



INTELLIGENT TRANSPORTATION SYSTEMS

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IEEE ITS SOCIETY NEWSLETTER

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Editor: Prof. Miguel Angel Sotelo, miguel.sotelo@uah.es

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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.

Editorial Board

Editor-in-Chief

Miguel Angel Sotelo miguel.sotelo@uah.es

Associate Editors

IEEE T-ITS and IEEE ITS-Magazine Report and Abstracts

Simona Berté TransITS@ce.unipr.it

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 miguel.sotelo@uah.es.

SOCIETY NEWS

From the Editor

Miguel Ángel Sotelo



Summer has just started with new activities in our ITS Society. In this issue, you can read a promotional summary of the ITS Podcast, a new initiative sponsored by the ITSS with a view to bringing the Intelligent Transportation Systems to a wide audience in a fashionable, enjoyable format. Javier Sánchez Medina is the Editor-in-Chief of this new publication. We wish Javier the best luck in this venture.

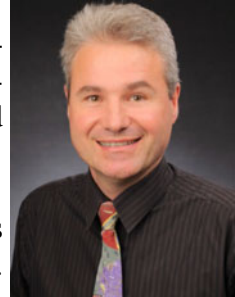
In the coming months, our ITS Society will be sponsoring its flagship conference. The 2013 IEEE Intelligent Transportation Systems Conference will be held in October 6-9, 2013, in the Hague, The Netherlands. The technical focus is on Intelligent Transportation Systems for all Transport Modes. After having received some 630 submissions, I have no doubt that the ITSC2013 will be an enormous success. I hope we can all meet there!

Message from President:

Bridging Academia and Industry in ITS

By Dr. Christoph Stiller, President

Eventually, scientists distinguish academic research from research that is relevant to industry. Indeed, already philosophers as Friedrich Schiller (1759 - 1805) knew about science directed towards the acquisition of knowledge and science directed towards the acquisition of “bread”.



Nowadays, such a distinction at least becomes fuzzy or is even outdated, as indeed in research the long-term outcome is impossible to predict. When e.g. in 1962 the team around Nick Holonyak in the Bell Laboratories developed a first red LED emitting sparse light, this finding was seen as a scientific success while its importance to industrial applications was hardly seen. It seemed like the LED would never be competitive against a light bulb, the main light emitting technical product at that time. It needed innovations to elevate the scientific findings to benefit humanity.

The IEEE Technical Activities Board (TAB) has identified bridging the gap between academia and practitioners as one of its goals. For those not familiar with IEEE: TAB is the forum of the 38 Technical Societies and 7 Councils within IEEE. It gathers society presidents and other representatives several times a year to further develop our community, activities and products. Thus it

- oversees some 125 IEEE journals, including our society’s IEEE Transactions on Intelligent Transportation Systems and the IEEE Intelligent Transportation Systems Magazine,
- sponsors standard activities, including e.g. the car2x communication standard 802.11p,
- sponsors conferences including our flagship conferences IV and ITSC of our society as well as the other conferences (co-)sponsored by our society, ICVES, SOLI, MESA, ISI, ICIRT, ICCVE, FISTS, and VNC. You might want to check our society website <http://sites.ieee.org/itss/> for details on those.
- develops educational products, such as tutorials, on-line courses or educational programs.

IEEE is dedicated to make these activities likewise attractive to academia and practitioners, as frequently it is indeed the interdisciplinary interaction of these that advances innovation and technological excellence for the benefit of humanity. We are convinced in the saying: “There is nothing more practical than a sound theory.”

From our society, the most breaking news is our two new publications meant to attract academia and practitioners likewise:

ITS Now is a new topical online publication and a one-stop source for free, limited-time access to IEEE ITS transactions/magazine publications and conference articles in Xplore. Every three months, 10-15 new articles, selected by an editorial team, cover a timely technical theme. It presents cutting-edge ITS research in a cohesive manner and offers a theme-based venue that creates synergy across multiple ITS publications and conference proceedings; helps foster meaningful linkage among ITS technical sub-committees and publications.

Message from President:

Bridging Academia and Industry in ITS

By Dr. Christoph Stiller, President


Read more at <http://sites.ieee.org/itss/introduction/its-now> for this activity of the editorial team around Daniel Zeng.

ITS Podcast disseminates cutting-edge science and engineering research on intelligent transportation in an attractive and easy-to-listen-to format. It offers insightful and entertaining monthly interviews with authors from selected papers in IEEE ITS publications, conference keynote speakers, and other top ITS scientists or engineers. Every podcast episode is enriched with news relevant to listeners, and a short “Transportation in History” section that educates on amazing past developments in transportation. It reaches out to new audiences, including interdisciplinary colleagues and the general public. The latest episode includes an interview with Tsuneo Takahashi, who was awarded an IEEE medal for pioneering vehicle navigation systems.

Read and foremost hear more at <http://itssp.cicei.com/> about this new publication format established by the editorial team around Javier Sánchez Medina.

You might read this message before our Society’s Intelligent Transportation Systems Conference, ITSC 2013 in the Netherlands.

See you at ITSC in The Hague!



Christoph Stiller
President IEEE ITSS

Report of ExCOM/BOG June 2013 Meetings

The ITSS Executive Committee and ITSS Board of Governors met on June 23, 2013 in Gold Coast, Australia for its summer meeting in conjunction with IV 2013. The ExCom meeting was attended by 9 of the 11 members, and the BOG was attended by 15 of the 25 BOG members. Both meetings took place at Sofitel Gold Coast Broadbeach Hotel. The ExCom meeting started at 9:00am and ended at 12:30pm. The BOG meeting began at 1:30pm and finished just after 6:30pm. The IV13 Associate Editors thank-you dinner followed at the Terrace, the room off “Bistro on 3” restaurant, at Sofitel Hotel. Each of the members of the ExCom gave a detailed presentation about all of the activities that have been and will be conducted. Discussion ensued on many topics, and the main points are summarized here.

All three of the ITSS publications (Transactions, Magazine, and Newsletter) are continuing to do well. The Magazine has included new sections: ITS Fun, ITS People, ITS Research Labs. Some Special Issues have been published in 2013, although The Magazine still needs to try to attract more regular submissions. An impact factor will hopefully be coming by mid 2014. The Transactions impact factor is still among the highest of all transportation journals.

Conferences and publications are doing well, and the latest closed conferences have been more than acceptable in all relevant aspects including attendance, scientific and industrial impact and financial numbers. The ITSS has received requests to become a technical cosponsor of several conferences. A general framework comprising aspects such as the review process, history, visibility and quality will be elaborated in order to make decisions in the future. Here are the upcoming conferences with confirmed locations in ITSS:

ITSC 2013 – The Hague, Netherlands
ITSC 2014 – Qingdao, China
ITSC 2015 – Las Palmas, Canary Islands
ITSC 2016 – Rio de Janeiro, Brazil
IV 2014 – Detroit, Michigan
IV 2015 – Seoul, South Korea (approved at June 2013 BOG meeting)
ISI 2013 – Seattle, Washington, USA
MESA/SOLI 2013 – Dongguan, China

A discussion occurred about the pros & cons of using different conference management systems, such as EasyChair and SPLTrack, as an alternative to Papercept for conference paper submission and registration. As a conclusion of the discussion, a committee, formed by 6 BOG members, is set up to further develop the issue and make a well grounded recommendation to the BOG at a future meeting.

Financially the society is staying consistent. The ITSS is providing financial support to recent initiatives, such as Students Activities and ITS Podcast, under the lead of Javier Sánchez Medina. The ITSS welcomes new ideas and initiatives.

Report of ExCOM/BOG June 2013 Meetings

New membership campaigns have been launched having achieved an increase of 8% in the number of members. The ITSS will continue to promote membership via the conference registration structure, as has already been done successfully in recent ITSS conferences. Chapter development issues and GOLD activities were discussed during the meeting.

The visibility of technical activities will be enhanced in the ITSS Web site, Magazine and Newsletter. More AEs from industry are expected to be incorporated to the Magazine Editorial Board.

The following ExCOM and BOG meetings will be on October 5 and October 6, 2013, respectively, in conjunction with ITSC 2013 in The Hague, the Netherlands.

If you have any questions about anything covered at the meeting, feel free to contact the VP Administrative Activities, Daniel Dailey, at dan@UW.EDU.

Launching of “ITS Podcast”

By Javier Sánchez Medina, Editor-in-Chief of ITS Podcast

ITS Podcast

The Intelligent Transportation Systems Podcast launching phase is going very well. We have delivered the two first episodes for May and June 2013. You can listen or download them at <http://itsp.cicei.com>.



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ITS Podcast Episode 1: VisLab Intercontinental Autonomous Challenge

In this first episode we have had the great pleasure of interviewing professor Alberto Broggi from University of Parma in Italy. He is CEO and President of VisLab, an Internationally renowned research center which has been present in many media recently, especially after accomplishing an astonishing challenge: during the 2010 Summer, for 100 days they drove autonomously from Parma to the International Expo in Shanghai, China. We talked to him on the lessons learnt on that challenge, their current works and some future forecasts on autonomous driving.

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ITS Podcast Episode 2: Eco-Routes and ITS vs. Global Climate Change

In this second episode we interviewed Professor Matthew Barth from the University of California Riverside. He is director of the Center for Environmental Research and Technology. Prof. Barth was interviewed by Professor Jeffrey Miller, from University of Alaska Anchorage. Among many other things, they talked about “Eco-Routes” and also about the role of Intelligent Transportation Systems in the global climate change.

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We don't stop! We are already working on next episodes. We will hopefully have an interview with Mr. Tsuneo Takahashi recorded on site, at the IEEE honors ceremony. Some insights from the ITSS President Prof. Christoph Stiller are also expected in that edition.

We will soon record another very interesting interview with Prof. Katsuhiro Nishinari, from University of Tokyo, on Jamology, a new interesting concept to fight traffic jams. He is also Keynote Speaker at the Intelligent Vehicles Symposium 2013.

Launching of “ITS Podcast”

By Javier Sánchez Medina, Editor-in-Chief of ITS Podcast

Again, I must ask for all the ITSS members cooperation to spread the voice and let the ITS Podcast known in the ITS Research community and even farther. We design our podcast to be easy listened even by the big public, as well as ITS scientists and practitioners. There are many ways for you to help out our society with this. Here are some of them.

- If you do have a Facebook account: Please like us ([itsp.itss](https://www.facebook.com/itsp.itss)).
- If you do have a Twitter account: Please follow us (@ITSPodcast).
- If you do have a Google+ account: Please like us (ITSPodcast).
- You can also visit our website (itsp.cicei.com) and click on the social sharing icons of your preference at the top or the bottom of each page/post.
- Finally, you can distribute this information to the email distribution lists you think it's opportune.

If you want to follow us, search for us at iTunes or Feedburner. You can also click in the lower right button "Follow" to subscribe to every new episode by introducing your email address.

Thank you very much for all your help! Please, remember you can post constructive comments on our website!

Javier Sánchez-Medina
ITS Podcast EiC

Formation of the Spanish Chapter of the IEEE ITS Society

By César Lanza, President

On May 23rd the Spanish section of the IEEE made a public presentation of the newly formed local chapter of the ITS Society in this country. The event was hosted by the Secretary of State for Telecommunications and Information Society (Ministry of Industry) with Mr. Víctor Calvo-Sotelo, Secretary of State, delivering the inaugural speech of welcome to attendees.

Current President of the IEEE in Spain, Mrs. Pilar Molina, explained later on the goals and activities of the Institute's section, being followed by Mr. César Lanza, first elected President of the ITSS local chapter who gave details on the planned activities for the coming months.

The event continued with a panel of experts on ITS featuring speakers from academia, industry and transport authorities. Mr. Miguel Ángel Sotelo, a member of the Board of Governors of the Society as well as an officer of the Steering Committee of the ITSS local chapter, wrapped-up the public presentation.

Refreshments were served after the meeting adjourned.

César Lanza.

President of the Spanish Chapter of the IEEE ITS Society.

Formation of the Nagoya Chapter of the IEEE ITS Society

By Hiroshi Murase (Chair), Toshihiro Wakita (Vice Chair), and Chunzhao Guo (Member)

The Nagoya Chapter of IEEE Intelligent Transportation Systems Society (ITSS) was created on 6 May 2013 as the result of hard work and dedication of the ITSS members of the Nagoya Section, especially of Prof. Hiroshi Murase of Nagoya University and Dr. Toshihiro Wakita of Toyota Central R&D Labs., Inc. It is the fourth chapter in IEEE Nagoya Section, the first ITSS chapter in IEEE Japan, and one of the earliest local chapters in the whole ITSS.

As is known, the Central Japan area (around the Nagoya City) is a major automotive industry center in Japan, where a number of academic institutes and industrial companies are located (see Fig. 1) and the automotive R&D is very active. In particular, the researches related to intelligent transportation systems (ITS) technologies have been vigorously promoting, thereby holding great potentials for both R&D and human resources that may expedite the development of the world-wide ITS technologies as well as the IEEE ITSS. The motivation to form the ITSS Nagoya Chapter is to pursue more active knowledge exchange and collaborative problem-solving between members, researchers, institutes and companies in this area for creating new values.

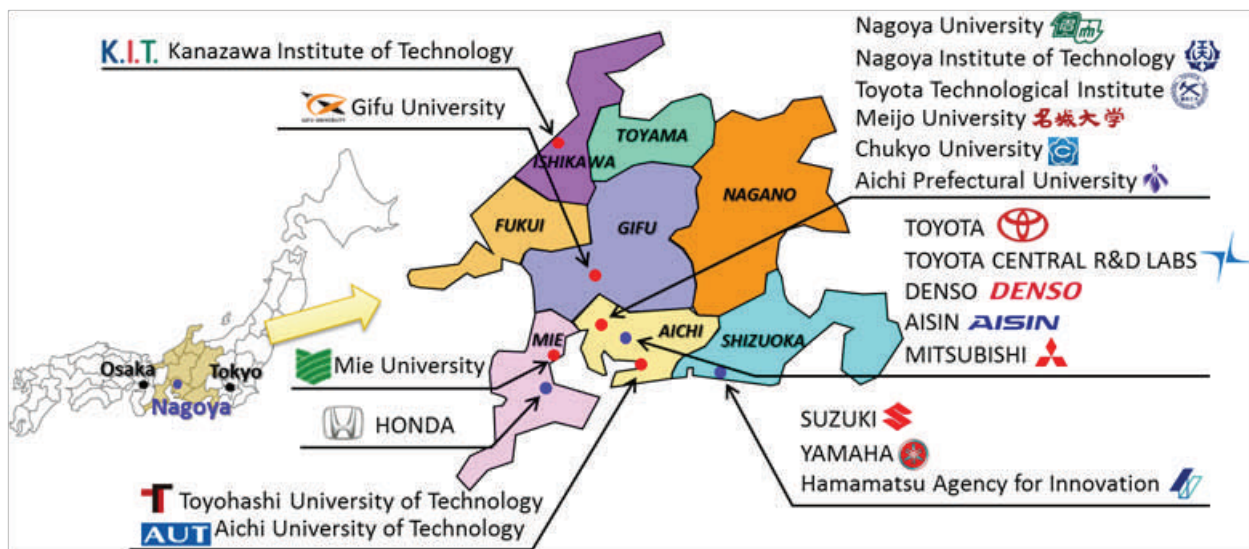


Fig. 1. Illustration of the Central Japan area, which is covered by the Nagoya Chapter, and some of the academic institutes and industrial companies in this area.

