THE TRANSPORTER

A NEWSLETTER FROM CENTER FOR INTEGRATED TRANSPORTATION SYSTEMS MANAGEMENT

Center for Integrated
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INSIDE

Center For Integrated Transportation Systems Management (CITSM) Selects Proposals

A SUCCESSFUL PROCESS FOR DEFINING AN EFFECTIVE TRANSPORTATION RESEARCH PROGRAM

INTRODUCTION: The Center for Integrated Transportation Systems Management (CITSM) was created in September 2007, with the approval of its strategic plan by the US Department of Transportation's Research and Innovative Technology Administration (RITA). The goal of the Center is "to provide improved mobility and reduced congestion for travelers and shippers using the nation's transportation system. The objectives of the Center include the development of advanced technology, improved processes and enhanced organizational structures for the integrated management and operation of existing transportation infrastructure and facilities." These objectives define a multi-disciplinary organization that recognizes the complexity of the modern transportation system.

The CITSM is a new Center that is funded by the RITA's, University Transportation Centers (UTC) Tier 1 program. Because it is new, the Center had the opportunity of defining a multi-disciplinary research program that meet's its objectives, while at the same time encouraging the participation of faculty and students with a broad range of experience and knowledge at the University of Maryland. It is anticipated that the transportation community will benefit from the fresh insights that result from the varying backgrounds of the participants.

STEERING COMMITTEE: The first step in the development of the research program was to form a Steering Committee consisting of representatives from the Civil Engineering's transportation program, as well as various departments within the University with an interest in transportation-related research. The Steering Committee includes; the Center Director, faculty members from the Department of Civil and Environmental Engineering (CEE), transportation group, the School of Public Policy, the R.H. Smith School of Business, the Urban Studies Program, and the Department of Electrical Engineering. Thus a range of specialties from are represented on the committee that reflects the broad interests of the Center.

The Steering Committee meets on an as-needed basis, beginning with the initial task of defining the process by which the research activities that make up the program are identified. The committee decided to fund an annual program consisting of eight research projects funded at a maximum of $85,000 per project. Projects were to be selected on a competitive basis in response to a solicitation issued by the CITSM. Multi-year projects were to be accepted, but subsequent year funding would be dependent on the results of the previous year's research and the continued relevance of the work.

A competitive project selection process was developed, in which research proposals would be evaluated by an independent panel of experts. Based on the experience of Steering Committee members who had reviewed proposals for other UTCs, it was decided that proposal submissions would be limited to a maximum length of seven pages, and that reviewers would be awarded an honorarium for their efforts. In this way, an unbiased and thorough evaluation would be ensured, by the leading experts in the country.

PROJECT SELECTION PROCESS: Using the guidance received from the Steering Committee, a solicitation was developed that defined the proposal preparation and selection process. The solicitation included the following features:

- As previously indicated, a maximum length of seven pages was specified, with a requirement that all offerors adhere to a predefined format. This requirement was defined to simplify the proposal evaluation process.
- A pre-screening process was used to avoid asking reviewers to spend time with proposals that were not responsive to the Center's requirements. All proposals were responsive to the requirements of the Solicitation.
- A review panel of ten experts offering a range of knowledge required to evaluate the diverse research proposals that were received. Review panel members included representatives from academia, government and industry.
- A final selection and ranking was performed by the steering committee. This last step was instituted to ensure consistency, balance, and a mix of projects that met the objectives of the Center.

The following evaluation criteria were provided to the review panel:

1. Alignment of proposed effort with Center's theme
2. Quality and intellectual merit of the research proposal
3. Potential benefits to society that would result from successful completion of the work;
4. Relevance of proposed effort with regional and national transportation agendas, including Department of Transportation priority areas;
5. Qualifications of the investigators;
6. Appropriateness of the proposed budget;
7. Number and role of students involved in the research work;
8. Principal investigator's performance in prior projects;
9. Balance between basic and applied research
10. Likelihood the proposed work can be completed in proposed timeframe and within proposed budget
11. Use of non-Federal matching funds to supplement CITSM funding

This process required three months to complete. Eight projects were selected that spanned a broad range of topics including a variety of engineering and behavioral disciplines. Research activities included modeling as well as empirical studies.

