INTELLIGENT TRANSPORTATION SYSTEMS

http://sites.ieee.org/itss/

IEEE ITS SOCIETY NEWSLETTER

Vol. 16, No. 2 April 2014 *Editor: Prof. Brendan Morris, brendan.morris@unlv.edu*

In This Issue

Society News and Announcements

Featured Article

Conferences and Call for Papers

Web Archive and Electronic Newsletter Subscription

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.

Information for Contributors

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

SOCIETY NEWS

From the Editor

Brendan Morris

I am very happy to deliver the first Newsletter as the newest Editor-in-Chief. It is an honor take over the reigns from Dr. Miguel Angel Sotelo. I will strive to continue the great work of my predecessors and look to make the Newsletter even more accessible. Please do not hesitate to contact me to tell me how you think the Newsletter can be best utilized.

In this issue, you find the call for participation in our ITSS Awards and a feature article highlighting the China's Fifth Annual Intelligent Vehicles Future Challenge by Professor Jingming Xin. As always, we have a message from our new Society President, Matt Barth, along with the upcoming conferences and abstracts for the newest Transactions and Magazine articles.

From the President

Matthew Barth

Living in a Connected World

We often hear these days how we are living in a "connected world" with access to the Internet, mobile phones, text messaging, and the many "apps" such as Facebook and Twitter. Since I've started my term as ITSS President in January, several things have happened that center around the theme of "being connected".

On February 3rd, the U.S. Department of Transportation announced that the National Highway Traffic Safety Administration (NHTSA) has initiated a process that will ultimately require that vehicle-to-vehicle communication technology be installed in all new cars and light trucks. Essentially, this vehicle-to-vehicle communications will be based on "Dedicated Short Range Communication" (DSRC) transceivers that are installed in vehicles and broadcast safety messages. The idea is that this technology will lead to fewer vehicle crashes and greater safety, as highlighted by the U.S. DOT's Safety Pilot Program being carried out in Ann Arbor, Michigan. As one of the leading ITS organizations, the IEEE ITS Society has published numerous articles on DSRC technology and its various applications. Even though this planned NHTSA rulemaking is aimed at vehicle-to-vehicle safety communications, there is even a greater number of applications that will emerge. In addition to cars talking to cars, cars will also being talking to trucks, buses, bikes, and even pedestrians. Further, there are a number of vehicle-to-infrastructure communication applications that can take place, building on this technology. Safety is of course the main objective, but other goals can be achieved in terms of improving mobility, as well as reducing energy consumption and vehicle emissions. Stay tuned to this exciting area, it will define a number of research directions well into the future.

Earlier this year in February, I attended the IEEE Technical Activities Board (TAB) meeting in Los Angeles. This meeting is a forum of 38 Technical Societies (of which we are one) and 7 Councils within the IEEE. The purpose gathers society presidents and other representatives several times a year to further develop the IEEE community, activities and products, such as conferences. It is amazing that in 2013, the IEEE sponsored 1489 conferences (including our conferences IV, ITSC, ICVES, SOLI, MESA, ISI, ICIRT, ICCVE, VNC, etc.; see http://sites.ieee.org/itss/) and had over 425,000 people attend these conferences. In addition, the IEEE oversees approximately 125 IEEE journals, including our society's IEEE Transactions on Intelligent Transportation Systems and the IEEE Intelligent Transportation Systems Magazine. But what I found very valuable at the IEEE TAB, is being able to connect to our sister societies. There are a number of initiatives at the TAB level that span several societies. The field of intelligent transportation systems inherently has very wide breadth in a number of topics areas, therefore it is quite natural that ITSS be active in these different initiatives. Examples include the RFID initiative, and the new IEEE Smart Cities community. Another key initiative is the

Transportation Electrification Initiative where certainly ITSS can play a key role. I encourage all ITSS members to get involved in these different initiatives based on your interests; it is one of the best ways to stay connected with other IEEE members and areas.

Matt Barth
IEEE ITSS President, 2014-2015

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

Call for Nominations

Purpose and Selection Criteria

The prestigious IEEE ITS Outstanding Research Award, IEEE ITS Outstanding Application Award, and IEEE ITS Lead Award are conferred annually to honor 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 have been established to recognize, promote, and publicize major research contributions, application innovations with real-world impact, and ITS institutional leadership.

Nomination Materials

Each nomination must consist of the following materials:

(1) A 5-page summary statement providing sufficient detail for evaluation of the innovations and impact 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 the work's significance and impact.

A dedicated selection committee will evaluate all qualified nominations for these IEEE ITS Awards. Awards will be announced in October 2014 at the ITSC 2014 conference in Qingdao, China, where the recipients will give featured presentations of their work.

Please email nominations before June 1, 2014 to ITSS Vice President for Membership at Daniel.D.Zeng@ieee.org

IEEE ITSS Best Ph.D. Dissertation Award

Call for Applications

Application Materials

Each application must consist of the following materials:

1. A doctoral dissertation written by the applicant in any language, no more than 18 months prior to the submission deadline.
2. A summary of the dissertation in English of up to 3 pages in length written by the Ph.D. candidate, highlighting the significance of the problem, the technical approach taken, application context and potential, and the scope of the dissertation.
3. Sample published paper(s) in English based on the dissertation written primarily by the Ph.D. candidate in scientific journals such as the IEEE Transactions on ITS or the IEEE ITS Magazine.
4. Listing of all publications by the applicant in the related field(s).
5. A letter of recommendation from the applicant's dissertation advisor that assesses the significance of the research, attests to the originality of the work, and comments on the engagement of the applicant in the ITS field and the IEEE ITS Society.

Prize and Presentation

The first place winner will receive USD 1,000. The second place prize winner will receive USD 500. Awards will be announced in October 2014 at the ITSC 2014 conference in Qingdao, China, where the recipients will give brief presentations of their work. Awardees' work will be featured in ITSS Transactions, ITS Magazine, and ITS Newsletter, when appropriate.

Applications

A dedicated selection committee will evaluate all qualified applications for the IEEE ITS Best Ph.D. Dissertation Awards and make selections. Please submit the application materials by email before June 20, 2014 to ITSS Vice President for Membership at
Daniel.D.Zeng@ieee.org.

Daniel Zeng
VP for Membership

ITS Podcast

Please, check out our new ITS Podcast episode on Computer Vision to Automatically Maintain Traffic Signs and Panels

Please, circulate this!

In this episode we have prepared some contents for your enjoyment, like a very nice interview with professor Miguel Angel Sotelo, from University of Alcala, in Spain, about VISUALISE, a tremendous project he has led to automatically inspect Traffic Signs and Panels.

As usual, we also have a transportation in history, this time about the epic history of the current water speed record, and a fascinating news minisection with a brand new event from VisLab, at Italy. Yeah, that italian folks just don't know how to stop. They are just presenting a new beautiful autonomous car they call DEEVA.

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

ITS Podcast Episode 12

Stay tuned for our first anniversary episode next month

We are preparing a special episode, including the announcement of our "Best Follower" contest winner.

If you want to receive an email with every new podcast…

Visit our website (http://itsp.cicei.com). There is a widget on the right of each page where you can introduce your email. You will receive then a confirmation email and once you click the confirmation link you are done, you will be in our email distribution list for your good!

Thanks for your support and help!

Javier Sanchez-Medina
EiC IEEE ITSS ITSPodcast
javier.sanchez.medina@ieee.org
itsspodcast@gmail.com

Featured Article

China Future Challenge: Beyond the Intelligent Vehicle

By Prof. Jingmin Xin, Chenghong Wang, Zhaotian Zhang, and Nanning Zheng,
Xi'an Jiaotong University, Xi'an, China

The 2013 China Intelligent Vehicle Future Challenge (IVFC'2013) was held on November 2 to 4, 2013 in Changshu, Jiangsu, China. This competition of unmanned vehicles was hosted by the National Natural Science Foundation of China (NSFC) and organized by the People's Government of Changshu City, Jiangsu Province, China.

In August 2008, the NSFC started the Major Research Plan "Cognitive Computing of Visual and Auditory Information" (study period: 2008 to 2015, total funding: 190 million RMB Yuan). The overall purposes of this major research plan are to study and construct new computational models and methods based on the human visual and auditory cognitive mechanism and to improve the computers' comprehension ability of unstructured visual and auditory perception information and their processing efficiency of massive heterogeneous information by giving full plays to the interdisciplinary advantages of information science, life science and mathematics. Especially one of the goals of this major research plan is to develop the verification platforms of unmanned vehicles with the perception of natural environment and the ability of decision-making. As an important part of this national major research plan, the competition of IVFC has been held annually since 2009. In order to make better progress and to promote the original innovations of this major research plan, the purpose of IVFC is to provide a platform for academic exchange and inspection for exploring the efficient computing models and improving the computers' comprehension ability of unstructured visual and auditory perception information and their processing efficiency of massive heterogeneous information. In the past six years, this major research plan funded 84 projects as fostering projects, key funding projects or integrated

Figure 1:Venues of five competitions of IVFC in China

projects from more than 490 proposals, where the averaged funding was about 1.59 million RMB Yuan per project.

The IVFC'2013 was the fifth competition of unmanned vehicle and the third one undertaken in the environment of real roads, and it was the first competition held in the southern cities of China, where the first four IVFCs were held in Xi'an, Ordos and Chifeng in 2009, 2010, 2011 and 2012 as shown in Fig. 1, and the team of the University of Parma, Italy attended the IVFC'2009. The IVFC'2013 was also the largest and more difficult competition, and there were 16 participating teams from major universities and research institutions in the research fields of intelligent vehicle such as Beijing University of Technology, Chang'an University, Military Transportation University, Nanjing University of Science & Technology, Shanghai Jiaotong University, Tongji University, Tsinghua University, Wuhan University, Xi'an Jiaotong University, and Hefei Institutes of Physical Science, Chinese Academy of Science. The team of Seoul National University, Korea also participated in this competition. Additionally, some emergency and rescue vehicles, ambulances, and five vehicles for the match-referee provided technical supports for the IVFC'2013.

Figure 2: Example suburban road testing

By using various sensors to perceive the environment outside vehicle and processing the obtained information with the processing mechanisms and methods of visual and auditory information, the unmanned vehicles can achieve the self-driving through the self-control and intelligent decision-making processes. The IVFC'2013 included two parts: the suburban road testing (about 18 km) and the urban road testing (about 5 km), where there were many bridges, tree-tunnel, entrance ramp, the school gate and other scenes. The assessment contents were set as follows: the interference of some moving vehicles, recognition of traffic lights, construction detour, obstacle avoidance, and stopping at finish line in the former testing, while the U-Turn, intersection crossing, slow-down in front of school and stopping for pedestrians in the latter testing. Unlike the unmanned vehicles developed in Europe and other developed countries, which basically rely on the GPS information and the navigation of electronic map, the IVFC requires the participating vehicles to percept the natural environment outside the vehicle with the equipped sensors such as the cameras for verifying the computers' handling capacity and

efficiency of visual and auditory information. Moreover in the IVFC'2013, the 4S (i.e., safety, smartness, smoothness, and speed) criteria were also used to evaluate the driving behavior of each unmanned vehicle. Additionally for enriching the competition content, the man-machine confrontation, challenge between teams and the friend match with Korean team were arranged during the IVFC'2013. See Figs. 2-4 for more details of this competition.

Figure 3: Example urban road testing

The IVFC'2013 was strongly supported by the China Central Television (CCTV), Changshu Customs, Changshu Entry-Exit Inspection and Quarantine Bureau, Changshu Institute of Technology and other related departments in the organization and implementation. The IVFC'2013 not only promoted the use and deep exploration of advanced technology in the automotive industry and to create a favorable environment for innovation-driven in the automobile industry but also provided strong impetus to the innovation and the development of the information science and other research areas such as the unmanned vehicle in China. It is reported that the 2014 China Intelligent Vehicle Future Challenge (IVFC'2014) will be held this fall.

Figure 3: Example of man-machine confrontation

IEEE ITSC 2014

October 8-11, 2014
Qingdao, China

The 17th International IEEE Conference on Intelligent Transportation Systems

The IEEE Conference on Intelligent Transportation Systems is the annual flagship conference of the IEEE Intelligent Transportation Systems Society. IEEEITSC2014 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. IEEE ITSC 2014 is organized by the State Key Laboratory of Management and Control for Complex Systems at the Institute of Automation, Chinese Academy of Sciences (CASIA). It will be held in Qingdao, a beautiful coastal city, home to Tsingtao beer, Mount Lao - one of the "cradles of Taoism", and numerous scenery & cultural attractions.

General Chairs

Nanning Zheng
Fei-Yue Wang

ProgramChairs

Daniel Zeng
Christoph Stiller
Azim Eskandarian

Program Co-Chairs

Brendan Morris (North America)
Javier Schanez Medina (Europe)
Kyongsu Yi (Asia)
Yibing Wang (Asia)

Local Chair

Xinzhu Zhang

Topics

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

- Artificial Transportation Systems
- 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
- 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
- Driver and Traveler Support Systems

Paper Submission

Complete manuscripts in the PDF format must be electronically submitted for peer-review, following the standard IEEE conference proceedings format. Detailed submission instructions can be found on the conference website. **DUE DATE: June 8, 2014.**

Special Sessions, Tutorials, and Workshops

Proposals for special sessions, tutorials, and workshops should be submitted via the conference submission website. **DUE DATE: May 12, 2014.**

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.

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 ITS or the IEEE ITS Magazine. Authors will be asked to revise their papers according to the standards of the Transactions or the Magazine. These papers will be subject to the Transactions' and Magazine's own peer-review process.

Important Dates

Please visit the conference website at http://www.itsc2014.org/ for details.

IEEE ITSC 2014 will be held in conjunction with the 2014 IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI).

ICCVE 2014

The 3rd International Conference on Connected Vehicles and Expo

Nov 3-7, 2014 | Messe Wien, Vienna, Austria

"The future of mobility enabled by Connected Automated Vehicles"

- Summits
- Industry Forums
- Paper Sessions
- Workshops
- Demos
- Exhibits
- Tutorials
- Tours
- Contests

ICCVE 2014 is the world's premier Connected Vehicles conference that gathers all the relevant communities together. During the 5-day conference, more than 2,000 experts, practitioners and policymakers from all around the world will present the latest innovations and advances on connected vehicles, share the experience and insights, forecast the trends and opportunities, and discuss the policy, economics and social implications. We are proudly and excitedly inviting you to participate in and enjoy this world-class festival.

Topics of interest include, but are not limited to:

- Wireless Communications and Vehicular Networking
- Mobile Internet, Mobility Internet and Internet of Things
- Cooperative Driving, Intelligent and Autonomous Vehicles
- Automotive Electronics and Automatic Control
- Transportation and Connected Vehicles
- Electric Vehicle and Transportation Electrification
- Geographic, Spatial and Social Information Systems
- Manufacturing and Product Safety Engineering in Connected Vehicles
- Practices, Recommendations and Standards in Connected Vehicles
- Policy, Economics and Social Implications of Connected Vehicles

www.ICCVE.org/2014

* Photos courtesy of Vienna Tourist Board

ICCVE 2014

The 3rd International Conference on Connected Vehicles and Expo

Nov 3-7, 2014 | Messe Wien, Vienna, Austria
www.iccve.org/2014

Call for Papers

Prospective authors are invited to submit **full papers** (6 pages maximum with 2 additional pages allowed but at an extra charge) or **digest papers** (2 pages) to showcase results recently obtained in industry or academia. All submissions should be written in English, must be electronically submitted in PDF (IEEE standard format, double column, 10-point font, US letter), and will be peer-reviewed. Accepted papers will be presented at the conference, published in the ICCVE 2014 Conference Proceedings, and submitted to IEEE Xplore®. The Proceedings will also be submitted for indexing through INSPEC, and EI's Engineering Information Index, Compendex, and ISI Thomson's Scientific and Technical Proceedings, ISTP/ISI Proceedings, and Current Contents on Diskette, and Scopus.

Paper Submission Deadline:	May 10, 2014
Notification of Acceptance:	Jun 28, 2014
Final Manuscript Due:	Jul 28, 2014

Top quality papers accepted and presented at the conference will also be invited to submit extended versions to special issues or special sections of the following IEEE journals:
- *IEEE Transactions on Intelligent Transportation Systems*
- *IEEE Intelligent Transportation Systems Magazine*
- *IEEE Consumer Electronics Magazine*
- *IEEE Transactions on Transportation Electrification*
- *IEEE Transportation Electrification Magazine*

Industry Forums - Call for Speech Proposals

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

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

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

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

Proposal Submission Deadline:	Jun 30, 2014
Notification of Acceptance:	10 working days after your submission

Patronage and Exhibition Opportunities

Patrons and exhibitors will become a part of our business network that is being built to develop / deploy products and services across cars, trucks, equipment, trains, ships, airplanes and the Intelligent Highway. We want to help you meet potential customers from around the world that will be interested in your products and services. We will ensure that you will have access to the leaders of the new Connected Vehicles world during the conference and long afterwards.

