# 2009 – 2010
# Annual Report

The Pennsylvania State University ▪ University of Maryland
▪ University of Virginia
▪ Virginia Polytechnic Institute & State University
▪ West Virginia University

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## THEME

MAUTC's theme, *Technology for Integrated Transportation Systems Operation and Performance,* recognizes the critical link between technology and management of our transportation infrastructure, and it provides for a multidisciplinary approach to many critical transportation issues facing the Mid-Atlantic Region. MAUTC's research, education, and technology transfer programs focus on the integration of knowledge and expertise in transportation operations, organizational management, and infrastructure management. The theme clearly reflects the strengths of the five universities of MAUTC and the interests of the faculty and state agencies that support much of the research conducted by MAUTC.

The distinctive elements of MAUTC's theme include the following:

- Design and implementation of research and educational programs that apply advanced technologies for information acquisition, analysis, and application to the management of the transportation system.
- Multidisciplinary approach to research, education, and technology transfer activities.
- Emphasis on the operations and management of the transportation system.
- Multimodal mission that addresses passenger and freight transportation, highway, transit, and intermodal facilities.

## MANAGEMENT STRUCTURE

Penn State has been the lead university and grantee for the University Transportation Centers (UTC) Program since 1986. MAUTC is administered through the Thomas D. Larson Pennsylvania Transportation Institute (Institute).

The MAUTC executive director and principal investigator, Dr. Martin T. Pietrucha, delegates day-to-day responsibility for MAUTC partner activities to each partner university:

- University of Maryland
- University of Virginia
- Virginia Polytechnic Institute and State University and
- West Virginia University

Dr. Paul Jovanis, professor, civil engineering, and director of the Transportation Operations Program, represents the Institute's faculty interests in MAUTC activities.

Ms. Janice Dauber, MAUTC coordinator, is responsible for MAUTC's technology transfer activities, publicity, and report preparation.

Ms. Mara Poorman and Ms. Lisa O'Hara, staff assistants, provide clerical support for the overall MAUTC administrative effort as well as for Penn State's MAUTC projects and programs. Additional Institute staff support MAUTC as needed.

## FUNDING and EXPENDITURES

MAUTC meets the U.S. Department of Transportation's 1:1 match requirement through state and local agencies, private companies, and universities. Maryland, Pennsylvania, Virginia, and West Virginia departments of transportation provide the majority of matching funds. (See figures 1 and 2.)

