and complete test is an important factor to assure the functionality and safety of the railway signal system before it is put into service. With the development of rail transportation in China, the traditional semi-automatic test methods cannot satisfy the timely and complete test requirements any longer. This paper proposes an automated model-based test method. Firstly, Colored Petri Net (CPN) is used as a formal language to describe the system specification; Secondly, All Paths Covered Optimal Algorithm (APCO) and the Sequence Priority Selected Algorithm (SPS) are proposed to generate the test cases and sequences automatically. Thirdly, taking the typical Radio Blocking Center (RBC) handover scenario as an example, the generated test cases and sequences are applied into the RBC functionality test platform. The testing result validated the feasibility and efficiency of the proposed automated test method. Compared with the Random-walk based test sequence generation (RW-TSG) algorithm, the repeatability rate of the generated test sequences is reduced by 46%. The test sequences can cover all generated test cases, and the cases can cover all the related criteria in CTCS- 3 Train Control System Function Requirements Specification (FRS).

AUTOMATIC PARALLEL PARKING IN TINY SPOTS: PATH PLANNING AND CONTROL

VOROBIEVA, HELENE; MINOIU ENACHE, NICOLETA; GLASER, SÉBASTIEN; MAMMAR, SAID

This paper presents the automatic parallel parking for a passenger vehicle with a highlight on the path planning method and on the experimental results. The path planning method consists in two parts. First, the kinematic model of the vehicle, with corresponding geometry, is used to create a path to park the vehicle in one or more maneuvers if the spot is very narrow. This path is constituted of circle arcs. Secondly this path is transformed in a continuous-curvature path using clothoid curves. In order to execute the generated path, control inputs for steering angle and longitudinal velocity depending on the traveled distance are generated. Therefore, the traveled distance and the vehicle pose during a parking maneuver are estimated. Finally, the parking performance is tested on a prototype vehicle.

BLUETOOTH VEHICLE TRAJECTORIES BY FUSING BLUETOOTH AND LOOPS: MOTORWAY TRAVEL TIME STATISTICS

BHASKAR, ASHISH; QU, MING; CHUNG, EDWARD

Loop detectors are widely used on the motorway networks where they provide point speed and traffic volumes. Models have been proposed for temporal and spatial generalization of speed for average travel time estimation. Advancement in technology provides complementary data sources such as Bluetooth MAC Scanner (BMS), detecting the MAC ID of the Bluetooth devices transported by the traveller. Matching the data from two BMS stations provides individual vehicle travel time. Generally, on the motorways loops are closely spaced, whereas BMS are placed few kilometres apart. In this research, we fuse BMSs and loops data to define the trajectories of the Bluetooth vehicles. The trajectories are utilised to estimate the travel time statistics between any two points along the motorway. The

proposed model is tested using simulation and validated with real data from Pacific motorway, Brisbane. Comparing the model with the linear interpolation based trajectory provides significant improvements.

CHAINCLUSTER: ENGINEERING A COOPERATIVE CONTENT DISTRIBUTION FRAMEWORK FOR HIGHWAY VEHICULAR COMMUNICATIONS

ZHOU, HAIBO; LIU, BO; LUAN, TOM~HAO; HOU, FEN; GUI, LIN; LI, YING; YU, QUAN; SHEN, XUEMIN

The recent advances in wireless communication techniques have made it possible for fast-moving vehicles to download data from the roadside communications infrastructure (e.g., IEEE 802.11b Access Point), namely Drive-thru Internet. However, due to the high mobility, harsh and intermittent wireless channels, the data download volume of individual vehicle per drive-thru is quite limited as observed in real-world tests. This would severely restricts the service quality of upper-layer applications, such as file download and video streaming. On addressing this issue, in this work, we propose ChainCluster, a cooperative Drive-thru Internet scheme. ChainCluster selects appropriate vehicles to form a linear cluster on the highway. The cluster members then cooperatively download the same content file, with each member retrieving one portion of the file, from the roadside infrastructure. With cluster members consecutively driving through the roadside infrastructure, the download of a single vehicle is virtually extended to that of a tandem of vehicles, which accordingly significantly enhances the probability of successful file download. With a delicate linear cluster formation scheme proposed and applied, in this work we first develop an analytical framework to evaluate the data volume that can be downloaded using cooperative drive-thru. Using simulations, we then verify the performance of ChainCluster and show that our analysis can match the simulations well. Lastly, we show that ChainCluster can outperform that of the typical studied clustering schemes, and provide general guidance for cooperative content distribution in highways vehicular communications.

CHALLENGES TOWARDS WIRELESS COMMUNICATIONS FOR HIGH-SPEED RAILWAY

AI, BO; CHENG, XIANG; KÜRNER, THOMAS; ZHONG, ZHANGDUI; KE, GUAN; HE, RUISI; XIONG, LEI; MATOLAK, DAVID; MICHELSON, DAVID; RODRIGUEZ, CESAR

High-speed railway (HSR) brings convenience to peoples' lives and is generally considered as one of the most sustainable developments for ground transportation. One of the important parts of HSR construction is the signaling system, also called the "operation control system," where wireless communications play a key role in the transmission of train control data. We discuss in detail the main differences in scientific research for wireless communications between the HSR operation scenarios and the conventional public land mobile scenarios. The latest research progress in wireless channel modeling in viaducts, cuttings and tunnels scenarios are discussed. The characteristics of non-stationary channel, the LOS sparse and LOS-MIMO channel, which are the typical channels in HSR scenarios, are analyzed. Some novel concepts such as composite transportation and key challenging techniques such as train to train communication, vacuum maglev train techniques, the security for HSR, the fifth generation (5G) wireless communications related techniques for future HSR development for safer, more comfortable and more secure HSR operation are also discussed.

CLOUD-BASED VELOCITY PROFILE OPTIMIZATION FOR EVERYDAY DRIVING: A DYNAMIC PROGRAMMING BASED SOLUTION

OZATAY, ENGIN; ONORI, SIMONA; WOLLAEGER, JAMES; OZGUNER, UMIT; RIZZONI, GIORGIO; FILEV, DIMITAR; MICHELINI, JOHN; DI CAIRANO, STEFANO

Driving style, road geometry, and traffic conditions have significant impact on the vehicle fuel economy. In general, drivers are not aware of the optimal velocity profile for a given route. Indeed, the global optimal velocity trajectory depends on many factors and its calculation requires intensive computations. In this study, we discuss the optimization of the speed trajectory to minimize fuel consumption and communicate it to the driver. With this information, the driver can adjust his/her speed profile to reduce the overall fuel consumption. We propose to perform the computation intensive calculations on a distinct computing platform called the "Cloud". In our approach, the driver sends the information of the intended travel destination to the cloud. In the cloud the server generates a route, collects the associated traffic and geographical information and solves the optimization problem by a spatial domain dynamic programming (DP) algorithm which utilizes accurate vehicle and fuel consumption models to determine the optimal speed trajectory along the route. Then, the server sends the speed trajectory to the vehicle where it is communicated to the driver. We tested the approach on a prototype vehicle equipped with a visual interface mounted on the dash of a test vehicle. The test results show 5%-15% improvement in fuel economy depending on the driver and route without significant effect on the travel time. Although the current research implements the speed advisory system (SAS) in a conventional vehicle, the solution is generic and it is applicable to any kind of powertrain structure.

DATA DISSEMINATION IN VANETS: A SCHEDULING APPROACH

SHEN, XIA; CHENG, XIANG; YANG, LIUQING; ZHANG, RONGQING; JIAO, BINGLI

Data dissemination is a promising application for the vehicular network. Existing data dissemination schemes generally are built upon some random access protocol, which results in the unavoidable collision problem. In order to address this problem, we design a novel data dissemination strategy from the scheduling perspective in this paper. A data dissemination scheduling framework is then proposed. In the proposed framework, the main challenge is how to assign the transmission opportunity to nodes with maximum dissemination utility and to avoid the collision problem. We then propose a novel and practical relay selection strategy, and adopt the space time network coding (STNC) with low detection complexity and space-time diversity gain to improve the dissemination efficiency. Compared with the random access dissemination such as CodeOn-Basic and the non-cooperative transmission, our proposed data dissemination strategy performs better in terms of the dissemination delay. In addition, the proposed strategy works even better in the dense network than the sparse scenario, benefitting from the space-time diversity gain of STNC and no-collision transmissions. This is on the sharp contrary of the CodeOn-Basic method.

DEDUCTION OF PASSENGERS' ROUTE CHOICES FROM SMART CARD DATA

VAN DER HURK, EVELIEN; KROON, LEO; MARÓTI, GÁBOR; VERVEST, PETER

Deducing passengers' route choices from smart card data provides public transport operators with the opportunity to evaluate and improve their passenger service. Especially in the case of disruptions, when traditional route choice models may not be valid, this is an advantage. This paper proposes a method for deducing the chosen route of passengers based on smart card data, and validates this method on a real life data set. The method deduces the correct route for about 95% of the journeys per day in our validation sample, also in case of disruptions. Moreover, it is shown how this method can be used to analyze and evaluate passenger service by a case study based on a real life data set of Netherlands Railways, the largest passenger railway operator in the Netherlands.

DEVELOPING A BODY SENSOR NETWORK TO DETECT EMOTIONS DURING DRIVING

REBOLLEDO-MENDEZ, GENARO; REYES, ANGELICA; PASZKOWICZ, SEBASTIAN; DOMINGO, MARI CARMEN; SKRYPCHUK, LEE

Emerging applications using body sensor networks (BSN) constitute a new trend in car safety. However, the integration of heterogeneous body sensors with vehicular ad hoc networks poses a challenge, especially for the detection of human behavioral states that may impair driving. This paper proposes a detector of human emotions, of which tiredness and stress (tension) could be related to traffic accidents. We present an exploratory study demonstrating the feasibility of detecting one emotional state in real time using a BSN. Based on these results, we propose middleware architecture able to detect emotions which can be communicated via the on-board unit of a vehicle with city emergency services, vehicular ad hoc networks, and roadside units aimed at improving the driver's experience as well as at guaranteeing better security measures for the car driver.

DISCOVERING REGIONS WHERE USERS DRIVE INEFFICIENTLY ON REGULAR JOURNEYS

CORCOBA-MAGANA, VICTOR; MUNOZ-ORGANERO, MARIO

In this paper, we propose a mechanism to optimize the fuel consumption on regular routes. The idea is to find out in which areas a driver usually realizes inefficient actions from the point of view of energy consumption. The aim is to alert the user in advance in order to adjust the vehicle speed or change gear, avoiding inefficient driving. Unlike other proposals, this solution does not require the driver to change the route in order to save fuel. To detect inefficient areas, the system uses vehicle telemetry: acceleration, deceleration, engine speed, engine load and vehicle speed. A fuzzy logic system determines whether the driver drove efficiently or not in a region. Then, when the driver drives in the same route, the system predicts if the driver will return to a similar inefficient driving pattern in the nearby region. If the probability is high, the system warns the user. Therefore, the driver can take the appropriate action. The results show that the system reduces the fuel consumption by 7.33% on average and even, in certain cases, the fuel saving is more than 10%.

DISTRIBUTED CONSENSUS STRATEGY FOR PLATOONING OF VEHICLES IN THE PRESENCE OF TIME VARYING HETEROGENEOUS COMMUNICATION DELAYS

DI BERNARDO, MARIO; SALVI, ALESSANDRO; SANTINI, STEFANIA

The aim of this paper is to analyze and solve platooning by treating it as the problem of achieving consensus in a network of dynamical systems affected by time-varying heterogeneous delays due to wireless communication among vehicles. Specifically, the platoon is represented as a dynamical network where: i) each vehicle, with its own dynamics, is a node; ii) the presence of communication links between neighboring vehicles is represented by the edges, and iii) the structure of the inter-vehicle communication is encoded in the network topology. A distributed control protocol is presented which is acting on every vehicle in the platoon and is composed by two terms: a local action depending on the state variables of the vehicle itself (measured on-board) and an action depending on the information received from the neighboring vehicles through the communication network. Stability of the platoon is proven by using the Lyapunov-Razumikhin theorem . Numerical results are included to confirm and illustrate the theoretical derivation.