Regarding the formation of the ITSS Nagoya Chapter, the kickoff meeting, organized by Prof. Murase and Dr. Wakita, took place in Nagoya University on 21 February 2013. During the meeting, all the attendant ITSS members first reached the consensus of the chapter formation, and then discussed the missions and activity plans, and finally elect the board members of the chapter. More specifically, the missions of the Nagoya Chapter include:

Formation of the Nagoya Chapter of the IEEE ITS Society

By Hiroshi Murase (Chair), Toshihiro Wakita (Vice Chair), and Chunzhao Guo (Member)

- Share and exchange ideas, achievements and vision;
- Encourage research activities in ITS
- Formulate new research direction and products

The board members are (See Fig. 2):

Chair: Dr. Hiroshi Murase, Nagoya University, Professor;

Vice Chair: Dr. Toshihiro Wakita, Toyota Central R&D Labs., Inc., Director, Member of Board;

Secretary: Mr. Takashi Naito, Toyota Central R&D Labs., Inc., Principle Researcher, Project Leader, Section Manager;

Treasurer: Dr. Koji Oguri, Aichi Prefectural University, Professor;

Technical Committee Chair: Dr. Takaya Yamazato, Nagoya University, Professor.

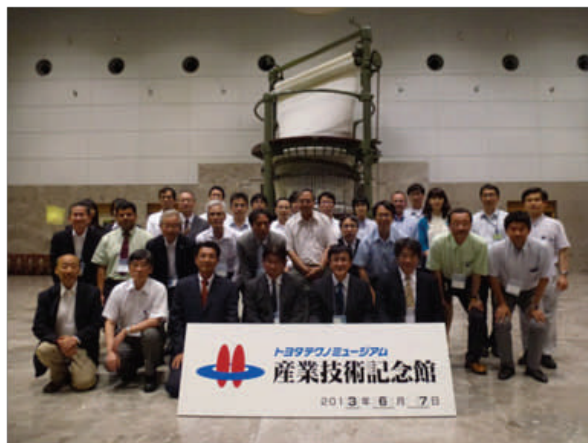


Fig. 2. Left: chapter board members (From left to right, Prof. Oguri, Dr. Wakita, Prof. Murase, Mr. Naito) and Chair of IEEE Nagoya Section, Prof. Mase. Right: part of the participants of the Formation Ceremony & Lecture.

Due to the secretary, Mr. Naito's great efforts, the petition with all necessary materials was sent to the IEEE on 1 April 2013, and was formally approved a month later, thanks to the supports of the ITSS President, Prof. Christoph Stiller and the VP for membership, Prof. Jason Geng. Currently the Nagoya Chapter has about 30 ITSS members (among about 1200 IEEE members in Nagoya Section). More information about the chapter can be found at <http://www.murase.m.is.nagoya-u.ac.jp/its-nagoya/index.html>. Although the IEEE ITSS is the international leader of the ITS R&D activities, many of the benefits that members obtain from IEEE are usually found at the local level. The ITSS Nagoya Chapter is aimed to connect the members with the IEEE ITSS and provide a platform at the local level for the members. In the first year, we are striving to meet the following accomplishments:

Formation of the Nagoya Chapter of the IEEE ITS Society

By Hiroshi Murase (Chair), Toshihiro Wakita (Vice Chair), and Chunzhao Guo (Member)

- Professional development: advance the professional skills and development of members through programs and events;
- Community service: promote mutually beneficial relations between members and local institutes and businesses;
- Membership: increase the involvement of members in chapter activities, retain members and recruit new members, particularly for the researchers related to ITS who are actually IEEE members but non ITSS members yet.
- Regular events: include technical and professional conferences/symposiums and joint events with other ITSS local chapters.

On 7 June 2013, the first formal chapter activity, i.e. the Formation Ceremony & Lecture, was held in the Toyota Commemorative Museum of Industry and Technology, which gathered about 70 participants from various institutes and companies of the Central Japan area (See Fig. 3).



Fig. 3. Example images of the Formation Ceremony & Lecture and the social party. Top left: Dr. Tokitsu and Prof. Tsugawa in their keynote speeches; Top right: old friends reunion after decades; Bottom left: Prof. Seiichi Mita's greeting at the social party; Bottom right: free conversations as well as excellent discussions between the diverse gatherings of personalities and backgrounds.

Formation of the Nagoya Chapter of the IEEE ITS Society

By Hiroshi Murase (Chair), Toshihiro Wakita (Vice Chair), and Chunzhao Guo (Member)

Brief highlights of the Formation Ceremony & Lecture include:

- Half of attendees are from academic institutes, such as Nagoya University, Toyota Technological Institute, Aichi Prefectural University, Meijo University, etc. The other half are from industrial companies, such as Toyota Central R&D Labs., Inc., DENSO Corporation, Aisin Seiki Co., Ltd., Tokai Rika, Co., Ltd., etc.
- The Chair, Prof. Murase, introduced the motivation and mission of the chapter.
- The Vice Chair, Dr. Wakita, introduced the chapter activity plans.
- Two distinguished researchers, i.e. Mr. Naoki Tokitsu, President of the Internet ITS Consortium, and Dr. Sadayuki Tsugawa, Professor of the Meijo University, were invited to give keynote speeches.
- About 40 attendees joined the social party after the Formation Ceremony & Lecture.

Mr. Tokitsu's keynote speech was about "the Integration of the Automobiles and the IT Society: Implementation Activities for the Automobile Cloud". In this talk, Mr. Tokitsu firstly introduced some of his past ITS R&D activities, including both failure cases and success cases. Then, he revealed the direction of the future automobile in his vision, i.e. Global automobile network, and discussed the role and activities of the Internet ITS Consortium with respect to the implementation of the internet ITS, such as probe cars, next generation security server system, smart phone ITS and automobile cloud.

In the other keynote speech, Prof. Tsugawa gave a talk titled "Subjects of ITS: Safety, Environment and Mobility". At the very beginning, Prof. Tsugawa pointed out that the ITS technology is the solution to the automobile traffic problem. After that, the specific subjects of ITS were addressed, including the pedestrian safety, elderly safety, deployment of advance driver assistance systems (ADAS), and implementation of autonomous driving systems. Particularly, the autonomous driving systems were discussed in details with a number of nowadays representative autonomous driving systems.

In the Formation Ceremony & Lecture and the social party, members meet others with similar interests in a familiar setting. Distinguished researchers share valuable information with their audiences who then have opportunities for questions, comments and further discussions. Needless to say, such a chapter activity, as well as the ones hereafter, can result in the formation of business contacts and friendships that frequently extend for many years. Currently, the ITSS Nagoya Chapter is planning to have more outstanding meetings and events in the future.

Hiroshi Murase (Chair), Toshihiro Wakita (Vice Chair), and Chunzhao Guo (Member).
Nagoya Chapter of the IEEE ITS Society.

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

Call for Nomination of Awards (Deadline Extension to July 31, 2013)

Purpose and Selection Criteria

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

Application Materials

Each application must consist of the following materials:

- (1) A summary statement (up to 3 pages) providing sufficient detail for evaluation of the innovations and impacts of the work.
- (2) At least 3 letters of recommendation from the recognized peer researchers, customers or users of the developed application, and organizations attesting to its significance and impact.

A dedicated selection committee will evaluate all qualified applications for the IEEE ITS Awards and make selections. Award selections will be announced October 2013 at the ITSC 2013 conference in Hague, Netherland, where the recipients will be asked to give featured presentations of their work.

Please email applications before **July 31, 2013** to ITSS Vice President of Membership:
jason.geng@ieee.org.

2013 IEEE Innovation in Societal Infrastructure Award

The IEEE is seeking nominations for the IEEE Innovation in Societal Infrastructure Award. This award was established in 2011 and is sponsored by Hitachi, Ltd. and IEEE Computer Society. It is presented to an individual, team, or multiple recipients up to three. It is for significant technological achievements and contributions to the establishment, development, and proliferation of innovative societal infrastructure systems through the application of information technology with an emphasis on distributed computing systems. The prize consists of a bronze medal, certificate, and cash honorarium. For further details, see http://www.ieee.org/about/awards/tfas/isi_award.html. If you have good candidate for nomination, please contact Matt Barth (barth@ee.ucr.edu).

Matthew Barth
ITSS President-Elect

Conference Report

2013 IEEE Intelligent Vehicles Symposium 23-26 June, Gold Coast, Australia

By Ljubo Vlacic, General Chair
Miguel Ángel Sotelo, IPC Co-Chair
Zoran Duric, IPC Co-Chair
Eduardo Nebot, Workshop Chair

The 2013 IEEE Intelligent Vehicles Symposium (IEEE-IV'13) was held in the City of Gold Coast, Australia, from 23 June to 26 June 2013. The IEEE-IV'13 is the premier annual forum sponsored by the IEEE Intelligent Transportation Systems Society (ITSS). The Symposium was also sponsored by the Gold Coast Tourism and Navteq. The first day of the Symposium is characterised by a number of workshops while the remaining three days are aimed at profiling oral session and poster session papers. In this year, the two distinctive features have been brought to the Symposium. Namely:

- IEEE-IV2013 was held back-to-back with the 2013 Intelligent Autonomous Vehicles Symposium of the International Federation of Automatic Control (IFAC-IAV2013). It is for the very first time, since their inception, that these two premier symposia are held in the same week and the same place, back-to-back.
- All workshop papers were reviewed based on the same quality rules as symposium papers. Consequently, each accepted and presented workshop paper will also be uploaded into the IEEEExplore database.

The achieved synergy between IEEE-IV'13 and IFAC-IAV'13 has been a significant as 32.89% IFAC-IAV'13 participants have also registered for IEEE-IV'13 thus contributing 9.12% to the IEEE-IV2013 registered cohort

The three workshops were held on the first day: (i) Workshop on Human Factors in Intelligent Vehicles; (ii) Workshop on Human Interaction with Intelligent Vehicles; and (iii) Workshop on Environment Perception and Navigation for Intelligent Vehicles.

The Symposium was addressed by three distinguished researchers: (i) Katsuhiro Nishinari of the University of Tokyo elaborated on his Jamology Theory aimed at solving traffic jam situations; (ii) Jack Singh of La Trobe University Australia presented field test results from testing his multimodal transport system solution; and (iii) Michel Parent of INRIA France elaborated on various cooperative driving schools of thoughts, differences and similarities.

The Symposium continued with its tradition of presenting its several awards. This time, the award recipients are:

Conference Report

2013 IEEE Intelligent Vehicles Symposium 23-26 June, Gold Coast, Australia

By Ljubo Vlacic, General Chair
Miguel Ángel Sotelo, IPC Co-Chair
Zoran Duric, IPC Co-Chair
Eduardo Nebot, Workshop Chair

The Best Symposium Paper Award – First Prize:

Christoph Roessing, Axel Reker, Michael Gabb, Klaus Dietmayer, and Hendrik P. A. Lensch for the paper entitled “*Intuitive Visualization of Vehicle Distance, Velocity and Risk Potential in Rear-View Camera Applications*”

The Best Symposium Paper Award – Second Prize:

Daniel Meissner, Stephan Reuter, and Klaus Dietmayer for the paper entitled “*Road User Tracking at Intersections Using a Multiple-Model PHD Filter*”

The Best PhD Student Paper Award – First Prize:

Laurent Caraffa and Jean-Philippe TAREL for the paper entitled “*Markov Random Field Model for Single Image Defogging*”

The Best PhD Student Paper Award – Second Prize:

Andreas Lawitzky, Daniel Althoff, Christoph Passenberg, Dirk Wollherr, and Martin Buss for the paper entitled “*Interactive Scene Prediction for Automotive Applications*”

The Best Poster Paper Award – the First Prize:

Takashi Bando, Kazuhito Takenaka, Shogo Nagasaka and Tadahiro Taniguchi for the paper entitled “*Unsupervised drive topic finding from driving behavioral data*”

The Best Poster Paper Award – the Second Prize:

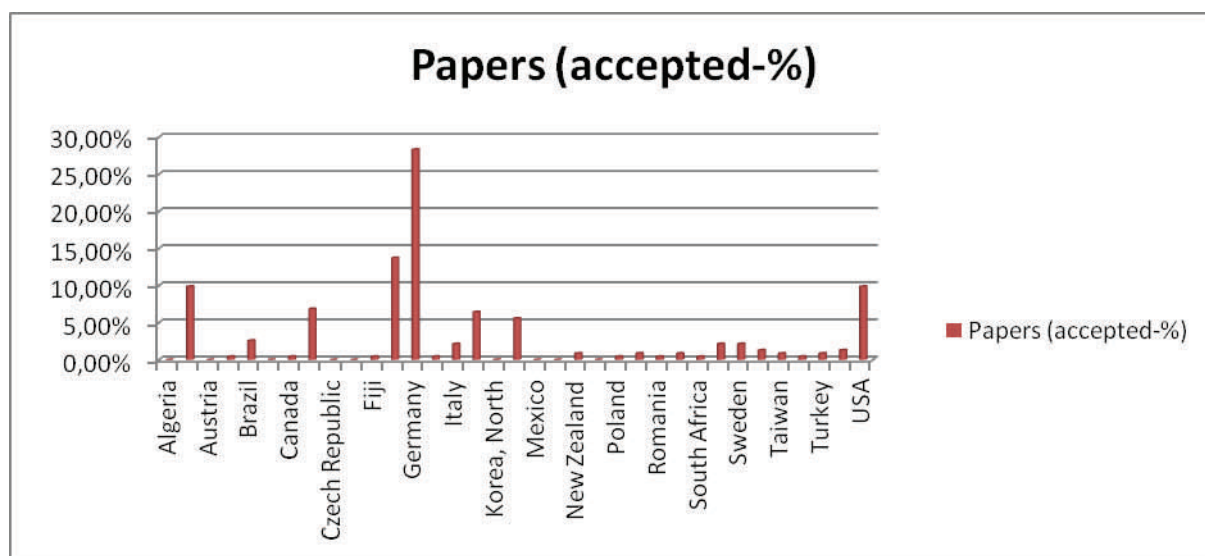
Nils Einecke and Julian Eggert for the paper entitled “*Stereo Image Warping for Improved Depth Estimation of Road Surfaces*”

The Symposium, together with its workshops, attracted 320 paper submissions (288 submissions to the Symposium and 32 submissions to Workshops). The total of 232 papers were accepted and included in the program (206 Symposium papers and 26 Workshop papers). Country contributions, measured in the terms of corresponding authors’ country of residence, are as follows:

Conference Report

2013 IEEE Intelligent Vehicles Symposium 23-26 June, Gold Coast, Australia

By Ljubo Vlacic, General Chair
Miguel Ángel Sotelo, IPC Co-Chair
Zoran Duric, IPC Co-Chair
Eduardo Nebot, Workshop Chair



The Symposium General Chair, the Symposium IPC Cho-chairs as well as the Workshop Chair, altogether, wish to offer their big thankyou to all paper co-authors as well as to paper reviewers for their enormous and valuable contributions to the Symposium.

