CITSM

The Transporter

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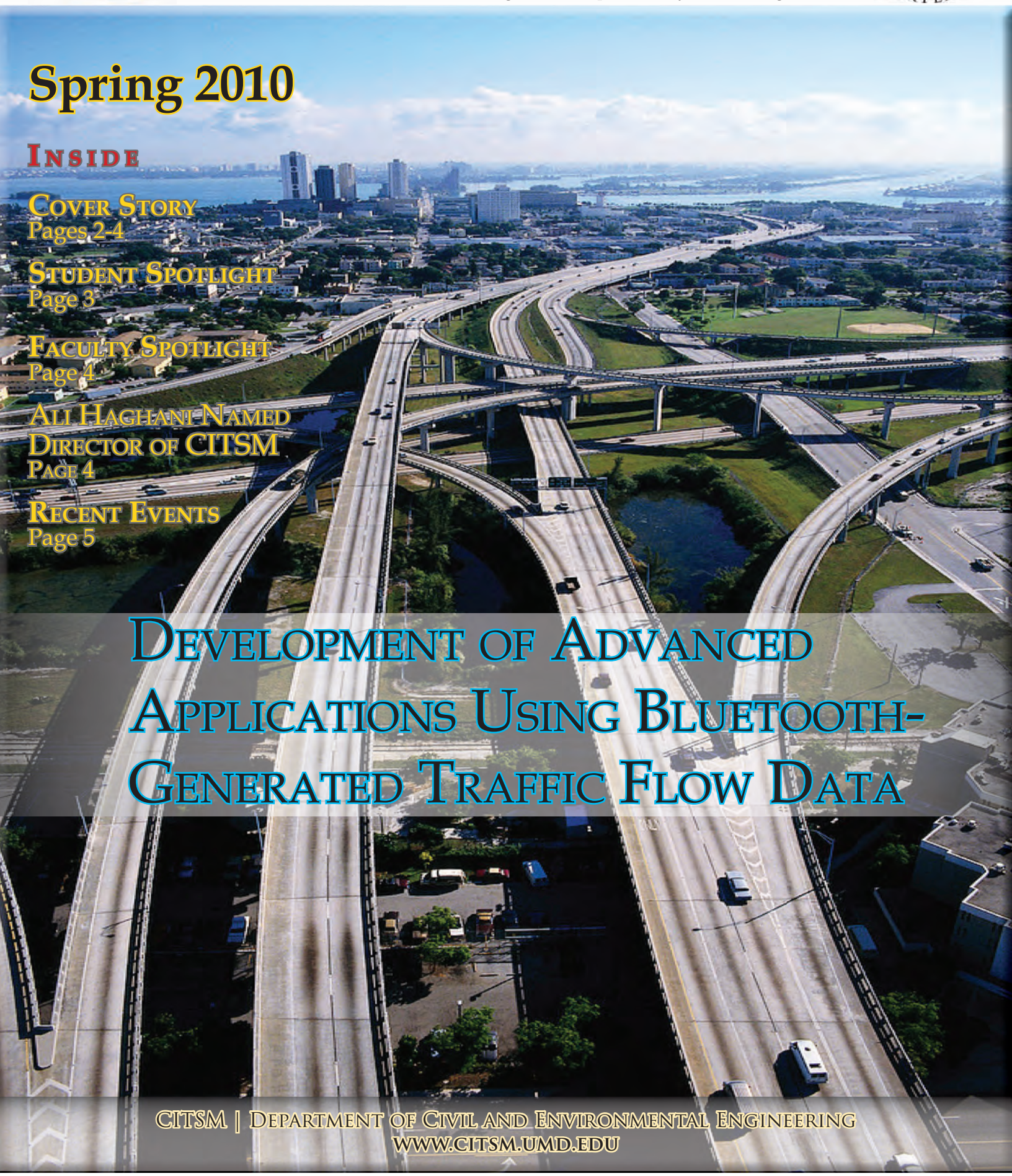

Development of Advanced Applications Using Bluetooth-Generated Traffic Flow Data

CITSM | Department of Civil and Environmental Engineering
www.citsm.umd.edu

Development of Advanced Applications Using Bluetooth-Generated Traffic Flow Data

Written by: Dr. Ali Haghani

This project which is generally referred to as the "Bluetooth Project" is focused on developing methods and tools to post-process travel time data received from Bluetooth data collection devices. The project is in its second year of support from CITSM and has produced some very useful software tools and products that have many versatile applications in Bluetooth data analysis and evaluation. The project's lead investigators are Mr. Philip Tarnoff and Dr. Ali Haghani.