DO WE REALLY NEED TO CALIBRATE ALL THE PARAMETERS? VARIANCE-BASED SENSITIVITY ANALYSIS TO SIMPLIFY MICROSCOPIC TRAFFIC FLOW MODELS

PUNZO, VINCENZO; MONTANINO, MARCELLO; CIUFFO, BIAGIO

Automated calibration of microscopic traffic flow model is all but simple for a number of reasons, including the computational complexity of black-box optimization and the asymmetric importance of parameters in influencing model performances. The main objective of this paper, therefore, is to provide a robust methodology to simplify car-

following models that is: to reduce the number of parameters (to calibrate) without sensibly affecting the capability of reproducing reality. To this aim, variance-based sensitivity analysis is proposed and formulated in a 'factor fixing' setting. Among the novel contributions are a robust design of the Monte Carlo framework that also includes, as an analysis factor, the main non-parametric input of car-following models i.e. the leader's trajectory; and a set of criteria for 'data assimilation' in car-following models. The methodology was applied to the Intelligent Driver Model (IDM) and to all the trajectories in the 'reconstructed' NGSIM I80-1 dataset. The analysis unveiled that the leader's trajectory is considerably more important than the parameters in affecting the variability of model performances. Sensitivity analysis also returned the importance ranking of the IDM parameters. Basing on this, a simplified model version with three (out of six) parameters is proposed. After calibrations, the full and the simplified models show comparable performances, in face of a sensibly faster convergence of the simplified version.

DRIVER MONITORING BASED ON LOW-COST 3D SENSOR

PELAEZ, GUSTAVO; GARCÍA FERNÁNDEZ, FERNANDO; JOSÉ MARÍA, ARMINGOL; DE LA ESCALERA, ARTURO

A solution for driver monitoring and event detection based on 3D information from a range camera is presented: The system combines 2D and 3D techniques to provide head pose estimation and regions of interest identification. Based on the captured cloud of 3D points from the sensor and analyzing the 2D projection, the points corresponding to the head are determined and extracted for further analysis. Later head pose estimation with 3 degrees of freedom (euler angles) is estimated based on ICP algorithm. Finally relevant regions of the face are identified and used for further analysis, e.g. event detection and behavior analysis. The resulting application is a 3D driver monitoring system, based on low cost sensors. It represents an interesting tool for human factors researches, allowing automatic study of specific factors and the detection of special event related to the driver e.g. driver drowsiness, inattentions or head pose.

DRIVER WORKLOAD CHARACTERISTICS ANALYSIS USING EEG DATA FROM URBAN ROAD

KIM, HYUNSUK; HWANG, YOON SOOK; YOON, DAESUB; CHOI, WONGEUN; PARK, CHEONG HEE

The main causes of traffic accidents are drivers' human errors such as cognitive, judgment and execution errors. To mitigate drivers' human errors, research on the measurement and quantification of driver workload as well as the development of smart vehicles is needed. Drivers' behavior while driving includes driving straight, turning left or right, U-turns, rapid acceleration, rapid deceleration, changing lanes, etc. To measure and quantify a driving workload, both the subjective workload and the behavior workload caused by varied driving behavior should be taken into account on the basis of understanding the visual, auditory, cognitive and psychomotor characteristics of the driving workload. In this study, we analyze electroencephalogram (EEG) data collected through an urban road driving test. In order to overcome large deviations of EEG values among drivers, we used EEG variation rates instead of raw EEG values. We extracted five kinds of behavior sections from the data: left turn section, right turn section, rapid acceleration section, rapid deceleration section, and lane change section. We then selected a reference section for each of these behavior sections and compared EEG values from the behavior sections to those from the reference sections to calculate the EEG variation rates, after which we made the statistical analysis. The analysis results of this study are being used to explain the cognitive characteristics of a driving workload caused by drivers' behavior in the Human-Vehicle Interface Management System (HVIMS), which will provide information for safe driving by taking into account the driving workload.

DYNAMIC CLASSIFICATION OF TRAFFIC FLOW PATTERNS SIMULATED BY A SWITCHING MULTI-MODE DISCRETE CELL TRANSMISSION MODEL

CELIKOGLU, HILMI BERK

In this paper, a dynamic approach to specify flow pattern variations simulated by a multi-mode macroscopic flow model is followed incorporating the neural network theory to reconstruct real-time traffic dynamics. In order to deal with the noise in and the wide scatter of traffic data, a filtering is applied prior to overall modeling process. Filtered data is dynamically and simultaneously input to neural density estimation and traffic flow modeling processes. Traffic flow is simulated by modifying the cell transmission model in order to explicitly account for flow condition transitions considering wave propagations. Cell-specific flow dynamics are used to determine the mode of prevailing traffic conditions, which are in turn sought to be reconstructed by neural methods. The classification of flow patterns over the fundamental diagram is obtained by considering traffic density as a pattern indicator. The fundamental diagram of speed-density is updated to specify the current corresponding flow pattern. The modified classification returned promising results in capturing sudden changes on test stretch flow patterns that are simulated by the switching multi-mode discrete macroscopic model.

EFFICIENT BI-LEVEL APPROACH FOR URBAN RAIL TRANSIT OPERATION WITH STOP-SKIPPING

WANG, YIHUI; DE SCHUTTER, BART; BOOM, TON J.J. VAN DEN; NING, BIN; TANG (GUEST EDITOR ICIRT 2013), TAO

The train scheduling problem for urban rail transit systems is considered with the aim of minimizing the total travel time of passengers and the energy consumption of the trains. We adopt a model-based approach where the model includes the operation of trains at the terminus and at the stations. In order to adapt the train schedule to the origin-destination dependent passenger demand in the urban rail transit system, a stop- skipping strategy is adopted to reduce the passenger travel time and the energy consumption. An efficient bi-level optimization approach is proposed to solve this train scheduling problem, which actually is a mixed integer nonlinear programming prob- lem. The performance of the new efficient bi-level approach is compared with the existing bi-level approach. In addition, we also compare the stop-skipping strategy with the all-stop strategy. The comparison is performed through a case study inspired by real data from the Beijing Yizhuang line. The simulation results show that the efficient bi-level approach and the existing bi-level approach have a similar performance but the computation time of the efficient bi-level approach is around one magnitude smaller than that of the bi-level approach.

EFFICIENT CLOSED-LOOP MULTIPLE-VIEW REGISTRATION

SHAO, XIAOWEI; SHI, YUN; ZHAO, HUIJING; LI, XUELONG; SHIBASAKI, RYOSUKE

Registering multiple views is an essential and challenging problem for many intelligent transportation applications which employ a mobile sensing platform or consist of multiple stationary sensors. In this study, a novel algorithm is presented for multiple-view registration under a loop closure constraint. Different from most existing methods which use general optimization techniques, our method studies the mechanism of adjusting the poses of views in a loop and provides a highly efficient and accurate solution. We prove that translation vectors can be decoupled if the same point set is used in each view to associate the previous and next views, leading to our solution for such decouplable cases. If this condition does not hold, an exact solution of translation vectors is provided when rotation parameters are given, which results in our iterative solution for general cases by updating rotation and translation alternately. In our method, the effect of the accumulated pose error in a loop can be distributed to all views efficiently through loop factors, and only a few iterations are needed. Most important of all, in each iteration our method has linear computational complexity with respect to the number of views, which is much superior to that of state-of-the-art methods. A series of experiments were conducted, involving simulation of thousands of views and real vehicle-borne

sensing data that include 65,371 point pairs in 352 views. Experimental results show our proposed method is not only stable and highly efficient, but also provides competitive accuracy relative to existing methods.

EFFICIENT ROAD DETECTION AND TRACKING FOR UNMANNED AERIAL VEHICLE

ZHOU, HAILING; KONG, HUI; WEI, LEI; CREIGHTON, DOUG; NAHAVANDI, SAEID

Unmanned Aerial Vehicle (UAV) has wide applications in a variety of fields. Detection and tracking of a specific road in UAV videos plays an important role on automatic UAV navigation, traffic monitoring, ground-vehicle tracking, and also very helpful on constructing road networks for modelling and simulation. In this paper, an efficient road detection and tracking framework in UAV videos is proposed. In particular, a graph-cut based detection approach is given to accurately extract a specified road region during the initialization stage and in the middle of tracking process, and a fast homography-based road tracking scheme is developed to automatically track road areas. The high efficiency of our framework is attributed to two aspects: the road detection is performed only when it is necessary and most work in locating road is done rapidly via very fast homography-based tracking. Experiments are conducted on UAV videos of real road scenes captured by ourselves and downloaded from internet. The promising results indicate the effectiveness of our proposed framework, with the precision of 98.4% and processing 34 frames per seconds for 1046*595 videos on average.

ELECTRIFIED VEHICLES AND THE SMART GRID: THE ITS PERSPECTIVE

CHENG, XIANG; HU, XIAOYA; YANG, LIUQING; HUSAIN, IQBAL; INOUE, KOICHI; KREIN, PHILIP; LEFEVRE, RUSSELL; LI, YAOYU; NISHI, HIROAKI; TAIBER, JOACHIM; WANG, FEIYUE; ZHA, YABING; GAO, WEN; LI, ZHENGXI

The vehicle electrification is envisioned to be a significant component of the forthcoming smart grid. In this article, a smart grid vision of the electric vehicles for the next 30 years and beyond is presented from six perspectives pertinent to intelligent transportation systems: i) vehicles; ii) infrastructure; iii) travellers; iv) systems, operations, scenarios; v) communications; and vi) social, economic, political.

EMERGENCY RAILWAY TRANSPORTATION PLANNING USING A HYPER-HEURISTIC APPROACH

ZHENG, YU-JUN; ZHANG, MIN-XIA; LING, HAI-FENG; CHEN, SHENG-YONG

Railway has played a significant role in disaster relief transportation in China. The paper presents an emergency railway transportation problem, which is to use limited transport capability to meet the urgent relief transportation requirements. We have applied several state-of-the-art evolutionary algorithms (EAs) on a variety of problem instances, but have found that none of them can obtain satisfactory solutions in all cases. To overcome this obstacle, we integrate a set of individual heuristic operators into a hyper-heuristic framework, which performs a stochastic search on the low-level heuristics by using feedback of their performance in the process of problem-solving, and thus yields a high overall performance on different instances. Computational experiments show that the hyper-heuristic exhibits significant advantages over the individual heuristics. The problem model and the hyper-heuristic solution approach has also been successfully applied to the emergency railway transportation in the 2013 Dingxi earthquake, China.

EQUITY-ORIENTED AIRCRAFT COLLISION AVOIDANCE MODEL

REY, DAVID; RAPINE, CHRISTOPHE; DIXIT, VINAYAK; WALLER, TRAVIS

The continuing increase in air travel demand combined with the saturation of air traffic networks lead to recurrent congestion episodes. Amongst the many elements responsible for the escalation of air traffic management costs, we focus particularly on the impact of conflict resolution strategies which arise in congested networks. In air traffic control, a conflict occurs when two or more aircraft fly too close to one another. While many automated conflict resolution methods have been proposed, most of them cannot be integrated without a profound revision of traffic control procedures as they lack interaction with air traffic controllers. Recently, subliminal speed control has been shown to be a promising approach to reduce the impact of air conflicts onto air traffic controllers' workload and potentially improve airspace capacity. From the perspective of airlines however, little has been done to quantify the impact of conflict resolution strategies onto direct operating costs. We address this gap by introducing an innovative formulation for the aircraft collision avoidance problem which integrates the economic profile of flights and promotes equitable solutions. We present a goal programming-based model designed to minimize the deviation from fair solutions during the resolution of potential conflicts. The performance of the model is evaluated using a fuel-equivalent conflict resolution scheme, hence offering a sustainable framework to efficiently and equitably resolve air conflicts.