All delegates have been invited to comment on the event by way of filling a Poste Event Evaluation Survey. By the time of writing this report only 21.5% delegates returned their survey results. Comments are still most welcome and the survey site will be closed from and after 22 July 2013. Thereafter, the detailed report will be submitted to ITSS including suggestions about new topics for the inclusion in the future IV symposia.

Conference Report**2013 IEEE Intelligent Vehicles Symposium
23-26 June, Gold Coast, Australia**

By Ljubo Vlacic, General Chair
Miguel Ángel Sotelo, IPC Co-Chair
Zoran Duric, IPC Co-Chair
Eduardo Nebot, Workshop Chair

	Excellent	Very Good	Average	Poor
Content	30.50%	54.50%	15%	
Catering	32.20%	49.15%	18.65	
Registration web site	16.90%	32.20%	37.3	13.6
Speakers Portal	25.40%	42.40%	32.20%	
Communication about the event	22%	50.80%	22.00%	5.20%
Venue & Location	54.20%	33.90%	11.90%	
Audio & Visual	30.50%	45.70%	11	12.80%
Length of Sessions	54.20%	33.90%	11.80%	0.10%
Overall organisation	49.15%	37.30%	10.15%	3.40%
Keynote speakers	30.50%	52.50%	17%	

Note: The table shows responses received by/before 11 July 2013

The Symposium General Chair, Ljubo Vlacic
The Symposium IP Co-Chairs, Miguel Ángel Sotelo & Zoran Duric
The Workshop Chair, Eduardo Nebot

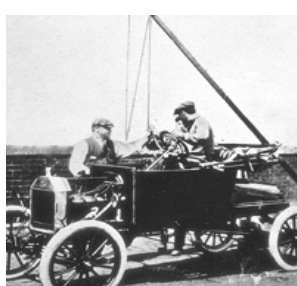
2014 IEEE Intelligent Vehicles Symposium

Sponsored by the IEEE Intelligent Transportation Systems Society
June 8 - 11, 2014, Ypsilanti, Michigan, USA

THE INTELLIGENT VEHICLES SYMPOSIUM (IV'14) 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 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
- Vehicular Safety, Active and Passive
- 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
- V2I / V2V 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 HMI
- Electric and Hybrid Technologies
- Novel Interfaces and Displays
- Intelligent Vehicle Software Infrastructure



SPECIAL and TUTORIAL SESSIONS are encouraged. Organizers should contact **Prof. Daniel J Dailey** at dan@uw.edu or **Prof. S. Tsugawa** at tsugawa@meijo-u.ac.jp.

PAPER SUBMISSION

Manuscripts must be electronically submitted through the conference website www.ieeeiv.net. 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

Special Session Proposal-----January 10, 2014
Paper submission deadline-----January 10, 2014
Notification of acceptance-----March 14, 2014
Final Paper Submission -----April 11, 2014

General Co-Chairs

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Keith Redmill

The Ohio State University, USA

6 - 9 October 2013

The Hague - The Netherlands
Steigenbergen Kurhaus Hotel



16th International IEEE Conference on Intelligent Transportation Systems

Intelligent Transportation Systems for All Transportation Modes

The IEEE Conference on Intelligent Transportation Systems is the annual flagship conference of the IEEE Intelligent Transportation Systems Society. IEEE-ITSC2013 welcomes articles in the field of Intelligent Transportation Systems, conveying new developments in theory, analytical and numerical simulation and modeling, experimentation, advanced deployment and case studies, results of laboratory or field operational tests.

The theme of the IEEE-ITSC2013 conference is Intelligent Transportation Systems for All Transportation Modes. Major advances in information and communication technology are enabling a vast array of new possibilities in transportation. ITS are emerging worldwide to make transportation more efficient, reliable, cleaner and safer. ITS are used in road, water, rail and air transportation to collect information about transportation flows from a multitude of sources and manage them effectively, shifting collective traffic and transportation management paradigms towards end user orientation.

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Shunsuke Kamijo (Asia/ Australia)

Miguel Angel Sotelo (Europe)

Program Topics

The technical areas include but are not limited to the following:

- Multi-modal ITS
- Advanced Public Transportation Management
- Ports, Waterways, Inland navigation, and Vessel Traffic Management
- Modeling, Simulation, and Control of Pedestrians and Cyclists
- Air, Road, and Rail Traffic Management
- ITS User services
- Emergency Management
- Transportation Networks
- Emissions, Noise, Environment
- Management of Exceptional Events: Incidents, Evacuation, Emergency Management
- Security Systems
- Safety Systems
- Driver and Traveler Support Systems
- Commercial Vehicle Operations
- Intelligent logistics
- Sensing and Intervening, Detectors and Actuators
- Data Management Systems
- Communication in ITS
- Cooperative Techniques and Systems
- Intelligent Vehicles
- Vision, and Environment Perception
- Electric Vehicle Transportation Systems
- Electronic Payment Systems
- Intelligent Techniques in ITS
- Traffic Theory for ITS
- Modeling, Control and Simulation
- Human Factors, Travel Behavior
- ITS Field Tests and Implementation

Paper submission

Complete manuscripts in PDF format must be electronically submitted for peer-review in IEEE standard format. Detailed submission instructions can be found through conference website.

Special Sessions, Tutorials, and Workshops

Special session organization is encouraged. Proposals for workshops, tutorials, and special sessions should be submitted via the conference submission website.

Best Paper Award and Best Student Paper Award

A "Best Paper Award" and a "Best Student Paper Award" will be conferred to the author(s) of a full paper presented at the conference, selected by the Awards Committee. The "Best Student Paper Award" will be given to a paper of which the first author is an MSc or PhD student.

Journal and Magazine Publication of Selected Papers

Selected papers of exceptional quality will be invited for submission to a special issue of the IEEE Transactions on Intelligent Transportation Systems or the IEEE Intelligent Transportation Systems Magazine. Authors will be asked to revise their papers according to the standards of the Transactions or the Magazine. The papers will be subject to the Transactions' and Magazine's review process.

Important Dates

Please visit the conference website at <http://ieee-itsc13.org/> for the deadlines.



Gemeente Den Haag



Special Issue on "Human Factors in Intelligent Vehicles"

IEEE Transactions on Intelligent Transportation Systems

An initiative of the Artificial Transportation Systems & Simulation (ATSS) Technical Activities Sub-Committee of IEEE ITS Society

Scope & Topics of Interest

The Special Issue on "Human Factors in Intelligent Vehicles" (HFIV) of IEEE Transactions on Intelligent Transportation Systems (IEEE T-ITS) aims to address issues related to the analysis of human factors in the design and evaluation of intelligent vehicles (IV) technologies, in a wide spectrum of applications and in different dimensions. We are pleased to welcome and to encourage prospective authors to contribute with manuscripts reporting on original research in different fields concerning HFIV.

HFIV Special Issue is planned and expected to build upon a proper environment to disseminate knowledge and motivate active discussion and interaction among the technical and the scientific communities, practitioners and students, leveraging state-of-the-art concepts, methodologies and cutting-edge results both to academia and to the Industry. Some topics of interest include (but are not limited to) the following:

- Intelligent user interfaces
- Human-machine interaction
- Human-in-the-loop simulation
- Cognitive and cultural aspects of driving
- Personality and emotions in driver interactions
- Human behavior and capability, affecting system design and operation
- Modeling and simulation in driver behavior analysis
- Ergonomics of traveler information systems
- Tools and approaches to analyze human factors
- Anthropometric layout of vehicular technical systems
- Methodologies to test, validate, calibrate and optimize overall system performance
- Virtual, augmented, and mixed realities
- Cross-Cultural Design
- Augmented Cognition
- User Experience and Usability
- Effects of in-vehicle systems on driver performance
- Tools and methodologies for usability assessment
- I/O modalities in system ergonomic design
- Anticipating reactions through learning and adaptation
- Methodologies for driver training
- Interactions with disabled-people and people with reduced mobility
- Accessibility of IV technologies
- Parallel Control and Management of Intelligent Vehicles

Manuscript Submission & Publication

Prospective authors are invited to submit contributions reporting on their current research on HFIV related areas and topics. Each paper will be analyzed by at least three reviewers of IEEE T-ITS according to their technical quality, relevance, results and contributions. Accepted papers will be included in the Special Issue on "Human Factors in Intelligent Vehicles" of IEEE T-ITS. Manuscripts must be submitted electronically at <http://mc.manuscriptcentral.com/t-its>

Guest Editors

Dr. Cristina Olaverri Monreal (olaverri@ife.mw.tum.de)
Institute of Ergonomics, Technische Universität München, Germany

Dr. Rosaldo J. F. Rossetti (rossetti@fe.up.pt)
Artificial Intelligence and Computer Science Laboratory, DEI/FEUP, University of Porto, Portugal

For more details and up-to-date information, please visit the HFIV Web page: [http://hfiv.ife.mw.tum.de/HFIV IEEE T-ITS/](http://hfiv.ife.mw.tum.de/HFIV%20IEEE%20T-ITS/)

Important Dates

The tentative schedule for the HFIV Special Issue is as follows:

- First submission deadline: Sept 15th, 2013.
- Notification of first decision: Nov 15th, 2013.
- Revision submission deadline: Jan 15th, 2014.
- Notification of final decision: Apr 15th, 2014.
- Final manuscript (camera ready) submission: May 1st, 2014.
- Issue of Publication: September 2014.

IEEE Transactions on Intelligent Transportation Systems

Special Issue Call for Papers

Next Generation Rail Operations

Throughout the world, many rails are heavily congested, resulting in services being very susceptible to minor delays and disturbances. Furthermore, there is pressure for rail to reduce their costs and carbon footprints. There is an opportunity for rail to adopt new methods to make better use of the existing capability of the system through improved rail operational strategies to reduce the impact of disruptions and to reduce energy utilisation. At a system level, in order to realise such approaches it is necessary to integrate a number of rail disciplines, for example, rail timetabling, rail operations, signalling and train control. This special issue will provide a platform for the communication of recent advances in rail transportation technology. The publication of this special issue follows the organization of IEEE International Conference on Intelligent Rail Transportation 2013 (IEEE ICIRT 2013), which is one of top international conferences on modern rail technology. IEEE ICIRT 2013 will centre on the topic of “Safe, Green & Intelligent Rail” and provide a forum for engineers and scientists in academia, industry and government to present their latest findings in any aspects of rail transportation. Those excellent papers which accepted by IEEE ICIRT 2013 will be recommended in first priority to publish in this special issue. The details of IEEE ICIRT 2013 can be found at <http://www.ieee-icirt.org/>

This special issue focuses on papers that present the ‘Next Generation of Rail Operations’. Papers could include, but not be limited to:

- Rail traffic operational control;
- Train control system;
- Human factors;
- Tools for system modelling, simulation and analysis;
- Automatic train operation;
- Train location technology;
- Real-time train scheduling and optimisation;
- Rail network complexity analysis.

Important dates

First submission deadline: Oct 15th, 2013.

Notification of first decision: Dec 15th, 2013.

Revision submission deadline: Feb 15th, 2014.

Notification of final decision: May 15th, 2014.

Final manuscript (camera ready) submission deadline: June 15th, 2014.

Issue of Publication: December 2014.

Submission

Manuscripts should be submitted at <http://mc.manuscriptcentral.com/t-its> by selecting the manuscript type ‘Special Issue on RailOps’.