The Bluetooth traffic detection technology that is developed at the Department of Civil and Environmental Engineering Center for Advanced Transportation Technology is based on signals available from the point-to-point networking protocol commonly referred to as Bluetooth. This technology has been continuously in use since 2008 in validation performed on INRIX data purchased by I-95 Corridor Coalition under Probe Vehicle project. The Bluetooth monitoring system consists of several detectors and a central processing unit. These detectors are deployed on a freeway or arterial in proximity to the roadway at the base of a sign post or guard rail post. These units are the size of a large briefcase or small carry on. A photo of the device and a sample placement next to a sign post are shown in Figure 1.

Figure 1. The Bluetooth detector deployed during data collection

Roadside deployment of Bluetooth sensors calls for safety measures to protect operators, devices and general stream of traffic alike. Figure 2 shows some typical safety gears and equipment used by deployment team. Two of the key researchers in the project who are featured in Figure 2 are Mr. Kaveh F. Sadabadi and Mr. Masoud Hamedi. Other project personnel include Ms. Mona Asudegi and Mr. Yashar Aliyari. Some difficulties in retrieving sensors from under a heap of snow resulting from the most recent snow storm in Maryland on capital beltway are depicted in Figure 3.

Figure 2. Typical Bluetooth detector deployment locations and safety equipment

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Figure 3. Typical problems in Bluetooth dector deployment and retrieval

The Bluetooth protocol uses an electronic identifier, or tag, in each device called a Machine Access Control address, or MAC address for short. The MAC address serves as an electronic nickname so that electronic devices can keep track of who's who during data communications. It is these MAC addresses that are used as the basis for obtaining traffic information. The concept for deriving traffic information in this manner is illustrated in Figure 4. Normally, a majority of the detected devices are seen at multiple stations when several Bluetooth sensors are deployed along a stretch of highway. When the MAC address of a device is matched between two consecutive sensors, the difference in time between the detections at the two sensors represent the travel time of the vehicle carrying the device.

The matched MAC addresses for all devices that are detected between two consecutive sensors can be used to develop a sample of travel time for that particular segment of the roadway. The research team has developed a sophisticated methodology for data processing, filtering outliers and data analysis.

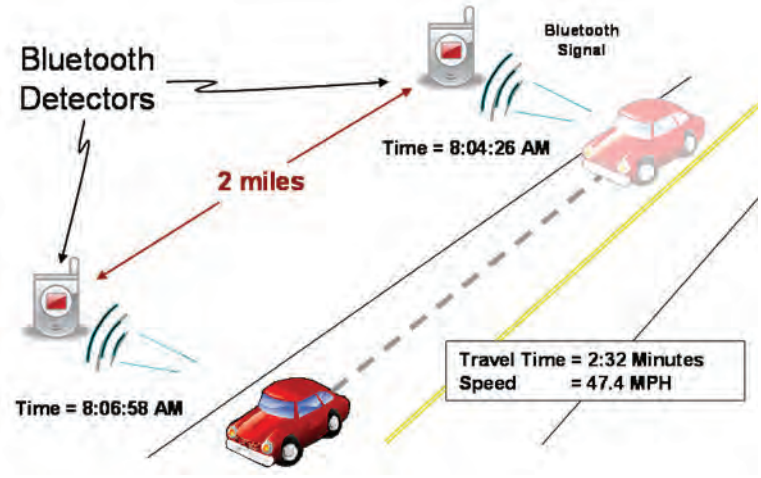

Figure 4. Bluetooth traffic monitoring operation concept

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Student SPOTLIGHT

Michael Maness

A true Terp! Mr. Maness received his bachelor degree in Civil Engineering and Computer Science from the University of Maryland in 2009 and decided to stay at UMD for his master's degree. He is currently a graduate student in the Department of Civil and Environmental Engineering specializing in Transportation Engineering, with a December 2010 expected completion.