FEEDBACK-BASED MAINSTREAM TRAFFIC FLOW CONTROL FOR MULTIPLE BOTTLENECKS ON MOTORWAYS

IORDANIDOU, GEORGIA-ROUMPINI; PAPAMICHAIL, IOANNIS; RONCOLI, CLAUDIO; PAPAGEORGIOU, MARKOS

Mainstream traffic flow control (MTFC) enabled via variable speed limits (VSL) has been investigated in previous studies, utilizing various control strategies. In this paper an extended feedback control strategy is proposed for MTFC enabled via VSL, considering multiple bottleneck locations. Feedback-based results are compared to optimal control results for the evaluation of the controller using a validated macroscopic model. The performance of the feedback controller is shown to approach the optimal control results, despite the fact that many practical and safety restrictions are additionally considered by the feedback controller.

HAPTIC STEERING SUPPORT FOR DRIVING NEAR THE VEHICLE'S HANDLING LIMITS; TEST-TRACK CASE

KATZOURAKIS, DIOMIDIS; VELENIS, EFSTATHIOS; HOLWEG, EDWARD; HAPPEE, RIENDER

Abstract— Current vehicle dynamic control systems from simple yaw control to high-end active steering support systems are designed to primarily actuate on the vehicle itself, rather than stimulate the driver to adapt his/her inputs for better vehicle control. The driver though dictates the vehicle's motion, and centralizing him/her in the control loop is hypothesized to promote safety and driving pleasure. Exploring the above statement, the goal of this study is to develop and evaluate a haptic steering support when driving near the vehicle's handling limits (Haptic Support near the Limits; HSNL). The support aims to promote the driver's perception of the vehicle's behaviour and handling capacity (the vehicle's internal model) by providing haptic cues on the steering wheel. The HSNL has been evaluated in a test-track where 17 test subjects drove around a narrow-twisting tarmac circuit, a vehicle (Opel Astra G/B) equipped with a steering system able to provide variable steering feedback torque. The drivers were instructed to achieve maximum velocity through corners, while receiving haptic steering feedback cues related to the vehicle's cornering potentials. The test-track tests led to the conclusion that haptic support reduced drivers' mental and physical demand without affecting their driving performance.

HAZOP STUDY ON CTCS-3 ONBOARD SYSTEM

LI, KAICHENG; YAO, XIAOFEI; CHEN, DEWANG; YUAN, LEI; ZHOU, DATIAN

Safe operation of Chinese Train Control System Level 3 (CTCS-3) is of great significance, particularly with respect to the increasing operational speed and expanding railway networks of the Chinese high-speed railway system, which has drawn deep concern from both customers and strategic makers. Hazard and Operability (HAZOP) study has been recognized as an effective systematic examination to identify any potential problems existing in various industrial processes or operations. This paper presents a process of applying HAZOP study to identify the hazards of CTCS-3 onboard system for the first time, which is composed of two major parts: system models and hazard identification on the examination session. To better reflect the structure and functions of CTCS-3 onboard system, the following models are developed, i.e., reference model, function hierarchical model, state diagram and sequence diagram. To demonstrate the effectiveness of HAZOP study, hazard identification on the basis of functions of the CTCS-3 onboard system as well as a scenario of temporary speed restriction (TSR) are considered and employed. The results indicate that existing hazards can be dug out at express speed, which allows the relevant actions to be proposed and implemented to prevent the hazards from spreading to a wide range in the whole CTCS-3 onboard system.

IMPACT OF IN-VEHICLE DISPLAYS LOCATION PREFERENCES ON DRIVERS' PERFORMANCE AND GAZE

OLAVERRI-MONREAL (GUEST EDITOR HUMAN FACTORS IN INT. VEH.), CRISTINA; HASAN, AHMED; BULUT, JONATHAN; KÖRBER, MORITZ; BENGLER, KLAUS

Advanced Driver Assistance (ADAS) and Driver Information Systems (DIS) do not always comply with the intended driver safety enhancement. Even if they aim to augment the driver's awareness of the surrounding environment, perceiving this information requires the occasional attention diversion from the road, which could lead to a loss of vehicle control if the total eyes-off-road time exceeds the NHTSA recommendation for glances away from the roadway. Additionally, technologies that can be found in other mobile environments, smart phones and tablets are increasingly being integrated into cars, providing a necessary facet of study and continued research in their effects. We addressed this question analyzing differential preferences for the layout of DIS and ADAS compared to existing ones through a card sorting experiment. To validate our data, we additionally studied the drivers performance and gaze with the preferred locations for in-vehicle information through gaze location and speed metrics measurements. Our validation process showed that the time the drivers needed to find the conveyed information in the preferred layout was within the recommended time of the NHTSA Guidelines. Drivers preferences regarding the functional layout of current DIS and ADAS compared to existing ones did not essentially differ from the layouts that are currently on the market. However, including mobile applications and social media in a vehicular context was not considered necessary.

IMPROVING HANDOVER AND DROP-OFF PERFORMANCE ON HIGH SPEED TRAINS WITH MULTI-RAT

LIN, YI-BING; YANG, SHUN-NENG; WU, CHIEN-TING

Provisioning commercial mobile telecommunications service on high speed train (HST) faces several challenges. In particular, when a HST quickly passes through the radio coverage of the base stations, frequent handovers may result in serious communication interruption. Methods such as the hierarchical two-hop (HTH) network and the seamless dual-link handover scheme were proposed to address these challenges. This paper proposes the multiple radio access technology (multi-RAT) to resolve the HST handover issue, which allows the HST to simultaneously connect to two or more heterogeneous mobile networks (e.g., Universal Mobile Telecommunications System (UMTS) and Long Term Evolution (LTE)). With this approach, the handover process can be improved by keeping multiple heterogeneous

network links of the HST at the same time and maintaining the connection through one link during the handover process of the other link. We show that multi-RAT can effectively enhance HST communications by reducing the impact of handover failure. This approach can work together with other solutions such as the dual-link scheme to further enhance the performance of the HST communications.

INCREASING THE REGENERATIVE BRAKING ENERGY FOR RAILWAY VEHICLE

LU, SHAOFENG; WESTON, PAUL; HILLMANSEN, STUART; GOOI, HOAY BENG; ROBERTS (GUEST EDITOR ICIRT2013), CLIVE

Regenerative braking improves the energy efficiency of railway transportation by converting the kinetic energy into the electric energy. This paper proposes a method to apply the Bellman-Ford algorithm to search for the train braking speed trajectory to increase the total regenerative braking energy (RBE) in a blended braking mode with both electric and mechanical braking forces available. The Bellman-Ford (BF) algorithm is applied in a discretized train-state model. A typical suburban train has been modeled and studied under real engineering scenarios involving changing gradients, journey time and speed limits. It is found that the searched braking speed trajectory is able to achieve a significant increase on the RBE in comparison with the constant-braking-rate (CBR) method with only a minor difference on the total braking time. A RBE increment rate of 17.23% has been achieved. Verification of the proposed method using BF has been performed in a simplified scenario with zero gradient and without considering the constraints of braking time and speed limits. Linear Programming (LP) is applied to search for a train trajectory with the maximum RBE and achieves solutions that can be used to verify the proposed method using BF. It is found that it is possible to achieve a near-optimal solution using BF and the solution can be further improved with a more complex search space. The proposed method takes advantage on robustness and simplicity of modeling in a complex engineering scenario where a number of non-linear constraints are involved.

INFERRING THE TRAVEL PURPOSES OF PASSENGER GROUPS FOR BETTER UNDERSTANDING PASSENGERS

LIN, YOUFANG; WAN, HUAIYU; JIANG, RUI; WU, ZHIHAO; JIA, XUGUANG

People usually travel to the same destinations and for the same purposes together with others in groups. Inferring the travel purposes of passenger groups is a very interesting research problem in the field of passenger transport, because it can help us to better understand passengers and should bring about meaningful changes for personalized travel service and decision-making of passenger carriers, organizations and even governments. In this paper, we attempt to solve this problem by utilizing the historical travel records of passengers. To overcome the constraint of the IID assumption of traditional classifiers, we propose a novel iterative classification approach based on the idea of collective inference. First, we construct co-travel networks by extracting social relations between passengers from their historical travel records that are available in carriers' passenger information systems. Then we generate a series of sophisticated features for each passenger group in the context of co-travel networks to capture the link structure information between passengers, and use the overlapping relations between passenger groups to capture the probabilistic dependencies between their labels. Finally we collectively infer the labels of all the groups in an iterative way. Experimental results on a real dataset of passenger travel records in the field of civil aviation demonstrate that our proposed iterative classification approach can efficiently infer the travel purposes of passenger groups.

INFERRING TRAFFIC SIGNAL PHASES FROM TURNING MOVEMENT COUNTERS USING HIDDEN MARKOV MODELS

REISI GAHROOEI, MOSTAFA; WORK, DANIEL

This work poses the problem of estimating traffic signal phases from a sequence of maneuvers. We model the problem as an inference problem on a discrete time hidden Markov model (HMM) where maneuvers are observations and signal phases are hidden states. The model is calibrated from maneuver observations using either the classical Baum–Welch algorithm or a Bayesian learning algorithm. The trained model is then used to infer the traffic signal phases on the dataset via the Viterbi algorithm. When training with the Bayesian learning algorithm, we set the prior distribution as a Dirichlet distribution. We identify the best parameters of the prior distribution for both fixed time and sensor actuated signals using numerical simulations, and employ them in the field experiments. It is shown that when the model is trained by the Bayesian learning method with appropriate prior parameters from the Dirichlet distribution, the inferred phases are more accurate in both numerical and field experiments. Because the best set of prior parameters for a fixed time intersection is different from those for sensor actuated signals, a classification strategy to distinguish between these two types of signals is proposed. The supporting source code and data are available for download at https://github.com/reisiga2/TrafficSignalPhaseEstimation.

INTELLIGENT CARPOOL ROUTING FOR URBAN RIDESHARING BY MINING GPS TRAJECTORIES

HE, WEN; HWANG, KAI; LI, DEYI

To support efficient carpooling service in heavy urban traffic, we propose an intelligent routing scheme based on mining GPS trajectories from shared riders. The carpooling system provides many-to-many services with multiple pickup and dropping points. To join a daily carpooling group, the riders must accept a compromised route that is efficient after merging preferred routes by all qualified riders. We developed three frequency-correlated algorithms for route mining, rider selection and route merging in urban carpool service. Our approach can cope with the traffic dynamics to yield sub-optimal shared route. Our scheme was successfully tested under heavy Beijing traffic over hundreds of riders. We developed performance metrics to measure the service cost and mileage saved. The ultimate goal is to minimize the riding distances and the transportation costs, and thus alleviate the urban traffic jams.

INTELLIGENT TRAIN OPERATION ALGORITHMS FOR SUBWAY BY EXPERT SYSTEM AND REINFORCEMENT LEARNING

YIN, JIATENG; CHEN, DEWANG; LI, LINGXI

Current researches in Automatic Train Operation (ATO) concentrate on optimizing energy-efficient speed profile and designing control algorithms to track the speed profile, which may reduce comfort of passengers, increase energy consumption and restrict the intelligence of train operation. Different from the previous researches, this paper presents two Intelligent Train Operation (ITO) algorithms without using the precise train model information and the offline optimized speed profile. The first algorithm, ITOE is based on Expert system that contains expert rules and a heuristic expert inference method. Then, to minimize energy consumption of train operation online, ITOR algorithm based on Reinforcement Learning (RL) is developed via designing RL policy, reward and value function. From the actual operation data in Yizhuang Line of the Beijing Subway (YLBS), we choose Manual driving data with the best performance as ITOM. Finally, we present some numerical examples to test the ITO algorithms on the ITO simulation platfrom established with actual data. The results indicate that, compared with ITOM, both ITOE and ITOR can improve punctuality and reduce energy consumption on the basis of ensuring comfort. Moreover, ITOR can save about 10% energy-consumption than ITOE. Specifically, ITOR is capable of adjusting the trip time dynamically, even in case of accidents.

INTRA-VEHICLE NETWORKS, A REVIEW

TUOHY, SHANE; GLAVIN, MARTIN; HUGHES, CIARAN; JONES, EDWARD; TRIVEDI, MOHAN; KILMARTIN, LIAM

Automotive electronics is a rapidly expanding area with an increasing number of safety, driver assistance and infotainment devices becoming standard in new vehicles. Current vehicles generally employ a number of different networking protocols to integrate these systems into the vehicle. The introduction of large numbers of sensors to provide driver assistance applications and the associated high bandwidth requirements of these sensors has accelerated the demand for faster and more flexible network communication technologies within the vehicle. This paper presents a comprehensive overview of current research on advanced intra-vehicle networks and identifies outstanding research questions for the future.