Guest editors

Professor Bin Ning, Beijing Jiaotong University

Professor Tao Tang, Beijing Jiaotong University

Professor Clive Roberts, University of Birmingham

Professor Hairong Dong, Beijing Jiaotong University

Professor Felix Schmid, University of Birmingham

Contact Email: ieeeicirt@gmail.com



Conference Calendar

Massimo Bertozzi / Paolo Grisleri

Conference Calendar

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

2013

July 15-16

International Conference on Vehicular Electronics and Safety (ICVES 2013)

Stockholm, Sweden

Submissions due by: April 20

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

July, 17-19

ISTTT20 - the 20th International Symposium on Transportation and Traffic Theory

Noordwijk, the Netherlands

<http://www.isttt.net/isttt20/>

August 24-27

National Rural ITS Conference

St. Cloud, MN, USA

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

August 28-30

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

Hyderabad, India

<http://msc2013.org>

September 1-4

IEEE Vehicular Technology Conference: VTC2013-Fall

Las Vegas, NV, USA

<http://www.ieeevtc.org/vtc2013fall/>

September 5-6

ICCARV 2013: International Conference on Control, Automation, Robotics and Vision

Luzern, Switzerland

<https://www.waset.org/conferences/2013/luzern/iccarv/>

September 6-9
IEEE Intelligent Transportation Systems Conference
The Hague, The Netherlands
<http://ieee-itsc13.org>

September 11-13
ICIAP 2013 : International Conference on Image Analysis and Processing
Naples, Italy
<http://www.iciap2013-naples.org/>

September 25-27
International Conference on Sustainable Automotive Technologies
Ingolstadt, Germany
<http://www.icsat2013.com>

October 14-18
20th World Congress on ITS
Tokyo, Japan
<http://www.itsworldcongress.jp>

October 16-18
13th International Conference on ITS Telecommunication
Tampere, Finland
<http://www.itst2013.org/>

November 3-7
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2013)
Tokyo Big Sight, Tokyo, Japan
<http://www.iros2013.org>

November 9-13
17th IRF World Meeting and Exhibition
Riyadh, Saudi Arabia
http://irfnews.org/files/pdfs/121016_IRF_bro_H_WEB.pdf

2014

May 18-21, 2014
IEEE Vehicular Technology Conference: VTC2013-Spring
Seoul, Korea
Submission not yet opened. <http://www.ieeevtc.org/vtc2014spring/>

May 31-June 5, 2014
2014 IEEE International Conference on Robotics and Automation (ICRA 2014)
Hong Kong, China
Submission due by: August 15 <http://www.icra2014.com>

June 1-4, 2014

IEEE International Symposium on Industrial Electronics (ISIE 2014)

Istanbul, Turkey

Submission due by: November 30

<http://www.isie.boun.edu.tr>

June 4-7, 2014

10th ITS European Congress

Helsinki, Finland

<http://www.itsineurope.com/its10>

June 8-11, 2014

The 2014 IEEE Intelligent Vehicles Symposium

Ypsilanti, MI, USA

Submission due by: January 10, 2014

<http://www.ieeeiv.net>

June 23-28, 2014

27th IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2014)

Columbus, OH, USA

April 8-10, 2014

SAE 2014 World Congress & Exhibition

Detroit, Michigan, USA

September 7-11, 2014

Detroit, MI, USA

<http://www.itsa.org/events/2014-world-congress>

November 20-21, 2014

VISIGRAPP 2014: 9th International Joint Conference on Computer Vision, Imaging and Computer Graphic Applications

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

November 14-15, 2014

ICTTE 2014 : International Conference on Traffic and Transportation Engineering

Italy, Venice

<https://www.waset.org/conferences/2014/italy/ictte/index.php>

November 20-21, 2014

ICIAP 2014: International Conference on Image Analysis and Processing

Capetown, South Africa

<https://www.waset.org/conferences/2014/capetown/iciap/>

Abstracts of forthcoming papers on IEEE Transactions on ITS

A DIAGNOSTIC APPROACH FOR ADVANCED TRACKING OF COMMERCIAL VEHICLES WITH TIME WINDOW CONSTRAINTS

BOUFAIED, AMINE

In this paper we introduce a fleet supervision system used for the monitoring of on road evolutions of commercial transport vehicles. This monitoring is accomplished by the automatic dispatch, when crossing of a tracking location, of information issued from the localization system on the vehicle. This information can be sent to a server through a direct TCP/IP connection in a GPRS network or through a satellite network. The information is provided by the system to some allowed users via an Internet website. The fleet supervision system also enables analyzing messages sent by vehicles in order to identify differences between real data and those planned. We are more particularly interested in the diagnostic of delays which can take place during deliveries. In fact, while crossing already fixed tracking locations, these delays are detected as early as possible and their consequences predicted so that corrective or preventive actions are undertaken as soon as possible.

A HEAD-UP DISPLAY-BASED P300 BRAIN-COMPUTER INTERFACE FOR DESTINATION SELECTION

BI, LUZHENG; FAN, XIN-AN; LUO, NINI; JIE, KE; LI, YUN; LIU, YILI

In this paper, we propose a P300 brain-computer interface (BCI) with visual stimuli presented on a head-up display (HUD) and we apply this BCI for selecting destinations of a simulated vehicle in a virtual scene. To improve the usability of the selection system, we analyze the effects of the number of EEG (electroencephalogram) rounds on system performance. Experimental results from eight participants show that the BCI-based model of destination selection can be built with EEG data from eight channels, and participants can use this BCI to select a desired destination with an accuracy of $93.6\% \pm 1.6\%$ (mean value with standard error) in about twelve seconds of selection time. This work lays a foundation for developing vehicles that use a BCI to select a desired destination from a list of predefined destinations and then use an autonomous navigation system to reach the desired destination.

A MAC PROTOCOL USING ROAD TRAFFIC ESTIMATION FOR INFRASTRUCTURE-TO-VEHICLE COMMUNICATIONS ON HIGHWAYS

KIM, KYUNGHWI; LEE, JEONGBEEN; LEE, WONJUN

The development of vehicular communication technology can make more intelligent transportation systems by enabling a large number of potential applications. Especially, infrastructure-to-vehicle (I2V) communication will support intelligent transportation system (ITS) applications and provide inexpensive high-rate Internet access as well. Thus, study on I2V communications may improve the quality of experience of end-users in vehicles, such as drivers and passengers. To this end, we propose a MAC protocol for I2V communications to improve the fairness of node throughput while maximizing the expected system throughput. We derive the way of estimating road traffic to precisely control the transmission probability of vehicles for maximizing system throughput, and a criterion is presented to limit the number of transmitted packets for the fairness of the vehicles. The estimation is performed by utilizing the spacing distribution model in transportation systems, and the criterion is set based on the achievable node throughput. Through extensive simulations based on the empirical vehicular trajectory data, we demonstrate

the improved performance of the proposed MAC protocol. The test results show that the expected system throughput is increased more than 21.3% and Jain's fairness index with regard to the number of transmitted packets among the nodes is close to 1.

A TWO-DIMENSIONAL OPTIMAL VELOCITY MODEL FOR UNIDIRECTIONAL PEDESTRIAN FLOW BASED ON PEDESTRIAN'S VISUAL HINDRANCE FIELD

LV, WEI; SONG, WEIGUO; MA, JIAN; FANG, ZHIMING

Modeling and simulation of pedestrian movement is a feasible and effective way to evaluate evacuation facilities and risk. Inspired by the visual field and movement characteristic of pedestrians, we developed a two-dimensional continuous model that integrates self-slowness, local direction-changing mechanism and visual hindrance information. The model allows for the movement in continuous space and time, only controlled by simple kinematic equations and visual hindrance distribution. In order to get the parameters of the kinematic equations, we conducted controlled experiments, collected empirical data and obtained the velocity-changing and direction-changing relations. We then validate the model by simulating three experimental scenarios: passage, bottleneck and classroom evacuation. It is found that some typical phenomena such as the stop-and-go waves in the passage and lane formation in the bottleneck can be reproduced. The obtained fundamental diagram, and specific flow agree classic conclusions and experimental measures very well. It is hoped that the idea of this study may be helpful to promote the modeling and simulation study of pedestrian flow.

A UNIFIED APPROACH TO THREAT ASSESSMENT AND CONTROL FOR AUTOMOTIVE ACTIVE SAFETY

GRAY, ANDREW; ALI, MOHAMMAD; GAO, YIQI; HEDRICK, KARL; BORRELLI, FRANCESCO

This paper presents the design of a novel active safety system preventing unintended roadway departures. The proposed framework unifies threat assessment, stability, and control of passenger vehicles into a single combined optimization problem. A nonlinear Model Predictive Control (NMPC) problem is formulated where the nonlinear vehicle dynamics, in closed-loop with a driver model, is used to optimize the steering and braking actions needed to keep the driver safe. A model of the driver's nominal behavior is estimated based on his observed behavior. The driver commands the vehicle while the safety system corrects the driver's steering and braking action in case there's a risk that the vehicle will unintentionally depart the road. The resulting predictive controller is always active and mode switching is not necessary. We show simulation results detailing the behavior of the proposed controller as well as experimental results obtained by implementing the proposed framework on embedded hardware in a passenger vehicle. The results demonstrate the capability of the proposed controller to detect and avoid roadway departures while avoiding unnecessary interventions.

ADAPTIVE, PERSONALIZED TRAVEL INFORMATION SYSTEMS: A BAYESIAN METHOD TO LEARN USERS' PERSONAL PREFERENCES IN MULTI-MODAL TRANSPORT NETWORKS

ARENTZE, THEO

Providing personalized advice is an important objective in the development of advanced traveler information systems. In this study, a Bayesian method to incorporate learning of users' personal travel preferences in a multi-modal routing system is proposed. The system learns preference parameters incrementally based on travel choices a user makes. Existing Bayesian inference methods require too much computation time for the learning problem we are dealing with here. Therefore, an approximation method is developed which is based on sequential processing of preference

parameters and systematic sampling of the parameter space. Data of repetitive travel choices of a representative sample of individuals are used to test the system. The results indicate that the system adapts rapidly to a user and learns his or her preferences effectively. The efficiency of the algorithm allows the system to handle realistically sized learning problems with short response times even when many users are to be processed simultaneously. It is concluded therefore that the approach is feasible; problems for future research are identified.

AGGREGATING AND SAMPLING METHODS FOR PROCESSING GPS DATA STREAMS FOR TRAFFIC STATE ESTIMATION

ZHANG, JIADONG; XU, JIN; LIAO, SHAOYI

Because of significant improvements in cost, accuracy and coverage over dedicated traffic infrastructures, GPS-enabled mobile devices are preferred for continuous collection of traffic data. Estimating traffic states accurately from the obtained GPS data streams has great potential to increase efficiency of the existing traffic systems and help reduce commuting time and fuel consumption. In this paper, firstly, we propose a novel method to reasonably process GPS data by increasing weights of recent records and high velocity, rather than employing the current two extreme and popular approaches: the naive method aggregating all records with equal weights and the sliding window sampling method only preserving the most recent records. Then in line with the existing works, the proposed weighted approach is explored in two ways: aggregate-based and sampling-based. The aggregate-based way is classical but somewhat specific to the particular goal of traffic state estimation, while the sampling-based way is sort of complicated but provides a universal set of samples for performing a variety of analyses. In the sampling-based way, a heuristic method is proposed to accurately estimate traffic states using preserved samples. Both ways are leveraged to evaluate performance of the novel weighed method and the heuristic method for estimating traffic states using samples. Finally, the feasibility and effectiveness of these methods is experimentally validated using a field experiment dataset (Mobile Century) and three simulated datasets.

AN INS-AIDED TIGHT INTEGRATION APPROACH FOR RELATIVE POSITIONING ENHANCEMENT IN VANETS

ALAM, NIMA; KEALY, ALLISON; DEMPSTER, ANDREW

Relative positioning among vehicles is a fundamental parameter for advanced applications of Intelligent Transportation Systems (ITSs) such as collision avoidance and road safety. However, the level of positioning accuracy achievable using the Global Navigation Satellite Systems (GNSSs) does not meet the requirements of these applications. Cooperative Positioning (CP) techniques can be used for improving the performance of absolute or relative positioning in a Vehicular Ad hoc Network (VANET). The tight integration of Global Positioning System (GPS) data among communicating vehicles has already been introduced by the authors as a tight CP approach with specific advantages over Differential GPS (DGPS) for relative positioning. In this paper we propose an enhanced tight CP technique adding low-cost Inertial Navigation Sensors (INS) and GPS Doppler shifts. Based on analytical and experimental results, the new method outperforms its predecessor and DGPS by 10% and 24% respectively.

AN INTELLIGENCE-BASED OPTIMISATION MODEL OF PASSENGER FLOW IN A TRANSPORTATION STATION

YUEN, J.K.K.; LEE, E.W.M.; LO, S.M.; YUEN, R.K.K.

This paper proposes an intelligence-based approach to predicting passengers' route choice behaviour, which is crucial to the effective utilisation of transportation stations and affects passenger comfort and safety. The actual route choice

decisions of passengers are extremely difficult to mimic, as they involve human behaviour. A comprehensive methodology for capturing route choice behaviour is still lacking, because extensive labour and time resources are required to collect passenger movement data from different stations. In this study, a four-month site-survey was carried out to collect actual route choice behaviour information in nine transportation stations in Hong Kong during peak hours. We developed an intelligent model to capture passengers' route choice decision-making that achieved a prediction accuracy of 86%. The applicability of this intelligent route choice model is demonstrated by optimising the number of gates in a transportation station to inform the spatial design of the station.

AN ONLINE CHANGE POINT BASED MODEL FOR TRAFFIC PARAMETER PREDICTION

COMERT, GURCAN; BEZUGLOV, ANTON

This study develops a method for predicting traffic parameters under abrupt changes based on change point models. Traffic parameters such as speed, flow, and density are subject to shifts because of weather, accidents, and driving characteristics etc. An intuitive approach of employing Hidden Markov model and Expectation Maximization algorithm as change point models at these shifts and adapting the ARIMA forecasting model accordingly is formulated. The model is fitted and tested using publicly available 1993 I-880 loop data. It is compared with basic and mean updating forecasting models. Detailed numerical experiments are given on several days of data to show the impact of using change point models for adaptive forecasting models.

APPROXIMATION-BASED ROBUST ADAPTIVE AUTOMATIC TRAIN CONTROL: AN APPROACH FOR ACTUATOR SATURATION

GAO, SHIGEN; DONG, HAIRONG; CHEN, YAO; NING, BIN; GUANRONG, CHEN; YANG, XIAOXIA

This paper addresses an on-line approximation-based robust adaptive control problem for the automatic train operation (ATO) system under actuator saturation caused by constraints from serving motors. A robust adaptive control law is proposed, which is proved capable of on-line estimating the unknown system parameters and stabilizing the closed-loop system. To cope with the actuator saturation, another robust adaptive control is proposed for the ATO system, by explicitly considering the actuator saturation nonlinearity other than unknown system parameters, which is also proved capable of stabilizing the closed-loop system. Simulation results are presented to verify the effectiveness of the two proposed control laws.

AUTOMATIC QUALITY CONTROL OF TRANSPORTATION REPORTS USING STATISTICAL LANGUAGE PROCESSING

GERBER, MATTHEW; TANG, LU

The processes of developing, monitoring, and maintaining transportation systems produce large volumes of information. Human fieldworkers are often responsible for gathering this information and, despite their best efforts, will inevitably introduce errors into the collected data. This is a critical problem, since (1) the collected data are used to justify key infrastructure maintenance and development decisions, and (2) the volume of unstructured information (e.g., plain text) makes manual quality control prohibitively expensive. We introduce a solution to this problem in the example domain of vehicle accident reports. First, we analyzed a sample of accident reports and confirmed the existence of many data entry errors. Second, we developed and evaluated a statistical language processing approach that automatically identifies reports containing data entry errors. We tested a variety of system configurations on real-world data and compared their performance with multiple baseline methods. The best configuration achieved a performance score of 84%, far outperforming the baseline methods. Our results and analyses have significant quality control implications for any data source that pairs structured (e.g., coded fields) with unstructured text.