CONCLUSIONS: The effectiveness of the research program processes cannot be judged exclusively on the basis of the projects that were selected, but rather on the success of the research being funded. After three quarters of activities, all of the projects selected are underway, and most are on schedule. Significant research results are anticipated by the end of the first year of activities. This level of success validates the effectiveness of the process by which the CITSM research program was developed. The Center anticipates the use of the same process for the selection of projects for its second year of operation.

The Center for Integrated Transportation System Management (CITSM)
Prepared by Philip J. Tarnoff (Director – CITSM)

RECENT EVENTS

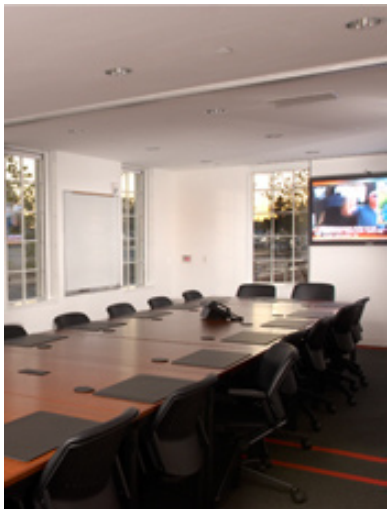
Seminar Series - Marlon Boarnet

On March 4, we, kicked off our first joint seminar with the Natioal Center for Smart Growth. The talk was given by Dr. Marlon Boarnet of UC Irvine on his recent paper entitled "Transportation Planning in an Era of Expensive Mobility". The seminar was very well received, Dr. Boarnet presented to a conference room packed with engineering and urban planning faculty and graduate students. More information on Dr. Boarnet can be gathered from his web-page at: http://socialecology.uci.edu/faculty/mgboarne/

Seminar Series - Yanfeng Ouyang

CITSM and the National Center for Smart Growth had their second successful seminar series with the invited speaker Dr. Yangfeng Ouyang, assistant professor of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign. Dr. Ouyang discussed his research on "Reliable Facility Location Planning under Probabilistic Disruptions". More information regarding Dr. Ouyang's research and interests can be found at his institutional webpage: https://netfiles.uiuc.edu/yfouyang/www/

Board of Advisors Spring Meeting



On Thursday, March 12th, we held our first annual Board of Advisors Meeting at the University of Maryland's Riggs Alumni Center. The half day meeting was extremely productive. It started out with an overview of recently awarded projects as well as developments related to those projects. Throughout the meeting, members of the board offered suggestions for applications of current research, directions for new research, and also suggested new partners for the Center. The day ended with a demonstration of the CATT Lab's Real-Time 3-D Traffic Monitoring System.