LIMITS OF PREDICTABILITY FOR LARGE SCALE URBAN VEHICULAR MOBILITY

LI, YONG; JIN, DEPENG; HUI, PAN; WANG, ZHAOCHENG; CHEN, SHENG

Key challenges in vehicular transportation and communication systems are understanding vehicular mobility and utilising mobility prediction, which are vital for both solving the congestion problem and helping to build efficient vehicular communication networking. Most of the existing works mainly focus on designing algorithms for mobility prediction and exploring utilisation of these algorithms. However, the crucial questions of how much the mobility is predictable and how the mobility predictability can be used to enhance the system performance are still the open and unsolved problems. In this paper, we consider the fundamental problem of the predictability limits of vehicular mobility. By using two large-scale urban city vehicular traces, we propose an intuitive but effective model of areas transition to describe the vehicular mobility among the areas divided by the city intersections. Based on this model, we examine the predictability limits of large scale urban vehicular networks and derive the maximal predictability based on the methodology of entropy theory. Our study finds that about 78% to 99% of the location and 70% of the staying time, respectively, are predicable. Our findings thus reveal that there is a strong regularity in the daily vehicular mobility, which can be exploited in practical prediction algorithm design.

MAGNETOMETER CALIBRATION FOR PORTABLE NAVIGATION DEVICES IN VEHICLES USING A FAST AND AUTONOMOUS TECHNIQUE

WAHDAN, AHMED; GEORGY, JACQUES; ABDELFATAH, WALID F.; NOURELDIN, ABOELMAGD

Using absolute navigation systems (such as Global Navigation Satellite Systems) has proved to be insufficient for indoor navigation, or when navigating in urban canyons; due to multipath and obstruction. This opened the gate widely for sensors-based navigation systems to be used, especially after the development of low-cost micro-electro-mechanical systems (MEMS) sensors. Heading determination is one of the most important aspects for navigation solutions. Magnetometer is a low-cost sensor that can provide an absolute heading from magnetic north by sensing the earth's magnetic field. Magnetometer readings are usually affected by magnetic fields, other than the earth magnetic field, and by other error sources; therefore magnetometer calibration is required. In this paper, a technique is proposed for fast and automatic magnetometer calibration that requires small space coverage. There is no user involvement in the calibration process and there are no required specific movements. The proposed technique performs 3D-space magnetometer calibration using 2D calibration equations with pitch and roll sectors. The 3D-space is divided into group of pitch and roll sectors. Inside each sector, 2D calibration can be performed for the levelled magnetometer readings which makes the calibration process faster and requiring less data. This technique makes the magnetometer useful for determining heading in pseudo-tethered devices, especially when used while driving. Pseudo-tethered navigation devices are tethered at normal operation but they can change their orientation according

to user needs such as portable vehicle navigation devices which can be placed on the dashboard of a vehicle or attached to the wind shield.

MEASURING NETWORK-WIDE TRAFFIC DELAY IN SCHEDULE OPTIMIZATION FOR WORK ZONE PLANNING IN URBAN NETWORKS

ZHENG, HONG; NAVA, ERIC; CHIU, YI-CHANG

In this paper we develop a mathematical decision model and a solution algorithm to prioritize and schedule work zones in the planning process. The model is designed to measure the mutually interacting traffic impact and delay as a result of work zone disruptions in the network. Several construction strategies interested by stakeholders are discussed, including daytime and nighttime construction modes, sequencing precedence, and seasonal variation effect of demand. The method evaluates network-wide traffic delay through a k-shortest path algorithm to analyze divers' behavior of alternative route selection. A numerical example is analyzed on a real-world network to demonstrate the solution quality.

MOBILE TRAFFIC SENSOR ROUTING IN DYNAMIC TRANSPORTATION SYSTEMS

ZHU, NING; LIU, YANG; MA, SHOU-FENG; HE, ZHENGBING

In transportation networks, traditional fixed sensors are used to monitor the operation of transportation systems. However, fixed sensors cannot move once installed. In our study, the motion ability of traffic sensors is introduced to improve the performance of transportation network surveillance. A mobile traffic sensor routing problem is proposed, modeled as a novel vehicle routing problem. A measure of traffic information acquisition benefits is developed and used to gauge the surveillance performance. To solve this mobile sensor routing problem, a hybrid two-stage heuristic algorithm is designed which is based on particle swarm optimization and ant colony optimization. Numerical experiments are conducted. The results show that the mobile traffic sensor has a better network surveillance performance than the fixed sensor in most experimental cases.

MULTI-ROI ASSOCIATION AND TRACKING WITH BELIEF FUNCTIONS: APPLICATION TO TRAFFIC SIGN RECOGNITION

BOUMEDIENE, MOHAMMED; LAUFFENBURGER, JEAN-PHILIPPE; DANIEL, JEREMIE; CUDEL, CHRISTOPHE; OUAMRI, ABDELAZIZ

This paper presents an object tracking algorithm using belief functions applied to vision-based traffic sign recognition systems. This algorithm tracks detected sign candidates over time in order to reduce false positives thanks to data fusion formalization. In the first stage, Regions Of Interest (ROIs) are detected and combined using the Transferable Belief Model semantics. In the second stage, the Local Pignistic Probability algorithm generates the associations maximizing the belief of each pairing between detected ROIs and ROIs tracked by multiple Kalman filters. Finally, the tracks are analyzed to detect false positives. Thanks to a feedback loop between the Multi-ROI Tracker and the ROI detector, the solution proposed reduces false positives by up to 45% while computation time remains very low.

MULTIPLE HUMAN TRACKING BY ITERATIVE DATA ASSOCIATION AND DETECTION UPDATE

WANG, LU; YUNG, N.H.C.; XU, LISHENG

Multiple object tracking is an important task in automated video surveillance. In this paper, we present a multiple human tracking approach that takes the single frame human detection results as input, and associates them to form trajectories while improves the original detection results by making use of reliable temporal information in a closed-loop manner. It works by first forming tracklets, from which reliable temporal information is extracted, and then refining the detection responses inside the tracklets, which also improves the accuracy of tracklets quantities. After that, local conservative tracklets association is performed and reliable temporal information is propagated across tracklets so that more detection responses can be refined. The global tracklet association is done lastly to resolve association ambiguities. Experimental results show that the proposed approach improves both the association and detection results. Comparison with several state-of-the-art approaches demonstrates the effectiveness of the proposed approach.

NEW EFFICIENT REGRESSION METHOD FOR LOCAL AADT ESTIMATION VIA SCAD VARIABLE SELECTION

YANG, BINGDUO; WANG, SHENG-GUO; BAO, YUANLU

This paper focuses on the estimation and variable selection for the local Annual Average Daily Traffic (AADT). The variable selection procedure by smoothly clipped absolute deviation penalty (SCAD) is proposed. It can select significant variables and estimate unknown regression coefficients simultaneously at one step. The estimation algorithm and the tuning parameters selection are presented. The data from Mecklenburg County of North Carolina in 2007 is used for demonstration with our proposed variable selection procedures. The results show that this penalized regression technology improves the local AADT estimation along with satellite information, and it outperforms some other benchmark models.

NIGHTTIME VISIBILITY ANALYSIS AND ESTIMATION METHOD IN PRESENCE OF DENSE FOG

GALLEN, ROMAIN; CORD, AURÉLIEN; HAUTIERE, NICOLAS; DUMONT, ERIC; AUBERT, DIDIER

Compared to daytime, a larger proportion of road accidents happens during nighttime. The altered visibility for the drivers partially explains this situation. It becomes worse when dense fog is present. In this paper, we first define a standard night visibility index, which allows specifying the type of fog an ADAS should recognize. A methodology to detect the presence of night fog and characterize its density in images grabbed by an in-vehicle camera is then proposed. The detection method relies on the visual effects of night fog. A first approach evaluates the presence of fog around the vehicle thanks to the detection of the backscattered veil created by the headlamps. In this aim, a correlation index is computed between the current image and a reference image where fog density is known. It works when the vehicle is alone on a highway without external light sources. A second approach evaluates the presence of fog thanks to the detection of halos around light sources ahead of the vehicle. It works with oncoming traffic and public lighting. Both approaches are illustrated with actual images of fog. Their complementarity makes it possible to envision a complete night fog detection system. If fog is detected, its characterization is achieved by fitting the different correlation indexes with an empirical model. Experimental results show the efficiency of the proposed method. The main applications for such a system are for instance: automation or adaptation of vehicle lights, contextual speed computation and reliability improvement for camera-based systems.

ONLINE COST-SHARING MECHANISM DESIGN FOR DEMAND-RESPONSIVE TRANSPORT SYSTEMS

FURUHATA, MASABUMI; DANIEL, KENNY; KOENIG, SVEN; ORDONEZ, FERNANDO; DESSOUKY, MAGED; BRUNET, MARC-ETIENNE; COHEN, LIRON; WANG, XIAOQING

Demand-responsive transport (DRT) systems provide flexible transport services for passengers that request door-to-door rides in shared-ride mode without fixed routes and schedules. DRT systems have interesting coordination challenges. For example, one has to design cost-sharing mechanisms for offering fare quotes to potential passengers so that all passengers are treated fairly. The main issue is how the operating costs of the DRT system should be shared among the passengers (given that different passengers cause different amounts of inconvenience to the other passengers), taking into account that DRT systems should provide fare quotes instantaneously without knowing future ride requests. We determine properties of cost-sharing mechanisms that make DRT systems attractive to both shuttle providers and passengers, namely online fairness, immediate response, budget balance and ex-post incentive compatibility. We propose a novel cost-sharing mechanism, called Proportional Online Cost Sharing (POCS), that provides passengers with upper bounds on their fares immediately after their arrivals, allowing them to accept their fare quotes or drop out. We examine how POCS satisfies these properties in theory and computational experiments.

ONLINE PREDICTION OF DRIVER DISTRACTION BASED ON BRAIN ACTIVITY PATTERNS

WANG, SHOUYI; ZHANG, YIQI; WU, CHANGXU; DARVAS, FELIX; CHAOVALITWONGSE, WANPRACHA

This paper presents a new computational framework for early detection of driver distractions (map-viewing) using brain activity measured by electroencephalographic (EEG) signals. Compared to most studies in the literature, which are mainly focused on classification of distracted and non-distracted periods, this study proposes a new framework to prospectively predict the start and the end of a distraction period, defined by map-viewing. The proposed prediction algorithm was tested on a dataset of continuous EEG signals recorded from 24 subjects. During the EEG recordings, the subjects were asked to drive from an initial position to a destination using a city map in a simulated driving environment. The overall accuracies for the prediction of the start and the end of map-viewing were 81% and 70%, respectively. The experimental results demonstrated that the proposed algorithm can predict the start and end of map-viewing with a relatively high accuracy and can be generalized to individual subjects. The outcome of this study has a high potential to improve the design of future intelligent navigation systems. Prediction of the start of map-viewing can be used to provide route information based on a driver's needs and consequently avoid map-viewing activities. Prediction of the end of map-viewing can be used to provide warnings for potential long map-viewing durations. Further development of the proposed framework and its applications in driver distraction predictions are also discussed.

OPTIMAL SCHEDULING FOR HIGHWAY EMERGENCY REPAIRS UNDER LARGE-SCALE SUPPLY-DEMAND PERTURBATIONS

YAN, SHANGYAO; CHU, JAMES; SHIH, YU-LIN

In this study, we develop a model for emergency repair problems under large-scale supply-demand perturbations. The model formulation proposed in this study has the following key features. First, a novel time-space network flow technique is adopted to generate detailed schedules for repair teams and allow dynamic updates of the network due to perturbations. Second, the original schedules prior to the perturbations are considered by controlling the total difference between the original schedule and the adjusted schedule. Third, to reduce computational complexity the model is formulated with different levels of detail (individual teams versus a team group). The model is also formulated as a special mixed-integer network flow problem with side constraints, which is characterized as NP-hard. An ant colony system based hybrid global search algorithm is developed to efficiently solve large-scale problems. To test how well the model formulation and the heuristic algorithm may perform in actual operations, we conduct a case study using actual data from the 1999 Chi-Chi earthquake in Taiwan. The results show that the proposed model and solution algorithm perform very well and thus have great potential for assisting with the making of emergency repair decisions in the event of disasters given large-scale perturbations in supply and demand.