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

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

ICCVE 2014

The 3rd International Conference on Connected Vehicles and Expo

Nov 3-7, 2014 | Messe Wien, Vienna, Austria
www.iccve.org/2014

Topics of interest include, but are not limited to:

Wireless Communications and Vehicular Networking

V2V, V2I and V2X Communications; Vehicular Ad Hoc Networks (VANET); Delay-Tolerant Networks (DTN); Mesh Networks and Sensor Networks; In-Vehicle Networks and Communications; Networking with Other Road Users; Vehicular Network as a Sensor Network; Security and Privacy; Reliability and Dependability; Architecture, Algorithms and Protocols (MAC, Routing, Mobility Management, Data Dissemination, etc.); In-Network Processing and Aggregation; Modeling, Simulation, Emulation and Performance Evaluation; Performance, Quality-of-Service (QoS) and Management; Signal Processing; Antennas and Propagation; Radio Resource Management; Energy Management; Multiple Antenna Systems and Space-Time-Frequency Processing; Transmission and Modulation; Opportunistic and Cooperative Networking; Cognitive Radio / Software Defined Radio and Spectrum Sensing; Cooperative Communications, Distributed MIMOs and Relaying; PHY and MAC Layer Design for Cooperative Wireless Networks; Wireless Multiple Access; Cross-Layer Design and Optimization; 3G/4G/5G; PANs, LANs, MANs and WANs (e.g. IEEE 802.15, 3, 11, 16, 20); Satellite & Space Communications; Access Networks; Fixed-Mobile Convergence; Green, Energy-efficient and Energy-aware Networks and Communication Systems; Green Communication Applications and Services; Energy Saving and Footprint Reduction; Human Electromagnetic Exposure and Electromagnetic Pollution; Emission Modelling and Environmental Impact Assessment; Impact on Transportation Efficiency and Safety; Experimental Systems, Field Operational Tests and Testbeds; Standardization and Economical Models; Regional Requirements and Consequences; Applications and Services in Industries (Transportation, Logistics, Automotive, Smart Cities, Smart Grid, etc.).

Mobile Internet, Mobility Internet and Internet of Things

Mobile Web-based Applications and Services; Information Distribution Services and Location Based Services; Context Aware Applications and Services; Broadband and Multimedia Applications and Services (IPTV, DMB, etc.); Wireless Body Area Network Applications; Service Architectures and Middleware; Service Creation and Composition; Security in Mobile Applications and Services; Digital Convergence; Mobile e-Commerce; Mobile Cloud; Augmented Reality; 3D Internet; Next Generation Internet; Cyber-Physical Systems (CPS); Machine-to-Machine (M2M); Pervasive and Ubiquitous Computing; Edge Computing and Appliance; Big Data; Internet of Things (IoT); IoT Architectures; IoT Sensors and Actuators; IoT Networks and Communications; IoT Data Processing and Storage; IoT Reliability and Security; IoT Management and Maintenance; IoT Industry Solutions (Transportation, Logistics, Automotive, Smart Cities, Smart Grid, etc.); IoT Business Models and Ecosystem.

Cooperative Driving, Intelligent and Autonomous Vehicles

V2V, V2I and V2X Systems, Applications and Services; Telematics Systems, Applications Services; Driver Assistance; Active Safety (Lane Departure Warning/Lane Keeping Assistance, Collision & Blindspot Warning, Active Pedestrian Protection, Backover Protection, Collision Imminent Braking, Collision Avoidance); Vehicle Environment Perception; Driver State and Intent Recognition; Driver Behavior Monitoring; Eco-Driving, Eco-Routing and Energy-Efficient Vehicles; Cooperative Vehicle-Infrastructure Systems; Vehicle-Highway Automation; Impact on Traffic Flows; Vision, Radar, Lidar Systems and Processing in Vehicles and ITS; Audio and Speech Systems and Processing in Vehicles and ITS; Data Fusion and Information Integration in Vehicles and ITS; Pattern Analysis and Computational Intelligence in Vehicles and ITS; Human Factors and Consumer Experience in Vehicles and ITS; Human-Machine Interface and Interaction (HMI) in Vehicles and ITS; Assistive Mobility Systems; Automated, Intelligent and Autonomous Vehicles and Robots; Architectures for Intelligent Autonomous Systems (Land, Marine, Aerial and Space Vehicles); Fault Tolerant Autonomous System Architectures; Smart Sensors, Sensor Networks and Sensor Integration for Autonomous Vehicles and Robots; Multiple Vehicle Systems and Networks of Autonomous Vehicles; Multiple Robot Systems and Networks; Cooperative Robots and Cooperative Driverless Vehicles; Decision Making for Autonomous Driving; Applications, Case Studies and Test Evaluations of Intelligent Autonomous Vehicles; Field Robotics (Search and Rescue, Agriculture, Humanitarian Demining, etc.); Indoor Robotics (Entertainment, Service Robots, Domestic Robots, Rehabilitation and Biomedical Robotic, etc.); Navigation, Guidance and Control of Autonomous Vehicles; Intelligent, Autonomous and Autonomic Systems in ITS; Socially-inspired Mechanisms for Future Mobility Services; Collaborative Driving to Demonstrate Global Traffic Improvements; Coexistence of Manually Operated and Automated Vehicles; Simulation, Experimental Systems, Testbeds and Field Trials.

Automotive Electronics and Automatic Control

Automotive Electronics Outlook and Roadmap; Sensors and Actuators in Vehicles and ITS; Vehicle Fuel Efficiency through Connectivity; Remote Service Provisioning and Over-the-Air Upgrading; Infotainment, Navigation and Telematics Systems; Safety, Security and Evacuation Systems; User Interfaces (Haptic, Speech, HUD, Biometric, etc.); In-Vehicle Audio/Video; In-Vehicle Accessories; Automotive Camera Systems; Vehicular Signal Processing; Instrumentation, Measurement, Diagnostics and Prognostics; Tire-Pressure Monitoring; Non-traction Motor Drives; High Temperature Electronics; Lower Power Consumption Devices; Vehicle Bus; Electronic Control Units (ECU); On Board Units (OBU); System-level, Board-level and Chip-level Electronics; Highly Integrated Automotive Electronics; System-On-a-Chip; Embedded Systems, Operating Systems, Middleware and Applications; Electrical & Electronic Systems; Electro-Mechanical Designs and Micro-electromechanical Systems (MEMS); Electronics Reliability; Electro Magnetic Compatibility; Automotive Control and Mechatronics; Drive-by-Wire, X-by-Wire Controls; Powertrain and Propulsion Controls; Adaptive Cruise Control (ACC) and Smart Speed Controls; Vehicle Dynamics and Stability Controls; Vehicle State Estimation; Human Factors in Driving Dynamics; Integrated Motion Control; Control Systems in Road Facilities and Roadside Infrastructure.

Transportation and Connected Vehicles

Traffic Theory, Modeling, and Simulation; Traffic and Travel Data and Information; Computational Transportation and Society; Cloud Computing for Transportation; Transportation Performance Data and Connected Vehicles; Floating Vehicles and Traffic Flow Analysis; Traffic Management; Traffic and Communications Networks; Intelligent Infrastructure and Guidance Systems; Traffic Control and Routing; Incident and Disaster Detection and Management; Congestion Management and Avoidance; Congestion Control by Cooperative Data Analysis; Infrastructure Capacity Management; Road Charging, Tolling and Electronic Toll Collection; Vehicle Clearance and Safety Inspection; Parking Management and Electronic Parking Payments; Pedestrian and Bicyclist Safety and Mobility systems; Mass Transit and Regional Transit Systems; Fleet and Commercial Vehicle Operations (Secure Cargo Management, Hazardous Goods Tracking, etc.); Connected Vehicles for Special Needs; Vehicle Ownership and Usage Alternatives (Shared Ownership, Renting, etc.); Pay-as-you-Drive (PAYD) and Vehicle Insurance; Vehicle Infrastructure Integration (VII); Emergency Warning System for Vehicles; Cooperative Adaptive Cruise Control; Cooperative Forward Collision Warning; Intersection Collision Avoidance; Highway-Rail Intersection Warning; Transit or Emergency Vehicle Signal Priority; Approaching Emergency Vehicle Warning; In-Vehicle Signing; Rollover Warning; Probe Data Collection; Multimodal Transportation (Journey Planner, Real Time Traveler Information, Payment and Ticketing, Outdoor and Indoor Navigation, etc.); Innovative Multimodal Mobility Services (Public Transport, Vehicle Sharing, etc.); Green, Environmental and Sustainable Transportation; Integration of Transportation Systems into Urban Environments; Simulation, Experimental Systems, Testbeds and Field Trials; Deployment Strategies and Predictions; Implementations and Practices; Innovative Concepts for Promoting Traffic Safety and Mobility.

Electric Vehicle and Transportation Electrification

Plug-in Hybrid Electric Vehicle (PHEV); Battery Electric Vehicle (BEV); Hybrid Electric Vehicle (HEV); Fuel Cell Electric Vehicle (FCEV); EV System Architecture Concepts for Passenger, Service and Utility Vehicles; EV Systems Modeling, Simulation and Testing; EV Components (Powertrains and Controllers, High Voltage Wiring, Thermal Systems, etc.); EV Energy Storage Solutions (Battery Chemistry, Ultra Capacitor, Fuel Cell, Battery Management System, etc.); EV Charging Solutions (AC and DC Conductive Charging, Wireless Charging, Smart Charging, Fast Charging, etc.); EV Power Electronics; EV Mass Production and Manufacturing; EV Maintainability; EV Mobility Services and Customer Experience; Power Grid Opportunities and Challenges for EV Charging/Discharging; Power Grid and Renewable Energy Resource Interfacing for EV Mass Deployment; Vehicle-to-Grid (V2G) and Interconnection of Devices with Smart Grid; EV Infrastructure Support; EV Fleet and Infrastructure Asset Management; IT and Communications for EV and EV Ecosystem; Global Standards Developments for EV and their Impact on EV R&D, Supply Chain, Manufacturing and Deployment; New Concepts and New Trends in EV R&D, Supply Chain, Manufacturing and Deployment; EV-related Educational Programs for Engineers, Legislators and Customers; International View on EV Market Development.

Geographic, Spatial and Social Information Systems

Positioning, Navigation and Localization Systems; LBS (Location Based Services) and SOLOMO (Social, Local, Mobile) Applications and Services; Map Data and Map Features for Connected Vehicles and ITS; Indoor Positioning and Navigation; Vehicle, Pedestrian and Robot Positioning and Navigation; Location-aided Communications and Services; Satellite (GPS, GALILEO, GLONASS, COMPASS, etc.) and Terrestrial Solutions for Accurate and Reliable Positioning; Cellular based Positioning and Hybrid Approaches; UWB and Narrow Band Positioning; MIMO Positioning; Distributed and Collaborative Localization; Geoscience and Remote Sensing for Connected Vehicles and ITS; Aeronautical and Maritime Systems.

Manufacturing and Product Safety Engineering in Connected Vehicles

Manufacturing and Product Safety Engineering of Vehicles and Automotive Electronics; Manufacturing and Product Safety Engineering of In-Vehicle and Mobile Consumer Electronics; Manufacturing and Product Safety Engineering of ITS Devices; OEM Global Supply Chain; Aftermarket Supply Chain.

Practices, Recommendations and Standards in Connected Vehicles

Vehicular Networking Standards and Practices; Electric Vehicle and Smart Grid Standards and Practices; ITS Standards and Practices; Other Emerging Standards and Practices for Connected Vehicles and ITS; Adoption of IEEE 802 Standards (WiFi/WAVE/MESH, ZigBee, Bluetooth, WiMAX, etc.) in Connected Vehicles and ITS; Adoption of Cellular Standards (2G/3G/4G) in Connected Vehicles and ITS; Adoption of DSRC, CALM, RFID, Satellite, MM-wave, Infrared, and Other Standards in Connected Vehicles and ITS.

Policy, Economics and Social Implications of Connected Vehicles

Policy, Governance, Cooperation and Organization for Connected Vehicles and ITS; Economics, Business Model and Financing of Connected Vehicles and ITS; Social Implications, Impact Assessment and Benefits of Connected Vehicles and ITS; Education, Training and Awareness of Connected Vehicles and ITS; Connected Vehicles and ITS in Developing Countries.

IEEE Joint Intelligence & Security Informatics Conference

The Premier Conference on Intelligence, Safety and Security Informatics

ISI/EISIC2014

The Hague, The Netherlands, September 24-26, 2014 **http://www.eisic.org**

Call for Papers

Since 2003 the IEEE International Conference on Intelligence and Security Informatics (ISI) is the leading international scientific conference on interdisciplinary research on information technology for intelligence, safety and security. In 2011, the European counterpart of the ISI started as European Intelligence and Security Informatics Conference (EISIC). For the first time both events meet in the IEEE Joint Intelligence and Security Informatics Conference (JISIC), enabling international researchers on the challenging field of intelligence and security informatics to share ideas on problems, solutions and new directions.

We invite academic researchers in the field of Intelligence and Security Informatics and related areas as well as companies, industry consultants, analysts and practitioners in the fields involved to submit papers and proposals for tutorials. We are soliciting both research and practice and experience papers on the topics of the tracks below and related topics.

IEEE JISIC features six tracks chaired by leading researchers on the respective theme:

1. Forensic Intelligence
Jeroen Keppens – King's College London
- Evidential reasoning
- Probabilistic reasoning
- Argumentation
- Forensic investigation
- Knowledge management

2. Decisioning and Interaction
John Stasko – Georgia Institute of Technology
- Visualization
- Visual analytics systems
- Interactive decision-support
- Analytical reasoning systems
- Multimedia information systems

3. Cyber and Infrastructure Security
V.S. Subrahmanian – University of Maryland
- Cyber security
- Infrastructure security
- Intelligence
- Terrorism
- Computational models

4. Financial and Fraud Analysis
Niall Adams – Imperial College London
- Adaptive systems
- Big data
- Insurance fraud
- Banking fraud
- Internet transactions

5. Computational Criminology
Thomas Holt – Michigan State University
- Offender behavior and victimology,
- Social network structures
- Organizational practices
- Crime prevention strategies
- Evaluations of crime prevention and intelligence led policing

6. Border Control
Jakub Piskorski – FRONTEX
- Authentication
- Risk assessment of travelers
- Modelling of border control processes
- Surveillance and situational awareness
- Technology impact, acceptance and integration

Advisory Board

Hsinchun Chen
University of Arizona
USA

General Chairs

Mariëlle den Hengst
Delft University of Technology
The Netherlands

Menno Israël
Netherlands Forensic Institute
The Netherlands

Daniel Zeng
University of Arizona
USA

Program Chairs

Cor Veenman
Netherlands Forensic Institute
The Netherlands

Alan Wang
Virginia Tech
USA

Publicity Chair

Dongsong Zhang
University of Maryland
Baltimore County
USA

Local Arrangement Chair

Chantal Janssen-Smittenaar
Netherlands Forensic Institute
The Netherlands

Netherlands Forensic Institute
Ministry of Security and Justice

TU Delft
Delft University of Technology

IEEE

INTELLIGENT TRANSPORTATION SYSTEMS SOCIETY ITSS IEEE

http://www.eisic.org

2014	Paper Submission Due	Notification of Acceptance	Camera Ready Paper Due/Authors Registration Due	Conference
	June 1	July 1	July 18	September 24-26

Technical University of Crete
Dynamic Systems and Simulation Laboratory
Chania 73100, Greece

11th Short Course 2014

****
DYNAMIC TRAFFIC FLOW MODELLING AND CONTROL
****

Lecturer: Prof. Markos Papageorgiou
Date: 3-7 November 2014
Location: Chania (Crete), Greece
Fee: 1.700 € (for graduate students: 1.300 €)
(20% reduction is granted in case of more than one participation from the same institution)

Scope

The design, analysis, and evaluation of Intelligent Transportation Systems (ITS) requires a good knowledge of traffic flow modelling and control techniques as well as of powerful methodologies from the areas of optimisation, control, networks and dynamic systems. The purpose of the intensive 5-day course is to cover the basic theory, methods and tools necessary for efficient design and evaluation of ITS on road and freeway networks. After a basic introduction to dynamic systems and control, the course continues with traffic flow modelling and validation issues, covering various traffic flow models, the modelling of traffic networks, dynamic traffic assignment and simulation tools. Measurement devices and estimation problems in traffic networks, including automatic incident detection and OD estimation, are presented and discussed. The state-of-the-art techniques in freeway traffic control, road traffic control and integrated traffic control, employing ramp metering, signal control, variable speed limits and route guidance, together with several field-implemented case studies are presented. Future prospects and challenges related to emerging vehicle automation and communication systems are discussed. Brief accounts of modern optimisation, control and estimation techniques are provided. Some 50 exercises are used for consolidation of the provided knowledge. Extensive written materials, including all transparency copies, are handed out.

Who Should Attend

Graduate students, engineers, researchers, consultants, and government employees who are interested in improving their understanding of advanced traffic flow modelling and control tools and in becoming familiar with their application in ITS.

Please forward the information about the Short Course to any of your colleagues who may be interested.