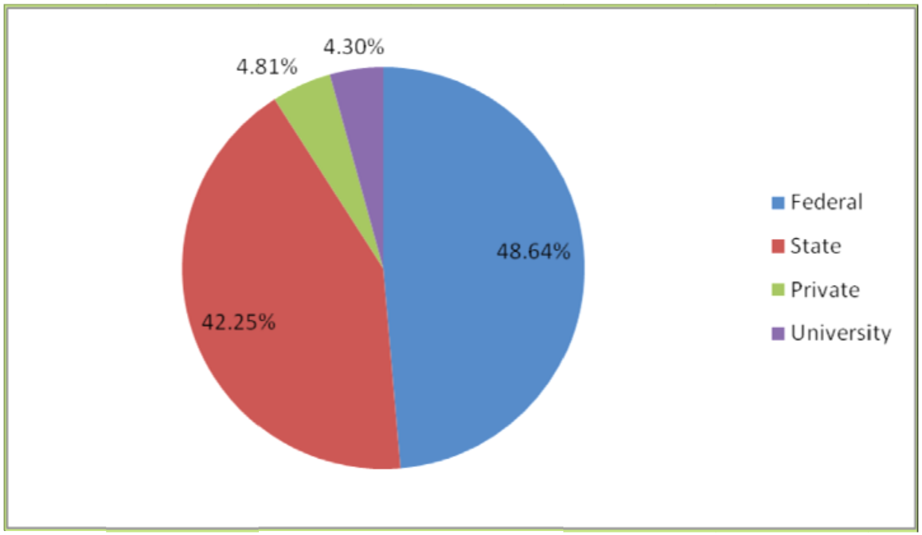



**Figure 1 Expenditures by Funding Source**

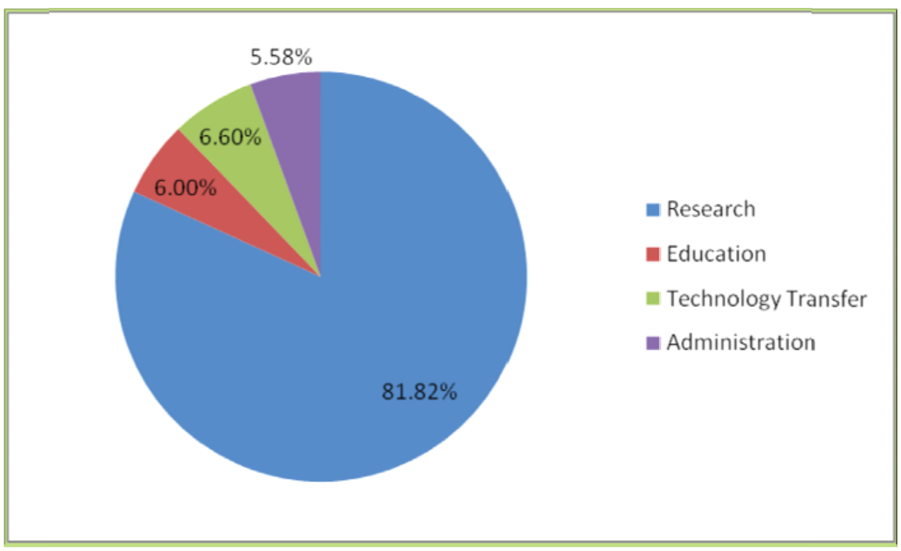



**Figure 2 Expenditures by Activity**

## The Pennsylvania State University

**The Thomas D. Larson Pennsylvania Transportation Institute** is one of the nation's leading university transportation centers. Since its first days in 1968, the Institute has pursued a mission of interdisciplinary research that today involves laboratories, departments, and colleges throughout Penn State and numerous state, federal, and private collaborators. The Institute supports University faculty and students by providing interdisciplinary educational and research opportunities that complement and enhance the University's undergraduate and graduate education programs.

The Institute is the locus for transportation-related research conducted by Penn State faculty from more than 14 colleges and research centers. Many of the faculty hold joint appointments with the Institute and Penn State's academic colleges and schools. Areas of specialization include civil, computer, electrical, industrial, and mechanical engineering as well as agriculture, information sciences and technology, supply chain management, architectural engineering, economics, geography, psychology, and statistics.

Through its multidisciplinary structure and support research environment, the Institute provides a unique focal point of collaboration for faculty from many different areas of the University.

Three programs comprise the Institute: Transportation Infrastructure Program, Transportation Operations Program, and Vehicles Systems and Safety Program. Faculty, researchers, and students from all three programs contribute to and benefit from the research projects funded under the auspices of MAUTC.

## University of Maryland

The University of Maryland (UMD) became a partner in 2007 when MAUTC re-competed for the Region 3 University Transportation Center. Professor Elise Miller-Hooks serves as MAUTC director for UMD.

UNIVERSITY OF MARYLAND

The University of Maryland transportation research effort benefits from the Intelligent Transportation Systems Laboratories in the state-of-the-art Engineering Research Building. New laboratories for transportation research include:

- Real-time Traffic Management Systems Research and Education Laboratory
- Collaborative Decision-Making Laboratory for Large-Scale Distributed Dynamic Systems
- Traffic Safety and Operations Laboratory and
- Intelligent Transportation Systems Planning Laboratory.

Direct connections exist from the various cameras and sensors installed along the freeway and highway system under the Maryland CHART traffic management center to provide live quasi-continuous feeds to the ITS Laboratories. Access to all archived CHART traffic data is also available through the University of Maryland laboratories. The Collective Decision-Making Laboratory provides unique capability to conduct interactive simulation-based experiments with multi-agent transportation decision systems. The University of Maryland offers transportation-related undergraduate and graduate degrees in civil engineering and mechanical engineering.

## University of Virginia

The transportation program at the University of Virginia (UVA) has expanded since its inception in the late 1940s when the University of Virginia School of Engineering and Applied Sciences began an ongoing partnership with Virginia Transportation Research Council (VTRC), the research branch of the Virginia Department of Transportation. The Center for Transportation Studies (CTS) was established to organize the existing academic program and research activities and to lay the groundwork for future growth.