OPTIMIZATION OF EVACUATION TRAFFIC MANAGEMENT WITH INTERSECTION CONTROL CONSTRAINTS

FU, HUI; PEL, ADAM; HOOGENDOORN, SERGE

Route guidance instructions are crucial in the implementation of an evacuation plan. Considering travelers' compliance with these instructions is controllable by adopting traffic management at intersections, a simulation-based framework for optimizing traffic management is presented with the objective function of maximizing evacuation efficiency with uncertain budget constraint. A comprehensive case study illustrates the sensitivity of traffic simulation model with traffic demand, duration of hazard, and traffic management. The specific analyses on network performances provide some practical insights. In reality, mandatory traffic management is unnecessary as the optimal instructions are unavailable. Well-staged departure and appropriate enforcement of traffic management at intersections are recommended, which contribute to extensive distribution of traffic flow and then high efficient evacuation.

PARALLEL MONITORING FOR THE NEXT GENERATION OF TRAIN CONTROL SYSTEMS

WANG, JUNFENG; WANG, JUNGANG; ROBERTS (GUEST EDITOR ICIRT2013), CLIVE; CHEN (GUEST EDITOR ICIRT 2013), LEI

Railway accidents, such as collisions, conflicts and derailments, are still happening, despite the implementation of advanced railway control systems. One of the reasons for this is the architecture employed in current systems and existing operating processes, which allow human errors to occur. This paper processes a design concept and architecture for the Next Generation of Train Control Systems (NGTCS). Some key technologies, such as parallel monitoring, system-level 'fail-safe', data sharing and fusion, common cause error avoidance and the illegal or incorrect operation of alarms by railway workers are considered. The paper also details the principle and method of parallel monitoring for some key operations such as train tracking interval, interlocking and train speed limit protection. NGTCS is a highly intelligent monitoring system which represents system engineering theory, system safety, deeper integration and data fusion between sub-systems and parallel monitoring on critical subjects.

POWER CONTROL GAME IN MULTI-SOURCE MULTI-RELAY COOPERATIVE COMMUNICATION SYSTEMS WITH QUALITY-OF-SERVICE CONSTRAINT

XIAO, HAILIN; OUYANG, SHAN

In this paper, we propose a game-theoretic power control algorithm to minimize the total power consumption in a cooperative communication network that transmits information from multiple sources to a destination via multiple relays to save energy and improve communication performance. Under the amplify-and-forward (AF) relaying scheme, the proposed approach not only selects the best source-relay pair but also obtains the optimal transmission powers while satisfying communication quality-of-service (QoS). Using a game-theoretic model, the impacts of the number of relays on the total power consumption are also analyzed. Finally, numerical results are provided to corroborate our theoretical results and demonstrate the performance of the proposed approach.

PREDICTING PERCEIVED VISUAL AND COGNITIVE DISTRACTIONS OF DRIVERS WITH MULTIMODAL FEATURES

LI, NANXIANG; BUSSO, CARLOS

The driver's behaviors can be affected by visual, cognitive, auditory and manual distractions. While it is important to identify the patterns associated with particular secondary tasks, it is more general and useful to define distraction modes that capture the general behaviors induced by various sources of distractions. By explicitly model the distinction between types of distractions, we can assess the detrimental effects induced by new in-vehicle technology. This study investigates drivers' behaviors associated with visual and cognitive distractions, both separately and jointly. External observers assessed the perceived cognitive and visual distractions from real world driving recordings, showing high inter-evaluator agreement in both dimensions. The scores from the perceptual evaluation are used to define regression models with elastic net regularization and binary classifiers to separately estimate the cognitive and visual distraction levels. The analysis reveals multimodal features that are discriminative of cognitive and visual distractions. Furthermore, the study proposes a novel joint visual-cognitive distraction space to characterize driver behaviors. A data-driven clustering approach identifies four distraction modes that provide insights to better understand the deviation in driving behaviors induced by secondary tasks. Binary and multi-class recognition problems demonstrates the effectiveness of the proposed multimodal features to infer these distraction modes defined in the visual-cognitive space.

RAPID MULTICLASS TRAFFIC SIGN DETECTION IN HIGH-RESOLUTION IMAGES

LIU, CHUNSHENG; CHANG, FALIANG; CHEN, ZHENXUE

This paper describes a traffic sign detection (TSD) framework that is capable of rapidly detecting multiclass traffic signs in high-resolution images while achieving a high detection rate. There are three key contributions. The first is the introduction of two features called multi-block normalization LBP (MN-LBP) and tilted MN-LBP (TMN-LBP), which are able to express multiclass traffic signs effectively. The second is a tree structure called split-flow cascade, which utilizes common features of multiclass traffic signs to construct a coarse-to-fine TSD detector. The third contribution is the Common-Finder AdaBoost algorithm (CF.AdaBoost), which is designed to find common features of different training sets to develop an efficient split-flow cascade for multiclass traffic sign detection. Through experiments with an evaluation dataset of high-resolution images, we show that the proposed framework is able to detect multiclass traffic signs with a high detection accuracy in real-time and that it outperforms the state-of-art approaches at detecting a large number of different types of traffic signs rapidly without using any color information.

RECOGNITION OF HIGHWAY WORKZONES FOR RELIABLE AUTONOMOUS DRIVING

SEO, YOUNG-WOO; LEE, JONGHO; ZHANG, WENDE; WETTERGREEN, DAVID

In order to be deployed in real-world driving environments, self-driving cars must be able to recognize and respond to exceptional road conditions, such as highway workzones, because such unusual events can alter previously known traffic rules and road geometry. In this paper, we present a set of computer vision methods which recognize, through identification of workzone signs, the bounds of a highway workzone and temporary changes in highway driving environments. Through testing using video data about highway workzones recorded under various weather conditions, our approach was able to perfectly identify the boundaries of workzones and robustly detect a majority of driving condition changes. In addition to these tests, we evaluated, using a mock workzone setup, the usefulness of our workzone recognition systems' outputs for safe-guarding a self-driving car.

RELIABLE VEHICLE POSE ESTIMATION USING VISION AND SINGLE-TRACK MODEL

NILSSON, JONAS; FREDRIKSSON, JONAS; ÖDBLOM, ANDERS

This paper examines the problem of estimating vehicle position and direction, i.e. pose, from a single vehicle-mounted camera. A drawback of pose estimation using vision only is that it fails when image information is poor. Consequently, other information sources, e.g. motion models and sensors, may be used to complement vision to improve the estimates. We propose to combine standard in-vehicle sensor data and vehicle motion models with the accuracy of local visual bundle adjustment. This means pose estimates are optimized not only with regards to observed image features, but also with respect to a single-track vehicle model and standard in-vehicle sensors. The described method has been tested experimentally on challenging data sets at both low and high vehicle speeds as well as a data set with moving objects. The vehicle motion model in combination with in-vehicle sensors exhibit good accuracy in estimating planar vehicle motion. Results show that this property is preserved, when combining these information sources with vision. Furthermore, the accuracy obtained from vision-only in direction estimation is improved, primarily in situations where the matched visual features are few.

ROBUST TRAFFIC SIGN RECOGNITION BASED ON COLOR GLOBAL AND LOCAL ORIENTED EDGE MAGNITUDE PATTERNS

YUAN, XUE; HAO, XIAOLI; CHEN, HOUJIN; WEI, XUEYE

In this paper, a novel Color Global and Local Oriented Edge Magnitude Pattern (Color Global LOEMP) is proposed. The Color Global LOEMP is a framework that is able to effectively combine color, global spatial structure, global direction structure, and local shape information, and balance the two concerns of distinctiveness and robustness. The contributions of this paper are as follows: 1) color angular patterns are proposed to provide the color distinguishing information; 2) a context frame is established to provide global spatial information, due to the fact that the context frame is established by the shape of the traffic sign, thus allowing the cells to be aligned well with the inside part of the traffic sign even when rotation and scale variations occur; and 3) a Local Oriented Edge Magnitude Pattern (LOEMP) is proposed to represent each cell. In each cell, the distribution of the orientation patterns is described by the HOG feature, and then each direction of HOG is respected in detail by the occurrence of local binary pattern (LBP) histogram in this direction. Experiments are performed to validate the effectiveness of the proposed approach with traffic sign recognition systems, and the experimental results are satisfying, even for images containing traffic signs that have been rotated, damaged, altered in color, or undergone affine transformations, or images that were photographed under different weather or illumination conditions.

ROLLOVER PREVENTIVE FORCE SYNTHESIS AT ACTIVE SUSPENSIONS IN A VEHICLE PERFORMING A SEVERE MANEUVER WITH WHEELS LIFTED OFF

PARIDA, NIGAM; RAHA, SOUMYENDU; RAMANI, ANANDA

Among the intelligent safety technologies for road vehicles, active suspensions controlled by embedded computing elements for preventing rollover have received a lot of attention. The existing models for synthesizing and allocating forces in such suspensions are conservatively based on the constraints that are valid till no wheels lift off the ground. However, the fault tolerance of the rollover preventive systems can be enhanced if the smart/active suspensions can intervene in the more severe situation where the wheels have just lifted off the ground. The difficulty in computing control in the last situation is that the vehicle dynamics then passes into the regime that yields a model involving disjunctive constraints on the dynamics. Simulation of dynamics with disjunctive constraints in this context becomes necessary to estimate, synthesize and allocate the intended hardware realizable forces in an active suspension. In this work we give an algorithm for this problem by solving it as a disjunctive dynamic optimization problem. Based on this we synthesize and allocate the roll stabilizing time-dependent active suspension forces in terms of sensor output data. We show that the forces obtained from disjunctive dynamics is comparable to existing force allocations and hence is possibly realizable in the existing hardware framework toward enhancing the safety and fault tolerance. The vehicle model used is similar to those used in the automobile industry and the synthesis is validated against arbitrary severe steering inputs that are consistent with the industrial practice.

SAMPLED-DATA COOPERATIVE ADAPTIVE CRUISE CONTROL OF VEHICLES WITH SENSOR FAILURES

GUO, GE; YUE, WEI

This paper investigates sampled-data cooperative adaptive cruise control (CACC) of vehicles with sensor failures. A novel switched sampled-data CACC system model is established, in which the effect of sensor failure is involved. Based on the new model, a design method of state feedback controllers that can robustly stabilize the CACC system is presented via the switched system approach. The obtained controller is complemented by additional conditions established for guaranteeing string stability and zero steady-state velocity error, which yields a useful string stable CACC algorithm. Several quantitative relations of parameters including the sensor complete failure rate, the system decay rate and sampling period are also derived. The effectiveness and advantage of the presented methodology are demonstrated by both numerical simulations and experiments with laboratory scale Arduino cars.

SEGMENTATION AND CLUSTERING OF CAR-FOLLOWING BEHAVIOR: RECOGNITION OF DRIVING PATTERNS

HIGGS, BRYAN; ABBAS, MONTASIR

Driving behavior can be influenced by many factors that are not feasible to collect in driving behavior studies. The research presented in this paper investigates the characteristics of a wide range of driving behaviors linking driving states to the drivers' actions. The proposed methodology is structured such that a known state can be linked to multiple actions, thus accounting for the effects of the unknown driving state factors. A two-step algorithm was developed and used for segmentation and clustering of driving behaviors. The algorithm segments and clusters car-following behavior based on eight state-action variables: longitudinal acceleration, lateral acceleration, yaw rate, vehicle speed, lane offset, yaw angle, range, and range rate. The results of this methodology are state-action clusters that define the driving pattern of drivers. The sample used in this paper included twenty different drivers—ten car and ten truck drivers. The results revealed that behavior patterns were different between car drivers, but not truck drivers. The results also show that car drivers exhibit behaviors that are unique to each driver while truck drivers show a common driving pattern. Characteristics and frequency of recognized driving patterns are provided in the paper, along with the corresponding modeling parameters of each pattern.