For more information

For more information (Detailed Course Contents, About the Lecturer, Registration Form, Location, Accommodation, Evaluation of Previous Courses), please visit the site: http://www.dssl.tuc.gr/en/shortcourse/ShortCourseAnnouncement.doc or email shortcourse@dssl.tuc.gr or contact:

****

Prof. Markos Papageorgiou
Director
Dynamic Systems & Simulation Laboratory
TECHNICAL UNIVERSITY OF CRETE
University Campus
GR-73100 Chania, GREECE

Tel: +30-28210-37240
Fax: +30-28210-37584/69410
E-mail: markos@dssl.tuc.gr
Web: http://www.dssl.tuc.gr
****

Invitation

On behalf of the Autonomous Systems Lab and the members of the V-Charge project, I have the pleasure to cordially invite you to the following robotics summer school which will be conducted this July at the Swiss Federal Institute of Technology Zurich (ETH Zurich):

July 7th – July 10th, 2014:

The V-Charge Summer School: Perception and Planning for Autonomous Driving

Research into fully automated driving is maturing rapidly with all major vehicle manufacturers targeting the rollout of some form of vehicle automation in the years ahead. This ambitious goal will see complicated robotic systems deployed widely. However, there is still a gap between the commercial systems now available—such as automated cruise control or parking assistance—and the functionality and robustness needed for truly automated driving. Providing this functionality using only a suite of sensors that is affordable for consumers is a great challenge that must be solved before fully automated vehicles make it into the hands of average consumers.

The V-Charge project will host a summer school on fully automated driving. We want to prepare a new generation of engineers for these challenges, expose them to the current state of the art, and highlight fascinating areas of future research. The summer school will give a compact introduction to the field of fully automated driving, offer technical sessions that will provide hands-on experience with state-of-the-art techniques, and present invited talks to frame the open research questions in the field.

The school is designed for graduate students of all levels. However, a solid

background in engineering will enable you to profit most from the lectures and exercises. In the courses, we seek to take your existing engineering skills and extend them to the most important fundamentals in this field. We will show you the current state of the art in each area and expose you to inspiring researchers from all over the world. To this end, the summer school will feature four full days of tutorials, lectures, hands-on exercises, and case studies presented by internationally recognized experts in the field.

Detailed information is given below in this email or accessible at http://www.roboticsschool.ethz.ch or http://www.v-charge.eu/?page_id=545

Speakers

- Roland Siegwart, ETHZ - ASL
- Paul Furgale, ETHZ - ASL
- Christoph Stiller, Karlsruhe Institute of Technology
- Michel Parent, INRIA
- Uwe Franke, Daimler
- Falko Dressler, University of Innsbruck
- Steven Shladover, University of California, Berkeley
- Ulrich Schwesinger, ETHZ - ASL
- Marc Pollefeys, ETHZ - CVG
- Torsten Sattler, ETHZ - CVG
- Stefano Cattani, University of Parma
- Julian Timpner, TU Braunschweig
- Lina Paz, University of Oxford
- Hugo Grimmet, University of Oxford
- Alex Stewart, University of Oxford
- Paolo Medici, University of Parma

Application

Participation is limited to 50 students. Candidates will be selected based on the quality of their application. Please state on one single page (11pt font):

- your scientific background and degree
- your motivation to come to this school
- the topic of your thesis
- any prior knowledge in the field Please include a current academic transcript with your application (and optionally a CV with a list of publications) and send it to v-charge-summerschool@mavt.ethz.ch

EXTENDED deadline for the application is April 22th, 2014.

Successful candidates will be notified by April 27th and need to register and pay the course fee by May 13.

Logistics

Cost:

The cost for the summer school is

- 300 CHF including accommodations
- 250 CHF without accommodations

This will cover all course materials, as well as breakfast, coffee-breaks, and two dinners during the school. Lunch and dinner are available at the ETH-Cafeterias and in nearby venues from ~15 CHF (including a drink). For the whole week, we put the additional living expenses at around CHF 200.

Accommodations:

We will provide basic accommodation for all participants in a remodeled former

air-raid shelter in the basement of the Computer Science building (no windows). This is right next door to the course venue, and will feature dormitory style rooms with shared bathrooms. Pillows, blankets, and sheets will be provided. This accommodation will be free of charge for all participants. It will be open from Sunday evening to Friday morning, to accommodate travel that requires an additional night in Zurich. If more privacy and comfort is desired, students must organize alternative accommodation on their own responsibility and expense (double rooms in Zurich start at around 65 CHF per night and person).

Organizers

The summer school is organized by the Autonomous Systems Lab (http://www.asl.ethz.ch/) and the V-Charge project (http://www.v-charge.eu) in collaboration with:

- Vislab at the University of Parma (http://vislab.it/)
- The Automotive Research Centre Niedersachsen at Technische Universität Braunschweig, Germany
- The ETH Zurich Computer Vision and Geometry Group (http://www.cvg.ethz.ch/)
- The Oxford Mobile Robotics Group (http://www.robots.ox.ac.uk/~mobile)

This summer school is funded by the EU FP7 2007–2013 Program, Challenge 2, Cognitive Systems, Interaction, Robotics, under grant agreement No 269916, V-Charge.

If you have any questions, please feel free to contact:
v-charge-summerschool@mavt.ethz.ch

With best regards,

Paul Furgale


Conference Calendar

Massimo Bertozzi / Paolo Grisleri

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

2014

May 18-21
IEEE Vehicular Technology Conference: VTC2014-Spring
Seoul, Korea
http://www.ieeevtc.org/vtc2014spring/

May 21-23
19th International Conference on Urban Planning and Regional Development in the Information Society REALCORP 2014
Wien, Austria
http://www.corp.at

May 31-June 5
2014 IEEE International Conference on Robotics and Automation (ICRA 2014)
Hong Kong, China
http://www.icra2014.com

June 1-4
IEEE International Symposium on Industrial Electronics (ISIE 2014)
Istanbul, Turkey
http://www.isie.boun.edu.tr

June 5-6
European Conference on human centred design for Intelligent Transport Systems
Vienna, Austria
http://conference2014.humanist-vce.eu

June 8-11
The 2014 IEEE Intelligent Vehicles Symposium
Ypsilanti, MI, USA
http://www.ieeeiv.net

June 16-19
10th ITS European Congress - ITS Helsinki
Helsinky, Finland
http://www.itsineurope.com/its10/

June 23-28
18th International Forum on Advanced Microsystems for Automotive Applications (AMAA 2014)
Kaiserin Friedrich-House, Berlin (Germany)
http://www.amaa.de/

June 24-27
27th IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2014)
Columbus,OH, USA
http://www.pamitc.org/cvpr14/

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

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

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

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

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

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

October 8-11
ITSC2014: The 17th International IEEE Conference on Intelligent Transportation Systems
Qingdao, Shandong, China
Submission due by: May 15, 2014
http://www.itsc2014.org/

October 22-25
14th International Conference on Transport Systems Telematics
Kraków, Ustroń, Poland
Submission due by: May 04, 2014
http://tst-conference.org/

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

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

May 21-23
19th International Conference on Urban Planning and Regional Development in the Information Society REALCORP 2014
Wien, Austria
http://www.corp.at

May 31-June 5
2014 IEEE International Conference on Robotics and Automation (ICRA 2014)
Hong Kong, China
http://www.icra2014.com

June 1-4
IEEE International Symposium on Industrial Electronics (ISIE 2014)
Istanbul, Turkey
Submission due by: January 12
http://www.isie.boun.edu.tr

Abstracts of forthcoming papers on IEEE Transactions on ITS

MODELING AND DETECTING AGGRESSIVENESS FROM DRIVING SIGNALS

RODRÍGUEZ GONZÁLEZ, ANA BELÉN; WILBY, MARK; VINAGRE, JUAN JOSÉ; SÁNCHEZ ÁVILA, CARMEN

The development of advanced driver assistance systems (ADAS) will be key in the future intelligent transportation systems in order to reduce the number of traffic accidents and their subsequent fatalities. Specifically, driving behaviors could be monitored on-line to determine the crash risk and provide this information to the driver via his ADAS. In this paper, we focus on aggressiveness as one of the potential causes of traffic accidents. We demonstrated that aggressiveness can be detected through the monitoring of external driving signals such as lateral and longitudinal accelerations, and speed. We modeled aggressiveness as a linear filter operating on these signals, thus scaling their probability distribution functions and modifying their mean value, standard deviation, and dynamic range. Next we proceed to validate this model via an experiment, conducted under real driving conditions, involving 10 different drivers, traveling a route with 5 different road-types sections, subject to both smooth and aggressive behaviors. The obtained results confirm the validity of the model of aggressiveness. In addition, they show the generality of this model and its applicability to every driving signal, every single driver, and every road-type. Finally we build a classifier capable of detecting aggressive behavior from the driving signal. This classifier achieves a success rate up to 92%.

SMART PUBLIC TRANSIT SYSTEM USING ENERGY STORAGE SYSTEM AND ITS COORDINATION WITH DISTRIBUTION GRID

AGRAWAL, AISHVARYA; KUMAR, MAHESH; PRAJAPATI, DHARMENDRA; SINGH, MUKESH; KUMAR, PRAVEEN

In this work, a transportation network based on a supercapacitor powered electric city-bus (Capabus) has been shown to work in harmony with the electric grid. The load profile of the transportation network and the grid are interfaced using a battery based energy storage system (ESS), which is used at each bus-stop to continuously charge the supercapacitors for bus operation and provide grid support. The power flow from the ESS to the grid and vice-versa is regulated using a Fuzzy logic controller (FLC). The FLC takes as input, the energy of ESS, node voltage (in p.u.) and the frequency of the buses plying on a practical ring-road circuit of a typical city. The ESSs stabilize the grid at the corresponding node through peak shaving and valley filing during peak and off-peak hours respectively. The objective of the present work is to achieve the required frequency of buses and maintain the grid voltage close to 1 per unit (p.u.). Increasing penetration of electric-bus based transit system will substantially improve the grid operation efficiency and also reduce oil consumption by the transport sector.

TOWARD DYNAMIC SCENE UNDERSTANDING BY HIERARCHICAL MOTION PATTERN MINING

SONG, LEI; JIANG, FAN; SHI, ZHONGKE; MOLINA, RAFAEL; KATSAGGELOS, AGGELOS

Our work addresses the problem of analyzing and understanding dynamic video scenes. A two-level motion pattern mining approach is proposed. At the first level, activities are modeled as distributions over patch-based features, including spatial location, moving direction and speed. At the second level, traffic states are modeled as distributions over activities. Both patterns are shared among video clips. Compared to other works, one advantage of our method is that moving speed is considered to describe visual word. The other one is that traffic states are detected and assigned to every video frame. These enable finer semantic interpretation, more precise video segmentation and anomaly detection. Specifically, every video frame is labeled by a certain traffic state, and the video is segmented frame by frame accordingly. Moving pixels in each frame which do not belong to any activity or cannot exist in the corresponding traffic state are detected as anomalies. We have successfully tested our approach on some challenging traffic surveillance sequences containing both pedestrian and vehicle motions.

CLASSIFICATION OF DRIVING DIRECTION IN TRAFFIC SURVEILLANCE USING MAGNETOMETERS

WAHLSTRÖM, NIKLAS; HOSTETTLER, ROLAND; GUSTAFSSON, FREDRIK; BIRK, WOLFGANG

Traffic monitoring using low-cost 2-axis magnetometers is considered. Though detection of metallic vehicles is rather easy, detecting the driving direction is more challenging. We propose a simple algorithm based on a nonlinear transformation of the measurements, which is simple to implement in embedded hardware. A theoretical justification is provided, and the statistical properties of the test statistic are presented in closed form. The method is compared to the standard likelihood ratio test on both simulated data and real data from field tests, where very high detection rates are reported, despite the presence of sensor saturation, measurement noise and near-field effects of the magnetic field.

LINEAR AND WEAKLY NON-LINEAR STABILITY ANALYSES OF COOPERATIVE CAR FOLLOWING MODELS

MONTEIL, JULIEN; BILLOT, ROMAIN; SAU, JACQUES; EL FAOUZI, NOUR-EDDIN

Stability analyses have been widely used to better understand the mechanism of traffic jam formation. In this paper, we consider the impact of cooperative systems (a.k.a. connected vehicles) on traffic dynamics and more precisely on flow stability. Cooperative systems are emerging technologies enabling communication between vehicles and/or with the infrastructure. In a distributed communication framework, equipped vehicles are able to send and receive information to/from others equipped vehicles. Here, the effects of cooperative traffic are modeled through a general bilateral multi-anticipative car following law that improves cooperative drivers' perception of their surrounding traffic conditions within a given communication range. Linear stability analyses are performed for a broad class of car following models. They point out different stability conditions in both multi-anticipative and non-multi-anticipative situations. To better understand what happens in unstable conditions, information on the shock wave structure is studied in the weakly non-linear regime by the mean of the reductive perturbation method. The shock wave equation is obtained for generic car following models by deriving the Korteweg de Vries (KdV) equations. We then derive traffic state dependent conditions for the sign of the solitary-wave (soliton) amplitude. This analytical result is verified

through simulations. Simulation results confirm the validity of the speed estimate. The variation of the soliton amplitude as a function of the communication range is provided. The performed linear and weakly non-linear analyses help justify the potential benefits of vehicle-integrated communication systems and provide new insights supporting the future implementation of cooperative systems.

ADAPTIVE VEHICLE NAVIGATION WITH EN ROUTE STOCHASTIC TRAFFIC INFORMATION

XIAO, LIN; LO, HONG

This paper develops an adaptive approach for vehicle navigation in a stochastic network with real time en route traffic information. This stochastic, adaptive approach is formulated as a probabilistic dynamic programming problem and solved through a backward recursive procedure. The formulation, as a modeling framework, is designed to be able to incorporate various sources of information and real time traffic states to improve the routing quality. In this paper, we prove that the approach outperforms deterministic instantaneous shortest paths in a statistical sense. We also analyze the algorithm's computational efficiency. Results from numerical example are included to illustrate the performance of the adaptive routing policy generated by the formulation.

MODELING AND NONLINEAR ADAPTIVE CONTROL FOR AUTONOMOUS VEHICLE OVERTAKING

PETROV, PLAMEN; NASHASHIBI, FAWZI

In this paper, we present a mathematical model and adaptive controller for an autonomous vehicle overtaking maneuver. We consider the problem of an autonomous three-phase overtaking without the use of any roadway marking scheme or inter-vehicle communication. The developed feedback controller requires information for the current relative inter-vehicle position and orientation, which is assumed to be available from onboard sensors. We apply standard robotic nomenclature for translational and rotational displacements and velocities and propose a general kinematic model of the vehicles and relative inter-vehicle kinematics during the overtaking maneuver. The overtaking maneuver is investigated as a tracking problem with respect to desired polynomial virtual trajectories for every phase, which are generated in real time. An update control law for the automated overtaking vehicle is designed that allows tracking the desired trajectories in the presence of unknown velocity of the overtaken vehicle. Simulation results illustrate the performance of the proposed controller.

A TWO-OBJECTIVE TIMETABLE OPTIMIZATION MODEL IN SUBWAY SYSTEMS

YANG, XIN; NING, BIN; LI, XIANG; TANG (GUEST EDITOR ICIRT 2013), TAO

The train timetable optimization problem in subway systems is to determine arrival and departure time for trains at stations so that the resources can be utilized effectively and the trains can be operated efficiently. Because that the energy-saving and the service quality are paid more attention, this paper proposes a timetable optimization model to increase the utilization of regenerative energy and simultaneously shorten the passenger waiting time. First, we formulate a two-objective integer programming model with headway time and dwell time control. Second, we design a genetic algorithm with binary encoding to find the optimal solution. Last, we conduct numerical examples based on

the operation data from Beijing Yizhuang subway line of China. The results illustrate that the proposed model can save energy by 8.86% and reduce passenger waiting time by 3.22% in comparison with the current timetable.

NORTH ATLANTIC AIRCRAFT TRAJECTORY OPTIMIZATION

RODIONOVA, OLGA; SBIHI, MOHAMED; DELAHAYE, DANIEL; MONGEAU, MARCEL

North Atlantic oceanic airspace accommodates air traffic between North America and Europe. Radar-based surveillance is not applicable in this vast and highly congested airspace. For conflict-free flight progress, the Organized Track System is established in North Atlantic, and flights are prescribed to follow pre-defined oceanic tracks. Re-routing of aircraft from one track to another is very rarely applied because of large separation standards. As a result, aircraft often follow routes that are not optimal in view of their departure and destination points. This leads to an increase in aircraft cruising time and congestion level in continental airspace at input and output. Implementing new technologies and airborne-based control procedures will enable significant decrease in the present separation standards and improvement of the traffic situation in North Atlantic. The aim of the present study is to show the benefits that can be expected from such a reduction of separation standards. Optimal conflict-free trajectories are constructed for several flight sets based on the new proposed separation standards, with respect to the flight input data and oceanic winds. This paper introduces a mathematical model; it proposes an optimization formulation of the problem; it constructs two test problems based on real air-traffic data, and it presents very encouraging results of simulations for these data.

ENERGY-EFFICIENT TRAIN OPERATION IN URBAN RAIL TRANSIT USING REAL-TIME TRAFFIC INFORMATION

GU, QING; TANG (GUEST EDITOR ICIRT 2013), TAO; CAO, FANG; SONG, Y. D.