As a graduate research assistant he is currently working for the department of Civil and Environmental Engineering on his second CITSM project, investigating future vehicle technologies, fuel and vehicle taxation, and tolling policies for implementation in discrete choice models of car ownership in Maryland. As well as designing combined revealed and stated preference surveys on the effects of vehicle technology, fuel pricing, taxation, and tolling on car ownership. In his new position, Michael continues the work that he started as an undergraduate, preparing web-based surveys used for online data collection. Additionally he is helping supervise foreign exchange students in the research and development of revealed and stated preference surveys on car ownership.

Already active, Michael is a student member of the American Society of Civil Engineers, the National Society of Black Engineers, and the Transportation Research Board. More notably, he was awarded the Louis Stokes Alliance for Minority Participation Bridge to the Doctorate Fellowship.

After graduation, Michael's goals are to obtain a Ph.D in Transportation Engineering with a focus in travel behavior analysis, further expand on his research as a professor, and to create a multi-discipline travel behavior analysis laboratory.

During the first year, the project focus was on determining minimum required sample sizes to reliably portray traffic conditions, identifying and eliminating sample outliers, filtering raw data in an automatic vehicle identification setting for real time travel time estimation and optimal sensor location to maximize travel time estimation reliability. The project team has successfully completed the first year of this project and the result of their work has been disseminated through several publications and presentations. Currently, the focus of the project is on real-time short term freeway travel time prediction, developing procedures for distinguishing between motor vehicles and pedestrians in urbanized areas, and automatic identification of the existence of freeway incidents. For more information regarding this project contact Dr. Ali Haghani at 301.405.1963 or haghani@umd.edu.

Ali Haghani Named Director of CITSM

Dr. Ali Haghani has been Named Director of the Center for Integrated Transportation Systems Management (CITSM), replacing Mr. Philip Tarnoff who recently retired.

Dr. Haghani is Professor and Chairman of the Department of Civil and Environmental Engineering at the University of Maryland at College Park. He holds a BS degree in civil engineering from Shiraz University in Iran and an MS and a PhD degree in civil engineering from Northwestern University. Prior to coming to the University of Maryland, he taught as an Assistant Professor at the University of Pittsburgh and was a Post Doctoral Fellow and Research Scientist at Northwestern University. Dr. Haghani is an expert in transportation systems analysis, large scale mathematical modeling, traffic management, logistics, and emergency response.

Dr. Haghani has over twenty years of experience in research and education as well as vast experience in managing research programs and administrative expertise. Some of his most recent completed projects are the evaluation of the cellular probe data for the Baltimore Multimodal Traveler Information System (MMTIS). He is currently conducting the evaluation of the real-time travel data provided by Inrix to I-95 Corridor Coalition member states as part of the I-95 Corridor Coalition Vehicle Probe Project.

As the chair of the Department of Civil and Environmental Engineering and one of the authors of the original proposal founding CITSM, Dr. Haghani has been closely involved with the Center from the start. He will work hard to continue the CITSM's tradition of supporting exciting new research into integrated transportation systems management.

faculty

BIOGRAPHY

Catherine Plaisant

Dr. Catherine Plaisant is a Senior Research Scientist and Associate Director of Research at the Human-Computer Interaction Lab of the University of Maryland Institute for Advanced Computer Studies. She earned a Doctorat d'Ingenieur degree in France (~ Industrial Engineering PhD) and co-authored with Ben Shneiderman the 4th and 5th Editions of Designing the User Interface, one of the major books on the topic of Human-Computer Interaction. She has written over 100 refereed papers on topics as varied as information visualization, digital libraries, universal access, technology for families, or evaluation methodologies. She enjoys working in HCIL with multidisciplinary teams on designing and evaluating new interface technologies that are useable and useful. Research contributions range from focused user interaction techniques (e.g.Excentric Labeling) to innovative visualizations (such as LifeLines for personal records or SpaceTree for hierarchical data exploration) and interactive search interface techniques which is the subject of her current CITSM project.

With graduate student Krist Wongsuphasawat she is developing interfaces to explore temporal patterns in categorical data, expanding early work done with electronic health records and applying our findings to tools that help analysts search and explore databases of incident management data. While the transportation community emphasizes developing standards for archiving and transmitting raw incident data, more effort is needed to design appropriate visual analytics tools to explore the data and extract meaningful knowledge.