BEEJAMA: A DISTRIBUTED, SELF-ADAPTIVE VEHICLE ROUTING GUIDANCE APPROACH

WEDDE, HORST; SENGE, SEBASTIAN

We present and evaluate our distributed and selfadaptive vehicle routing guidance approach, termed BeeJamA, which provides drivers safely with routing directions well before each intersection. Our approach is based on a multi-agent system which is inspired by the honey bee foraging behavior. It relies on a distributed vehicle-to-infrastructure architecture. On the basis of microscopic traffic simulations under varying penetration rates we show that BeeJamA outperforms dynamic shortest path algorithms with respect to average (global) travel times and regarding congestion avoidance.

BRAKING PENALIZED RECEDING HORIZON CONTROL OF HEAVY HAUL TRAINS

ZHANG, LIJUN; ZHUAN, XIANGTAO

Incorporated with a receding horizon control (RHC) approach, a penalty method is proposed to reduce energy wasted by braking in a heavy haul train's operation. The train's practical nonlinear model is linearized to design the RHC controller. This controller is then applied to the train practical nonlinear dynamics and its performances are analyzed. In particular, the main focus in this study is on the brake penalty's impact on the train performances. Meantime, a fence method is presented to tackle two issues. The first one is that all the cars in a train cannot be controlled individually due to limit of available transmission channels for control systems in a long train. The other one is that the RHC approach suffers from heavy computation and memory load. Simulations verified that the brake penalty presented in the design can reduce a train's energy consumption and in-train forces remarkably without sacrificing the train's velocity tracking performance. Simulations also verified that the fence method is essential to reduce the related computation load when the RHC approach is applied to a long heavy haul train. Further, it is demonstrated that the fence method can effectively shorten computation time and reduce memory usage without severely jeopardizing the train's performance.

CONGESTION CONTROLLED COORDINATOR BASED MAC FOR SAFETY-CRITICAL MESSAGE TRANSMISSION IN VANETS

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

Vehicular Ad Hoc Network (VANET) provides the communication framework for dissemination of safety-critical messages such as beacons and emergency messages. The communication channel witnesses significant network load generated by frequently exchanged beacons. Under high density situations, it leads to serious scalability problem in VANET. Moreover, contention-based MAC protocols suffer from great number of packet collisions and as a result, the reliability and latency of safety messages are severely affected. Because of the periodic nature of beacons, TDMA can be a good choice over contention-based MAC. In this paper, we propose a congestion controlled coordinator based MAC (CCC-MAC) which is a time slot based medium access protocol that addresses beacons as well as emergency messages. Basically, the network is virtually partitioned into a number of segments. Within a segment, medium access is accomplished by using a time slot scheduling mechanism supervised by a local coordinator vehicle. A significant number of vehicles can be supported under the proposed configuration. In fact, the proposed scheduling mitigates channel congestion by reducing the transmission time of beacons through the use of multiple data rates. Bandwidth utilization is also improved by reusing the unoccupied time slots. Finally, CCC-MAC ensures fast and reliable propagation of emergency messages by employing a pulse-based reservation mechanism. In the simulations, we demonstrate the ability of CCC-MAC to scale well in different vehicular density scenarios. Moreover, it outperforms existing MAC layer protocols with respect to packet reception probability and latency of safety messages.

CONTEXT-AWARE AND ENERGY-DRIVEN ROUTE OPTIMIZATION FOR FULLY ELECTRIC VEHICLES

WANG, YAN; JIANG, JIANMIN; MU, TINGTING

Route planning for fully electric vehicles (FEV) must take energy efficiency into account due to limited battery's capacity and time-consuming recharging. Besides, the planning algorithm should allow for negative energy costs in the road network due to regenerative braking which is a unique feature of FEVs. In this paper, we propose a framework for energy driven and context aware route planning for FEVs. It has two novel aspects: (a) Context aware: The framework has access to real time traffic data for routing cost estimation. (b) Energy driven: Both time and energy efficiency are accounted, which implies a bi-objective nature of the optimization. Besides, in case of insufficient energy on-board, an optimal detour via recharge points is computed. Our main contributions to address the above issues can be highlighted as follows: (1) A vehicle-to-vehicle (V2V) communication protocol is proposed to realize the context awareness. (2) We replace the original bi-objective form of optimality with two single objective forms and a constrained A* (CA*) algorithm is proposed to find the solutions. The algorithm maintains a Pareto front while confines its search by energy constraints. The best recharging detour can also be found by the algorithm. We firstly compared the performance of CA* with other algorithms. We then evaluate the impact of the context awareness on road traffic by simulations using a realistic road network regarding different forms of optimality. Finally we show that CA* can effectively produce optimal recharging detours.

COOPERATIVE INERTIAL NAVIGATION FOR GNSS CHALLENGED VEHICULAR ENVIRONMENTS

ALAM, NIMA; KEALY, ALLISON; DEMPSTER, ANDREW

Cooperative Positioning (CP) is an approach for positioning and/or positioning enhancement among a number of participants which communicate and fuse their position-related information. Due to the shortcomings of Global Navigation Satellite Systems (GNSSs), modern CP approaches are considered for improving vehicular positioning where the GNSS cannot address the requirements of the specific applications such as collision avoidance or lane-level positioning. Inertial Navigation System (INS) has not been considered for CP in the literature. The hybrid INS/GNSS methods used for positioning enhancement in standalone nodes cannot be classified as CP because the position-related data are not communicated between at least two independent entities. In this work, we present a novel CP technique to improve INS-based positioning in vehicular networks. This Cooperative Inertial Navigation (CIN) method can be used to enhance INS-based positioning in difficult GNSS environments, such as in very dense urban areas and tunnels. In the CIN method proposed, vehicles communicate their Inertial Measurement Unit (IMU) and INS-based position data with on-coming vehicles travelling in the opposite direction. Each vehicle fuses the received data with those locally observed and the Carrier Frequency Offset (CFO) of the received packets to improve the accuracy of its position estimates. The proposed method is analysed using simulations and verified experimentally. The experimental results show up to 72% improvement in positioning over the standalone INS-based method.

COOPERATIVE POSITIONING FOR VEHICULAR NETWORKS:FACTS AND FUTURE

ALAM, NIMA; DEMPSTER, ANDREW

Intelligent Transportation Systems (ITSs) are increasingly being considered to mitigate the impacts of road transportation including road injuries, energy waste, and environmental pollution. Vehicular positioning is a fundamental part of many ITS applications. Although Global Navigation Satellite Systems (GNSSs), for example the Global Positioning System (GPS), are applicable for navigation and fleet management, the accuracy and availability of GNSS do not meet the requirements for some applications including collision avoidance or lane-level positioning. Cooperative Positioning (CP) based on vehicular communication is an approach to tackle these shortcomings. The applicability of vehicular CP techniques proposed in the literature is questionable due to viability issues including inter-node distance estimation which is an important part of many CP techniques. Conventional CP systems such as

Differential GPS (DGPS) and other augmentation systems are also effectively incapable of addressing the ITS applications mentioned. In this work, modern and conventional CP systems are discussed and the viability of radio ranging/range-rating and constraints of vehicular communication as main pieces of modern CP systems are investigated. The general performance boundaries for modern CP systems are explained as is the gap existing between the positioning accuracy required for crucial ITS applications and what modern CP can provide. This is followed by introduction of a novel trend for vehicular CP research, a potential reliable solution using a modified concept of Real Time Kinematic (RTK) GPS for vehicular environments.

COOPERATIVE REGULATION AND TRADING OF EMISSIONS USING PLUG-IN HYBRID VEHICLES

SCHLOTE, ARIEH; HÄUSLER, FLORIAN; HECKER, THOMAS; BERGMANN, ASTRID; CRISOSTOMI, EMANUELE; RADUSCH, ILJA; SHORTEN, ROBERT

We present a new approach to regulating traffic related pollution in urban environments by utilising hybrid vehicles. To do this we orchestrate the way each vehicle in a large fleet chooses its engine mix based on simple communication signals from a central infrastructure. Our approach can be viewed both as a control algorithm and an optimisation algorithm. The primary goal is to regulate emissions and we discuss a number of control strategies to achieve this; secondly we want to allocate the available pollution budget in a fair way among the participating vehicles and again we explore several different notions of fairness that can be achieved. The efficacy of our approach is exemplified both by the construction of a proof of concept vehicle and by extensive simulations and verified by mathematical analysis.

DESIGN, ANALYSIS AND VALIDATION OF A HAPTIC-BASED DRIVER SUPPORT SYSTEM FOR TRACTION CONTROL

CORNO, MATTEO

This paper presents the design of a driver support system for the manual acceleration control of a car. The aim of the system is that of assisting the driver safely accelerating on a slippery surface. A force feedback (haptic) gas pedal guides the driver toward applying the correct throttle; the haptic-based approach enables the driver to override the system if needed. Three main issues are addressed: 1) the choice of the feedback law 2) the stability of the haptic interaction at the neuro-musculo-skeletal level, formally analyzed through the passivity framework and 3) the tuning and validation of the system. An experimental campaign, carried out with a driver-in-the-loop simulator in two driving scenarios, shows that the system improves safety without negatively affecting performance. The occurrences of loss of control are reduced from 35% without haptic feedback to 10% with haptic feedback. The subjective feedback from the test drivers is also analyzed, showing acceptance

DYNAMIC QUEUING NETWORK MODEL FOR FLOW CONTINGENCY MANAGEMENT

WAN, YAN; TAYLOR, CHRISTINE; ROY, SANDIP; WANKE, CRAIG; ZHOU, YI

We introduce a queuing-network model that can comprehensively represent traffic-flow dynamics and flow-management capabilities in the United States National Airspace System (NAS). We envision this model as a framework for tractably evaluating and designing coordinated flow-management capabilities at a multi-Center or even NAS-wide spatial scale, and at a strategic (2-15 hour) temporal horizon. As such, the queuing-network model is expected to serve as a critical piece of a strategic flow-contingency management solution for the Next Generation Air Traffic System (NextGen). Based on this perspective, we outline in some detail the evaluation and design tasks that can be performed using the model, as well as the construction of the flow network underlying the model. Finally, some examples are presented – including one example that replicates traffic in Atlanta Center on an actual bad-weather day – to illustrate simulation of the model and interpretation/use of model outputs.

EFFECTIVENESS OF PHYSIOLOGICAL AND PSYCHOLOGICAL FEATURES TO ESTIMATE HELICOPTER PILOTS' WORKLOAD: A BAYESIAN NETWORK APPROACH

BESSON, PATRICIA; BOURDIN, CHRISTOPHE; BRINGOUX, LIONEL; DOUSSET, ERICK; MAÏANO, CHRISTOPHE; MARQUESTE, TANGUY; MESTRE, DANIEL; GAETAN, SOPHIE; BAUDRY, JEAN-PIERRE; VERCHER, JEAN-LOUIS

Despite growing interest over the decades, the question of estimating cognitive workload of operators involved in complex multitask operations, such as helicopter pilots, remains a key issue. One of the main difficulties facing workload inference models is that no single specific indicator of workload exists, so that multiple sources of information have to be inputted to the model. The question then arises as to the nature and the quantity of features to be used for increasing model performance. In this research, done in cooperation with Eurocopter, the effectiveness of physiological, psychological and cognitive features for estimating helicopter pilots' workload was systematically investigated, using Bayesian networks. The study took place in two different contexts: a constrained laboratory situation with low ecological validity and a more realistic and challenging situation relying on virtual reality. The constrained conditions of the laboratory study allowed us for testing various combinations of entropy-based physiological, cognitive and affect features as inputs of Bayesian network models. These three different kinds of features are shown to carry complementary information that can be used with advantage by the model. The results also suggest that increasing the number of physiological inputs improves the model performance. The second study aimed at challenging some of these conclusions in a more ecological context, by using the NH90 full flight simulator of the Helisim company. The results emphasize the problem of accessing the ground truth as well as the need for an efficient feature selection or extraction step prior to the classification step.

EXTENSIVE TESTS OF AUTONOMOUS DRIVING TECHNOLOGIES

BROGGI, ALBERTO; BUZZONI, MICHELE; DEBATTISTI, STEFANO; GRISLERI, PAOLO; LAGHI, MARIA CHIARA; MEDICI, PAOLO; VERSARI, PIETRO

This paper presents VisLab's vision on future automated vehicles, ranging from sensors selection up to their extensive testing. VisLab's design choices are explained using the BRAiVE autonomous vehicle prototype as an example: BRAiVE, specifically designed to develop, test, and demonstrate advanced safety applications with different automation levels, features a high integration level and a low-cost sensor suite, mainly based on vision as opposed to many other autonomous vehicle implementations based on expensive and invasive sensors. The importance of performing extensive tests to validate the design choices is considered as a hard requirement and different tests have been organized, including an intercontinental trip from Italy to China. The paper also presents the test, the main challenges, and the vehicles that have been specifically developed for this test, which was performed by 4 autonomous vehicles based on BRAiVE's architecture. The paper also includes final remarks on VisLab's perspective on future vehicle's sensor suite.

FORWARD-BACKWARD MEAN-SHIFT FOR VISUAL TRACKING WITH LOCAL BACKGROUND WEIGHTED HISTOGRAM

WANG, LINGFENG; YAN, HONGPING; WU, HUAIYU; PAN, CHUNHONG

Object tracking plays an important role in many intelligent transportation systems. Unfortunately, it remains a challenging task due to some factors such as occlusion and target appearance variation. In this work, we present a new tracking algorithm to tackle the difficulties caused by the two factors. First, considering the target appearance variation, we introduce the local background weighted histogram (LBWH) to describe the target. In our LBWH, the local background is treated as the context of the target representation. Compared with traditional descriptors, LBWH is more robust to the variability or clutter of the potential background. Second, to deal with the occlusion case, a new forward-backward mean-shift (FBMS) algorithm is proposed by incorporating a forward-backward evaluation scheme,

in which the tracking result is evaluated by the forward-backward error. Extensive experiments on various scenarios have demonstrated that our tracking algorithm outperforms the state-of-the-art approaches in tracking accuracy.