Energy-efficient train operation represents an important issue for daily operational urban rail transit. Most energy-efficient train operation strategies are normally planned according to a timetable, which is designed by offline traffic information. In this paper, a new energy-efficient train operation model based on real-time traffic information is proposed from the geometric and topographic points of view through nonlinear programming method, leading to an energy-efficient driving strategy with real-time interstation running time monitored by the automatic train supervision system. The novelty of this work lies not only in the establishment of a new model for energy-efficient train operation but also in the utilization of combining analytical and numerical methods for deriving energy-efficient strategies. More specifically, the energy-efficient operation model is built based on trajectory analysis when the energy-efficient optimal controls is applied, from which energy-efficient reference trajectory is obtained under the running time and distance constraints, where the nonlinear programming method is utilized. In contrast to most existing methods, the proposed model turns out to be a small-scale problem, and the difficulties of solving partial differential equations or the process of predetermining and reiteratively calculating some key factors as traditionally involved are avoided. Thus, it is more feasible to implement the strategy and easier to make real-time adjustment if needed. The comparative analysis and the simulation verification with the actual operating data confirm the effectiveness of the proposed method. With the proposed method, some delayed trains are able to keep punctuality at the next station and sometimes even reducing energy consumption.

ON TOPOLOGY OF SENSOR NETWORKS DEPLOYED FOR MULTI-TARGET TRACKING

ZHU, YE; VIKRAM, ANIL; FU, HUIRONG

In this paper, we study topologies of sensor networks deployed for tracking multiple targets. Tracking multiple moving targets is a challenging problem. Most of previously proposed tracking algorithms simplify the problem by assuming access to the signal from individual target for tracking. Recently tracking algorithms based on Blind Source Separation (BSS), a statistical signal processing technique widely used to recover individual signals from mixtures of signals, were proposed. BSS-based tracking algorithms are proven to be effective in tracking multiple indistinguishable targets. The topology of a wireless sensor network deployed for tracking with BSS-based algorithms is critical to tracking performance: (a) The topology affects separation performance. (b) The topology determines accuracy and precision of estimation on the paths taken by targets. We propose cluster topologies for BSS-based tracking algorithms. Guidelines on parameter selection for proposed topologies are given in this paper. We evaluate the proposed cluster topologies with extensive experiments. Our experiments show that the proposed topologies can significantly improve both the accuracy and the precision of BSS-based tracking algorithms.

VISION ONLY LOCALIZATION

LATEGAHN, HENNING; STILLER, CHRISTOPH

Autonomous and intelligent vehicles will undoubtedly depend on an accurate ego localization solution. Global navigation satellite systems (GNSS) suffer from multipath propagation rendering this solution insufficient. Herein we present a real time system for six degrees of freedom (DOF) ego localization that uses only a single monocular camera. The camera image is harnessed to yield an ego pose relative to a previously computed visual map. We describe a process to automatically extract the ingredients of this map from stereoscopic image sequences. These include a mapping trajectory relative to the first pose, global scene signatures and local landmark descriptors. The localization algorithm then consists of a topological localization step that completely obviates the need for any global positioning sensors like GNSS. A metric refinement step that recovers an accurate metric pose is subsequently applied. Metric localization recovers the ego pose in a factor graph optimization process based on local landmarks. We demonstrate a centimeter level accuracy by a set of experiments in an urban environment. To this end, two localization estimates are computed for two independent cameras mounted on the same vehicle. These two independent trajectories are thereafter compared for consistency. Finally, we present qualitative experiments of an augmented reality (AR) system that depends on the aforementioned localization solution. Several screen shots of the AR system are shown confirming centimeter level accuracy and sub degree angular precision.

FUEL PANICS INSIGHTS FROM SPATIAL AGENT-BASED SIMULATION

NUTTALL, WILLIAM; UPTON, EBEN

The United Kingdom has twice suffered major disruption as a result of fuel panics first in September 2000 coincident with a wave of fuel protests and more recently in March 2012 following political warnings of possible future supply chain disruption. In each case the disruption and economic consequences were serious. Approaches to supply-chain planning based on linear programming are poorly suited to modelling non-equilibrium effects, while coarse-grained system dynamics models often fail to capture local phenomena which contribute to the evolution of global demand. In this Paper, we demonstrate that computational agent-based techniques offer a powerful framework for co-simulation

of supply chains and consumers under conditions of transient demand. In the case of fuel panic crisis, we show that even a highly abstract model can reproduce a range of transient phenomena seen in the real world, and present a set of practical recommendations for policymakers faced with panic-buying.

SITUATIONAL KNOWLEDGE REPRESENTATION FOR TRAFFIC OBSERVED BY A PAVEMENT VIBRATION SENSOR NETWORK

STOCKER, MARKUS; RÖNKKÖ, MAUNO; KOLEHMAINEN, MIKKO

Information systems that build on sensor networks often process data produced by measurement of physical properties. This data can serve in the acquisition of knowledge for real-world situations of interest to information services and, ultimately, to people. Such systems face a common challenge, namely the considerable gap between the data produced by measurement and the abstract terminology used to describe real-world situations. We present and discuss the architecture of a software system that utilizes sensor data, digital signal processing, machine learning, and knowledge representation and reasoning to acquire, represent, and infer knowledge about real-world situations observable by a sensor network. We demonstrate the application of the system to vehicle detection and classification by measurement of road-pavement vibration. Thus, real-world situations involve vehicles and information for their type, speed, and driving direction.

COMPARING OPTIMAL RELOCATION OPERATIONS WITH SIMULATED RELOCATION POLICIES IN ONE-WAY CARSHARING SYSTEMS

JORGE, DIANA; CORREIA, GONÇALO; BARNHART, CYNTHIA

One-way carsharing systems allow travelers to pick up a car at one station and return it to a different station, thereby causing vehicle imbalances across the stations. In this paper, realistic ways to mitigate that imbalance by relocating vehicles are discussed. Also presented are a new mathematical model to optimize relocation operations that maximize the profitability of the carsharing service and a simulation model to study different real-time relocation policies. Both methods were applied to networks of stations in Lisbon Portugal. Results show that real-time relocation policies, and these policies when combined with optimization techniques, can produce significant increases in profit. In the case where the carsharing system provides maximum coverage of the city area, imbalances in the network resulted in an operating loss of 1160 €/day when no relocation operations were performed. When relocation policies were applied, however, the simulation results indicate that profits of 854 €/day could be achieved, even with increased costs due to relocations. This improvement was achieved through reductions in the number of vehicles needed to satisfy demand and the number of parking spaces needed at stations. This is a key result that demonstrates the importance of relocation operations for sustainably providing a more comprehensive network of stations in one-way carsharing systems, thus reaching a higher number of users in a city.

COOPERATIVE ADAPTIVE CRUISE CONTROL: NETWORK-AWARE ANALYSIS OF STRING STABILITY

ONCU, SINAN; PLOEG, JEROEN; VAN DE WOUW, NATHAN; NIJMEIJER, HENK

In this study, we consider a Cooperative Adaptive Cruise Control (CACC) system which regulates inter-vehicle distances in a vehicle string for achieving improved traffic flow stability and throughput. Improved performance can be achieved by utilizing information exchange between vehicles through wireless communication besides local sensor measurements. However, wireless communication introduces network-induced imperfections such as e.g. transmission delays due to limited bandwidth of the network, and the fact that multiple nodes are sharing the same medium. Therefore, we approach the design of a CACC system from a Networked Control System (NCS) perspective and present a NCS modelling framework that incorporates the effect of sample-and-hold and network delays that occur due to wireless communication and sampled-data implementation of the CACC controller over this wireless link. Based on this network-aware modelling approach, we develop a technique to study the so-called string stability property of the string in which vehicles are interconnected by a vehicle following control law and a constant time headway spacing policy. This analysis technique can be used to investigate tradeoffs between CACC performance (string stability) and network specifications (such as delays) which are essential in the multi-disciplinary design of CACC controllers. Finally, we demonstrate the validity of the presented framework in practice by experiments performed with CACC-equipped prototype vehicles.

DYNAMIC PROBABILISTIC DRIVABILITY MAPS FOR LANE CHANGE AND MERGE DRIVER ASSISTANCE

SIVARAMAN, SAYANAN; TRIVEDI, MOHAN

In this study, we present a novel probabilistic compact representation of the on-road environment, the Dynamic Probabilistic Drivability Map, and demonstrate its utility for predictive lane change and merge [LCM] driver assistance during highway and urban driving. The DPDM is a flexible representation, and readily accepts data from a variety of sensor modalities to represent the on-road environment as a spatially-coded data structure, encapsulating spatial, dynamic, and legal information. Using the DPDM, we develop a general predictive system for lane changes and merges [LCM]. We formulate the LCM assistance system to solve for the minimum-cost solution to merge or change lanes, efficiently solved using dynamic programming over the DPDM. Based on the DPDM, the LCM system recommends the required acceleration and timing to safely merge or change lanes with minimum cost. System performance has been extensively validated using real-world on-road data, including urban driving, on-ramp merges, and both dense and free-flow highway conditions.

GROWING SPATIALLY EMBEDDED SOCIAL NETWORKS FOR ACTIVITY-TRAVEL ANALYSIS BASED ON ARTIFICIAL TRANSPORTATION SYSTEMS

CHEN, SONGHANG; ZHU, FENGHUA; CAO, JIANPING

Social activity-travel has gained more and more attention as making up a growing percentage of the whole travel. To study its generation mechanism and behavioral characteristics, social network data is usually essential. However, due to individual privacy, it is rather difficult for traditional methods like questionnaires to collect abundant reliable data. Therefore, we propose a novel method to grow realistic social networks based on Artificial Transportation Systems (ATS). By incorporating the activity-travel simulation provided by ATS and a new agent-based model for social interaction, the method takes into account human mobility to generate spatially embedded social networks. Human mobility shapes and impacts social networks dynamically but is usually ignored by related studies. A case study based on computational experiments is carried out to verify the method. The results indicate that the method can generate social networks with similar topological and spatial characteristics to real social networks.

FINITE-STATE MARKOV MODELING FOR WIRELESS CHANNELS IN TUNNEL COMMUNICATION-BASED TRAIN CONTROL (CBTC) SYSTEMS

WANG, HONGWEI; YU, F. RICHARD; ZHU, LI; TANG (GUEST EDITOR ICIRT 2013), TAO; NING, BIN

Communication based train control (CBTC) is rapidly adopted in urban rail transit systems, as it can significantly enhance railway network efficiency, safety and capacity. Since CBTC systems are mostly deployed in underground tunnels and trains move in high speed, building a train-ground wireless communication system for CBTC is a challenging task. Modeling the tunnel channels is very important to design the wireless networks and evaluate the performance of CBTC systems. Most of existing works on channel modeling do not consider the unique characteristics in CBTC systems, such as high mobility speed, deterministic moving direction, and accurate train location information. In this paper, we develop a finite-state Markov channel (FSMC) model for tunnel channels in CBTC systems. The proposed FSMC model is based on real field CBTC channel measurements obtained from a business operating subway line. Unlike most existing channel models, which are not related to specific locations, the proposed FSMC channel model takes train locations into account to have a more accurate channel model. The distance between the transmitter and the receiver is divided into intervals, and an FSMC model is applied in each interval. The accuracy of the proposed FSMC model is illustrated by the simulation results generated from the model and the real field measurement results.

IMPROVING TRAFFIC FLOW EFFICIENCY BY IN-CAR ADVICE ON LANE, SPEED AND HEADWAY

SCHAKEL, WOUTER; VAN AREM (MAGAZINE AE), BART

This paper presents a new in-car advisory system that gives advices on lane, speed and headway. The advices are determined at a traffic management centre based on a new lane level traffic state prediction model, in order to prevent or solve suboptimal traffic flow conditions. The system aims at an optimal lane distribution in high flow conditions, decreasing the chance of spillback by advising drivers away from the right lane, and a reduction of the capacity drop by advising drivers to maintain a short (but safe) headway at the end of congestion. The system is implemented in microscopic simulation to evaluate the potential benefits for different penetration and compliance rates. Benefits at both low and high rates are found as only a small redistribution of traffic over the lanes may be required to stabilize flow. The capacity drop is reduced mainly at high rates as it is required that many vehicles accelerate more. The maximum benefit found is a reduction of 49% in travel time delay. Effects are smaller at lower rates. Negative side effects are also found including oversaturation of lanes partially by advised lane changes and increased probability of spillback taking effect.

GENERAL BEHAVIOR PREDICTION BY A COMBINATION OF SCENARIO SPECIFIC MODELS

BONNIN, SARAH; WEISSWANGE, THOMAS; KUMMERT, FRANZ; SCHMUEDDERICH, JENS

Before taking a decision, a driver anticipates the future behavior of other traffic participants. However, if a driver is inattentive or overloaded he may fail to consider relevant information. This can lead to bad decisions and potentially result in an accident. A computational system designed to anticipate other traffic participants' behaviors could assist the driver in his decision making by sending him an early warning when a risk of collision is predicted. Existing

research in this area usually focuses on only one of two aspects: quality or scope. Quality refers to the ability to warn a driver early before a dangerous situation happens. Scope is the diversity of scenarios in which the approach can work. In general we see methods targeting broad scope but showing low quality and others having narrow scope but high quality. Our goal is to create a system with high quality and high scope. To achieve this, we propose an architecture that combines classifiers to predict behaviors for many scenarios. In this paper we will first introduce the generic concept of such a system applicable to highway scenarios as well as inner-city scenarios. We will show that a combination of general and specific classifiers is a solution to improve quality and scope based on a concrete implementation for lane change prediction in highway scenarios.

COTRAMS: A COLLABORATIVE AND OPPORTUNISTIC TRAFFIC MONITORING SYSTEM

RIBEIRO JÚNIOR, JOSÉ GERALDO; COSTA, LUIS; CAMPISTA, MIGUEL

Traffic monitoring and control are becoming more and more important as the number of vehicles and traffic jams grow. Nevertheless, these tasks are still predominantly done by visual means using strategically placed video cameras. For more effectiveness, proposals to improve the traffic monitoring and control should consider automated systems. In this paper, we propose COTraMS (Collaborative and Opportunistic Traffic Monitoring System), a system which monitors traffic using available IEEE 802.11 networks. COTraMS is collaborative because the user participation is essential to define the vehicle movement, and opportunistic because it uses existent available information. To evaluate the performance of COTraMS, a prototype is implemented using an IEEE 802.11 b/g network. Measurements from a real public wireless network, in Rio de Janeiro, demonstrate the possibility of obtaining traffic conditions with our proposed monitoring system. In addition, we analyze COTraMS via simulation to evaluate its performance in scenarios with larger number of vehicles. The comparison of the obtained results with data obtained from GPS shows a high accuracy in detecting both the position of the vehicle and the estimation of the road condition, using a simple architecture and a small amount of network bandwidth.

DESIGN AND PERFORMANCE ENHANCEMENTS IN COMMUNICATION-BASED TRAIN CONTROL (CBTC) SYSTEMS WITH COORDINATED MULTI-POINT TRANSMISSION AND RECEPTION (COMP)

ZHU, LI; YU, F. RICHARD; WANG, HONGWEI; TANG (GUEST EDITOR ICIRT 2013), TAO; NING, BIN

Communication-Based Train Control (CBTC) system is an automated train control system using bidirectional train-ground communications to ensure the safe operation of rail vehicles. CBTC systems have stringent requirements for communication availability and latency. Due to unreliable wireless communications and frequent handoff, existing CBTC systems can severely affect train control performance, train operation efficiency, and the utility of railway. In this paper, we use recent advances in Coordinated Multi-Point transmission and reception (CoMP) to enhance the train control performance of CBTC systems. With CoMP, a train can communicate with a cluster of base stations simultaneously, which is different from the current CBTC systems, where a train can only communicate with a single base station at any given time. In addition, unlike the exiting works on CoMP, in this paper, linear quadratic cost for the train control performance in CBTC systems is considered as the performance measure. We jointly consider base station cluster selection and handoff decision issues in CBTC systems. Moreover, in order to mitigate the impacts of communication latency on the train control performance, we propose an optimal guidance trajectory calculation scheme in the train control procedure that takes full consideration of the tracking error caused by handoff latency.

Simulation results show that the train control performance can be improved substantially in our proposed CBTC system with CoMP.

AUTOMATIC DETECTION OF SQUATS IN RAILWAY INFRASTRUCTURE

MOLODOVA, MARIA; LI, ZILI; NUÑEZ, ALFREDO; DOLLEVOET, ROLF

This paper presents an automatic method for detecting railway surface defects called “squats” using axle box acceleration (ABA) measurements on trains. The method is based on a series of research results from our group in the field of railway engineering that includes numerical simulations, the design of the ABA prototype, real-life implementation, and extensive field tests. We enhance the ABA signal by identifying the characteristic squat frequencies, using improved instrumentation for making measurements, and using advanced signal processing. The automatic detection algorithm for squats is based on wavelet spectrum analysis and determines the squat locations. The method was validated on the Groningen – Assen track in the Netherlands and accurately detected moderate and severe squats with a hit rate of 100%, with no false alarms. The methodology is also sensitive to small rail surface defects and enables the detection of squats at their earliest stage. The hit rate for small rail surface defects was 78%.