CTS is located within the civil engineering department on the grounds of UVA. With offices and laboratory facilities located on two floors, including the Smart Travel Labe, CTS also shares the resources, laboratories and library of the VTRC facility, a 100-employee research complex at UVA. The academic and research programs of CTS are closely associated with VTC. Through this partnership, faculty hold joint appointments, VTRC research scientists teach specialized courses, and graduate student work is supported through a Graduate Research Assistantship Program. The Research Council also supports the Virginia Technology Transfer Center, the Smart Travel Lab, shared computational facilities, and the largest transportation library in the state of Virginia.

Today CTS oversees a flourishing program that includes education, research, and public service. Its faculty, which span the departments of civil engineering and systems and information engineering at the University, are highly regarded both as teachers and as researchers. They have been the recipients of University teaching awards and include two members of the National Academy of Engineering.

Thanks to the extensive longstanding ties with such organization as VTRC, MAUTC, as well as the Federal Highway Administration and the Institute of Justice, CTS has a stable, flourishing research program, covering such areas as transportation and land use, traffic simulation, highway safety, freight operations, and traffic operations.

## Virginia Polytechnic Institute and State University

Virginia Technology and Transportation Institute (VTTI) was established in August 1988 in response to the U.S. Department of Transportation's University Transportation Centers program and in cooperation with the Virginia Department of Transportation. VTTI pursues its mission by encouraging research, attracting a multi-disciplinary core of researchers, and educating students in the latest transportation technologies through hands-on research and experience. The Institute is both an FHWA/FTA ITS Research Center of Excellence and a Mid-Atlantic Universities Transportation Center.

VTTI is housed in a 30,000 square-foot building located in Blacksburg, Virginia. It was built at the western end of Virginia's Smart Road, a road designed specifically for testing new transportation technology. The building accommodates the Smart Road Control Center, where researchers monitor and control data collection, weather-generation, lighting, power grids, and roadway surveillance cameras. The building is equipped with office and laboratory space for VTTI, VDOT's Christiansburg Residency, and companies that contract for use of the facility. Additionally, it holds a fully staffed garage and shop for experimental vehicles.

VTTI is used by more than 90 researchers and faculty. In addition, approximately 80 students have access to the facility as well as its laboratories and equipment.

## West Virginia University

The Staggers Center at West Virginia University (WVU) is a comprehensive transportation research institute that has served regional and national transportation research, education, and technology transfer needs since 1977. The center includes nearly 20 core faculty and staff members currently conducting nearly $2 million of research, education, and technology transfer activities. As part of a large university, the center can bring the necessary expertise to bear on virtually any client's problem. The Staggers Center has five primary research areas:

- Infrastructure Management
- Planning and Economics
- Transportation Design and Operations
- Energy and Environmental Impacts and
- Transportation Structures

Public service is one of the Center's primary missions in concert with WVU's role as the land grant institution for the state. The center strives to ensure that benefits of research extend beyond the solving of technical problems. Through the technology transfer center, routine training sessions are held for transportation engineering and maintenance personnel. Faculty and researchers serve as technical and educational support to state agencies, legislature, municipalities, and private citizens. In addition, the research program provides the primary support for graduate students while they pursue their studies, a tremendous investment in the future of transportation engineering.

# RESEARCH

## The Pennsylvania State University

### *Dynamic, Stochastic Models for Congestion Pricing and Congestion Securities*

Congestion pricing is a classical mechanism to charge travelers for network use in order to reduce congestion and is being used in several cities around the world. However, congestion pricing is not a market-based solution, making it extremely difficult for metropolitan planning organizations (MPOs) to measure the true social costs of congestion and establish a rate that ensures those costs are allocated in a way that promotes social justice. An alternative is congestion securities—a family of schemes for creating direct markets for congestion. A key feature of congestion securities is that MPOs would not be directly involved in the ongoing management of congestion securities markets. They would be designed up front to ensure efficient pricing. In this project, researchers are developing mathematical models for congestion pricing and novel congestion securities that allow travel rights to be priced and traded to reduce the social costs of congestion. The results of the research will allow informed debate over whether congestion rights in the form of derivatives—contracts to buy or sell the privilege to travel certain routes at specific times of day at specific levels of congestion—may be priced and traded in a way that lessens the aggregate social costs of congestion.