faculty SPOTLIGHT

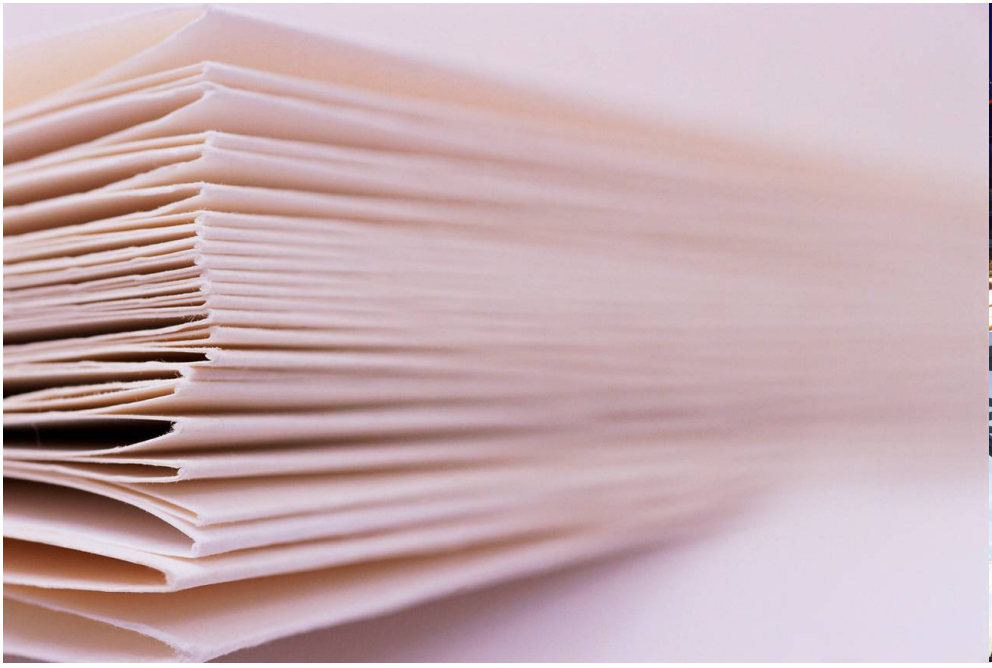
DR. LEI ZHANG

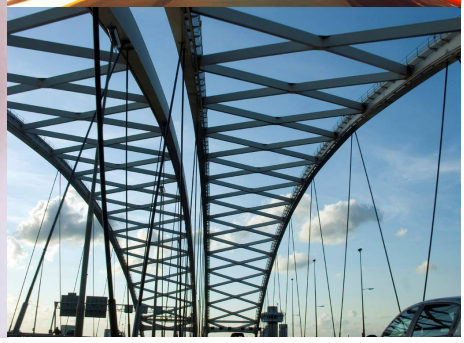
Dr. Lei Zhang joined the Department of Civil and Environmental Engineering at University of Maryland (UMD) as a tenure-track Assistant Professor in August 2008, after earning his master's degrees in Civil Engineering and Applied Economics, and a Ph.D. in Civil Engineering from the University of Minnesota at Twin Cities. Before moving to Maryland, he had been an Assistant Professor in Civil Engineering for two years at Oregon State University.

Dr. Zhang conducts advanced and applied research on the dynamics of transportation and urban systems, as well as their implications on management and policy decisions. He leads the Sustainable Transportation Analysis and Research (STAR) group at UMD. STAR promotes and employs interdisciplinary approaches to modeling the interdependencies between transportation, land use, and natural resources, analyzing the full impact of engineering and planning decisions to ensure efficient resource allocation and sustainable development in the broad domain of transportation. He has led research projects on optimal traffic control, traveler information systems, transportation pricing and investment, alternative financing, land use-transportation interaction, social, economic, and environmental impact of transportation, and multimodal transportation analysis. His research program is funded by various federal, state, and local government agencies, and research foundations.

You can find Dr. Zhang at:
http://www.lei.umd.edu/

Center For Integrated Transportation Systems Management (CITSM) Selects Proposals





The Center for Integrated Transportation Systems Management granted its first awards in October of last year. Eight awards were granted in total to professors from Civil and Environmental Engineering, Electrical and Computer Engineering and Urban Studies and Planning. A brief description of each project follows.

INTEGRATION OF OFF-RAMP AND ARTERIAL SIGNAL CONTROLS TO MINIMIZE THE RECURRENT CONGESTION ON CAPITAL BELTWAY

Gang-Len Chang - PI
Civil & Environmental Engineering

This research intends to capture the complex interaction between freeway off-ramp flows and traffic queues at neighboring arterial intersections, as several mainline segments on the Capital Beltway are often plagued by off-ramp spillback queues that significantly degrade their operational capacity. To minimize freeway congestion due to off-ramp queues but not to incur excessive arterial delay, this study will develop a multiple-objective model to first evaluate their interrelations, and then generate the optimal off-ramp and local signal controls to achieve the preset control objective such as maximizing the total throughput or minimizing the total delay. The proposed model features its ability to reliably determine when to activate such an integrated control, and how many upstream segments should be included in the control boundaries. The solution algorithm developed for this model will be sufficiently efficient to ensure its potential for use in real time operations.