SEMI-AUTONOMOUS VEHICULAR CONTROL USING DRIVER MODELING

SHIA, VICTOR; GAO, YIQI; VASUDEVAN, RAMANARAYAN; DRIGGS-CAMPBELL, KATHERINE; LIN, THERESA; BORRELLI, FRANCESCO; BAJCSY, RUZENA

Threat assessment during semi-autonomous driving is used to determine when correcting a driver's input is required. Since current semi-autonomous systems perform threat assessment by predicting a vehicle's future state while treating the driver's input as a disturbance, autonomous controller intervention is limited to a restricted regime. Improving vehicle safety demands threat assessment that occurs over longer prediction horizons wherein a driver cannot be treated as a malicious agent. In this paper, we describe a real-time semi-autonomous system that utilizes empirical observations of a driver's pose to inform an autonomous controller that corrects a driver's input when possible in a safe manner. We measure the performance of our system using several metrics that evaluate the informativeness of the prediction and the utility of the intervention procedure. A multi-subject driving experiment illustrates the usefulness, with respect to these metrics, of incorporating the driver's pose while designing a semi-autonomous system.

SMART ELECICAL INFRASTRUCTURE FOR AC-FED RAILWAYS WITH NEUTRAL ZONES

PILO DE LA FUENTE, EDUARDO; MAZUMDER, SUDIP; GONZALEZ FRANCO, IGNACIO

This paper presents a proposal to modify power supply systems currently used in AC-fed railways with neutral zones in order to allow power-flow routing. The proposed system complements the existing infrastructure with additional power-electronic devices connected in parallel to both sides of the neutral zones, allowing control of power flow through adjacent electrical sections. Description and control of such a modified railway system is outlined in this paper. Also, a mixed integer programming (MIP) optimization problem is formulated which minimizes the investment and the operation costs, while ensuring the power supply to the train traffic. This optimization model is used to allow a systematic evaluation of the benefits of implementing such a railway smart grid system. Finally, a section of the high-speed line Madrid-Barcelona is used as a case study and the advantages of the proposed system are quantified in two different scenarios.

STOCHASTIC ANALYSIS OF SINGLE-HOP COMMUNICATION LINK IN VEHICULAR AD HOC NETWORKS

ABBOUD, KHADIGE; ZHUANG, WEIHUA

A vehicular ad hoc network (VANET) is a promising addition to our future intelligent transportation systems, which supports various safety and infotainment applications. The high node mobility and frequent topology changes in VANETs impose new challenges on maintaining a long-lasting connection between network nodes. As a result, the lifetime of communication links is a crucial issue in VANET development and operation. This paper presents a probabilistic analysis of the communication link in VANETs for three vehicle density ranges. Firstly, we present the stationary distribution of the communication link length using mesoscopic mobility models. Secondly, we propose a stochastic microscopic mobility model that captures time variations of inter-vehicle distances (distance headways). A discrete-time finite-state Markov chain with state dependent transition probabilities is proposed to model the distance headway. Thirdly, the proposed stochastic microscopic model and first passage time analysis are used to derive the probability distribution of the communication link lifetime. Numerical results are presented to evaluate the proposed model, which demonstrate a close agreement between analytical and simulation results.

SUBJECTIVE TRAFFIC SAFETY EXPERTS' KNOWLEDGE FOR DRIVING RISK DEFINITION

S. SIORDIA, OSCAR; MARTÍN DE DIEGO, ISAAC; CONDE, CRISTINA; CABELLO, ENRIQUE

This paper presents a novelty system for the detection of driving risk situations based on the combination of the knowledge acquired from traffic safety experts. A complete methodology to generate a driving risk reference signal has been developed. A set of driving sessions were executed in a very realistic truck simulator, where several measures and visual information from the vehicle, driver and road were collected. Two kinds of experiments were designed: controlled driving sessions (where several risk situations were induced), and natural driving sessions (where no risk situations were induced and a natural driving behavior was expected). A group of traffic safety experts from the Royal Automobile Club of Spain were consulted to evaluate the driving risk in each simulated session. The information acquired from the traffic safety experts was used to develop a methodology to combine their evaluations. The risks detected with the proposed methodology were analyzed to determine the most common human factors related with the generation of driving risk situations.

SWITCHING-BASED STOCHASTIC MODEL PREDICTIVE CONTROL APPROACH FOR MODELING DRIVER STEERING SKILL

QU, TING; CHEN, HONG; CAO, DONGPU; GUO, HONGYAN; GAO, BINGZHAO

Great advances in simulation-based vehicle system design and development of various driver assistance systems have enhanced the research of improved modeling of driver steering skill. However, little effort has been attempted on developing driver steering skill models while capturing the uncertainties or statistical properties of the vehicle-road system. In this paper, a stochastic model predictive control (SMPC) approach is proposed to model the driver steering skill which effectively incorporates the random variations in the road friction and roughness, a multi-point preview approach and a piecewise affine (PWA) model structure are developed to mimic the driver's perception of the desired path and the nonlinear internal vehicle dynamics. The SMPC method is then used to generate a steering command by minimization of a cost function including the lateral path error and ease of driver control. In the analyses, first, the experimental data of Hongqi HQ430 are used to validate the driver steering skill controller. Then, the parametric studies of control performance during a nonlinear steering maneuver are provided. Finally, further discussions about the driver's adaption and the indication on vehicle dynamics tuning are given. The proposed switching-based SMPC driver steering control framework offers a new approach for driver behavior modeling.

TEMPORAL DATA DISSEMINATION IN VEHICULAR CYBER-PHYSICAL SYSTEMS

LIU, KAI; LEE, VICTOR; NG, JOSEPH; CHEN, JUN; SON, SANG

Efficient data dissemination is one of the fundamental requirements in vehicular cyber-physical systems. This work focuses on the roadside-to-vehicle communication environment where the roadside unit provides real-time data services to passing vehicles. Data items maintained in the database are updated periodically to keep the information up-to-date. According to the analysis of the temporality of data items and the time-constraint of request services, we formulate the temporal data dissemination problem, and prove that it is NP-hard. Based on an intensive analysis with respect to the time bound of serving requests with temporal data items, we propose a heuristic scheduling algorithm, which considers the request characteristics of productivity, status and urgency in scheduling. An extensive performance evaluation demonstrates that the proposed algorithm is able to effectively exploit the broadcast effect, improve the bandwidth efficiency and increase the service chance of requests, and hence it significantly enhances the system performance.

THE EFFECT OF USING AN IN-VEHICLE SMART DRIVING AID ON REAL-WORLD DRIVER PERFORMANCE

BIRRELL, STEWART; FOWKES, MARK; JENNINGS, PAUL

A Smart driving system (providing both safety and fuel efficiency driving advice in real-time in the vehicle) was evaluated in real-world, on-road driving trials to see if any measurable beneficial changes in driving performance would be observed. Forty participants drove an instrumented vehicle over a 50-minute mixed route driving scenario. Two conditions were adopted, one a control with no smart driving feedback offered, the other with advice being presented to the driver via a Smartphone in the vehicle. Key findings from the study showed a 4.1% improvement in fuel efficiency when using the smart driving aid, importantly with no increase in journey time or reduction in average speed. Primarily these efficiency savings were enabled by limiting the use of lower gears (facilitated by planning ahead to avoid unnecessary stops) and an increase in the use of 5th gear (as advised by the in-vehicle system). Significant and important changes in driving safety behaviors were also observed, with an increase in mean headway to 2.3 seconds and an almost 3-fold reduction in time spent travelling closer than 1.5 seconds to the vehicle in front. This study has shown that an in-vehicle Smart driving system specifically developed and designed with the drivers'

information requirements in mind can lead to significant improvements in driving behaviors in the real world on real roads with real users.

THE EXPLOITATION OF VEHICLE-TO-GRID FUNCTION FOR POWER QUALITY IMPROVEMENT IN A SMART GRID

FOIADELLI, FEDERICA; BRENNA, MORRIS; LONGO, MICHELA; ZANINELLI, DARIO

Smart Grids can be a good challenge for the next future if they are intelligently managed. Therefore the exploitation of the energy resources distributed into the network is one of the most discussed themes in the actual scientific literature, together with the attention to be paid to the power quality improvement. This paper wants to provide a possible solution to some common and dangerous power quality problems, the voltage sags, considering the large diffusion of the electric vehicles. A deep energy and power analysis to evaluate the feasibility of the V2G function to compensate PQ disturbs will be presented.

TOWARDS A METHODOLOGY FOR ASSESSING ELECTRIC VEHICLE EXTERIOR SOUNDS

SINGH, SNEHA; PAYNE, SARAH; JENNINGS, PAUL

Laws mandate that electric vehicles emit sounds to ensure pedestrians' safety by alerting pedestrians of the vehicles' approach. Additionally, manufacturers want these sounds to promote positive impressions of the vehicle brand. A reliable and valid methodology is needed to evaluate electric vehicles' exterior sounds. To help develop such a methodology, this paper examines automotive exterior sound evaluation methods in the context of experimental design and cognitive psychology. Currently such evaluations are usually conducted on-road or inside a laboratory, yet a virtual environment provides advantages of both these methods but none of their limitations. The stimuli selected for evaluations must satisfy legislative guidelines. Methods for presenting and measuring the stimuli can affect study outcomes. A methodology is proposed for conducting evaluations of an electric vehicle's exterior sounds, testing its detectability and emotional evaluation. An experiment tested the methodology. Thirty-one participants evaluated an electric car in a virtual environment of a town's T-junction with 15 exterior sounds as stimuli. The car's arrival time, direction of approach and thus distance to pedestrian varied across conditions. Detection time of the sound, and pleasantness and powerfulness evaluations of the car were recorded. The vehicle's arrival time and approach direction affected its detectability and emotional evaluation, thus these are important elements to vary and control in studies. Overall the proposed methodology increases the realistic context and experimental control than in existing listening evaluations. It benefits by combining two competing elements necessary for assessing electric vehicle exterior sounds, namely pedestrian safety and impressions of the vehicle brand.

TOWARDS PRIVACY PROTECTING SAFETY SYSTEMS FOR NATURALISTIC DRIVING VIDEOS

MARTIN, SUJITHA; TAWARI, ASHISH; TRIVEDI, MOHAN

A common pool of naturalistic driving data is necessary to develop and compare algorithms that infer driver behavior, in order to improve driving safety. Naturalistic driving data, such as video sequences of looking at the driver, however, causes concern for privacy of individual drivers. In an ideal situation, a de-identification filter applied to the raw image of looking at the driver would, semantically, protect the identity and preserve behavior (e.g. eye gaze, head pose, hand activity) of the driver. Driver gaze estimation is of particular interest because it is a good indicator of driver's visual attention and a good predictor of driver's intent. Interestingly, the same facial features that are explicitly or implicitly used for gaze estimation, play a key role in recognizing a person's identity. In this study, we implement a

specific de-identification filter on video sequences of looking at the driver from naturalistic driving and present novel findings on its effect on face recognition and driver gaze zone estimation

TOWARDS SYSTEM-OPTIMAL ROUTING IN TRAFFIC NETWORKS: A REVERSE STACKELBERG GAME APPROACH

GROOT, NOORTJE; DE SCHUTTER, BART; HELLENDOORN, HANS

In the literature, several road pricing methods based on hierarchical Stackelberg games have been proposed in order to reduce congestion in traffic networks. We propose three novel schemes to apply the extended reverse Stackelberg game, through which traffic authorities can induce drivers to follow routes that are computed to reach a system-optimal distribution of traffic on the available routes of a freeway, e.g., to minimize the total time spent of traffic in the network, as well as to reduce traffic emissions in urban traffic networks. In this game-theoretical approach, the leader player representing the traffic authority communicates with the followers (drivers) via an on-board computer, where the main instrument of the leader is the so-called leader function. This function maps the follower's decision space into the leader's decision space, resulting in a leader decision that is directly dependent on the follower's decision variables. Compared to the original game, we can rely on solution methods developed for the general reverse Stackelberg game and show that a system-optimal behavior can be reached, while taking heterogeneous driver classes into account.