LEARNING A PART-BASED PEDESTRIAN DETECTOR IN VIRTUAL WORLD

XU, JIAOLONG; VÁZQUEZ, DAVID; LÓPEZ, ANTONIO M.; MARÍN, JAVIER; PONSA, DANIEL

Detecting pedestrians with on-board vision systems is of paramount interest for assisting drivers to prevent vehicle-to-pedestrian accidents. The core of a pedestrian detector is its classification module, which aims at deciding if a given image window contains a pedestrian. Given the difficulty of this task, many classifiers have been proposed during the last fifteen years. Among them, the so-called (deformable) part-based classifiers including multi-view modeling are usually top ranked in accuracy. Training such classifiers is not trivial since a proper view clustering and spatial part alignment of the pedestrian training samples are crucial for obtaining an accurate classifier. In this paper, first we perform automatic view clustering and part alignment by using virtual-world pedestrians, i.e., human annotations are not required. Second, we use a mixture-of-parts approach that allows part sharing among different views. Third, these proposals are integrated in a learning framework which also allows to incorporate real-world training data to perform domain adaptation between virtual- and real-world cameras. Overall, the obtained results on four popular on-board datasets show that our proposal clearly outperforms the state-of-the-art deformable part-based detector known as latent SVM.

AN IRANIAN LICENSE PLATE RECOGNITION SYSTEM BASED ON COLOR FEATURES

ASHTARI, AMIR HOSSEIN; NORDIN, MD. JAN; FATHY, MAHMOOD

In this paper, an Iranian vehicle license plate recognition system based on a new approach for its localization is proposed along with a hybrid classifier that recognizes license plate characters. The proposed method is based on a modified template-matching technique by its geometric description and by the analysis of target color pixels to detect the location of a vehicle’s license plate. A modified strip search to localize a standard color-geometric template in Iran and a few European countries is proposed. The proposed method is scale and rotation invariant. It avoids time-

consuming image algorithms and transformations, such as resizing and Hough, Fourier, and wavelet transforms, thereby cutting down response time of detection. License plate characters are recognized by a hybrid classifier that comprises a decision tree and a support vector machine with a homogeneous fifth-degree polynomial kernel. The proposed system ensures 96% performance detection rate and 94% performance recognition rate.

DYNAMIC VEHICLE REDISTRIBUTION AND ONLINE PRICE INCENTIVES IN SHARED MOBILITY SYSTEMS

PFROMMER, JULIUS; WARRINGTON, JOSEPH; SCHILDBACH, GEORG; MORARI, MANFRED

This paper considers a combination of intelligent repositioning decisions and dynamic pricing for the improved operation of shared mobility systems. The approach is applied to London's Barclays Cycle Hire scheme, which the authors have simulated based on historical data. Using model-based predictive control principles, dynamically varying rewards are computed and offered to customers carrying out journeys. The aim is to encourage them to park bicycles at nearby under-used stations, thereby reducing the expected cost of repositioning them using dedicated staff. In parallel, the routes that repositioning staff should take are periodically recomputed using a model-based heuristic. It is shown that it is possible to trade off reward payouts to customers against the cost of hiring staff to reposition bicycles, in order to minimize operating costs for a given desired service level.

PROBABILISTIC AND HOLISTIC PREDICTION OF VEHICLE STATES USING SENSOR FUSION FOR APPLICATION TO INTEGRATED VEHICLE SAFETY SYSTEMS

KIM, BEOMJUN; YI, KYONGSU; SON, YOUNGSEOP

This paper presents a probabilistic and holistic prediction algorithm for vehicle states using multi-sensor fusion. Three concerns are mainly considered in this study: reliable and reasonable information fusion, extension of predicted states, and real-time evaluation of prediction uncertainties. The main idea of this study is that a state-prediction problem can be solved as a multi-stage optimal estimation problem based on the current vehicle motion, a road geometry description in the current body-fixed frame, a path-following behavior model, and the error covariance of each. The prediction algorithm consists of two sequential parts. The first part is estimation, which contains a vehicle filter that estimates the current vehicle states, and a road geometry filter which approximates the road geometry. The second part is prediction, which consists of a path-following model that generates the future desired yaw rate, which acts as a virtual measurement, and a vehicle predictor, which predicts the future vehicle states by a maximum likelihood filtering method. The prediction performance of the proposed method has been investigated via vehicle tests. And its applicability to Integrated Vehicle Safety System (IVSS) has been validated via computer simulation studies. It is shown that the state-prediction performance can be significantly enhanced by the proposed prediction algorithm compared to conventional methods. The enhancement of the prediction performance allows for the improvement of driver assistance functions of an IVSS by providing accurate predictions about the future driving environment.

STUDY ON THE DISPLAY POSITIONS FOR THE HAPTIC ROTARY DEVICE-BASED INTEGRATED IN-VEHICLE INFOTAINMENT INTERFACE

TIAN, RENRAN; LI, LINGXI; RAJPUT, VIKRAM; WITT, GERALD; DUFFY, VINCENT; CHEN, YAOBIN

Integrated multimodal systems is one promising direction to improve human vehicle interaction. In order to create intelligent human vehicle interfaces and reduce visual load during secondary tasks, combining haptic rotary device and graphic display will provide one practical solution. However, in literature, proper display position for haptic rotary device is not fully investigated. In this paper, one experimental infotainment system is studied (including a haptic rotary control device and a graphic display) to evaluate the proper display position. Measurements used include task completion time, reaction to road event, lane/velocity keeping during secondary tasks, and user preference. Three display positions are considered: high mounted position, cluster position, and center stack position. The results show that with increased on-road and off-road visual loads, the cluster display position can reduce lane position deviation significantly compared to high mounted and center stack positions. Also, high mounted display position and cluster display position are better towards two different road events including strong wind gust and extreme deceleration of the lead car.

A PROXY-BASED AUTHENTICATION AND BILLING SCHEME WITH INCENTIVE-AWARE MULTIHOP FORWARDING FOR VEHICULAR NETWORKS

YEH, LO-YAO; LIN, YU-CHENG

To support the high mobility of vehicles, the IETF (Internet Engineering Task Force) defines proxy mobile IPv6 (PMIPv6) to reduce the signaling overhead. However, the design of PMIPv6 does not thoroughly consider security issues, such as man-in-the-middle and impersonation attacks. Moreover, the traditional authentication/authorization/accounting (AAA) server architecture in PMIPv6 could impede the localized advantage because of the long-distance delivery between a mobile access gateway (MAG) and the AAA server. In practice, the billing is a crucial issue, which is unfortunately rarely discussed in VANETs. In this paper, a localized-based authentication and billing scheme is proposed to really lessen the long-distance communication overhead. An incentive-aware multihop forwarding procedure is also offered to stimulate the help of forwarding others' messages in a V2V environment. Therefore, the proposed billing scheme is designed for full VANETs including the V2I and V2V environments. Light-weight keyed hash functions as well as batch verification are employed for efficient computation and concise communication overhead. Only a few signatures are used in the first message to ensure the non-repudiation payment approval. Security analysis and performance evaluation show that the proposed scheme is secure and efficient, compared with conventional public-key based scheme. The advantages of the proposed scheme include: (1) mutual authentication and session key agreement; (2) privacy preservation; (3) confidentiality, integrity, free-riding resistance, double-spending avoidance and non-repudiation properties; (4) efficient billing and payment clearance.

ADCROSS: ADAPTIVE DATA COLLECTION FROM ROAD SURVEILLING SENSORS

CHAKRABORTY, SUCHETANA; CHAKRABORTY, SANDIP; NANDI, SUKUMAR; KARMAKAR, SUSHANTA

Wireless sensor network has grown a significant attention among the researchers for providing a flexible and low-cost framework to design an architecture for Intelligent Transport Systems. The inherent challenges in distribution and management of sensor networks along the road require an application-specific protocol support for the network connectivity, sensing coverage, reliable data forwarding and the network lifetime improvement. This paper introduces the concept of k-strip length coverage along the road, that ensures a better sensing coverage for the detection of moving vehicles, compared to the conventional barrier coverage and full area coverage, in terms of the availability of

sufficient information for statistical processing as well as the number of sensors required to be active. To extend the network lifetime, every sensor follows a sleep-wakeup schedule maintaining the network connectivity and the k-strip length coverage. This scheduling problem is modeled as a graph optimization, the NP-hardness of which motivates to design a centralized heuristic, providing an approximate solution. As sensor network is inherently distributed in nature, properties of the centralized heuristic are explored to design a per-node solution based on local information. Performance of the proposed scheme is analyzed through the simulation results.

ADAPTIVE BIDIRECTIONAL PLATOON CONTROL USING A COUPLED SLIDING MODE CONTROL METHOD

KWON, JI-WOOK; CHWA, DONGKYOUNG

This paper proposes an adaptive bidirectional platoon control method for an interconnected vehicular system using a coupled sliding mode control (CSMC) to improve the performance and stability of the bidirectional platoon control and guarantee the string stability. The previous works in the field of platoon control are based on two strategies: leader-predecessor strategy and bidirectional strategy. In the case of the leader-predecessor strategy, all vehicles should use the information of all the leading and preceding vehicles. On the other hand, the bidirectional strategy uses the information of its neighboring preceding and following vehicles. Due to the drawbacks of the bi-directional strategy, most previous works have preferred to employ the leader-predecessor strategy which can guarantee the stability and the improved performance. However, the bi-directional strategy is advantageous in that its implementation of the actual system becomes much more feasible than the leader-predecessor strategy. Thus, to employ the platoon control law to the actual system, we propose the platoon control law using a CSMC method for the interconnected vehicular system based on the bidirectional strategy such that the problems arising from communication devices in the previous works can be overcome. In particular, unlike the previous works using the bidirectional strategy, the proposed adaptive platoon control law can lead to the improved control performance of the whole system and also guarantee the string stability. The stability analysis and the simulation results of the proposed method in the presence of uncertainties and disturbances are included to demonstrate the practical application of the proposed algorithm.

BAYESIAN ROAD ESTIMATION USING ON-BOARD SENSORS

GARCÍA-FERNÁNDEZ, ÁNGEL; HAMMARSTRAND, LARS; FATEMI, MARYAM; SVENSSON, LENNART

This paper describes an algorithm for estimating the road ahead of a host vehicle based on the measurements from several on-board sensors: a camera, a radar, wheel speed sensors and an inertial measurement unit. We propose a novel road model that is able to describe the road ahead with higher accuracy than the usual polynomial model. We also develop a Bayesian fusion system that uses the following information from the surroundings: lane marking measurements obtained by the camera, leading vehicles and stationary objects measurements obtained by a radar-camera fusion system. The performance of our fusion algorithm is evaluated in several drive tests. As expected, the more information we use, the better the performance is.

STOCHASTIC ALGORITHMS FOR PARKING SPACE ASSIGNMENT

SCHLOTE, ARIEH; KING, CHRISTOPHER; CRISOSTOMI, EMANUELE; SHORTEN, ROBERT

This paper introduces and illustrates some novel stochastic policies that assign parking spaces to cars looking for an available parking space. We analyse in detail both the main features of a single park, i.e., how a car could conveniently decide whether to try its luck at that parking lot or try elsewhere, and also the case when more parking lots are available, and how to choose the best one. We discuss the practical requirements of the proposed strategies in terms of infrastructure technology and vehicles' equipment and the mathematical properties of the proposed algorithms in terms of robustness against delays, stability and reliability. Preliminary results obtained from simulations are also provided to illustrate the feasibility and the potential of our stochastic assignment policies.

ROBUST OPTIMIZATION OF DYNAMIC MOTORWAY TRAFFIC VIA RAMP METERING

CHOW, ANDY; LI, YING

This paper presents a robust optimization model for motorway management. The optimization aims to minimize motorway delay via ramp metering with consideration of uncertainties in traffic demand and its characteristics. The robust optimization is formulated as a minimax problem and solved by a two-stage solution procedure. The performances of different control policies are illustrated through working examples with traffic data collected from UK M25 motorway. Experiments reveal that the robust control provides a reliable performance over a range of uncertain scenarios. Results also show that the proposed robust controller is particularly effective during transition periods when congestion has yet fully developed.

MULTI-MODEL ENSEMBLE FOR FREEWAY TRAFFIC STATE ESTIMATIONS

LI, LI; CHEN, XIQUN; ZHANG, LEI

Freeway traffic state estimation is a vital component of traffic management and information systems. Macroscopic model based traffic state estimation methods are widely used in this field and have gained significant achievements. However, tests show that the inherent randomness of traffic flow and uncertainties in the initial conditions of models, model parameters as well as model structures all influence traffic state estimations. To improve the estimation accuracy, this paper presents an ensemble learning framework to appropriately combine estimation results from multiple macroscopic traffic flow models. This framework first assumes that any models existing are imperfect and have their own strengths/weaknesses. It then estimates the online traffic states in a rolling horizon scheme. This framework automatically ensembles the information from each individual estimation models, based on their performance during the selected regression horizon. In particular, we discuss three weighting algorithms: least square regression, ridge regression and lasso, which represent different presumptions of model capabilities. A field test based on real freeway measurements indicates that lasso ensemble best handles various uncertainties and improves estimation accuracy significantly. It should also be pointed out that the proposed framework is a flexible tool to assemble non-model based traffic estimation algorithms. This framework can also be extended for many other applications, including traffic flow prediction and travel time prediction.

COST-OPTIMAL CHARGING OF PLUG-IN HYBRID ELECTRIC VEHICLES UNDER TIME-VARYING ELECTRICITY PRICE SIGNALS

BASHASH, SAEID; FATHY, HOSAM

This paper develops a convex quadratic programming (QP) framework for the charge pattern optimization of plug-in hybrid electric vehicles (PHEVs) under time-varying electricity price signals. The work is motivated by the need for a computationally-efficient PHEV charging and discharging model in bidirectional vehicle-to-grid (V2G) integration studies, accounting for the hybrid powertrain dynamics and battery energy losses of PHEVs. We adopt a previously-developed PHEV power management system, and construct a simplified PHEV model for the convex optimization problem studied in this effort. We use an equivalent circuit battery model to compute battery energy losses during grid charging and discharging. We then derive the total fuel and electricity cost of the PHEV model as a quadratic function of battery state-of-charge (SOC), and use a standard QP solver to minimize it for a few sample trips obtained from the National Household Travel Survey (NHTS) dataset. Using a quad-core computer, the daily PHEV charging trajectory with 5 minute time resolution can be optimized in fraction of a second. Through several examples, we show the application of the proposed method in various V2G-related problems, such as obtaining the aggregate load patterns of PHEVs, analyzing the potential impacts of large-scale bidirectional V2G integration, benchmarking the fuel economy of PHEVs, and determining the sensitivity of V2G load to abrupt price variations.

COOPERATIVE BAYESIAN ESTIMATION OF VEHICULAR TRAFFIC IN LARGE-SCALE NETWORKS

PASCALE, ALESSANDRA; NICOLI, MONICA; SPAGNOLINI, UMBERTO

Intelligent transportation systems have enormous potential for improving the quality of our lives. They rely on traffic monitoring and control infrastructures to enable an efficient management of mobility. A crucial task is the estimation or prediction of traffic flows by large-scale sensor networks, a topic that has been attracting a growing attention in recent year because of the relevance in traffic control over urban areas or freeways. In this paper we propose an innovative stochastic method for vehicular traffic estimation based on a distributed reconstruction of the density field through the cooperation of smaller monitoring sub-networks. The method guarantees high accuracy (because of information sharing) and at the same time moderate computational cost (thanks to distributed processing). Moreover, subnetworks do not need to exchange sensitive information (e.g., raw data) but simply traffic beliefs. We evaluate the performance of the method on simulated single-lane road scenarios, highlighting the potential benefits of the cooperative approach. As an example of application, we consider a fragmented monitoring scenario characterized by several sensor failures and we show how the proposed approach can overcome the problem related to the sensor malfunctions leveraging on information shared with neighboring subnetworks.

EARLIEST DEADLINE BASED SCHEDULING TO REDUCE URBAN TRAFFIC CONGESTION

AHMED, ASIF; ARSHAD, RABIA; MAHMUD, SAHIBZADA ALI; KHAN, GUL MUHAMMAD; AL-RAWESHIDY, HAMED

One of the major problems, caused by the traffic congestion, owes its existence to the unwanted delay experienced by the priority vehicles. The evaluation of two scheduling algorithms as adaptive traffic control algorithms has been proposed here to reduce this unwanted delay. One of these algorithms is the earliest deadline first (EDF) while the other is the fixed priority (FP) algorithm. The performance of both the algorithms as adaptive traffic lights control

algorithms is evaluated for isolated traffic intersections. A comparative study is performed here, where the performance of these algorithms is compared against a fixed static traffic lights controller. Moreover their performance is also compared against each other. Conclusive results from the simulation of the algorithms reveal that the number of stops, average delay and mean trip time of the priority vehicles is significantly reduced by the implementation of these algorithms. Furthermore it has been shown that the overall performance of the EDF is much better than the FP in terms of improvement of different performance measures for congestion reduction of Priority vehicles.