INTEGRATING VEHICLE OWNERSHIP DECISIONS INTO THE MARYLAND STATEWIDE TRANSPORTATION MODEL

Kelly Clifton - PI
Urban Studies & Planning
Cinzia Cirillo - PI
Civil & Environmental Engineering

This applied research program proposes to develop a modeling framework for vehicle ownership in the State of Maryland for use in the Maryland Statewide Transportation Model (MSTM). The modeling system aims to produce the tools needed to understand and predict consumers' preferences on vehicle ownership, as a function of socio-demographic, economic, transportation system, and land development characteristics. Econometric equations relying primarily on discrete choice methodologies (joint revealed and stated preference models) will be estimated from Maryland specific data. This framework can be used to test the outcomes of various future scenarios, including reaction to fuel efficiency, levels of congestion, land use policies, and changing economic conditions. It improves the capacity of MSTM by improving its ability to capture ownership, a key component of trip generation and mode choice, thus improving system planning capabilities for the state.

MODELING VIOLATIONS IN HIGH-OCCUPANCY TOLL LANE STUDIES

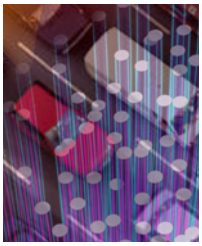
Elise Miller-Hooks - PI
Civil & Environmental Engineering

States are increasingly looking to HOT lane facilities to improve mobility and reduce congestion for travelers and shippers using the nation's freeway corridors. While continuous access to HOV lanes is standard practice, due to existing toll collection technologies, access to HOT lanes must be more limited. Physical barriers in the form of concrete barricades or plastic pylons, for example, are often constructed to ensure compliance with rules for accessing HOT lanes. Increasingly, however, nonbarrier

separation techniques are employed for this purpose. Such techniques may be used where the necessary space required for physical barrier separation and police activities required for enforcement is limited or construction and maintenance costs of such barriers is prohibitive. Nonbarrier separation methods, as a result, have become more common. Nonbarrier separation methods, however, permit nearly unlimited improper ingress/egress to/from the managed lanes. These violations impact free-flow speeds of both managed and general purpose lanes. Additionally, violations have a negative impact on revenue. Even with significant enforcement, violation rates related to non-barrier separated managed lanes in the U.S. are considerable. Despite this, no prior model developed for the purpose of predicting improvements in travel speeds and other traffic performance metrics and the potential revenue that can be raised through the introduction of a new HOT lane facility within an existing roadway or to assess potential practicable operational strategies and facility designs has incorporated this violation behavior. This research effort will seek to assess the importance of this omission. Specifically, the proposed research effort will quantify the impact of the various types of violations associated with HOT lanes on estimates of travel speeds and other traffic metrics obtained through simulation modeling of proposed HOT lane facility designs and determine the criticality of modeling such violations in conducting studies of proposed HOT lane facilities.

PROTOTYPING A LOW COST AND SCALABLE WIRELESS SENSOR NETWORK FOR TRAFFIC MEASUREMENT

Mehdi Kalantari Khandani
Electrical and Computer Engineering



In this project, we develop low cost, low profile, and energy self sufficient sensor modules for different applications of intelligent transportation systems. The proposed sensors harvest the mechanical vibration in street pavement and convert it to electrical energy for operation of sensors. As an important application of this architecture, prototyping and field evaluation will be done for a variation of the proposed sensors that measure quantities such as traffic volume, speed, density, and distribution of vehicle lengths. Compared to the existing solutions, the proposed architecture is economical, easy to install, easy to maintain, and energy self sufficient. We expect the following outcome for this project: (i) Architectural design, development, and implementation of wireless sensors that harvest their energy from vibration in the road pavements; (ii) Signal processing techniques and algorithms to convert raw data of sensors into quantities such as space mean speed, vehicle length, etc. and, (iii) reports on road evaluation of the developed sensor in field experiments and simulations.