TRACKING HEAVY VEHICLES BASED ON WEIGH-IN-MOTION AND VEHICLE SIGNATURE TECHNOLOGIES

JENG, SHIN-TING (CINDY); CHU, LIANYU

Weigh-In-Motion (WIM) has been employed as a major technology to collect heavy vehicles' data on the freeways. Because WIM is one of the most costly and sophisticated data collection system, how to effectively utilize the valuable WIM data and monitor WIM stations' performance are especially important. In this study, we proposed an innovative and yet practical approach for heavy vehicle tracking that combines the use of both WIM data and the inductive loop signature data. The proposed multi-level vehicle reidentification approach was able to generate promising tracking performance with both inductive loop signatures and WIM data applied.

TRAFFIC SIGNAL PHASE AND TIMING ESTIMATION FROM LOW-FREQUENCY TRANSIT BUS DATA

FAYAZI, S. ALIREZA; VAHIDI, ARDALAN; MAHLER, GRANT; WINCKLER, ANDREAS

The objective of this paper is to demonstrate the feasibility of estimating traffic signal phase and timing from statistical patterns in low-frequency vehicular probe data. We use a public feed of bus location and velocity data in the city of San Francisco as an example data source. We show it is possible to estimate, fairly accurately, cycle times and duration of reds for fixed-time traffic lights traversed by buses using a few days worth of aggregated bus data. Furthermore, we also estimate the start of greens in real-time by monitoring movement of buses across intersections. The results are encouraging, given that each bus sends an update only sporadically (~ every 200 meters) and that bus passages are infrequent (every 5-10 minutes). When made available on an open server, such information about traffic signals' phase and timing can be valuable in enabling new fuel efficiency and safety functionalities in connected vehicles: Velocity advisory systems can use the estimated timing plan to calculate velocity trajectories that reduce idling time at red signals and therefore improve fuel efficiency and lower emissions. Advanced engine management

strategies can shut down the engine in anticipation of a long idling interval at red. Intersection collision avoidance and active safety systems could also benefit from the prediction.

TRANSIT TIMETABLES RESULTING IN EVEN MAX-LOAD ON INDIVIDUAL VEHICLES

CEDER, AVISHAI; PHILIBERT, LUCAS

With advances in ITS technology of passenger-information systems, the importance of even and clock headways in transit timetables is reduced. This allows the creation of timetables with even average max passenger loads on individual vehicles. The max-load attained is a load standard desired at the max-load stop. These timetables minimize overcrowding and produce more reliable and efficient schedules than other timetables, from both passenger and operator perspectives. Thus it will make the transit service more attractive. The study provides a procedure for the creation of transit timetables to improve the correspondence of vehicle departure times with passenger demand. The algorithm developed yields departure times (timetable) for vehicles so as to achieve even max-load on each vehicle and a smoothing consideration in the transition between time periods. A case study was carried out using data of one bus route in Auckland, New Zealand with modeling and simulation analyses. The results of even max-load on individual vehicles, in terms of elimination of overcrowding and schedule adherence, exhibit significant improvement over timetables with even headways or with headways based on hourly even max loads.

TRAVEL TIME RELIABILITY VERSUS SAFETY: A STOCHASTIC HAZARD-BASED MODELING APPROACH

HAMDAR, SAMER; TALEBPOUR, ALIREZA; DONG, JING

This paper presents a modeling approach to linking stochastic acceleration and lane changing behavior to travel time reliability on congested freeways. Individual driving behavior is represented by a prospect theory based model that takes into account uncertainty and risk evaluation in terms of gains and losses while following a lead vehicle. Given a set of stimuli (i.e. headways, relative speeds, etc.), the stochastic acceleration model generates acceleration probability distribution functions rather than deterministic acceleration values. Such distribution functions may be associated with travel time reliability through the construction of travel time distributions. In addition, lane changing decision is represented by a stochastic hazard-based duration model that accounts for the surrounding traffic conditions (i.e. traffic density, distance to ramp, etc.). Numerical results from Monte Carlo simulations demonstrate that the proposed microscopic stochastic modeling approach produces realistic macroscopic traffic flow patterns and can be used to generate travel time distributions. With proper experimental set-up and sensitivity analysis, the travel time distributions may be estimated and linked to safety-based parameters.

UNDERSTANDING TAXI SERVICE STRATEGIES FROM TAXI GPS TRACES

ZHANG, DAQING; SUN, LIN; LI, BIN; CHEN, CHAO; PAN, GANG; LI, SHIJIAN; WU, ZHAOHUI

Taxi service strategies, as the crowd intelligence of massive taxi drivers, are hidden in their historical time- stamped GPS traces. Mining GPS traces to understand the service strategies of skilled taxi drivers can benefit the drivers themselves, passengers and city planners in a number of ways. This paper intends to uncover the efficient and inefficient taxi service strategies, based on a large-scale GPS historical database of approximately 7600 taxis over one year in a city in China. First, we separate the GPS traces of individual taxi drivers and link them with the revenue generated. Second, we investigate the taxi service strategies from three perspectives: passenger- searching strategies, passenger-delivery strategies, and service- region preference. Finally, we represent the taxi service strategies with a feature matrix and evaluate the correlation between service strategies and revenue, informing which strategies are

efficient or inefficient. We predict the revenue of taxi drivers based on their strategies and achieve a prediction residual as less as 2.35RMB1 per hour, which demonstrates that the extracted taxi service strategies with our proposed approach well characterize the driving behavior and performance of taxi drivers.

VALIDATION METHODS FOR DIGITAL ROAD MAPS IN PREDICTIVE CONTROL

KOCK, PETER; WELLER, RALF; ORDYS, ANDRZEJ; COLLIER, GORDANA

Digital road maps with slope, curve and other road information provide the opportunity to apply model based predictive control approaches which can help to save fuel, increase safety and comfort and reduce wear in vehicle operation. The problem is that the maps obtained from different providers have different quality and that the prediction model that uses slope, curve radius and other information can only be tested with the map. Here a method is presented which enables a quality benchmark from altitude and slope information of different sources together with a vehicle longitudinal dynamic model with only one driving experiment and before the predictive control application is ready or used. The example is a truck model. The used maps include two from commercial providers and two self-made maps. The latter use two different GPS1 based technologies to sample the altitude profile of the road. The paper presents methods to evaluate altitude and slope information from digital road maps, to find local map errors using a vehicle model, to benchmark different maps with a vehicle model and to find the most suitable map for a predictive control application.

VEHICLE ACTIVE STEERING CONTROL SYSTEM BASED ON HUMAN MECHANICAL IMPEDANCE PROPERTIES OF THE ARMS

TANAKA, YOSHIYUKI; YAMADA, NAOKI; TSUJI, TOSHIO; SUETOMI, TAKAMASA

This paper presents the experimental data of human mechanical impedance properties (HMIP) of the arms measured in the steering operations according to the angle of a steering wheel (limbs posture) and the steering torque (muscle co-contraction). The HMIP data shows that human stiffness/viscosity has the minimum/maximum value at the neutral angle of the steering wheel in relax (standard condition) and increases/decreases for the amplitude of steering angle and torque, and that the stability of arms motion in handling the steering wheel becomes high around the standard condition. Next a novel methodology for designing an adaptive steering control system based on HMIP of the arms is proposed, and the effectiveness was then demonstrated via a set of double-lane-change tests with several subjects using the originally developed stationary driving simulator and the 4-DOF driving simulator with a movable cockpit.

VEHICLE LOCALIZATION USING IN-VEHICLE PITCH DATA AND DYNAMICAL MODELS

LAFTCHIEV, EMIL; LAGOA, CONSTANTINO; BRENNAN, SEAN

This paper describes a dynamical model-based method for the localization of road vehicles using terrain data from the vehicle's on-board sensors. Road data is encoded using linear dynamical models, and then, during travel, the location is identified through continuous comparison of a bank of linear models. The approach presented has several advantages over previous methods described in the literature. First, the approach creates computationally efficient linear model map representations of the road data. Second, the use of linear models eliminates the need for metrics during the localization process. Third, the localization algorithm is a computationally efficient approach that can have a bounded localization distance in the absence of noise given certain uniqueness assumptions on the data. Fourth, encoding road data using linear models has the potential to compress the data, while retaining the sensory information. Lastly performing only linear operations on observed noisy data simplifies the creation of noise mitigation algorithms.

WHEN TO CONTROL THE RAMPS ON FREEWAY CORRIDORS? A NOVEL STABILITY-AND-MFD-BASED APPROACH

TU, HUIZHAO; LI, HAO; WANG, YIBING; SUN, LIJUN

Coordinated ramp metering (CRM) is an efficient measure to mitigate traffic congestion on freeway corridors. One of the key issues of implementing CRM is to decide when to start the control on the ramps. Generally, the control timing for CRM is determined on the basis of the traffic state on a freeway corridor to prevent traffic jams on corridors. In principle, high throughputs and less congestions on corridors are aimed when determining the control timing of CRM. However, it is found that the traffic state at high densities is fairly unstable with high probabilities of traffic breakdown. This paper proposes to determine the control timing, by considering not only high throughputs, but also stable flows on freeway corridors. A novel approach is developed by introducing an indicator of production stability (PS) to determine when to start the control of CRM. The indicator is established on a basis of Macroscopic Fundamental Diagram and the instability of traffic flows. Empirical traffic data from urban freeway networks in the city of Shanghai are utilized to verify the feasibility of using the PS indicator. It is found that the flows at high accumulations are very unstable with high probabilities to breakdown. The developed indicator PS has a clear peak, from which a critical accumulation level could be identified. The critical accumulation level derived according to PS is lower than that simply determined from MFD, which implies that the control should start earlier to guarantee stable flows.

Abstracts of forthcoming papers on IEEE ITS Magazine

A COMPARISON OF DETRENDING MODELS AND MULTI-REGIME MODELS FOR TRAFFIC FLOW PREDICTION

LI, ZHIHENG; LI, YUEBIAO; LI, LI

Short-term traffic flow prediction received considerations from different fields, because of its essentialness in traffic engineering and its theoretical difficulties. In this paper, we studied two important approaches of traffic flow prediction: detrending methods and multi-regime methods. First, we compared their differences in modeling philosophy and compared their merits as well as shortcomings. Then, we tested several representative prediction models of these two approaches on the openly accessible PeMS traffic flow database to find their merits and shortcomings. The obtained results threw some interesting light on how to select the appropriate traffic prediction models in practices.

A REVIEW OF NETWORK MOBILITY PROTOCOLS FOR FULLY ELECTRICAL VEHICLES SERVICES

IMADALI, SOFIANE; KAISER, ARNAUD; SIVRIKAYA, FIKRET; EL SAYED, NADIM; BOC, MICHAEL; KLAUDEL, WITOLD; PETRESCU, ALEXANDRU; VÈQUE, VÉRONIQUE

This article reviews IETF network mobility techniques and ISO data protocols involved in electrical charging which represent key enablers for an IP-based platform composed of backend servers, networks of fixed charging stations and of mobile Fully-Electrical Vehicles (FEVs). This platform further allows services for ensuring driver's confidence in reaching arbitrary destinations, despite well-known limitations such as battery technologies, and mitigating the risks involved by the use of inherently insecure basic IP datagram exchanges. This paper first gives the overall picture that integrates the reviewed technologies before stressing the importance of IP network mobility in such scenarios. The FEVs' use of data communication protocols are analyzed from a "Vehicle-to-Grid" standpoint including the ISO-15118 standards description. Host-based and Network-based addressing and mobility architectures are compared before focusing on the problem of session continuity for IP-based electric mobility related services. In particular, Mobile IPv6 (MIPv6) and Proxy Mobile IPv6 (PMIPv6) standards are reviewed from a network mobility perspective which allows to introduce our PMIPv6 Network Mobility extension and describe its features. A qualitative feature characterization and an analytical model to compare the protocols are provided.

BUSINESS MODELS TOWARDS THE EFFECTIVE INTEGRATION OF ELECTRIC VEHICLES IN THE GRID

SÁNCHEZ-MIRALLES, ÁLVARO; GÓMEZ, TOMÁS; FERNÁNDEZ, ISMAEL; CALVILLO MUÑOZ, CHRISTIAN

To achieve an effective integration of the electric vehicle in the grid, not only technical issues must be solved, but also a new regulatory context and business models must be proposed. This paper proposes two electric vehicle integration business models; one resembles the mobile-phone business, while the other is more based on current practices in the electricity-supply business. Decomposition into three layers: physical, management, and business, is used to describe

those business models. Furthermore, electric vehicle charging scenarios are presented to illustrate how the proposed business models fit in each of the potential situations. Finally, several practical study cases are presented.