BAYESIAN PRE-CALIBRATION OF A LARGE STOCHASTIC MICROSIMULATION MODEL

BOUKOUVALAS, ALEXIS; SYKES, PETE; CORNFORD, DAN; MARURI-AGUILAR, HUGO

Calibration of stochastic traffic microsimulation models is a challenging task. This paper proposes a fast iterative probabilistic pre-calibration framework and demonstrates how it can be successfully applied to a real-world traffic simulation model of a section of the M40 motorway and surrounding area in the UK. The efficiency of the method stems from the use of emulators of the stochastic microsimulator which provide fast surrogates of the traffic model. The use of emulators minimizes the number of microsimulator runs required and the emulators probabilistic construction allows the consideration of the extra uncertainty introduced by the approximation. It is shown that automatic pre-calibration of this real-world microsimulator, using turn count observational data, is possible considering all parameters at once and that this pre-calibrated microsimulator improves on the fit to observations compared to the traditional expert tuned microsimulator.

A SWITCHING ROLLOVER CONTROLLER COUPLED WITH CLOSED-LOOP ADAPTIVE VEHICLE PARAMETER IDENTIFICATION

AKAR, MEHMET; DERE, ALI

This paper presents a real-time adaptive switching controller in order to mitigate rollover accidents without reducing the performance of the vehicle. The proposed controller relies on adaptive identification of vehicle lateral and vertical dynamics parameters, including the CG height that has a major role in rollover. Least Squares and Kalman Filtering techniques are employed in order to propose two novel identification algorithms that are robust against speed variations, which can further be coupled effectively with a switching rollover controller while parameter identification is in progress. Extensive simulations are carried out in order to demonstrate the superior performance of the proposed method.

A MONTE CARLO APPROACH TO SIMULATE THE STOCHASTIC DEMAND IN A CONTINUOUS DYNAMIC TRAFFIC NETWORK LOADING PROBLEM

SÁNCHEZ-RICO, MARÍA TERESA; GARCÍA-RÓDENAS, RICARDO; ESPINOSA-ARANDA, JOSÉ LUIS

Dynamic Traffic Assignment (DTA) models, are mathematical tools used for traffic management and control. These require a Dynamic Network Load (DNL) model, a route choice model and a mechanism to ensure the relationship between the sub-models. The DNL problem aims to find, on a congested network, dynamic traffic volumes and travel

times for a given time period. The DNL problem involves a high computational cost, so the model becomes intractable in real-time and often on off-line applications. This paper proposes a discrete event algorithm for the continuous DNL problem based on flow discretizations, instead of time discretizations. These discretizations create homogeneous traffic packets according to their route. The algorithm propagates the packets synchronously across the links. The dynamic mechanism used in the network links, are based on a generalization of the Whole-link Travel Time model, which divides the links in the running section and the vertical queue section. The first one is associated with the travel time and the second one with the capacity. A generalization of the point-queue model is introduced to tackle dynamic link capacities such as signalised intersections. Under certain assumptions, the resulting model satisfies the FIFO rule and it is used to obtain a computationally tractable model. It allows stochastic demands to be dealt with a Monte Carlo simulation approach. This scheme is computationally expensive but can be addressed through distributed computing techniques. The method and its implementation by using parallel computing techniques is assessed using the Nguyen-Dupuis and Sioux Falls networks.

AN EXPLORATORY STUDY OF TWO EFFICIENT APPROACHES FOR THE SENSITIVITY ANALYSIS OF COMPUTATIONALLY EXPENSIVE TRAFFIC SIMULATION MODELS

GE, QIAO; CIUFFO, BIAGIO; MENENDEZ, MONICA

One of the main challenges arising when calibrating a complex traffic simulation model concerns the selection of the most important input parameters. The quasi-OTEE and the Kriging-based SA are two recently developed efficient approaches for the Sensitivity Analysis (SA) of computationally expensive simulation models. In this paper, two experimental studies using two different traffic simulation models (i.e., Aimsun and VISSIM) are presented to compare these two methods, and better understand their advantages and disadvantages. Results show that both methods are able to identify, to a good degree, the important parameters. In particular, the quasi-OTEE is better in screening the parameters, while the Kriging-based approach has a higher precision in ranking the parameters. These findings suggest the following rule-of-thumb for the SA of computationally expensive traffic simulation models: the quasi-OTEE SA can be used first to screen the parameters, and decide which parameters to discard. Then, the Kriging-based SA can be used to refine the analysis and calculate first order indices to identify the correct rank of the important parameters.

A SENSITIVITY-ANALYSIS-BASED APPROACH FOR THE CALIBRATION OF TRAFFIC SIMULATION MODELS

CIUFFO, BIAGIO; LIMA AZEVEDO, CARLOS

In this work a multi-step sensitivity analysis approach for model calibration is proposed and applied to a complex traffic simulation model with more than one hundred parameters. Throughout the paper it is argued that the application of sensitivity analysis (SA) is crucial for a true comprehension and the correct use of traffic simulation models, but it is also acknowledged that the main obstacle towards an extensive use of the most sophisticated techniques is the high number of model runs usually required. For this reason we have tested the possibility to perform a multi-step sensitivity analysis, where at each step model parameters are grouped on the basis of possible common features, and a final sensitivity analysis on the parameters pertaining to the most influential groups is then performed. The proposed methodology was applied to an urban motorway case study simulated using MITSIMLab, a complex microscopic traffic simulator. The method allowed the analysis of the role played by all parameters and by the model stochasticity itself with 80% fewer model evaluations than the standard variance-based approach. Ten

model parameters accounted for a big share in the output variance for the specific case study. A Kriging meta-model was then estimated and integrated with the multi-step SA results for a global calibration framework in the presence of uncertainty. Results confirm the great potential of this approach and open up to a novel view for the calibration of a traffic simulation model.

AN ADAPTIVE BI-LEVEL GRADIENT PROCEDURE FOR THE ESTIMATION OF DYNAMIC TRAFFIC DEMAND

CANTELMO, GUIDO; CIPRIANI, ERNESTO; GEMMA, ANDREA; NIGRO, MARIALISA

The paper presents an in-depth analysis of the bi-level gradient approximation approach for dynamic traffic demand adjustment and the development of new adaptive approaches. Initially, a comparison between the Simultaneous Perturbation Stochastic Approximation (SPSA), Asymmetric Design (AD), Polynomial Interpolation (PI) method, firstly proposed by authors in 2010-2011, and its second order development is presented; then a sensitivity analysis of the parameters of the SPSA AD-PI is reported; finally, some new advances of the estimation method based on an adaptive approach are proposed and evaluated on a real test network.

A META-MODEL FOR ESTIMATING ERROR BOUNDS IN REAL-TIME TRAFFIC PREDICTION SYSTEMS

PEREIRA, FRANCISCO; ANTONIOU (GUEST EDITOR UNCERT. IN COMP. TRAFFIC MOD.), CONSTANTINOS; FARGAS, JOAN; BEN-AKIVA, MOSHE

This paper presents a methodology for estimating the upper and lower bounds of a real-time traffic prediction system, i.e. its prediction interval (PI). Without a very complex implementation work, our model is able to complement any pre- existing prediction system with extra uncertainty information such as the 5% and 95% quantiles. We treat the traffic prediction system as a black box that provides a feed of predictions. Having this feed together with observed values, we then train conditional quantile regression methods that estimate upper and lower quantiles of the error. The goal of conditional quantile regression is to determine a function, $d_\tau(x)$, that returns the specific quantile τ of a target variable d, given an input vector x. Following Koenker [1], we implement two functional forms of $d_\tau(x)$: locally weighted linear, which relies on value on the neighborhood of x; and splines, a piecewise defined smooth polynomial function. We demonstrate this methodology with three different traffic prediction models applied to two freeway data-sets from Irvine, CA, and Tel Aviv in Israel. We contrast the results with a traditional confidence intervals approach that assumes that error is normally distributed with constant (homoscedastic) variance. We apply several evaluation measures based on earlier literature and also contribute two new measures that focus on relative interval length and balance between accuracy and interval length. For the available dataset, we verified that conditional quantile regression outperforms the homoscedastic baseline in the vast majority of the indicators.

PARALLEL PUBLIC TRANSPORTATION SYSTEM AND ITS APPLICATION IN EVALUATING EVACUATION PLANS FOR LARGE-SCALE ACTIVITIES

ZHU, FENGHUA; CHEN, SONGHANG; MAO, ZHI-HONG; MIAO, QINGHAI

This paper proposes a method based on ACP (Artificial societies, Computational experiments, and Parallel execution) to build parallel public transportation systems (PPTS). The framework and components of a PPTS are analyzed, and some details for building the PPTS are discussed. One prototype based on intelligent traffic clouds is established. One specific PPTS is developed for Guangzhou 2010 Asian Games in the case study and its effectiveness is verified through the evaluation of two evacuation plans for Asian Games.

FUTURE DUAL-FREQUENCY GPS NAVIGATION SYSTEM FOR INTELLIGENT AIR TRANSPORTATION UNDER STRONG IONOSPHERIC SCINTILLATION

SEO, JIWON; WALTER, TODD

Global Positioning System (GPS) technology is essential for future intelligent air transportation systems such as the Next Generation Air Transportation System (NextGen) of the United States. However, observed deep and frequent amplitude fading of GPS signals due to ionospheric scintillation can be a major concern in expanding GPS-guided aviation to the equatorial area where strong scintillation is expected. Current civil GPS airborne avionics track signals at a single frequency (L1 frequency) alone because it was the only civil signal available in the frequency band for aviation applications. The first GPS Block IIF satellite was launched in May 2010. This next generation satellite transmits a new civil signal at L5 frequency, which can be used for air transportation. This paper investigates possible improvement in the availability of GPS-based aircraft landing guidance down to 200 ft above the runway, also known as Localizer Performance with Vertical guidance (LPV)-200, under strong ionospheric scintillation when dual frequency signals are available. Based on the availability study, this paper proposes and justifies a GPS aviation receiver performance standard mandating a fast reacquisition after a very brief signal outage due to scintillation. In order to support a temporary single-frequency operation under a single frequency loss due to scintillation, a new Vertical Protection Level (VPL) equation is proposed and justified. With this new performance requirement and new VPL equation in place, 99% availability of LPV-200 would be attainable, rather than 50% at the current standards, even under the severe scintillation scenarios considered in this paper.

AUTONOMOUS VISUAL NAVIGATION AND LASER-BASED MOVING OBSTACLE AVOIDANCE

CHERUBINI, ANDREA; SPINDLER, FABIEN; CHAUMETTE, FRANCOIS

Moving obstacle avoidance is a fundamental requirement for any robot operating in real environments, where pedestrians, bicycles and cars are present. In this paper, we propose and validate a framework for avoiding moving obstacles during visual navigation with a wheeled mobile robot. Visual navigation consists of following a path, represented as an ordered set of key images, which have been acquired by an on-board camera in a teaching phase. While following such path, our robot is able to avoid static as well as moving obstacles, which were not present during teaching, and which are sensed by an onboard lidar. The proposed approach takes explicitly into account obstacle velocities, estimated using an appropriate Kalman-based observer. The velocities are then used to predict the obstacle positions within a tentacle-based approach. Finally, our approach is validated in a series of real outdoor experiments,

showing that when the obstacle velocities are considered, the robot behaviour is safer, smoother, and faster than when it is not.

MULTI-VEHICLE COOPERATIVE LOCAL MAPPING: A METHODOLOGY BASED ON OCCUPANCY GRID MAP MERGING

LI, HAO; TSUKADA, MANABU; NASHASHIBI, FAWZI; PARENT, MICHEL

Local mapping is valuable for many real-time applications of intelligent vehicle systems. Multi-vehicle cooperative local mapping can bring considerable benefits to vehicles operating in some challenging scenarios. In this paper, we introduce a method of occupancy grid map merging, dedicated to multi-vehicle cooperative local mapping purpose in outdoor environments. In a general map merging framework, we propose an objective function based on occupancy likelihood, and provide some concrete procedures designed in the spirit of genetic algorithm to optimize the defined objective function. Based on the introduced method, we further describe a strategy of indirect vehicle-to-vehicle relative pose estimation, which can serve as a general solution for multi-vehicle perception association. We present a variety of experiments that validate the effectiveness of the proposed occupancy grid map merging method. We also demonstrate several useful application examples of the indirect vehicle-to-vehicle relative pose estimation strategy.

VEHICLE COLOR RECOGNITION ON URBAN ROAD BY FEATURE CONTEXT

CHEN, PAN; BAI, XIANG; LIU, WENYU

Vehicle information recognition is a key component of Intelligent Transportation Systems (ITS). Color plays an important role in vehicle identification. As a vehicle has its inner structure, the main challenge of vehicle color recognition is to select the region of interest (ROI) for recognizing its dominant color. In this paper, we propose a method to implicitly select the ROI for color recognition. Preprocessing is performed to overcome the influence of image quality degradation. Then the ROI in vehicle images is selected by assigning the sub-regions with different weights which are learnt by a classifier trained on the vehicle images. We train the classifier by linear SVM for its efficiency and high precision. The experiments are extensively validated on both images and videos, which are collected on urban roads. The proposed method outperforms other competing color recognition methods.

ON-DEMAND CONFLICT RESOLUTION PROCEDURES FOR AIR TRAFFIC INTERSECTIONS

YOO, JEFF; DEVASIA, SANTOSH

This article develops a provably-safe, on-demand Conflict Resolution Procedure (CRP) for intersecting routes in en-route Air Traffic Control (ATC). Recent works have developed provably-safe CRPs, which solve the conflict resolution for intersecting routes in a local manner that leads to decoupling of CRPs for different intersections. However, such CRP is inefficient because it is always on — even in the absence of conflicts. This always-on CRP (even without conflicts) leads to unwanted CRP maneuvers resulting in increased travel time, travel distance and required fuel. The current article removes the inefficiency of always-on CRPs by developing provably-safe CRPs that can be activated on-demand (when conflicts appear) to accommodate an impending conflict. Conditions are developed to guarantee

safety during activation and deactivation of the CRP, and the proposed on-demand approach is illustrated through an example route intersection.

FORMAL INTENT-BASED TRAJECTORY DESCRIPTION LANGUAGES

FRONTERA, GUILLERMO; BESADA, JUAN; BERNARDOS, ANA; CASADO, ENRIQUE; LOPEZ, JAVIER

This paper describes a improved version of our intent-related hierarchy of formal languages designed to describe aircraft trajectories. These languages allow a complete or partial specification of aircraft trajectories at different levels, and the extension of its features described in this paper allows their applicability to define more complex kind of missions, such as those of unmanned vehicles or military aircraft. This paper provides a complete description on lexicon, syntax and graphical representation details for each language and shows their applicability through a set of clarifying examples of flight specifications with different granularity. The described language hierarchy has been proven as a suitable framework for describing aircraft trajectories with different levels of detail and for different applications. Its versatility and flexibility are demonstrated through a set of scenarios identifying characteristic operational examples.

YAW ESTIMATION USING CYLINDRICAL AND ELLIPSOIDAL FACE MODELS

S, ATHINARAYANAN; M.R., KAIMAL; BIJLANI, KAMAL

Accurate head yaw estimation is necessary for detecting driver inattention in forward collision warning systems. In this paper, we propose three geometric models under the ellipsoidal framework for accurate head yaw estimation. We present theoretical analysis of the cylindrical and ellipsoidal face models used for yaw angle estimation of head rotation. Relationship between cylindrical, ellipsoidal and the proposed models is derived. We provide error functions for all models. Further, for each model, over/under estimation of angle, zero crossings of error, bounds on yaw angle estimate and bounds on error are presented. Experimental results of the proposed models on four standard head pose datasets yielded a mean absolute error between 4° and 8° demonstrating the efficacy of the proposed models over the state of the art methods.

MODELING SHUTTLE-LANE ROADWORKS OPERATED BY TEMPORARY TRAFFIC SIGNALS USING MICRO-SIMULATION

ALTERAWI, MOHAMMED; YOUSIF, SAAD

Abstract—this paper presents a newly developed micro-simulation model for shuttle-lane urban roadworks (which is closing one lane of a single carriageway road and leaving the other for use by both directions in alternate one-way working) focusing on issues relating to Temporary Traffic Signals (TTS) control and its effectiveness. The model deals with general as well as more specific drivers' behavior, such as following too closely (tailgating), effect of dilemma zone and non-compliance with temporary traffic signals. The main criteria of this model are governed by the application of car following and shuttle-lane rules (with no lane changing rule). The model has been calibrated and validated using real traffic data taken from observed urban shuttle-lane roadworks sites for both Fixed Time (FT) and

Vehicle Actuated (VA) TTS. Modified signal settings and various MVD (Microwave Vehicle Detector) detection ranges were also assessed in terms of their impact on capacity (throughput) and delays.

DRIVER/VEHICLE RESPONSE DIAGNOSTIC SYSTEM FOR THE VEHICLE FOLLOWING CASE

BUTAKOV, VADIM; IOANNOU, PETROS

It is well known that not all drivers drive the same and the same driver has different driving characteristics with different vehicles. Identifying the characteristics that are unique to each driver/vehicle response opens the way for more personalized and accurate driver assistance systems. In this paper we consider the problem of identifying the driver/vehicle characteristics by processing real time driving response data. We propose the use of a Gaussian Mixture Model (GMM) combined with knowledge of dynamic characteristics modeled as probability distributions together with additional logic and appropriate thresholds in order to implement a real-time driver/vehicle response diagnostics system. We focus our efforts on the vehicle following part of driving. The system is tested on a customized vehicle using different drivers under different driving conditions. We demonstrated that the system can distinguish between different drivers and can classify driver aggressiveness during vehicle following.