MODELING CAR OWNERSHIP DECISIONS AND VEHICLE AVAILABILITY IN THE STATE OF MARYLAND

Gerrit-Jan Knaap
Urban Studies & Planning

Under a contract with the Maryland State Highway Administration and in cooperation with Parson's Brinkerhoff, the National Center for Smart Growth is building a sketch-level transportation model. That model, which will include the entire states of Maryland and Delaware, the District of Columbia, and parts of Virginia, West Virginia, and Pennsylvania will be used for a variety of purposes, including but not limited to examining the effects of various transportation investments on traffic flows, examining the effects of transportation investments on land use patterns, and examining alternative future development scenarios. The model is expected to play an important role in transportation decision making for years into the future. Among the many policy decisions that must be made in the near future is how to respond to climate change. A recently issued report from the Maryland Climate Commission recommends that emissions associated with vehicle miles traveled be reduced by 25 to 50 percent of 2006 levels by 2020. Interim reduction goals are 10 percent by 2012 and 15 percent reductions by 2015, respectively. Under this project supported by the Maryland University Transportation Center, researchers at the National Center

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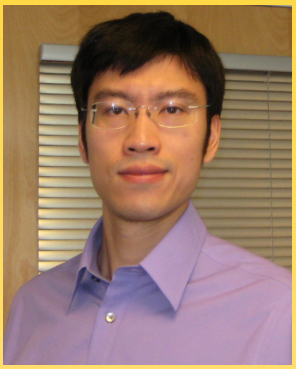
student SPOTLIGHT



YUE LIU

Mr. Yue Liu finished his B.S. and M.S. degrees in Civil Engineering at Tongji University, China, and joined the Civil Engineering Department of the University of Maryland, January 2005. His doctoral research, supervised by Professor G.L. Chang, has been in the development of an integrated optimal control system to assist responsible transportation agency in best contending with the non-recurrent congestion on urban freeway corridors caused by incidents. In addition, his research also spans the areas of traffic control and operations, emergency evacuation planning, network analysis and optimization, traffic flow models and simulation, intermodal facility location theory, and traffic safety.

He plans on completing his thesis this summer. Entitled "An Integrated Optimal Control Model for Urban Freeway Corridor Incident Management" it looks at the solving the problem of non-recurrent traffic congestion on US freeways by effectively optimizing implementation and management of detour routes, often caused by the capacity reduction due to the lane blockage when incidents occur. In most scenarios, if proper routing and control strategies can be implemented in time, motorists can circumvent the congested segments by detouring through parallel arterials. To accomplish this, the responsible agency needs to effectively implement strategies at all control points (ramps, intersections, etc). The thesis develops an optimization model and its solution algorithm for freeway corridor control during incident management. With a parallel arterial as the detour route, the proposed model aims to produce the optimal set of diversion rates from the freeway mainline to relieve the congestion at the incident segment, and concurrently adjust signal timings at the arterial intersections to best accommodate the detour traffic.

Among his many published articles, presentations, and accolades, Mr. Liu is also the recipient of the 2006 TRB Poster Contest First Place Award and 2009 Best PHD research award by Civil Engineering Department. He is the 2008 Future Faculty Fellow at the Engineering School, and was awarded the 2008-2009 Ann G. Wiley Fellowship by the Graduate School.

Upon completion of his doctoral dissertation, Mr. Liu has accepted a tenure-track assistant professor position at the University of Wisconsin, Milwaukee.

PERSISTENT AND AUTONOMOUS TRANSPORTATION ANALYSIS AND SURVEILLANCE USING A HIGH DEFINITION WIRELESS NETWORKED IMAGING SYSTEM

Persistent and ubiquitous monitoring and surveillance of transportation systems is typically achieved by transmitting images from geographically dispersed cameras. These cameras are generally in fixed locations, and are usually mounted close to the system being monitored.

For example, highway-monitoring cameras are usually mounted on structures above the roadway. They transmit live, limited resolution, streaming images over dedicated wired networks or even over the Internet. Because of their low resolution, they are capable of simple singular event detection, such as counting vehicles, identifying accidents and estimating speeds of vehicles within a fixed area. Many such transmissions converge in operations centers, and they are viewed on multiple screens whose displays cycle over time. Critical events can be missed if they are not viewed by an operator when it is their turn to be displayed.

Professors Christopher Davis (ECE) and Stuart Milner (CEE) are developing technology that enables an operation center, and all of its mobile subscribers on an intranet (e.g., police cars) to receive real-time alerts of multiple events just milliseconds after their occurrence, with follow up after the detection.