HYBRIDISATION OF NONLINEAR AND MIXED INTEGER LINEAR PROGRAMMING FOR AIRCRAFT SEPARATION WITH TRAJECTORY RECOVERY

OMER, JÉRÉMY; FARGES, JEAN-LOUP

The approach presented in this article aims at finding a solution to the problem of conflict-free motion planning for multiple aircraft on the same flight level with trajectory recovery. One contribution of this work is to develop three consistent models, from a continuous-time representation to a discrete-time linear approximation. Each of these models guarantees separation at all times as well as trajectory recovery, but they are not equally difficult to solve. A new hybrid algorithm is thus developed in order to use the optimal solution of a mixed integer linear program as a starting point when solving a nonlinear formulation of the problem. The significance of this process is that it always finds a solution when the linear model is feasible while still taking into account the nonlinear nature of the problem. A test bed containing numerous data sets is then generated from three virtual scenarios. A comparative analysis with three different initialisations of the nonlinear optimisation validates the efficiency of the hybrid method.

INTEGRATED URBAN TRAFFIC CONTROL FOR THE REDUCTION OF TRAVEL DELAYS AND EMISSIONS

LIN, SHU; DE SCHUTTER, BART; XI, YUGENG; HELLENDORRN, HANS

Refining transportation mobility and improving the living environment are two important issues that need to be addressed in urban traffic. In order to reduce traffic delays as well as traffic emissions for urban traffic networks, this paper first proposes an integrated macroscopic traffic model that integrates a macroscopic urban traffic flow model with a microscopic traffic emission model for individual vehicles. This integrated model is able to predict the traffic flow states, as well as the emissions released by every vehicle at different operational conditions, i.e. the speed and the acceleration. Then, Model Predictive Control is applied to control urban traffic networks based on this integrated traffic model, aiming at reducing both travel delays and traffic emissions of different gases. Finally, simulations are performed to assess this multi-objective control approach. The obtained simulation results illustrate the control effects of the model predictive controller.

KING'S GRAPH BASED NEIGHBOR VEHICLE MAPPING FRAMEWORK

MARIA JOSEPH, XAVIER PUNITHAN; SEO, SEUNG-WOO

Vehicle localization algorithms aim to provide accurate location estimation of neighbor vehicles for critical applications in intelligent vehicles. For initial location estimation, localization algorithms use either Global Positioning System (GPS) or radio based lateration techniques, or both. These techniques suffer from three major issues, namely flip ambiguities, location information exchange (beacon) overhead and forged relative location information. The accuracy of these algorithms at the early iterations primarily affected by flip ambiguities which in turn result in erroneous initial location estimates. These errors are a monotonically increasing function of time and propagated to the subsequent iterations to build an erroneous neighbor vehicle map. In this paper, we propose a novel GPSfree vehicle mapping framework that provides reliable initial relative position estimates of neighbor vehicles that mitigates aforementioned issues. This framework uses presence/absence status information of neighbor vehicles in binary form from a vision based environment sensor system to associate a vehicle's cardinal location with its identification information such as MAC/IP addresses. We represent a vehicle's neighborhood region and neighborhood topology using Moore neighborhood and King's graph, respectively, by analysing the vehicle formations in a multi-lane roadway. We also introduce a King's graph based neighborhood information overlap measurement algorithm for

neighbor mapping by exploiting the perspective symmetric properties of Moore neighborhood. Performance analysis and simulation results show that the proposed algorithm builds an accurate relative neighbor vehicle map and outperforms trilateration and multilateration methods in mitigating flip ambiguities and location information exchange overhead.

LOOKING AT VEHICLES ON THE ROAD: A SURVEY OF VISION-BASED VEHICLE DETECTION, TRACKING, AND BEHAVIOR ANALYSIS

SIVARAMAN, SAYANAN; TRIVEDI, MOHAN

This document provides a review of the literature in on-road vision-based vehicle detection, tracking, and behavior understanding. Over the past decade, vision-based surround perception has progressed from its infancy into maturity. We provide a survey of recent works in the literature, placing vision-based vehicle detection in the context of sensor-based on-road surround analysis. We detail advances in vehicle detection, discussing monocular, stereo-vision, and active sensor-vision fusion for on-road vehicle detection. We discuss vision-based vehicle tracking in the monocular and stereo-vision domains, analyzing filtering, estimation, and dynamical models. We discuss the nascent branch of intelligent vehicles research concerned with utilizing spatio-temporal measurements, trajectories, and various features to characterize on-road behavior. We provide discussion on the state-of-the-art, detail common performance metrics and benchmarks, and provide perspective on future research directions in the field.

MARV-X: APPLYING MANEUVER ASSESSMENT FOR RELIABLE VERIFICATION OF CAR-TO-X MOBILITY DATA

FIRL, JONAS; STUEBING, HAGEN; HUSS, SORIN; STILLER, CHRISTOPH

Advanced Driver Assistance Systems (ADAS) employ single object information to provide safety, comfort, or infotainment features. While today's systems use common sensors like radar or camera to recognize and predict the future states of relevant traffic participants, next generation ADAS will also use data from additional sources like, e.g., Car-to-X (C2X) communication networks. We present a method, which uses information on other traffic participants and furthermore recognizes and considers their interactions in terms of traffic maneuvers. For this purpose, a probabilistic approach is presented, which identifies object interactions as well as different road characteristics. This method may find especially application in the C2X domain for evaluating the mobility of neighboring vehicles based on received messages. In this work we present MARV-X (Maneuver Assessment for Reliable Verification of Car-to-X mobility data), a tool embodying a two-stage process for reliable C2X mobility data verification. The first stage consists of a dedicated mobility estimator realized by a Kalman filter. In the second stage a plausibility check for highly dynamic traffic situations is applied using the advocated probabilistic traffic maneuver recognition. MARV-X is fully integrated into the vehicle's C2X architecture. Its effectiveness is demonstrated by means of extensive real world experiments.

MINIMAL-ENERGY DRIVING STRATEGY FOR HIGH-SPEED ELECTRIC TRAIN WITH HYBRID SYSTEM MODEL

LI, LIANG; DONG, WEI; JI, YINDONG; ZHANG, ZENGKE; TONG, LANG

This paper studies the minimal-energy driving strategy for high-speed electric train with fixed travel time. A hybrid system model is proposed to describe the new characteristics of high-speed electric train, including the extended speed range, energy efficiency and regenerative brake. Based on this model, the driving of train is characterized by the gear sequence and the switching locations. An approximate gradient information is derived via the variational principle. To avoid the combinatorial explosion, the gear sequence is fixed by a priori knowledge. Then a gradient-

based exterior point method is proposed to calculate the optimal driving. In case study, the minimal-energy driving with fixed travel time for CRH3 is investigated, and the result reveals some new understandings for high-speed electric train drive. Additionally, the trade-off relationship between energy consumption and travel time is quantitatively studied, which is helpful to assign an appropriate travel time for high-speed train.

MODELING PEDESTRIAN CROSSING PATHS AT UNMARKED ROADWAY

ZHUANG, XIANGLING; WU, CHANGXU

At the unmarked roadway, pedestrians cross the road with changing speeds and directions that result in curved paths and high chances of road accidents. However, few computational models have been built to address the mechanisms behind the curved paths in crossing unmarked roadways. To better understand pedestrian behaviors and finally facilitate their safety, this study modeled pedestrian paths at the unmarked roadway as a result of the decision making process where pedestrians try to minimize discomfort by weighing perceived risk with efficiency. Perceived risk is assumed to come from vehicles and specific positions on the road. Efficiency is modeled by the deviation from destination. The modeling mechanisms are consistent with existing theories, enhancing the understanding of pedestrian crossing behavior mechanisms at the unmarked roadway rather than treating the crossing process as a black box. The observed 135 pedestrian paths at two unmarked roadways in the real-world were used to compare with the model's predictions. The potential applications of the model in exploring pedestrian position distribution at a crossing site, and improving pedestrian presentation in existing driving simulators and intelligent transportation systems are discussed, as well as its limitations.

OPTIMIZATION OF FUEL COST AND EMISSIONS USING V2V COMMUNICATIONS

ALSABAAN, MAAZEN; NAIK, KSHIRASAGAR; KHALIFA, TAREK

Vehicular communication networks are increasingly being considered as a means to conserve fuel and reduce emissions within transportation systems. This paper focuses on using traffic light signals to communicate with approaching vehicles. The communication can be traffic light signal-to-vehicle (TLS2V) and vehicle-to-vehicle (V2V). Based on the information sent, the vehicle receiving the message adapts its speed to a recommended speed ($S_{R\</sub>}$), which helps the vehicle reduce fuel consumption and emissions. The key contribution of this paper is proposing a comprehensive optimization model that involves V2V and TLS2V communications. The objective function is to minimize fuel consumption by and emissions from the vehicles. The speed that can achieve this goal is the optimum $S_{R\</sub>}$ ($S_{R\</sub>}$ *). We also propose efficient heuristic expressions to compute the optimum or near-optimum value of $S_{R\</sub>}$.

PART-BASED PEDESTRIAN DETECTION AND FEATURE-BASED TRACKING FOR DRIVER ASSISTANCE: REAL-TIME, ROBUST ALGORITHMS AND EVALUATION

PRIOLETTI, ANTONIO; MØGELMOSE, ANDREAS; GRISLERI, PAOLO; TRIVEDI, MOHAN; BROGGI, ALBERTO; MOESLUND, THOMAS

Detecting pedestrians is still a challenging task for automotive vision system due the extreme variability of targets, lighting conditions, occlusions, and high speed vehicle motion. A lot of research has been focused on this problem in the last 10 years and detectors based on classifiers has gained a special place among the different approaches presented. This work presents a state-of-the-art pedestrian detection system based on a two stages classifier. Candidates are extracted with a Haar cascade classifier trained with the DaimlerDB dataset and then validated through part-based HOG classifier with the aim of lowering the number of false positives. The surviving candidates are

then filtered with a feature-based tracking to enhance the recognition robustness and improve the results' stability. The system has been implemented on a prototype vehicle and offers high performance in terms of several metrics, such as detection rate, false positives per hour, and frame rate. The novelty of this system rely in the combination of HOG part-based approach, tracking based on specific optimized feature and porting on a real prototype.

PERSON-BASED TRAFFIC RESPONSIVE SIGNAL CONTROL OPTIMIZATION

CHRISTOFA, ELENÍ; PAPAMICHAIL, IOANNIS; SKABARDONIS, ALEX

This paper presents a person-based traffic responsive signal control system for transit signal priority on conflicting transit routes. A mixed integer nonlinear program is formulated that minimizes total person delay at an intersection while assigning priority to the transit vehicles based on their passenger occupancy. The mathematical formulation marks an improvement to previous formulations in that it ensures global optimality for undersaturated traffic conditions and intersection design and traffic characteristics that lead to convex objective functions in reasonable computation time for real-time applications. The system has been tested for a complex signalized intersection located in Athens, Greece, which is characterized by multiple bus lines traveling in conflicting directions. Testing includes cases with deterministic vehicle arrivals at the intersection as well as emulation-in-the-loop simulation tests that incorporate stochasticity in the vehicle arrivals. The results show that the proposed person-based traffic responsive signal control system reduces total person delay at the intersection and effectively provides priority to transit vehicles even when perfect information about the auto and transit arrivals at the intersection is not available.

PLANNING AUTONOMOUS VEHICLES IN THE ABSENCE OF SPEED LANES USING AN ELASTIC STRIP

KALA, RAHUL; WARWICK, KEVIN

Planning of autonomous vehicles in the absence of speed lanes is a little researched problem. Yet it is an important step towards extending the possibility of autonomous vehicles to countries where speed lanes are not followed. The advantages of having non-lane oriented traffic include larger traffic bandwidth and more overtaking, features which are highlighted when vehicles vary in terms of speed and size. In the most general case the road would be filled with a complex grid of static obstacles and vehicles of varying speeds. The optimal travel plan consists of a set of maneuvers which enable a vehicle to avoid obstacles, overtake vehicles in an optimal manner and in turn enable other vehicles to overtake. Desired characteristics of such a planning scenario include near-completeness and near-optimality in real-time with an unstructured environment; with vehicles essentially displaying a high degree of cooperation and enabling every possible (safe) overtaking procedure to be completed as soon as possible. Challenges addressed in this paper include a (fast) method for initial path generation using an elastic strip, (re-) defining the notion of completeness specific to the problem, and inducing the notion of cooperation in the elastic strip. Using this approach, vehicular behaviors of overtaking, cooperation, vehicle following, obstacle avoidance, etc. are demonstrated

PREDICTING TAXI-PASSENGER DEMAND USING STREAMING DATA

MOREIRA-MATIAS, LUÍS; GAMA, JOÃO; FERREIRA, MICHEL; MENDES-MOREIRA, JOÃO; DAMAS, LUIS

Informed driving is increasingly becoming a key feature to increase the sustainability of taxi companies. The sensors installed in each vehicle are providing new opportunities to automatically discover knowledge, which in return deliver information for real-time decision-making. Intelligent transportation systems for taxi dispatching and for finding time-saving route are already exploring this sensing data. This paper introduces a novel methodology to predict the spatial distribution of taxi-passenger for a short-term time horizon using streaming data. Firstly, the information was aggregated into a histogram time series. Then, three time series forecasting techniques were combined to originate a prediction. Experimental tests were conducted using the online data transmitted by 441 vehicles of a fleet running in

the city of Porto, Portugal. The results demonstrated that the proposed framework can provide an effective insight on the spatiotemporal distribution of taxi-passenger demand for a 30 minutes horizon.