TRANSIT COORDINATION USING INTEGER RATIO HEADWAYS

TUZUN AKSU, DILEK; AKYOL, UGUR

Coordination of transit routes is essential in reducing the travel time for connecting passengers, thus improving the service quality of the transit system. Perfect coordination can be achieved through the usage of common headways; however, this leads to an increase in operational costs, especially when the variance of route headways is high. In this case, route coordination can be achieved through integer-ratio headways, where headway of each coordinated route is an integer multiple of a base cycle. In this study, we propose a novel genetic algorithm that creates clusters of routes whose coordination reduces transfer time for connecting passengers. The objective is to minimize the total system cost, which includes in-vehicle, waiting and transfer costs for all passengers served by the transit system and the operating cost of all transit vehicles. The experimental study conducted on one transit network from the literature as well as a new network based on the Istanbul rail system demonstrates that this approach produces superior results compared to the literature.

DEEP ARCHITECTURE FOR TRAFFIC FLOW PREDICTION: DEEP BELIEF NETS WITH MULTI-TASK LEARNING

HUANG, WENHAO; HONG, HAIKUN; SONG, GUOJIE; XIE, KUNQING

Traffic flow prediction is a fundamental problem in transportation modeling and management. Many existing approaches fail at providing favorable results due to being: 1) shallow in architecture; 2) hand-engineered in features; 3) separate in learning. In this paper, we propose a deep architecture that consists of two parts: a Deep Belief Network on the bottom and a multi-task regression layer on the top. The Deep Belief Network is employed here for unsupervised feature learning. It can learn effective features for traffic flow prediction in an unsupervised fashion, which has been examined and found to be effective for many areas such as image and audio classification. To the best

of our knowledge, this is the first work that applies the deep learning approach to transportation research. To incorporate multi-task learning in our deep architecture, a multi-task regression layer is used above the Deep Belief Network for supervised prediction. We further investigate homogeneous and heterogeneous multi-task learning for traffic flow prediction. To make multi-task learning more effective and take advantage of weight sharing in our deep architecture, we propose a grouping method based on weights in the top layer to make multi-task learning more effective. Experiments on transportation datasets show good performance of our deep architecture. It is also presented that multi-task learning can improve generalization performance of shared tasks. Abundant experiments show that our approach achieved near 5% improvements over state-of-the-art. These positive results demonstrate that deep learning and multi-task learning are promising in transportation research.

DETECT ROAD TRAFFIC EVENT WITH COUPLED NONPARAMETRIC BAYESIAN METHOD

YANG, SHIMING; KALPAKIS, KONSTANTIONS; BIEM, ALAIN

Road traffic sensors provide us with rich multi-variable datastreams about the current traffic conditions. Occasionally, there are unusual traffic events (such as accidents, jams, severe weather, etc) that disrupt the expected road traffic conditions. Detecting the occurrence of such events in an online and real-time manner is useful to drivers in planning their routes and in the management of the transportation infrastructure. We propose a new method for detecting traffic events that impact road traffic conditions by extending the Bayesian Robust Principal Component Analysis (RPCA) approach. Our method couples multiple traffic datastreams so that they share a certain sparse structure. This sparse structure is used to localize traffic events in space and time. The traffic datastreams are measurements of different physical quantities (e.g. traffic flow, road occupancy) by different nearby sensors. Our proposed method process datastreams in an incremental way with little computational cost, and hence it is suitable to detect events in an online and real-time manner. We experimentally analyze the detection performance of the proposed coupled Bayesian RPCA using real data from loop detectors on the Minnesota I-494. We find that our method significantly improves the detection accuracy when compared with the traditional PCA and non-coupled Bayesian RPCA.

DETECTION OF INTOXICATED DRIVERS USING ONLINE SYSTEM IDENTIFICATION OF STEERING BEHAVIOR

SHIRAZI, MEHRAN; RAD, AHAMED

Impaired driving is known to be among the leading causes of death and injury on the roads; however, the existing measures to address this menace appear to be insufficient. This paper presents a novel method to detect intoxicated driving and lays a foundation that can be implemented in future cars to derive personalized models of the drivers and to detect not only intoxicated driving, but also other reckless driving style. We employ system identification techniques to develop models for sober and impaired drivers. Two hundred sets of data from various subject drivers were collected in a high-fidelity driving simulator. Lateral preview error and steering wheel angle were considered as input and output of the driver, respectively. We will demonstrate the auto-regressive noise integration moving average with exogenous input (ARIMAX) model is the best fit the data to describe the steering behavior of drivers. The positions of model poles are shown to be a good indicator of intoxicated driving behavior. Aggressive driving style due to impaired driving leads to migration of dominant poles towards the instability region. Kalman filter and online identification techniques are used to update the driver model during driving. The poles of this updated model are used for detection of impaired driving.

STUDY ON EMERGENCY AVOIDANCE BRAKING FOR THE AUTOMATIC PLATOONING OF TRUCKS

ZHENG, RENCHENG; NAKANO, KIMIHIKO; YAMABE, SHIGEYUKI; AKI, MASAHIKO; NAKAMURA, HIROKI; SUDA, YOSHIHIRO

In the development of automatic platooning of trucks as an energy saving technology, reliable driving of the platooned trucks is a primary objective for public implementation and future applications. At the same time there is also an emergency requirement to ensure the safety of the driving experiment in the automatic platooning of trucks, including conditions of system failure. This paper presents a detailed experimental study on emergency braking to avoid rear-end collisions during the automatic platooning of trucks, using an advanced driving simulator system and an actual vehicle. Initially, an experimental platform was built to reproduce the automatic platooning of trucks in an advanced driving simulator system. Assuming system failure and emergency deceleration of the preceding truck without warning, the behavior of the driver in the following truck was studied in terms of emergency avoidance of collision. In particular, with different settings for the mean maximum decelerations of the brake system of the following truck, the stopping gap distances and driver reaction times were analyzed in the driving experiment using the advanced driving simulator and an actual vehicle. The experimental results indicated that emergency braking is an effective method for avoiding rear-end collision when there is a system failure in the automatic platooning resulting in the mean maximum deceleration for the following truck being higher than for the preceding truck.

MONOCULAR ROAD TERRAIN DETECTION BY COMBINING VISUAL AND SPATIAL INFORMATION

FRITSCH, JANNIK; KUEHNL, TOBIAS; KUMMERT, FRANZ

For future driver assistance systems and autonomous vehicles, the road course, i.e., the width and shape of the driving path, is an important source of information. In this contribution we introduce a new hierarchical two-stage approach for learning the spatial layout of road scenes. In the first stage, base classifiers analyze the local visual properties of patches extracted from monocular camera images and provide metric confidence maps. We use classifiers for road appearance, boundary appearance, and lane-marking appearance. The core of the proposed approach is the computation of SPatial RAY (SPRAY) features from each metric confidence map in the second stage. A boosting classifier selecting discriminative SPRAY features can be trained for different types of road terrain and allows to capture the local visual properties together with their spatial layout in the scene. In this contribution, the extraction of road area and ego-lane on inner city video streams is demonstrated. Especially the detection of the ego-lane is a challenging semantic segmentation task showing the power of SPRAY features, because on a local appearance level, the ego-lane is not distinguishable from other lanes. We have evaluated our approach operating at 20 Hz on a GPU on a publicly available dataset, demonstrating the performance on a variety of road types and weather conditions.

EFFICIENT EVALUATION OF COLLISIONS AND COSTS ON GRID MAPS FOR AUTONOMOUS VEHICLE MOTION PLANNING

TANZMEISTER, GEORG; FRIEDL, MARTIN; WOLLHERR, DIRK; BUSS, MARTIN

Collision checking is the major computational bottleneck for many robot path and motion planning applications, such as for autonomous vehicles, particularly with grid-based environment representations. Apart from collisions, many applications benefit from incorporating costs into planning; cost functions or cost maps are a common tool. Similar to checking a single configuration for collision, evaluating its cost using a grid-based cost map also requires examining every cell under the robot footprint. This work gives theoretical and practical insights on how to efficiently check a large number of configurations for collision and cost. As part of this work, configuration space costs are formulated, which can be seen as generalization of configuration space obstacles allowing a complete configuration check incorporating the robot geometry to be done using a single look-up. Furthermore, this paper presents two efficient algorithms for their calculation. FAMOD, an approximate method based on convolution, which is independent of the size and the shape of the robot mask, and vHGW-360, an exact method based on the van Herk-Gil-Werman morphological dilation algorithm, that can be used if the robot shape is rectangular. Both algorithms were implemented and evaluated on graphics hardware to demonstrate the applicability and benefit to real-time path and motion planning systems.

A SIMULATION ANALYSIS ON THE EXISTENCE OF NETWORK TRAFFIC FLOW EQUILIBRIA

LIN, SHU; KONG, QING-JIE; HUANG, QINGMING

Macroscopic Fundamental Diagram (MFD) can be applied to design simple and effective traffic network control strategies to prevent congestion in an urban traffic network. Network flow equilibria on MFDs are important properties for designing an effective network controllers for urban traffic networks. In order to verify the existence of the equilibria on MFDs, microscopic simulations are run for an urban traffic network with various network input traffic flows and traffic signal control strategies. The simulation results show that the traffic network can reach its network flow equilibria, if the traffic flows in the network are in the linear region (the free-flow region) of the MFD, even though the network flows are heterogeneous; but network flow equilibria do not exist for the nonlinear region (the non-free-flow region) of the MFD, unless the traffic network flows are homogeneous. Properly designed traffic signal control strategies can improve the degree of the traffic flow homogeneity, and thus network flow equilibria are easy to be achieved under a bounded network input flow.

SUPERVISORY POWER MANAGEMENT CONTROL ALGORITHMS FOR HYBRID ELECTRIC VEHICLES: A SURVEY

MALIKOPOULOS, ANDREAS

The growing necessity for environmentally benign hybrid propulsion systems has led to the development of advanced power management control algorithms to maximize fuel economy and minimize pollutant emissions. This paper surveys the control algorithms for hybrid electric vehicles (HEVs) and plug-in HEVs (PHEVs) that have been reported in the literature to date. The exposition ranges from parallel, series and power split HEVs and PHEVs and includes a classification of the algorithms in terms of their implementation and the chronological order of their appearance. Remaining challenges and potential future research directions are also discussed.

PEDESTRIAN SIMULTANEOUS LOCALIZATION AND MAPPING IN MULTISTORY BUILDINGS USING INERTIAL SENSORS

GARCIA PUYOL, MARIA; BOBKOV, DMYTRO; ROBERTSON, PATRICK; JOST, THOMAS

Pedestrian navigation is an important ingredient for efficient multimodal transportation, such as guidance within large transportation infrastructures. A requirement is accurate positioning of people in indoor multistory environments. To achieve this, maps of the environment play a very important role. FootSLAM is an algorithm based on the Simultaneous Localization and Mapping (SLAM) principle that relies on human odometry, i.e. measurements of a pedestrian's steps, to build probabilistic maps of human motion for such environments and can be applied using crowdsourcing. In this paper we extend FootSLAM to multistory buildings following a Bayesian derivation. Our approach employs a particle filter and partitions the map space into a grid of adjacent hexagonal prisms with eight faces. We model the vertical component of the odometry errors using an autoregressive integrated moving average (ARIMA) model and extend the geographic tree-based data structure that efficiently stores the probabilistic map, allowing real-time processing. We present the multistory FootSLAM maps that were created from three datasets collected in different buildings (one large office building and two university buildings). Hereby, the user was only carrying a single foot-mounted Inertial Measurement Unit (IMU). We believe the resulting maps to be strong evidence of the robustness of FootSLAM. This work raises the future possibility of crowdsourced indoor mapping and accurate navigation using other forms of human odometry, e.g. obtained with the low-cost and non-intrusive sensors of a hand-held smartphone.

B-PLANNER: PLANNING BIDIRECTIONAL NIGHT BUS ROUTES USING LARGE-SCALE TAXI GPS TRACES

CHEN, CHAO; ZHANG, DAQING; LI, NAN; ZHOU, ZHI-HUA

Taxi GPS traces can inform us the human mobility patterns in modern cities. Instead of leveraging the costly and inaccurate human surveys about people's mobility, we intend to explore the night bus route planning issue by using taxi GPS traces. Specifically, we propose a two-phase approach for bi-directional night-bus route planning. In the first phase, we develop a process to cluster "hot" areas with dense passenger pick-up/drop-off, and then propose effective methods to split big "hot" areas into clusters and identify a location in each cluster as a candidate bus stop. In the second phase, given the bus route origin, destination, candidate bus stops as well as bus operation time constraints, we derive several effective rules to build the bus route graph, and prune invalid stops and edges iteratively. Based on this graph, we further develop a Bi-directional Probability based Spreading (BPS) algorithm to generate candidate bus routes automatically. We finally select the best bi-directional bus route which expects the maximum number of passengers under the given conditions and constraints. To validate the effectiveness of the proposed approach, extensive empirical studies are performed on a real-world taxi GPS data set which contains more than 1.57 million night passenger delivery trips, generated by 7,600 taxis in a month.

COORDINATED CONTROL OF WHEELED VEHICLES IN THE PRESENCE OF A LARGE COMMUNICATION DELAY THROUGH A POTENTIAL FUNCTIONAL APPROACH

HU, HAIYUN; YOON, SE YOUNG; LIN, ZONGLI

This paper studies the flocking problem for a multi-agent system, where each agent is a vehicle with nonholonomic dynamics. In particular, we consider the case where the agents are subjected to an arbitrarily large communication delay. A distributed low gain control law is derived based on the gradient of an artificial potential function. We demonstrate using the Lyapunov functional approach that the proposed control law drives the multi-agent system into the stable flocking behavior. The effectiveness of the proposed control law is verified in numerical simulation.

VEHICLE-TO-VEHICLE PROPAGATION MODELS WITH LARGE VEHICLE OBSTRUCTIONS

HE, RUISI; MOLISCH, ANDY; TUFVESSON, FREDRIK; ZHONG, ZHANGDUI; AI, BO; ZHANG, TINGTING

Vehicle-to-Vehicle (V2V) communication is an enabler for improved traffic safety and congestion control. As for any wireless system the ultimate performance limit is determined by the propagation channel. A particular point of interest is the shadowing effect of large vehicles such as trucks and buses, as this might affect the communication range significantly. In this paper we present measurement results and model the propagation channel in which a bus acts either as a shadowing object, or as a relay between two passenger cars. The measurement setup is based on a WARP FPGA software radio as transmitter, and a Tektronix RSA5106A real-time complex spectrum analyzer as receiver. We analyze the influence of the bus location and car separation distance on the path loss, shadowing, small-scale fading, delay spread, and cross-correlation. The main effect of the bus is that it is acting as an obstruction creating an additional 15-20 dB attenuation, and an increase in the root-mean-square (RMS) delay spread by roughly 100 ns. A Nakagami distribution is found to well describe the statistics of the smallscale fading, by using Akaike's Information Criterion and the Kolmogorov-Smirnov test. The distance-dependency of the path loss is analyzed, and a stochastic model is developed.

A REAL-TIME TRANSIT SIGNAL PRIORITY CONTROL MODEL CONSIDERING STOCHASTIC BUS ARRIVAL TIME

ZENG, XIAOSI; ZHANG, YUNLONG; BALKE, KEVIN; YIN, KAI

Transit Signal Priority (TSP) strategy is an effective preferential treatment to move transit vehicles through an intersection with minimum delay. To produce a good TSP timing, advance planning with enough look-ahead time is the key. This, however, means added uncertainty about the bus arrival at the stop bar, which has been difficult to be accounted for. In this paper, we proposed a stochastic mixed-integer nonlinear model (SMINP) to be used as the core component of a real-time transit signal priority control system. The model adopts a novel approach to capture the impacts of the priority operation to other traffic by using the deviations of the phase split times from the optimal background split times. In addition, the model explicitly accounts for the randomness of a bus arrival time to the stop bar, by considering the bus stop dwell time and the delay caused by standing vehicle queues. The SMINP is implemented in a simulation evaluation platform developed using a combination of a microscopic traffic simulator and a commercial optimization solver. Comparison analyses were performed to compare the proposed control model with the state-of-the-practice TSP system (namely RBC-TSP). The results showed the SMINP has yielded as much as 30%

improvement of bus delay comparing to RBC-TSP in single bus case. In multiple bus case, SMINP handles the bus priority request much more effectively under congested traffic conditions.

ANALYSIS OF THE GODUNOV BASED HYBRID MODEL FOR RAMP METERING AND ROBUST FEEDBACK CONTROL DESIGN

KACHROO, PUSHKIN; RATLIFF, LILLIAN; SASTRY, SHANKAR

This paper presents the detailed analysis of a Godunov approximation based dynamics model for an isolated traffic ramp metering problem. The model for the system is based on a Godunov numerical scheme so that the lumped parameter approximation retains the weak solution shock and rarefaction wave properties exhibited by the distributed model. The paper explicitly considers uncertainty in the system parameters and shows how to design controllers that are robust to those uncertainties. Simulations are performed to show the effectiveness of the proposed control law.