### *Monitoring of Integral Abutment Bridges and Design Criteria Development*

It has been observed that Pennsylvania integral abutment bridge behavior is much different from that predicted by current design methodologies. Thermally induced displacement magnitudes are typically on the order of 10 percent to 25 percent of predicted values. Thermally induced rotations and displacements are, in certain locations, opposite predicted rotations and displacements. Thermally induced stresses are not currently incorporated into design aids and guidelines and are not insignificant. Design methodologies must consider actual field observations such that the design accurately predicts the structural behavior. Proper application of integral abutments can then be made considering the findings of this study with new integral abutment bridge designs. In addition, PennDOT integral abutment design requirements will represent the state-of-the-art. The objective of this project was to revise and make more accurate integral abutment bridge design criteria based on observed structural behavior and results of numerical parametric studies. Observed behaviors were on the basis of field monitoring conducted at four integral abutment bridge sites and a weather station utilizing previously installed instrumentation and data acquisition systems. Integral abutment bridge engineering data were continuously collected over the entire two-year contract period at bridges 109, 203, 211, and 222 and compiled, processed and evaluated. Numerical parametric studies were conducted on the basis of 2D and 3D finite element models, developed and calibrated to the observed integral abutment behavior, in order to evaluate the field performance of integral abutments and establish the range of potential applications for integral abutment bridge construction in Pennsylvania.

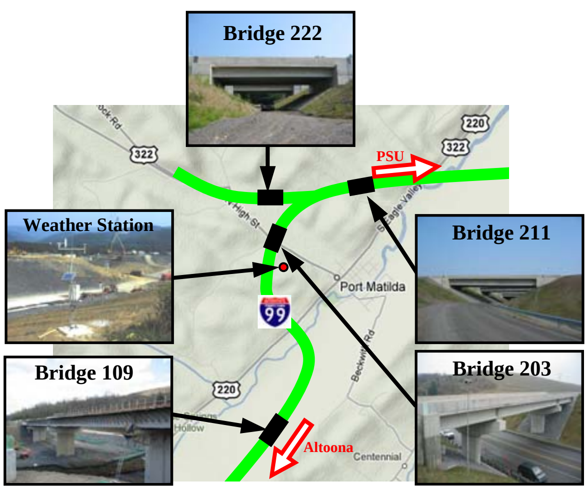



**Figure 3 Location of Four Selected I-99 IABs**

This project was a continuation of research to monitor and evaluate the behavior of four I-99 integral abutment bridges begun in October 2000. The bridges were selected prior to construction and monitoring began on each bridge as it was constructed and has continued uninterrupted to the present.

The integral abutment bridge instrumentation and subsequent monitoring may be the largest, most extensive study of its kind ever conducted nationally. Full reports on research conducted from October 2000 to March 2003, June 2005 to July 2006 and March 2007 to June 2009 are available by contacting the Larson Institute.

***Evaluating the Performance of Limestone Prone to Polishing***

Road surfaces develop gradually deteriorating surface characteristics such as macro- and microtexture, friction or skid resistance, among many others. The speed and form of the deterioration are a function of many parameters, including the road design, construction techniques, mix and aggregate types used, age, traffic magnitude and composition, weather, and other factors. On road geometries and areas where vehicle maneuvers require the utilization of friction, traffic safety is strongly dependent on available surface friction. It was discovered that in Pennsylvania several roads manufactured according to standard design and construction techniques and paved with portland cement concrete have shown unwarranted rapid friction (skid resistance) deterioration well before the expected time limits and reached dangerously low levels of frictional characteristics.

This research project evaluated the effect of blending Vanport limestone and other aggregates on the frictional surface characteristic properties of constructed trial road surfaces. The study undertook the evaluation of the performance of different mortar fractions and aggregate concentrations to determine the effect of coarse aggregate usage in the top mortar layer on pavement friction performance, as well as the effect of the substitution of different aggregates in place of Vanport limestone. The project developed a test matrix to evaluate the effect of the changes in these factors on portland cement concrete using state-of-the-art laboratory test equipment for assessing surface characteristics and using accelerated wearing for the evaluation of long-term pavement surface performance.

## University of Maryland

***Review and Enhancement for Crash Analysis and Prediction: Phase 1, Evaluation of the Crash Studies and Analysis Standard Operating Procedures in Maryland***

The primary objective of this study was to identify the deficiencies of the current accident studies and analysis SOPs in Maryland. Based on these identified deficiencies, several possible improvements were suggested for further investigation. This study focused on the following critical issues:

- Can the current procedures for identifying candidate locations for safety improvement projects truly sort out the high-risk location for more detailed investigation?
- Does the current cost/benefit analysis and before/after study truly measure the effectiveness for different improvement plans?
- What possible improvements for the current accident studies and analysis SOPs in Maryland?