Continuous, real-time monitoring of very many events and parameters of objects in the field of view is possible in a variety of transportation settings including:

- roads and highways (e.g., vehicle type identification, speeds, collisions);
- maritime (e.g., port and sea lane surveillance, combat piracy)
- terminals (e.g., airport, train and bus terminal surveillance)

When an event occurs, the video resolution is automatically increased and given priority over all non-critical monitoring. Instantaneous monitoring is achieved throughout the entire fixed and mobile transportation system and transmitted to the operations team.

An illustration of multiple event detection and follow-up in the context of highways is shown in Figure 1. A vehicle type has been identified and followed after detection. At the same time, multiple other moving vehicles are monitored in the field of view.

USING HIGH DEFINITION IMAGERY PROVIDES A GREATER CAPABILITY FOR AUTOMATIC AND REAL-TIME MULTI-EVENT DETECTION.

The unique comaponent of Davis and Milner's research is the exploitation of high definition, multiple single frame, digital imagery (e.g., 1080p) that can be analyzed and flexibly transported in an advanced, high bandwidth (up to Gb/s) wireless internet.

Using high definition imagery provides a greater capability for automatic and real-time multi-event detection. This includes vehicle identification, tracking and alerts, and detection of emerging or anomalous traffic patterns, as well as surveillance at transportation terminals and other sites where human and cargo traffic events need to be precisely identified. The high definition imagery transport enables more precise identification of events and objects than can be achieved using low-data-rate wireless or closed-circuit analog cameras.

Figure 1. In the photo at left, the system is tracking five vehicles simultaneously. The SUV in the frame at far right was originally recorded as it passed the region identified by the empty green box. The recording was compared to a database of similar vehicles, and the center frame shows the closest match—a mid-sized SUV. This process occurred in real time, the ~0.5 seconds it took for the SUV to travel from the empty box to the position seen in the first frame; and the identified vehicle can be tracked autonomously throughout the field of view. Simultaneously, multiple other events in the field of view are being detected and followed-up.

The system uses digital cameras mounted on low cost, agile gimbals and fixed wide angle cameras that direct zooming and scanning of other independent cameras for purposes of autonomous, multi-event tracking, zooming and follow-up of events that can be relayed in real-time to operations centers. The autonomous follow-up and tracking is based on Davis and Milner's research on machine vision using radial trifocal tensors and related techniques.

While current traffic control, monitoring and surveillance technologies typically use fixed infrastructures and camera and fields of view close to travel lanes and intersections, the Davis-Milner system can exploiting imagery from any angle and with substantial range. The wireless and portable nature of the technologies allows for rapid deployment and "instant infrastructure."

FOR MORE INFORMATION
Contact Professor Christopher Davis at davis@umd.edu, 301 405 3637 or Professor Stuart Milner at milner@umd.edu, 301 405 0267.

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for Smart Growth will enhance the capacity of the transportation model and exercise the model to explore alternative options for meeting these greenhouse gas reduction goals.

A PROOF-OF-CONCEPT AND DEMONSTRATION OF A HIGH DEFINITION, DIGITAL VIDEO SURVEILLANCE AND WIRELESS TRANSMISSION SYSTEM FOR TRAFFIC MONITORING AND ANALYSIS

Christopher Davis - PI
Electrical & Computer Engineering
Stuart Milner - PI
Civil & Environmental Engineering

In this applied research project, we plan to conduct a proof-of-concept and demonstration of a high definition (HD), digital video surveillance and wireless transmission system for traffic monitoring and analysis, enabled by rapidly deployable, RF directional wireless links. This system will also provide improved capabilities to emergency responders. The demonstration will consist of HD cameras networked through a 4-node directional wireless network on the University of Maryland campus, and will include the development of real-time "event" detection algorithms specially tailored to our unique combination of HD image capture, wireless transport, and real-time processing. This project will lead to a greater understanding of video technology and image analysis requirements for HD traffic analysis with rapidly deployable advanced wireless systems. It will further allow analysis of gaps between current practice and capability vis-à-vis our HD, high capacity, and deployable wireless image transport system.