TASK-SPECIFIC PERFORMANCE EVALUATION OF UGVS: CASE STUDIES AT THE IVFC

HUANG, WULING; WEN, DING; GENG, JASON; ZHENG, NANNING

Performance Evaluation is considered as an important part of the Unmanned Ground Vehicle (UGV) development, helps to find out research problems and improve driving safety. In this paper, a Task-Specific Performance Evaluation model of UGVs applied in the Intelligent Vehicle Future Challenge (IVFC) annual competitions is discussed. It is defined in functional levels with a formal evaluation process, including metrics analysis, metrics pre-processing, weights calculation, and TOPSIS and Fuzzy comprehensive evaluation methods. IVFC 2012 is selected as a study case and five UGVs overall performances are evaluated with specific analyzed autonomous driving tasks of environment perception, structural on-road driving, unstructured zone driving and dynamic path planning. The model is proved to be helpful in IVFC serial competitions UGVs performance evaluation.

REALIZATION OF A DILEMMA ZONE GUIDING ALGORITHM AT SIGNALIZED INTERSECTIONS

YANG, DONG; JIA, HONGFEI; TANG, MING

This paper presents a dilemma zone (DZ) avoidance guiding system for vehicles approaching the intersection. The purpose of the system is to assist drivers in determining the driving behavior and prevent vehicles from being caught in a dilemma zone at the onset of yellow. The optimal driving behavior is determined through warning information or detailed guiding strategy. To calculate the guiding strategies, a dilemma zone guiding algorithm is proposed with special focus on vehicle DZ state and interaction between vehicles. A simulation-based study proved the function of the proposed system as well as the effectiveness of the algorithm. It is found that based on the conditions of driver's comfort and car-following safety, guiding system can provide proper guidance for vehicles and determine the optimal driving behavior in advance.

HINGE LOSS STOCHASTIC GRADIENT DESCENT FOR TRAINING CONVOLUTIONAL NEURAL NETWORKS

JIN, JUNQI; FU, KUN; ZHANG, CHANGSHUI

We describe the details of our model's architecture and suggest a hinge loss stochastic gradient descent(HLSGD) method to train convolutional neural networks(CNN). Our C- NN consists of 3 stages(70-110-180) with 1,162,284 trainable parameters. The HLSGD is evaluated on the German Traffic Sign Recognition Benchmark, which gives faster and more stable convergence and state-of-the-art recognition rate of 99.65%. We write a GPU package to train several CNNs, and establish the final classifier in an ensemble way.

LOCAL RAMP METERING IN THE PRESENCE OF A DISTANT DOWNSTREAM BOTTLENECK: THEORETICAL ANALYSIS AND SIMULATION STUDY

WANG, YIBING; KOSMATOPOULOS, ELIAS; PAPAGEORGIOU, MARKOS; PAPAMICHAIL, IOANNIS

The well-known feedback ramp metering algorithm ALINEA can be applied for local ramp metering or used as a key component in a coordinated ramp metering system. ALINEA uses real-time occupancy measurements from the ramp flow merging area that may be at most few hundred meters downstream of the metered on-ramp nose. In many practical cases, however, bottlenecks with smaller capacity than the merging area may exist further downstream for various reasons, which suggests using measurements from those further-downstream bottlenecks rather than from the merging area. This paper addresses the local ramp-metering problem in such a downstream-bottleneck case. Theoretical analysis indicates that ALINEA may lead to a poorly damped closed-loop behavior in this case, but PI-ALINEA, a suitable Proportional-Integral (PI) extension of ALINEA, can lead to satisfactory control performance. The stability of the closed-loop ramp metering system with PI-ALINEA is rigorously proved by use of Lyapunov stability arguments. The root-locus method is also employed to analyze the linearized closed-loop system performance of ALINEA and PI-ALINEA with and without a downstream bottleneck so as to provide insights on both controllers' performance. Simulation studies are conducted using a macroscopic traffic flow model to demonstrate that the ramp metering performance of ALINEA indeed deteriorates in the distant downstream bottleneck case, while a significant improvement is obtained using PI-ALINEA. Moreover, with its control parameters appropriately tuned, PI-ALINEA is found to be universally applicable to a range of distances between the on-ramp and downstream bottleneck. This indicates that little fine-tuning would be necessary in field applications.

BUS BRIDGING DISRUPTION IN RAIL SERVICES WITH FRUSTRATED AND IMPATIENT PASSENGERS

WANG, YIBING; GUO, JINGQIU; CURRIE, GRAHAM; CEDER, AVISHAI; WEI, DONG; PENDER, BRENDAN

Urban rail networks play an important role in urban transport. An unexpected disruption in a rail network can cause a significant degradation in the level of service. When a disruption occurs, it is crucial to provide quick and efficient substitution of services via alternative transportation modes, including bridging disconnected railway stations using bus services. The amount of disruptions, surprisingly, is high; for example more than 15,000 disruptions in six months in Melbourne, Australia. The provision of bus bridging services calls for proper planning and designing of a temporary bus bridging network considering limited bus and driver resources and prevailing urban traffic conditions. Among a number of tasks concerning bus bridging, the demand modeling of affected train passengers is a pre-requisite for

satisfactory bus bridging practice. This paper explores this demand modeling problem based on the theory of compound Poisson processes and formulates it as a bulk queueing problem involving balking and reneging. The problem is carefully studied with a series of analytical results delivered. Large-scale Monte-Carlo simulations were designed and implemented to demonstrate a range of mathematical conclusions.

Abstracts of forthcoming papers on IEEE ITS Magazine

FAULT DETECTION FOR VEHICULAR AD HOC WIRELESS NETWORKS

WORRALL, STEWART; AGAMENNONI, GABRIEL; WARD, JAMES; NEBOT (MAGAZINE GUEST EDITOR), EDUARDO

An increasing number of intelligent transportation applications require robust and reliable wireless ad hoc communication. The process of communicating using radio requires a series of software and hardware modules to be functioning correctly. For many vehicle safety and automation applications communication is relied upon to the point where undetected faults can result in potentially dangerous situations, for example if a warning cannot be given in time to prevent a collision. The consequence of problems with any of the network components can be a partial or complete loss of radio communication. Generally, most systems will consider network failure when there is no communication, but this overlooks problems where a partial fault causes degradation in the communication performance. There is a fundamental requirement to detect and respond to the partial failure of a network to ensure that communication is not intermittent, or performs poorly after a certain range. The partial loss of communication is difficult to detect, and is often overlooked in mobile ad hoc network applications. This paper introduces a novel method for modelling the antenna performance using collected data, and using the model to determine the probability that an antenna has some level of performance degradation.

INTERSECTION-BASED ROAD USER TRACKING USING A CLASSIFYING MULTIPLE-MODEL PHD FILTER

MEISSNER, DANIEL; REUTER, STEPHAN; STRIGEL, ELIAS; DIETMAYER (MAGAZINE AE), KLAUS

The number of fatal accidents involving pedestrians and bikers at urban intersections is still increasing. Therefore, an intersection-based perception system provides a dynamic model of the intersection scene to the vehicles. Based on that, the intersection perception facilitates to discriminate occlusions which is expected to significantly reduce the number of accidents at intersections. Therefore this contribution presents a general purpose multi-sensor tracking algorithm, the classifying multiple-model probability hypothesis density (CMMPHD) filter, which facilitates the tracking and classification of relevant objects using a single filter. Due to the different motion characteristics, a multiple-model approach is required to obtain accurate state estimates and persistent tracks for all types of objects. Additionally, an extension of the PHD filter to handle contradictory measurements of different sensor types based on the Dempster-Shafer theroy of evidence is proposed. The performance of tracking and classification is evaluated using real world sensor data of a public intersection.

PARKING ASSISTANCE SYSTEM FOR LEAVING PERPENDICULAR PARKING LOTS: EXPERIMENTS IN DAYTIME/NIGHTTIME CONDITIONS

FERNANDEZ-LLORCA, DAVID; GARCÍA-DAZA, IVÁN; MARTÍNEZ-HELLÍN, AGUSTÍN; ÁLVAREZ-PARDO, SERGIO; SOTELO, MIGUEL ÁNGEL

Backing-out and heading-out maneuvers in perpendicular or angle parking lots are one of the most dangerous maneuvers, specially in cases where side parked cars block the driver view of the potential traffic flow. In this paper a new vision-based Advanced Driver Assistance System (ADAS) is proposed to automatically warn the driver in such scenarios. A monocular gray-scale camera was installed at the back-right side of a vehicle. A Finite State Machine (FSM) defined according to three CAN-Bus variables and a manual signal provided by the user is used to handle the activation/deactivation of the detection module. The proposed oncoming traffic detection module computes spatio-temporal images from a set of pre-defined scan-lines which are related to the position of the road. A novel spatio-temporal motion descriptor is proposed (STHOL) accounting for the number of lines, their orientation and length of the spatio-temporal images. Some parameters of the proposed descriptor are adapted for nighttime conditions. A Bayesian framework is then used to trigger the warning signal using multivariate normal density functions. Experiments are conducted on image data captured from a vehicle parked at different locations of an urban environment, including both daytime and nighttime lighting conditions. We demonstrate that the proposed approach provides robust results maintaining processing rates close to real-time.

THE IMPACT OF AN ANTICIPATORY ECO-DRIVER ASSISTANT SYSTEM IN DIFFERENT COMPLEX DRIVING SITUATIONS ON THE DRIVER BEHAVIOR

ROMMERSKIRCHEN, CHRISTOPH; HELMBRECHT, MAGNUS; BENGLER, KLAUS

The anticipatory advanced driver assistance system (ADAS) developed at the Institute of Ergonomics at the TU München assists to reduce the individual fuel consumption of each driver by anticipating earlier. The goal is to achieve improvements in as many road situations as possible. The paper gives an overview on the different options to support the driver to reduce its fuel consumption. Than it discusses the possibilities of an extension of anticipation to support the driver in eco-driving. Related work shows that anticipatory advanced driver assistance systems help to save fuel, but they focus on the general potentials of the system. The presented study in this paper, however, deals with the question of the impact of different road traffic situations on an anticipatory driver assistance system. Different traffic scenarios were chosen and varied in its complexity to evaluate the impact of the complexity of different driving situations on an anticipatory ADAS. A driving simulator study was conducted with 27 participants. The results showed that the fuel consumption is reduced with the assistant system due to earlier and better reaction but that there is no influence of the complexity of a situation on that. The influence of the situation on the driver in his use of the ADAS can be shown by his visual behavior. The percentage of the gaze time on the human machine interface (HMI) on the system is significantly reduced in the more complex situations.

MAKING BERTHA DRIVE --- AN AUTONOMOUS JOURNEY ON A HISTORIC ROUTE

ZIEGLER, JULIUS; DANG, THAO; FRANKE, UWE; LATEGAHN, HENNING; BENDER, PHILIPP; SCHREIBER, MARKUS; STRAUSS, TOBIAS; APPENRODT, NILS; KELLER, CHRISTOPH; KAUS, EBERHARD; STILLER, CHRISTOPH; HERRTWICH, RALF

125 years after Bertha Benz completed the first overland journey in automotive history, the Mercedes Benz S-Class S 500 INTELLIGENT DRIVE followed the same route from Mannheim to Pforzheim, Germany, in fully autonomous manner. The autonomous vehicle was equipped with close-to production sensor hardware and relied solely on vision and radar sensors in combination with accurate digital maps to obtain a comprehensive understanding of complex traffic situations. The historic Bertha Benz Memorial Route is particularly challenging for autonomous driving. The

course taken by the autonomous vehicle had a length of 103 km and covered rural roads, 23 small villages and major cities (e.g. downtown Mannheim and Heidelberg). The route posed a large variety of difficult traffic scenarios including intersections with and without traffic lights, roundabouts, and narrow passages with oncoming traffic. This paper gives an overview of the autonomous vehicle and presents details on vision and radar-based perception, digital road maps and video-based self-localization, as well as motion planning in complex urban scenarios.

THE WARRIGAL DATASET: MULTI-VEHICLE TRAJECTORIES AND V2V COMMUNICATIONS

WARD, JAMES; WORRALL, STEWART; AGAMENNONI, GABRIEL; NEBOT (MAGAZINE GUEST EDITOR), EDUARDO

Intelligent Transportation Systems rely on understanding, predicting and affecting the interactions between vehicles. Development of such systems must be based upon data derived from actual interactions if they are to be effective when used in real world applications. Increasingly, systems are being developed that are based on radio communication of state and intent between vehicles. Understanding of how these interactions occur is also necessary to creating robust systems. In order to test and compare new techniques, approaches and algorithms it is necessary to have a rich dataset to experiment with. This paper presents a detailed dataset useful for members of the Intelligent Transportation Systems community. It contains vehicle state information, vehicle-to-vehicle communications and road maps at high temporal resolution for large numbers of interacting vehicles over a long time period. This data set has already been used for a number of Intelligent Transportation Systems projects such as road mapping, driver intent prediction and collision avoidance among others.

HOW ELECTRIC VEHICLES AFFECT DRIVING BEHAVIORAL PATTERNS

HELMBRECHT, MAGNUS; OLAVERRI-MONREAL (GUEST EDITOR HUMAN FACTORS IN INT. VEH.), CRISTINA; BENGLER, KLAUS; VILIMEK, ROMAN; KEINATH, ANDREAS

The gradual introduction of fully electrically powered vehicles into the market has extended the opportunities for sustainable mobility and a new technological era. In this paper we investigate the changes in driver behavior patterns compared with patterns of traditional vehicles with combustion engines after having acquired the necessary adjustments needed for driving an electric vehicle. We aim to expound upon the differences present in driving habits after the individual has become adjusted to the driving patterns of an electric vehicle. Results showed that there is a significant difference in the driving habits of an internal combustion vehicle and that of an electric vehicle. Particularly a development from stronger accelerating and decelerating within the first experiences with electric vehicles to a more calm driving after 5 months of experience was noticeable in acceleration and braking maneuvers. Additionally, results for constant driving proved that interaction with electric vehicles with one-pedal driving capability is not a barrier for efficient driving with constant velocity.

OPTIMIZATION OF CHARGING STOPS FOR FLEET OF ELECTRIC VEHICLES: A GENETIC APPROACH

ALESIANI, FRANCESCO; MASLEKAR, NITIN

Electrification of transport is one of the approach to improve transport efficiency and sustainability. The current cost of transport associated with electrical vehicles is mainly related to the cost of acquisition and maintenance of batteries. Finding an efficient way of managing the available energy allows reducing the size of the batteries and thus the cost associated with transport. Recently taxi services and urban delivery companies are introducing electric vehicles in their fleet. Available route planners do not consider properly the characteristics and charging stop

requirements of EV fleets in decision making which results in non-optimal routing solution. The proposed work addresses the problem of finding the routes for a fleet of electric vehicles which will not only consider the battery limit of the vehicle, but also the concurrent use of charging stations along the route. The proposed solution computes routes for the fleet of vehicles that minimizes the associated cost which is a combination of travel time, charging time and the energy consumption along the route and is based on an evolutionary genetic algorithm with learning strategy. The results demonstrate that, the proposed algorithm finds a feasible solution in a reasonable amount of time and distributes the vehicles amongst the charging station to minimize the concurrency. The stated problem is non-polynomial and while genetic algorithm allows to efficiently explore large solution spaces, the work also presents some approximations and some strategies that allow to reduce the computational requirements and to find a solution in reasonable time.

Officers and Committee Chairs

Officers	
President:	Matt Barth, University of California, Riverside, CA, USA
Past-President:	Christoph Stiller, Karlsruhe Institute of Technology, Karlsruhe, Germany
VP Admin Activities:	Daniel J. Dailey, U. of Washington, Seattle, WA, USA
VP Conference Activities:	Wei-Bin Zhang, U. of California, Berkeley, CA, USA
VP Financial Activities:	Alberto Broggi, Università di Parma, Parma, Italy
VP Member Activities:	Daniel Zeng, U. of Arizona, Tucson, AZ, USA
VP Publication Activities:	Jason Geng, Galax LLC, Rockville, MD, USA
VP Technical Activities:	Yaobin Chen, Purdue U. Indianapolis, Indiana, USA
Transactions Editor:	Fei-Yue Wang, CAS, China, and U. of Arizona, Tucson, AZ, USA
Magazine Editor:	Miguel Angel Sotelo, U. of Alcalá, Alcalá de Henares, Spain
Newsletter Editor:	Brendan Morris, University of Nevada, Las Vegas, NV, USA
Committee Chairs	
Awards:	Jason Geng
Conferences and Meetings:	Wei-Bin Zhang
Constitution and Bylaws:	Daniel J. Dailey
Education Outreach:	Petros Ioannou
Fellow Evaluation:	Fei-Yue Wang
Finance:	Alberto Broggi
History:	Umit Ozguner
Long-Range Planning:	Alberto Broggi
Member Activities:	Daniel Zeng
Nominations and Appointments:	Alberto Broggi
Publications:	Jason Geng
Standards:	Jason Geng
Student Activities:	Brendan Morris
Technical Activities:	Yaobin Chen