PSEUDORANGES ERROR CORRECTION IN PARTIAL GPS OUTAGES FOR NON-LINEAR TIGHTLY-COUPLED INTEGRATED SYSTEM

IQBAL, UMAR; GEORGY, JACQUES; ABDELFAH, WALID F.; KORENBERG, MICHAEL; NOURELDIN, ABOELMAGD

Integrated navigation systems based on the tightly-coupled integration scheme utilize pseudoranges and pseudorange rates from the orbiting satellites measured by the GPS receiver, instead of the position and velocity computed by the receiver and used in loosely-coupled integration when at least four satellites are visible. The positioning accuracy is highly dependent on the accuracy of the pseudoranges whose residual errors can deteriorate the overall positioning accuracy. The integrated system can be improved by the provision of more accurate pseudoranges, which is feasible by robustly modeling the residual correlated errors. Parallel Cascade Identification (PCI), a non-linear system identification technique, is utilized to model these correlated errors. To address the non-linear error characteristics in the whole integrated navigation system, Mixture Particle filter (M-PF), a nonlinear filtering technique is employed to perform tightly-coupled integration of three-dimensional reduced inertial sensors system (RISS) with GPS. This paper proposes a solution that exploits the fact that PF can accommodate the PCI models of the pseudoranges errors in the measurement model of the filter. PCI models for the residual error of the pseudorange measurement from each visible satellite are built when four or more satellites are available. When less than four satellites are visible, the identified models for the still visible satellites are used to estimate the residual pseudorange errors. This improvement in pseudorange measurements provides further accurate aiding update for RISS. The results demonstrate the advantages of using M-PF-PCI for correcting the pseudoranges and enhancing the positioning solution as compared to M-PF-only, KF-PCI and KF-only solutions.

REAL-TIME ROAD SLOPE ESTIMATION BASED ON INTEGRATION OF ON-BOARD SENSORS WITH GPS USING AN IMMPDA FILTER

SUNWOO, MYOUNGHO; JO, KICHUN; KIM, JUNSOO

This paper proposes a road slope estimation algorithm to improve the performance and efficiency of intelligent vehicles. The algorithm integrates three types of road slope measurements from a GPS receiver, automotive on-board sensors, and a longitudinal vehicle model. The measurement integration is achieved through a probabilistic data association filter (PDAF) that combines multiple measurements into a single measurement update by assigning statistical probability to each measurement and removing faulty measurement via the false alarm function of the PDAF. In addition to the PDAF, an interacting multiple-model filter (IMMF) approach is applied to the slope estimation algorithm in order to allow adaptation to various slope conditions. The model-set of the IMMF is composed of a constant slope road model (CSRM) and a constant rate slope road model (CRSRM). The CSRM assumes that the slope of the road is always constant, and the CRSRM assumes that the slope of the road changes at a constant rate. The IMMF adapts the road slope model to the driving conditions. The developed algorithm is verified and evaluated through experimental and case studies using a real-time embedded system. The results show that the performance and efficiency of the road slope estimation algorithm is accurate and reliable enough to apply to intelligent vehicle applications.

REASONING-BASED FRAMEWORK FOR DRIVING SAFETY MONITORING USING DRIVING EVENT RECOGNITION

WU, BING-FEI; CHEN, YING-HAN; YEH, CHUNG-HSUAN; LI, YEN-FENG

With the growing concern for driving safety, many driving assistance systems have been developed. In this study, we develop a reasoning-based framework for the monitoring of driving safety. The main objective is to present drivers with an intuitively understood green/yellow/red indicator of their danger level. Because the danger level may change owing to the interaction of the host vehicle and the environment, the proposed framework involves two-stages of danger-level alerts. The first stage collects the lane bias, the distance to the front car, the longitudinal and lateral accelerations, and the speed data from sensors installed in a real vehicle. All data were recorded in a normal driving environment for the training of hidden Markov models of driving events, including normal driving, acceleration, deceleration, changing to the left lane or right lane, zigzag driving, and approaching the car in front. In addition to recognizing these driving events, the degree of each event is estimated according to its character. In the second stage, the danger-level indicator, which warns the driver of a dangerous situation, is inferred by fuzzy logic rules that address the recognized driving events and their degrees. A hierarchical decision strategy is also designed in order to reduce the number of rules that are triggered. The proposed framework was successfully implemented on a TI DM3730-based embedded platform and was fully evaluated in a real road environment. The experimental results achieved a detection ratio of 99% for event recognition, compared with that achieved by four conventional methods.

SHORT-TERM TRAFFIC STATE PREDICTION BASED ON TEMPORAL-SPATIAL CORRELATION

PAN, TIANLU; SUMALEE, AGACHAI; ZHONG, RENXIN; INDRA-PAYOONG, NAKORN

The stochastic cell transmission model (SCTM) was originally developed for stochastic dynamic traffic state modeling under several assumptions, e.g. the independent/uncorrelated assumption of the underlying stochastic processes governing demand and supply uncertainties. However, traffic flow, by nature, is correlated in both spatial and temporal domains due to its dynamics, similar environmental conditions and human behaviors. The independent assumption in the original SCTM framework may prevent the model from a broad range of applications, e.g. short-term traffic state prediction. In this paper, the SCTM framework is extended to consider the spatial-temporal correlation of traffic flow and to support short-term traffic state prediction. First, a multivariate normal distribution based best linear predictor is adopted as an auxiliary dynamical system to the original SCTM to forecast boundary variables and/or supply functions. The predicted boundary variables and supply functions are taken as inputs to the SCTM to perform short-term traffic state prediction. The independent assumption of the SCTM is relaxed by incorporating the covariance structure calibrated from the spatial correlation analysis for probabilistic traffic state evaluation. For real-time application purpose, the prediction is conducted in a rolling horizon manner which is useful for adjusting the predicted traffic state using real-time measurements. The proposed traffic state prediction framework is validated by empirical studies which demonstrate the effectiveness of the proposed method.

SPATIO-TEMPORAL ANALYSIS OF TRAFFIC CONGESTION CAUSED BY RUBBERNECKING OF FREEWAY ACCIDENTS

CHUNG, YOUNSHIK; RECKER, WILL

In this paper we present a well-specified analytical methodology for estimating the capacity reduction attributable to accidents in the opposite direction of accident—the condition whereby drivers in the opposite direction of an accident, by virtue of their curiosity, tend to be distracted by accident. The methodology is based on a binary integer programming formulation that is used to identify the spatio-temporal region affected by the influence of the accident, and then use thresholds measured against control sample readings from inductance loop detectors to determine the patterns and magnitudes of the delay. A key feature of the methodology is the ability to separate the non-recurrent delay from any recurrent delay that is present on the road at the time and place of a reported accident, in order to

estimate the contribution of non-recurrent delay caused by the specific accident. A case study based on historical inductance loop detector data from six major freeways in Orange County, California, is presented. Potential factors contributing to delay, including accident characteristics, geometric characteristics, environmental condition, traffic characteristics, and congestion characteristics are analyzed for their effects by using the semi-parametric Cox PH model.

STATISTICAL BEHAVIOR MODELING FOR DRIVER-ADAPTIVE PRE-CRASH SYSTEMS

MUEHLFELD, FLORIAN; DORIC, IGOR; ERTLMEIER, RUDOLF; BRANDMEIER, THOMAS

Pre-crash systems have the potential for preventing or mitigating the results of an accident. However, optimal pre-crash activation can only be achieved by a driver-individual parameterization of the activation function. In this paper, an adaption model is proposed, that calculates a driver-adapted activation threshold for the considered pre-crash algorithm. The model analyses past situations to calculate a driver-individual activation threshold that achieves a desired activation frequency. The advantage of the proposed model is that the distribution is estimated using a distribution model. This has the result that an activation threshold can already be determined using a small data set. In addition the confidence interval that has to be considered is decreased. The proposed model was applied in a study with test subjects. Results of this study confirm the usability of the model. In comparison to an empirical approach, the proposed model achieves a significantly lower threshold and thus a higher safety effect of the system.

STUDYING THE EFFECTS OF DRIVER DISTRACTION AND TRAFFIC DENSITY ON THE PROBABILITY OF CRASH AND NEAR-CRASH EVENTS IN NATURALISTIC DRIVING ENVIRONMENT

TIAN, RENRAN; LI, LINGXI; CHEN, MINGYE; CHEN, YAOBIN; WITT, GERALD

Driver distraction detection and intervention are important for designing modern driver assistance systems and improving safety. The main research question of this paper is to investigate how the cumulative driver off-road glance duration can be controlled to reduce the probability of occurrences of crash and near-crash events. Based on the available datasets from Virginia Tech Transportation Institute (VTTI) 100-car study, the conditional probability is calculated to study the chance of crash and near-crash events when the given cumulative off-road glance duration in six seconds has been reached. Different off-road eye glance locations and traffic density levels are also evaluated. The results show that one linear relationship can be obtained between the cumulative off-road eye glance durations in six seconds and the risk of occurrences of crash and near-crash events, which varies for different off-road eye-glance locations. In addition, traffic density level is found to be one significant moderator to this linear relationship. Detailed comparisons are made for different traffic density levels and one non-linear equation is obtained to predict the probability of occurrences of crash and near-crash events by considering both cumulative off-road glance duration and traffic density levels.

SUPERVISED WEIGHTING-ONLINE LEARNING ALGORITHM FOR SHORT-TERM TRAFFIC FLOW PREDICTION

JEONG, YOUNG-SEON; BYON, YOUNG-JI; CASTRO-NETO, MANOEL; EASA, SAID

Prediction of short-term traffic flow has become one of the major research fields in intelligent transportation systems. Accurately estimated traffic flow forecasts are important for operating effective and proactive traffic management systems in the context of dynamic traffic assignment. For predicting short-term traffic flows, recent traffic information is clearly a more significant indicator of the near future traffic flow. In other words, the relative significance depending

on the time difference between traffic flow data should be considered. Even though there have been several research works for short-term traffic flow predictions, they are off-line methods. This paper presents a novel prediction model, called online learning weighted support-vector regression (OLWSVR) for short-term traffic flow predictions. The OLWSVR model is compared with several well-known prediction models, including artificial neural network models, conventional SVR, and online learning support-vector regression (OLSVR). The results show that the performance of the proposed model is superior to that of existing models.

SUPPORTING DRIVERS IN KEEPING SAFE SPEED IN ADVERSE WEATHER CONDITIONS BY MITIGATING THE RISK LEVEL

GALLEN, ROMAIN; HAUTIERE, NICOLAS; CORD, AURÉLIEN; GLASER, SÉBASTIEN

Overspeeding is both a cause of accidents and an aggravation factor of the traffic accidents. Consequently, lots of efforts are devoted so as to limit overspeeding and consequently to increase the safety of road networks. In this article, a novel approach to compute a safe speed profile to be used in an adaptive Intelligent Speed Adaptation system (ISA) is proposed. The method presents two main novelties. First, the 85th percentile of observed speeds (V85), estimated along a road section, is used as a reference speed practiced and practicable in ideal conditions. Second, this reference speed is modulated in adverse weather conditions in order to account for a lowered friction and a lowered visibility distance. This risk mitigation is done by modulating the potential severity of crashes by means of a generic scenario of accident. Within this scenario, the difference in speed that should be applied in adverse conditions is estimated so that the highway risk is the same as in ideal conditions. The system has been tested on actual data collected on a French secondary road and implemented on a test track and a fleet of vehicles. The performed tests and the experiments of acceptability show a great interest for the deployment of such a system.

THE OPTIMAL SYSTEM DESIGN OF THE ON-LINE ELECTRIC VEHICLE UTILIZING WIRELESS POWER TRANSMISSION TECHNOLOGY

KO, YOUNG DAE; JANG, YOUNG

The On-Line Electric Vehicle (OLEV) is an innovative electric-powered transportation system developed by the Korea Advanced Institute of Science and Technology (KAIST), which remotely picks up electricity from power transmitters buried underground. Unlike a conventional electric vehicle that requires significant re-charging down time, the battery in the OLEV can be charged while the vehicle is in motion. Selected as one of “the 50 Best Innovations of 2010” by TIME Magazine, the OLEV is considered as a potential solution for the next generation electric-powered public transportation system in South Korea. The prototype of the OLEV has been developed and the commercialization process is now in progress. One of the main tasks to achieve the successful commercialization of the system is to determine economically how to allocate the power transmitters on the given routes and how to evaluate the right battery capacity for the vehicle. The allocation of the power transmitters and the size of the battery capacity directly affect the initial infrastructure cost. In this paper, we first introduce the system design issues of the mass transportation system operating with OLEV. We then present a mathematical model and optimization method to economically allocate the power transmitters and determine the battery capacity of the OLEV-based mass transportation system. The Particle Swarm Optimization algorithm is used as the solution method for the optimization problem. Numerical problems with sensitivity analysis are presented to show the validity of the mathematical model and solution procedure.

THE SPLIT COVARIANCE INTERSECTION FILTER: THEORY, AND ITS APPLICATION TO VEHICLE LOCALIZATION

LI, HAO; NASHASHIBI, FAWZI; YANG, MING

Data fusion is an important process in a variety of tasks in the ITS field. Most existing data fusion methods rely on the assumption of conditional independency or known statistics of data correlation. In contrast, the Split Covariance Intersection Filter (Split CIF) was heuristically presented in literature, which aims at providing a mechanism to reasonably handle both known independent information and unknown correlated information in source data. In this paper, we provide a theoretical foundation for the Split CIF: 1) we clearly specify the consistency definition (coined as split consistency) for estimates in split form; 2) we provide a theoretical proof for the fusion consistency of the Split CIF; 3) we provide a theoretical derivation of the Split CIF for partial observation case. We also present a general architecture of decentralized vehicle localization, which serves as a concrete application example of the Split CIF to demonstrate the advantages of the Split CIF and how it can potentially benefit vehicle localization (non-cooperative and cooperative). In general, this paper aims at providing a baseline for researchers who might intend incorporating the Split CIF (a useful tool for general data fusion) into their prospective research works.

VAIT: A VISUAL ANALYTICS SYSTEM FOR METROPOLITAN TRANSPORTATION

LIU, SIYUAN; PU, JIANSU; LUO, QIONG; QU, HUAMIN; NI, LIONEL; KRISHNAN, RAMAYYA

With the increasing availability of metropolitan transportation data, such as those from vehicle GPSs (Global Positioning Systems) and road-side sensors, it becomes viable for authorities, operators, as well as individuals to analyze the data for a better understanding of the transportation system and possibly improved utilization and planning of the system. We report our experience in building the VAIT (Visual Analytics for Intelligent Transportation) system, the first system on real life large scale data sets for intelligent transportation. Our key observation is that metropolitan transportation data are inherently visual as they are spatio-temporal around road networks. Therefore, we visualize and manage traffic data together with digital maps and support analytical queries through this interactive visual interface. As a case study, we demonstrate VAIT on real-world taxi GPS and meter data sets from 15, 000 taxis running two months in a Chinese city of over 10 million population. We discuss the technical challenges in data calibration, storage, visualization, and query processing, and offer our first-hand lessons learned from developing the system. Based on our extensive empirical experiment results, VAIT beats the state-of-the-art methods and systems in terms of scalability, efficiency and effectiveness, and offers us an easy-use, efficient and scalable platform to shed more light on intelligent transportation research.