Passenger Transport Demand Modeling at European Level - Political Background, Methods, and Application Examples

Speaker: Dr. Eckhard Szimba, Ph.D., is a senior researcher at the Institute for Economic Policy Research (IWW) of the Karlsruhe Institute of Technology (KIT) in Germany. In 2006 he finished his PhD on the development of a methodology for analysing interdependencies between transport infrastructure projects. His PhD was awarded by the European Friedrich List Prize in 2007.

Seminar Abstract: Presented on January 15, this seminar covered the different aspects of (passenger) transport demand modelling at strategic European level will be presented. The political need for transport demand modelling at European level will be addressed, by tackling the process of European integration and the development of trans-European networks for transportation. Based on this, the policy requirements transport demand models have to meet will be outlined. Insight in the methods applied for passenger transport demand modelling will also be discussed. Selected methodological aspects will be presented with respect to two models: the long-distance passenger transport demand model VACLAV developed at the Institute for Economic Policy Research (IWW); and the designated reference transport demand and assessment model of the European Union, TRANS-TOOLS.

Impact of White House Street Closings

Speaker: Dr. Fred Ducca, Ph.D., National Center for Smart Growth, has 30 years of experience in travel demand modeling and forecasting. He holds a B.S. in Mathematics from St. Peter's college, an MBA from the Wharton School, University of Pennsylvania and a Ph.D. in City Planning from the University of Pennsylvania.

Seminar Abstract: Presented on February 19, this seminar discussed the aftermath of September 11, and how the street closings around the White House, for Security purposes, caused major rerouting of traffic in downtown D.C. and surrounding areas. The FHWA conducted a study on the effects of these closings on traffic and possible strategies to mitigate the impacts. To do this a model was constructed to simulate the movements of 2 million vehicles in the downtown DC area and to account for 20 million moving within the DC region. This seminar will cover the purpose of the study, the findings and methods for presenting technical findings in a form which non-technical audiences can understand.

Transit Simulation for the White House Area Transportation Study: An Overview of the Analysis Issues, Methodologies, and Results

Speaker: Mr. Brian Gardner, team leader for the Planning Methods Team within the Office of Planning at the Federal Highway Administration. Mr. Gardner earned a BSCE and MCE from North Carolina State University.

Seminar Abstract: Presented on March 12, this seminar discussed the White House Area Transportation Study commissioned by Congress which evaluated options to mitigate congestion caused by the street closures in the vicinity of the White House in response to security concerns. The study considered significant construction options to restore the street grid, operations options to reduce congestion impacts, and transit options to restore person capacity through the area. The model framework employed a dynamic router integrated with a large area meso-scale simulation overlayed on the existing MPO trip model. This presentation focused on the transit options and included: an overview of the analysis methodologies, a summary of the results and various ways to present them; and a discussion of modeling issues and lessons learned.

Exploratory Advanced Research at Federal Highway Administration

Speaker: Mr. David Kuehn, Program Manager for the Federal Highway Administration (FHWA) Exploratory Advanced Research Program. He holds a Masters of Public Administration from the University of Southern California and a B.A from the University of California, Irvine and is a member of the American Institute of Certified Planners (AICP).

Seminar Abstract: Presented on March 31, this seminar discussed the transportation industry facing unprecedented challenges. In order to meet those challenges, the industry needs to engage in high-risk, breakthrough research. Relying only on incremental improvements will not meet future needs. The Federal Highway Administration (FHWA) is building capacity for high-risk, high-impact research by engaging research partnerships across sectors and across disciplines. Federal legislation established an exploratory advanced research (EAR) program that addresses longer term and higher risk breakthrough research with the potential for dramatic long-term improvements to plan, build, renew, and operate safe, congestion-free and environmentally sound transportation systems. The FHWA EAR Program funds exploratory advanced research across the range of issues critical to the transportation industry. Using full and open competition and expert review to identify areas of research focus and assess technical excellence, the FHWA has awarded funding for 29 projects during involving 20 different universities and colleges, 13 private businesses, eight state and local agencies and five federal laboratories including the Turner Fairbank Highway Research Center. Research includes both foundational work that anticipates the questions and future needs in applied research and the application of innovations from other industries to the transportation sector. This presentation will discuss the role of EAR in preparing for the future of transportation and processes FHWA uses for partnerships that are leading the way.

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 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.

CITSM

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