DRIVER BEHAVIOR PROFILING USING SMARTPHONES: A LOW-COST PLATFORM FOR DRIVER MONITORING

CASTIGNANI, GERMAN; DERRMANN, THIERRY; FRANK, RAPHAËL; ENGEL, THOMAS

Today's smartphones and mobile devices typically embed advanced motion sensors. Due to their increasing market penetration, there is a potential for the development of distributed sensing platforms. In particular, over the last few years there has been an increasing interest in monitoring vehicles and driving data, aiming to identify risky driving maneuvers and to improve driver efficiency. Such a driver profiling system can be useful in fleet management, insurance premium adjustment, fuel consumption optimization or CO2 emission reduction. In this paper, we analyze how smartphone sensors can be used to identify driving maneuvers and propose SenseFleet, a driver profile platform that is able to detect risky driving events independently from the mobile device and vehicle. A fuzzy system is used to compute a score for the different drivers using real-time context information like route topology or weather conditions. To validate our platform, we present an evaluation study considering multiple drivers along a predefined path. The results show that our platform is able to accurately detect risky driving events and provide a representative score for each individual driver.

EFFICIENT ALLOCATION OF ELECTRIC VEHICLES CHARGING STATIONS: OPTIMIZATION MODEL AND APPLICATION TO A DENSE URBAN NETWORK

BAOUCHE, FOUAD; BILLOT, ROMAIN; TRIGUI, ROCHDI; EL FAOUZI, NOUR-EDDIN

The deployment of Electric Vehicles (EV) needs an optimized and cost-effective implementation of charging stations. As a decision support tool for network design, we define a methodology to allocate charging stations in a real network. This study uses trip OD matrix information from household travel survey coupled with a dynamic vehicle model to evaluate EVs consumption based on realistic trips (urban drive cycles). These trips are computed based on routing tools and supplied with elevation information. This enables an accurate characterization of energy needs in the Lyon Metropolitan Area. All these parameters are used as inputs of an integer linear optimization program for the location of charging stations. The methodology is based on an adaption of the classic fixed charge location model with a p-dispersion constraint. The results indicate that this methodology can help the future implementation of charging stations at an urban scale.

ENERGY OPTIMAL REAL-TIME NAVIGATION SYSTEM

CELA, ARBEN; JURIK, TOMAS; HAMOUCHE, REDHA; NATOWICZ, RENÉ; REAMA, ABDELATIF; NICULESCU, SILVIU-IULIAN; JULIEN, JEROME

Abstract—The rapid development of Mobile Internet and Smart Devices and advent of a new generation of Intelligent Transportation Systems (ITS) increase information about present driving conditions and make its prediction possible. Real time traffic information systems (TIS) like SYTADIN help in route to destination planning and traffic state prediction. Energyoptimal routing for electric vehicles creates novel algorithmic challenges where the computation complexity and the quality of information on traffic state are the main issues. This complexity is induced by the possible negative values of edge energy as well as the variability of route and vehicle variables which render the

standard algorithms unsuitable. In this paper we present an Energy Optimal Real Time Navigation System (EORTNS), implemented on Samsung Galaxy Tab, capable of calculating the route to destination based on information flow obtained from SYTADIN. As an application example we propose a real time energy management for a Hybrid Electrical Vehicle (HEV) composed of batteries and Super-Capacitors (SC). The EORTNS is not only capable of energy optimal route to destination calculation with respect to traffic state but also operates the On- Board power splitting between batteries and Super-Capacitors.

GREEN MOVE: A PLATFORM FOR HIGHLY CONFIGURABLE, HETEROGENEOUS ELECTRIC VEHICLE SHARING

BIANCHESSI, ANDREA; CUGOLA, GIANPAOLO; FORMENTIN, SIMONE; MORZENTI, ANGELO; ONGINI, CARLO; PANIGATI, EMANUELE; ROSSI, MATTEO; SAVARESI, SERGIO; SCHREIBER, FABIO; TANCA, LETIZIA; VANNUTELLI DEPOLI, EDOARDO

Vehicle sharing in urban areas has the potential to be the answer to some of the main issues that hinder the spreading of electric vehicles, in particular for what concerns the high upfront costs of the vehicles, combined with their still limited range, which can induce phenomena such as range anxiety. For its potential to be realized, vehicle sharing must be tailored to the multiform needs of its users by offering a wide range of support services that can be selected based on the user preferences. In this paper we present the platform for vehicle sharing developed in the Green Move project, which allows services to be dynamically loaded and unloaded on vehicles, and describe a pair of prototype applications to illustrate its benefits.

INTEGRATION OF DRIVE-BY-WIRE WITH NAVIGATION CONTROL FOR A DRIVERLESS ELECTRIC RACE CAR

BRAUNL, THOMAS; DRAGE, THOMAS; KALINOWSKI, JORDAN

This article presents the design and implementation of a drive-by-wire system and a navigation control system for an autonomous Formula SAE race car. The result is the development of a platform for research into autonomous driving which can be easily replicated. Drive-by-wire actuators for acceleration, braking and steering of the vehicle are discussed, as well as the embedded low-level control system. The high-level navigation system features sensor fusion of a 6-dof IMU with a standard GPS and the integration of an automotive LIDAR. Operation of the vehicle is via a multi-threaded program with asynchronous IO and is based upon recording and driving waypoints. In addition to independent safety interlocks, active safety systems are an integral part to both the drive-by-wire and navigation systems.

MANAGING THE CHARGING OF ELECTRICAL VEHICLES: IMPACTS ON THE ELECTRICAL GRID AND ON THE ENVIRONMENT

FARIA, RICARDO; MOURA, PEDRO; DELGADO, JOAQUIM; ALMEIDA, ANÍBAL

Electric vehicles are seen as an option to reduce greenhouse emissions, directly related with the electricity generation mix and with the time of charging due to the variations of the generation sources during the day. At the same time, with their widespread adoption the increase in the demand for electricity to charge these vehicles could pose significant challenges to the electrical grid in terms of additional load due to unmanaged charge strategies. In order to mitigate these problems, the charging of the electrical vehicles must be managed. This paper presents the

development of a system architecture to dynamically control the charging of electric vehicles to maintain the proper operation of the local distribution grid and minimize the environmental impact. The hardware consists of two modules, a meter and controllable plugs both with communication capabilities, while the software consists in a forecast and scheduler module. The forecast module calculates the load based on the power consumption behavior and uses the renewable generation forecast to assign the best time slot to charge the vehicle. The system aims to minimize the load peaks and flatten the load profile, while minimizing the environmental impacts. Based on the user preferences, system characteristics, consumption and renewable generation forecast, the system will assign the most suitable time slot to charge the electric vehicle. For the case of multiple electric vehicles, the system will schedule their charge based on a calculated priority level, in order to maintain a reliable operation of the local electrical grid.

MODELLING THE DRIVING BEHAVIOUR OF ELECTRIC VEHICLES USING SMARTPHONES AND NEURAL NETWORKS

DIAZ, ALBERTO; SERRADILLA, FRANCISCO; NARANJO, JOSE; ANAYA, JOSE; JIMENEZ (MAGAZINE GUEST EDITOR), FELIPE

The modelling of eco-driving behaviours is a key issue in the research of Intelligent Transportation Systems. Most efforts have been made regarding internal combustion vehicles, and few works have reported in the field of electric vehicles. On the other hand, these behaviour analyses are usually conducted through naturalistic driving researches that involve the use of instrumented vehicles, available in a small number, which reduces the impact of the results. This paper presents a system for estimating the remaining charge of an electric vehicle by considering the driving behaviour measured using a smartphone. For this purpose, first of all, data measured by the smartphone and by the onboard instrumentation were compared in order to demonstrate that both sources are equivalent and that the former is sufficiently accurate. The driving profiles obtained were then used to estimate the expected battery consumption of the electric vehicle using a Neural Network to represent the model that uses the information provided from the smartphone as input, such as speed, acceleration and jerk. The system has been tested with 10 drivers with a prediction capability of the expected battery consumption higher than 95%. These results show that a smartphone is a tool with a sufficient degree of fidelity to capture data from drivers, and so avoid expensive, complex systems like instrumented vehicles, and it can also be used for estimating energy consumption and predicting the remaining battery charge.

SIMPATO – THE SAFETY IMPACT ASSESSMENT TOOL OF INTERACTIVE

VAN NOORT, MARTIJN; BAKRI, TAOUFIK; FAHRENKROG, FELIX; DOBBERSTEIN, JAN

One step in the development of safety oriented Advanced Driver Assistance Systems (ADAS) is an ex ante assessment of the expected safety impacts. This requires a careful analysis combining models and data from various sources. This paper describes the Safety IMPact Assessment Tool, called SIMPATO, that was developed in the interactIVe project. This tool performs “what if” analysis for accident scenarios to determine the effect of an ADAS on the outcome. The unique quality of the tool is that it requires very little data on the ADAS itself, and uses in-depth accident data to obtain a representative result.

THE FLATBED PLATOON TOWING MODEL FOR SAFE AND DENSE PLATOONING ON HIGHWAYS

ALI, ALAN; GARCIA, GAETAN; MARTINET (MAGAZINE GUEST EDITOR), PHILIPPE

Optimizing the inter-distances between vehicles is very important to reduce traffic congestion on highways. Variable spacing and constant spacing are the two policies for the longitudinal control of platoons. Variable spacing doesn't require a lot of data (position, speed...) from other vehicles, and string stability can be obtained using on-board information only. However, inter-vehicle distances are very large, and hence traffic density is low. Constant spacing offers string stability with high traffic density, but it requires data communication between the vehicles, at least from the leader. In this paper, a new platoon model and a modification of the variable spacing policy are proposed. This modification is effective to decrease the distances between the cars, making them nearly equal to the constant spacing policy. It also enables increasing string stability. This new approach doesn't require heavy communication between the vehicles. The new model is based on an unidirectional spring-damper model between vehicles, with the vehicles loaded on a virtual flatbed tow truck. From this configuration, conditions of stability and safety of the platoon are derived. Based on this new model, a control has been derived and evaluated by simulation with a perfect system model using Matlab, and with a more realistic vehicle model using TORCS (The Open Racing Car Simulator). The simulation consists of a platoon of ten vehicles, moving on highways, with a desired inter-vehicle distance equal to 1 meter. The stability and the safety of the platoon are tested during platoon creation, changing the speed and emergency stop.

THREE DECADES OF DRIVER ASSISTANCE SYSTEMS. REVIEW AND FUTURE PERSPECTIVES

DIETMAYER (MAGAZINE AE), KLAUS; STILLER, CHRISTOPH; WINNER, HERMANN; MAURER, MARKUS; BENGLER, KLAUS; FAERBER, BERTHOLD

This contribution provides a review of fundamental goals, development and future perspectives of driver assistance systems. Mobility is a fundamental desire of mankind. Virtually any society strives for safe and efficient mobility at low ecological and economic costs. Nevertheless, its technical implementation significantly differs among societies, depending on their culture and their degree of industrialization. A potential evolutionary roadmap for driver assistance systems is discussed. Emerging from systems based on proprioceptive sensors, such as ABS or ESC, we review the progress incented by the use of exteroceptive sensors such as radar, video, or lidar. While the ultimate goal of automated and cooperative traffic still remains a vision of the future, intermediate steps towards that aim can be realized through systems that mitigate or avoid collisions in selected driving situations. Research extends the state-of-the-art in automated driving in urban traffic and in cooperative driving, the latter addressing communication and collaboration between different vehicles, as well as cooperative vehicle operation by its driver and its machine intelligence. These steps are considered important for the interim period, until reliable unsupervised automated driving for all conceivable traffic situations becomes available. The prospective evolution of driver assistance systems will be stimulated by several technological, societal and market trends. The paper closes with a view on current research fields.

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