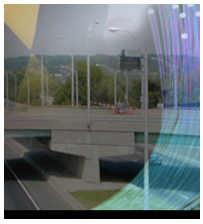
INTERMODAL TRANSFER COORDINATION IN LOGISTIC NETWORKS

Paul Schonfeld
Civil & Environmental Engineering

A model will be developed for integrating and optimizing logistic networks relying on intermodal transfers. It will combine (1) a pre-planning component for optimizing system characteristics such as terminal and vehicle characteristics, routes and schedules, and (2) real-time control algorithms for dealing with service disruptions.

DEVELOPMENT OF ADVANCED APPLICATIONS USING BLUETOOTH-GENERATED TRAFFIC FLOW DATA

Dr. Ali Haghani and Mr. Phil Tarnoff
Civil & Environmental Engineering



During the past year, research personnel of the CATT successfully developed and demonstrated a new technology for the collection of travel times and space mean speeds of traffic based on the reception of signals emitted by Bluetooth equipped electronics (PDAs, cell phones, car radios, laptop computers, etc.) located in passing vehicles. Bluetooth is a standards-based, pervasive wireless networking protocol whose use is rapidly expanding throughout the computer electronics industry.

Because of the quality and large sample size of the Bluetooth data sets, this project is focused on research related to the use of this data for advanced analysis of the traffic conditions that existed at the time that the data was collected. This research is intended to address both near-term analytical challenges and long term applications.

In the near term (year one), the research will concentrate on determining the minimum required sample sizes to reliably portray the traffic conditions; identifying and eliminating sample outliers; and developing procedures for distinguishing between motor vehicles and pedestrians in urbanized areas. In the long term (years two and three), the research will concentrate on the development of applications that take advantage of the size and quality of the Bluetooth data. This will include automatic identification of the existence of freeway incidents; use of origin-destination data to evaluate the impact of variable message sign (VMS) (also known as dynamic message sign (DMS) messages on traffic diversions; and predicting the impacts of incidents on travel time.

staff SPOTLIGHT

MICHAEL PASZKIEWICZ

In the fall of 2008, Michael Paszkiewicz joined the Center for Integrated Transportation Systems Management as the Assistant Director, responsible for the day to day management of center activities. Mike comes to us from the Institute for Systems Research (ISR) at the University of Maryland. The ISR program started from a National Science Foundation Research Center twenty years ago, with the mission to promote cross-disciplinary research and has faculty representing departments campus-wide. While he was with the ISR, Mike was responsible for the management and oversight of the Institute's grant funding from pre- to post-award. He was also the steward of the ISR's endowment.

Michael has two bachelor's degrees, one in Economics and one in Kinesiology, and recently received his Masters in Business Administration all from the University of Maryland. In his spare time he teaches flying trapeze, coaches gymnastics, trains for marathons, and brews his own beer.

ABOUT CITSM

The Center for Integrated Transportation Systems Management (CITSM) at the University of Maryland College Park was established as a tier I university transportation center in 2008. The goal of the center is the Development of Advanced Technology, Improved Processes, and Enhanced Organizational Structures for the Integrated Management and Operation of Transportation Facilities and Corridors.

The Center for Integrated Transportation System Management (CITSM) focuses on the development of tools, processes and institutional relations that foster seamless management and operations of today's transportation infrastructure. Such seamless operations will be derived from concentrating on the overall mission of transportation agencies rather than the narrower objectives of individual institutions and facilities. Integrated operation of the transportation infrastructure as a system rather than a collection of individual resources, offers the potential for significant improvements in system efficiency as measured by reductions in travel time and congestion along with improvements in travel reliability. Integrated system operation will have a positive impact on the nation's economy, safety, air quality and energy consumption.

The theme of the Center is "Integrated Transportation Systems Management." The Center conducts research and provides education and technology transfer related to this theme. The objective of this research is to provide improved mobility and reduced congestion for travelers and shippers using the nation's transportation infrastructure. The emphasis of this work is on the integrated management of the transportation systems at all levels including planning, engineering, and operations. The University of Maryland has selected this theme because of its potential for significantly improving transportation system mobility and reliability, as demonstrated by numerous prior research projects conducted by its faculty and staff. A second, but equally important, objective of the Center is to educate the next generation of transportation engineers and planners with the tools needed for seamless management and operations of today's transportation infrastructure and the deep understanding of the benefits of such a fully integrated system.

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