VEHICLE DETECTION BY INDEPENDENT PARTS FOR URBAN DRIVER ASSISTANCE

SIVARAMAN, SAYANAN; TRIVEDI, MOHAN

In this study, we introduce vehicle detection by independent parts for urban driver assistance. In urban environments, vehicles appear in a variety of orientations: oncoming, preceding, and side-view. Additionally, partial vehicle occlusions are common at intersections, during entry and exit from the camera's field of view, or due to scene clutter. Vehicle detection by independent parts provides a lightweight, robust framework for detection oncoming, preceding, side-view, and partially occluded vehicles in urban driving. In this study, we use active learning to train independent part detectors. A semi-supervised approach is used for training part matching classification, which forms side-view vehicles from independently-detected parts. The hierarchical learning process yields vehicle detection by independent parts, featuring efficient evaluation and strong performance. Parts and vehicles are tracked using Kalman filtering. The fully-implemented system is lightweight, and runs in real-time. Extensive quantitative analysis on real-world on-road datasets is provided.

VEHICLES MEET INFRASTRUCTURE: TOWARDS CAPACITY-COST TRADEOFFS FOR VEHICULAR ACCESS NETWORKS

LU, NING; ZHANG, NING; CHENG, NAN; SHEN, XUEMIN; MARK, JON W.; BAI, FAN

access infrastructure Access infrastructure, such as Wi-Fi access points and cellular base stations, plays a vital role to provide pervasive Internet services to vehicles. However, the deployment costs of different access infrastructure are highly variable. In this paper, we make an effort to investigate the capacity-cost tradeoffs for vehicular access networks in which access infrastructure is deployed to provide a downlink data pipe to all vehicles in the network. Three alternatives of wireless access infrastructure are considered, i.e., cellular base stations (BSs), wireless mesh backbones (WMBs), and roadside access points (RAPs). We first derive a lower bound of downlink capacity for each type of access infrastructure. We then present a case study based on a perfect city grid of 400 km^2 with 0.4 million vehicles, in which we examine the capacity-cost tradeoffs of different deployment solutions in terms of both capital expenditures (CAPEX) and operational expenditures (OPEX). Rich implications from our results provide fundamental guidance on the choice of cost-effective for the emerging vehicular networking.

VISUAL ANALYSIS OF EYE STATE AND HEAD POSE FOR DRIVER ALERTNESS MONITORING

OYINI MBOUNA, RALPH; KONG, SEONG; MYUNG-GEUN, CHUN

This paper presents visual analysis of eye state and head pose for continuous monitoring of alertness of a vehicle driver. Most existing approaches to visual detection of non-alert driving patterns rely either on eye closure or head nodding angles to determine the driver drowsiness or distraction level. The proposed scheme uses visual features such as Eye Index (EI) and Pupil Activity (PA) as well as Head Pose (HP) to extract critical information on non-alertness of a vehicle driver. EI determines if the eye is open, half closed, or closed from the ratio of pupil height and eye height. PA measures the rate of deviation of the pupil center from the eye center over a time period. HP finds the amount of the driver's head movements by counting the number of video segments that involve a large deviation of three Euler angles of head pose, nodding, shaking, and tilting, from its normal driving position. HP provides useful information on the lack of attention, especially when the driver's eyes are not visible due to occlusion caused by large head movements. A support vector machine classifies a sequence of video segments into alert or non-alert driving events. Experiment results show that the proposed scheme offers high classification accuracies with acceptably low errors and false alarms for the people of various ethnicities and gender in real road driving conditions.

Abstracts of forthcoming papers on IEEE ITS Magazine

AGILE URBAN PARKING RECOMMENDATION SERVICE FOR INTELLIGENT VEHICULAR GUIDING SYSTEM

WU, HSIAOKUANG; SAHOO, JAGRUTI; LIU, CHI-YUN; JIN, MING-HUI; LIN, SHU HUI

Nowadays, Intelligent Transportation Systems (ITS) technologies are exploring a wide range of services such as freeway management, crash prevention & safety, driver assistance, and infotainment of drivers and/or passengers. In this paper, an agile urban parking recommendation service for vehicular intelligent guiding system is designed to facilitate city citizens with fully efficient, real-time and precise parking lot guiding suggestions for the sustainability of the future green city. The system offers drivers a friendly parking lot recommendation sequence and saves drivers' time circling around by the accurate prediction of the successful parking probability in each parking lot. The proposed cost model constructs an optimal recommendation sequence considering successful parking probability and time to reach the parking lot. Through the collection and analysis of realistic records from parking lots in Taipei city, a prediction algorithm is developed to estimate the successful parking probability by using current available space counts. Extensive experiments are conducted to demonstrate the effectiveness of the prediction algorithm.

ANTICIPATED EFFECTS OF GRADUAL REPLACEMENT OF INTERNAL COMBUSTION ENGINES WITH ELECTRIC DRIVES ON VEHICLE EXHAUST EMISSIONS IN PRAGUE

VOJTISEK-LOM, MICHAL

One of the benefits of introducing electric and hybrid-electric vehicles into the fleet is the reduction of exhaust and to a lesser extent evaporative emissions from vehicles powered by internal combustion engines. Such reductions are often based on "average" emissions rates of the regulated pollutants. In reality, electric vehicles are being introduced in a rather selective manner, with preference to low speed, short distance urban trips, due to energy storage limitations. As a coincidence, during such operating regimes, the internal combustion engines are at their worst not only in terms of efficiency and emissions of regulated pollutants, but, more importantly, in terms of the health effects caused by these emissions. Deployment of electric drive vehicles in congested urban areas, where it appears most advantageous technically and economically, is therefore expected to have relatively high benefits to human health due to reduced exhaust emissions.

CENTIMETER-ACCURACY SMOOTHED VEHICLE TRAJECTORY ESTIMATION

VU, ANH; FARRELL, JAY A.; BARTH, MATTHEW

Next generation roadway maps and vehicle navigation systems have the objective of reliably achieving where-in-lane positioning accuracy. Various methods are under consideration both to attain the requisite roadway map accuracy via post-processing and real-time vehicle positioning accuracy and reliability. Fundamental to these methods is the problem of accurately and reliably estimating a sensor platform trajectory in a post-processing environment. For mapping, the platform trajectory provides the pose for feature sensors (e.g., camera, LIDAR, RADAR). For navigation, the platform trajectory is the ground-truth reference.

This article describes a smoothing framework for estimating sensor platform trajectories using an Inertial Measurement Unit (IMU) and a dual-frequency GPS pseudo-range and carrier-phase receiver. A Bayesian estimation framework is present-ed and transformed to a series of nonlinear least squares problems. The result of this optimization process is the platform trajectory estimate at the IMU measurement rate (200 Hz) with position accuracy at the centimeter level. One of the contributions of this research is the method developed to solve for the carrier-

phase integer ambiguities. Real-world experimental results are presented to validate the proposed smoothing framework.

CHANNEL ESTIMATION SCHEMES FOR IEEE 802.11P STANDARD

ZHAO, ZIJUN; CHENG, XIANG; WEN, MIAOWEN; WANG, CHENG-XIANG; JIAO, BINGLI

In vehicle-to-vehicle (V2V) communications, reliable channel estimation is critical for the system performance due to the extremely time-varying characteristic of V2V channels. In this article, we present a survey on the current channel estimation techniques for the IEEE 802.11p standard. According to deficiencies of the current schemes and characteristics of the V2V standard, we propose a novel channel estimation scheme, which utilizes the data symbols to construct pilots as well as the correlation characteristics between channels within two adjacent symbols. Analysis and simulation results demonstrate that our proposed scheme outperforms all current ones especially in high signal-to-noise ratio regime. At the end, some open issues for the future work conclude this article.

DEALING WITH PACKET DELAY VARIATION IN IEEE 1588 SYNCHRONIZATION USING A SAMPLE-MODE FILTER

ANYAEGBU, MARGARET; WANG, CHENG-XIANG; BERRIE, WILLIAM

In this paper, we characterize the delay profile of an Ethernet cross-traffic network statically loaded with one of the ITU-T network models and a larger Ethernet inline traffic loaded with uniformly-sized packets, showing how the average time interval between consecutive minimum-delayed packets increases with increased network load. We compare three existing skew-estimation algorithms and show that the best performance is achieved by solving a linear programming problem on "de-noised" delay samples. This skew-estimation method forms the basis of a new sample-mode algorithm for packet delay variation filtering. We use numerical simulations in OPNET to illustrate the performance of the sample-mode filter in the networks. We compare the performance of the proposed PDV filter with those of the existing sample minimum, mean, and maximum filters and observe that the sample-mode filtering algorithm is able to match or outperform other types of filters, at different levels of network load.

DETECTABILITY PREDICTION FOR INCREASED SCENE AWARENESS

ENGEL, DAVID; CURIO, CRISTÓBAL

A driver assistance system realizes that the driver is distracted and that a potentially hazardous situation is emerging. In this scenario the driver needs to make an optimal decision as fast as possible. His attention needs to be directed to the location that enhances the perception of all action relevant entities. But where is that optimal spot? Pedestrian detectability is a measure of the probability that a driver perceives pedestrians in static and dynamic scenes. Leveraging this information allows a driver assistance system to direct the attention of the driver to the spot that maximizes the probability that all pedestrians are seen. In this paper we present a thorough description and a strong theoretical foundation of this concept. We use annotated datasets recorded in urban environments, and acquire the detectabilities of pedestrians via psychophysical experiments. Based on these measured detectabilities, we train a machine learning algorithm to predict detectability from an optimized set of image features. We furthermore exploit this mapping to obtain the optimal focus of attention, thus demonstrating the potential benefit of our method in a realistic driver assistance context.

MODELING MICROSCOPIC FREEWAY TRAFFIC USING CUSP CATASTROPHE THEORY

PAPACHARALAMPOUS, ALEXANDROS; VLAHOIANNI, ELENI

This paper proposes a framework based on stochastic cusp catastrophe theory to model microscopic freeway traffic flow. The approach considers that each driver – regardless of being aggressive or timid - may shift his/her behaviour and behave aggressively or timidly during driving. Based on the proposed modelling approach, the spacing of a driver is a function of his speed and acceleration. Moreover, the driver's behaviour comprises of two equilibrium states - being aggressive or timid - and a shift between these states is considered to occur as a catastrophe phenomenon. Different models are developed with varying sampling intervals, while some of them possess memory properties. Results show that the cusp catastrophe model may accurately describe microscopic traffic, especially when compared to linear or logistic models. Results for models with memory are even more promising. Based on the proposed method, preliminary results on the critical regions of breakdown conditions or attitude shifting are described and discussed.

MULTI-LAYER APPROACH TO FUTURE GREEN MOBILE COMMUNICATIONS

BOGUCA, HANNA; HOLLAND, OLIVER

This article addresses design concepts for mobile radio communications particularly addressing the crucial trade-offs between system performance and energy-consumption. System performance depends on various adaptive procedures and parameters adopted at multiple OSI layers of the communication system. However, these procedures and parameters require spectrum and energy resources and contribute to the overall system and network energy-consumption and to the resulting CO₂ emission. This article also therefore presents a vision on green mobile communication technology, and analyses some trade-offs among different methodologies toward energy-efficient system-design. It particularly discusses the degrees of freedom in the design of communications systems and networks using various technologies, and investigates their energy-saving options.

PERFORMANCE LIMITATIONS IN VEHICLE PLATOON CONTROL

SOLYOM, STEFAN; COELINGH, ERIK

One of the major benefits of driving vehicles in controlled, close formations such as platoons is that of reduced air drag. However, this will set hard performance requirements on the system actuators, sensors and controllers of each vehicle. This paper analyses the effects of fundamental limitations on the longitudinal and lateral control performance of a platoon and the effects on following distance, perceived safety and fuel economy. The trade-off between minimizing fuel consumption and maintaining a safe following distance is analyzed and described. The analysis is based on fundamental properties of linear systems such as Bode's phase area relation. Design guidelines are proposed and results from vehicle testing are presented.

RELOCATION STRATEGIES AND ALGORITHMS FOR FREE-FLOATING CAR SHARING SYSTEMS

WEIKL, SIMONE; BOGENBERGER, KLAUS

During the last years so-called free-floating Car Sharing Systems became very popular. These systems in comparison to the conventional Car Sharing Systems allow short one-way trips. Today, the spatial distribution of vehicles within free-floating Car Sharing Systems is either self-organized, which means it is only dependent on the customer's demand or in a few cases the positioning is manually controlled by system operators. None of the real-life free-floating Car Sharing Systems has a clear defined relocation strategy or is even online optimized based on the current demand.

Within this paper several relocation strategies are introduced and categorized. For each category known relocation algorithms are described and evaluated. Also a new integrated two-step model for optimal vehicle positioning and relocation is described in detail. This new approach consists of an offline demand clustering that allows for the prediction of demand and thus the prediction of the optimal future state of spatially available vehicles. The online module of the approach measures the differences between optimal vehicle positioning and current positioning. An optimization algorithm finds optimal relocation strategies if necessary. The main focus of this paper is on the description of the Offline Demand Module.

VEHICULAR DELAY-TOLERANT NETWORKS – A NOVEL SOLUTION FOR VEHICULAR COMMUNICATIONS

ISENTO, JOÃO; RODRIGUES, JOEL; DIAS, JOÃO; PAULA, MAICKE; VINEL, ALEXEY

Vehicular Delay-Tolerant Networks (VDTNs) is a breakthrough based DTN-based solution to provide vehicular communications under challenging scenarios characterized by long delays and sporadic connections. VDTN uses a store-carry-and-forward paradigm, inspired from Delay Tolerant Networks, which allows forward bundles to asynchronously reach the destination hop by hop over traveling vehicles equipped with short-range Wi-Fi devices. The proposed VDTN architecture assumes out-of-band signaling with control and data planes separation. VDTNs also assume datagrams aggregation under the network layer in large size packets, called bundles, following an IP over VDTN approach. This paper presents VDTN networks focusing on their layered architecture, bundle aggregation and de-aggregation mechanisms, network protocols, scheduling and dropping policies, fragmentation mechanisms, and the created tools for VDTNs performance evaluation, demonstration, and validation.

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