The study will help the SHA to: (1) better understand the strengths and weaknesses of the current SOP and to avoid overlooking any important aspects in using the current SOPs; and (2) define the potential direction to improve the SOPs in order to provide a more comprehensive and systematic method for identifying and evaluating the location for safety improvements.

The researchers made numerous recommendations to enhance the existing safety improvement program in Maryland, including:

- Develop a multi-criteria method to enhance the current procedures to select and rank high-crash locations,
- Use SPFs and the observed crash frequency to reliably estimate site-specific crash frequency,
- Include secondary costs/benefits in the evaluation, and
- Explore the use of different selection indicators.

***Passenger Demand Model for Railway Revenue Management***

Researchers are developing revenue management (RM) strategies based on passenger demand models for the Amtrak Acela Express serving the Northeast Corridor (NEC) region. Revenue management is the process of managing the sales of perishable assets by controlling price and inventory so as to maximize profit. RM has been applied to the U.S. airline industry, which is mainly characterized by relatively fixed capacity, product sold in advance, fluctuating demand, and low marginal cost.

Railway shares similarities with the airline industry in terms of applicability of the RM. Furthermore, railway is considered the most energy-efficient mode of transportation, and its role has become increasingly important around the world with ever-growing concerns about the energy crisis and climate change. Implementing an RM strategy for railways is expected to contribute a significant lessening of this environment burden by making better use of the existing railway infrastructure. Moreover, efficient RM would allow the railway operator to generate more revenue from ticket sales and passengers with flexible demand would benefit from the discounted ticket in the off-peak market.

The railway RM problem presents both probabilistic and dynamic aspects. The probabilistic aspect is the result of uncertainty about the ultimate number of requests that a company will receive for seats on a train. The dynamic aspect is due to the fact that the number of reservation requests already accepted affects the estimates of requests still to come and, in turn, the optimal management of the remaining seats. According to the aforementioned, passenger demand forecast is considered to be a significant element toward successful RM implementation.

Most publications in the area of railway RM have mainly focused on seat inventory control and pricing policy, while passenger demand forecasting has received far less attention. Currently, the demand forecast being used in RM, especially for the airline industry, has focused on the macro and micro level. The macro level aims to forecast the total demand of the airline while the micro level aims to forecast the number of passengers on a specific flight. While these two methods rely mainly on historical data, using so-called independent demand model, they do not consider the fact that customer choice behavior can be affected by the ticket price, ticket policy, and availability of the service provided by other competing firms. Clearly, this assumption is not realistic. In fact, the likelihood of a ticket request from a customer should also depend on the availability and price of the ticket being offered by the competitor firm. Recent publications have begun to focus more on a passenger behavior model to resolve unrealistic assumption of the independent demand model. Usually the methods adopted are derived from discrete choice analysis (Ben Akiva and Lerman, 1985). It is therefore the objective of this project to incorporate passenger choice behavior into the U.S. railway RM process and to assess the potential revenue improvement from applying the passenger behavior choice model.

As a result of the research, a new fare strategy for Acela Express that allows fares to be changed on a daily basis was proposed. The fare strategy is based on fare price, departure day of week, and destination-specific effects. The passenger choice model and the aggregate demand function are incorporated in an optimization module. This model system is formulated as an expected revenue maximization problem that gives the optimal fare strategy for each destination on a particular departure day over the sale horizon.

### *Integration of Fixed and Flexible Route Public Transportation Systems*

This applied research study will quantitatively explore some opportunities for better integrating conventional and paratransit services, focusing especially on switching vehicles and drivers among different service types in peak and off-peak periods and on feeding conventional routes with paratransit services in areas and periods with low demand densities. Optimization models will be developed to enable public transit operators to exploit such opportunities. The expected benefits include improved utilization of drivers and vehicles, improved service quality in off-peak periods, and reduced capacity requirements during peak periods.

### *Network Design of Vehicle Sharing Systems*

Vehicle sharing programs (VSPs) have been gaining ground around the world for providing an environment-friendly, socially responsible and economical mode of transport. These programs involve a fleet of vehicles positioned strategically at stations across the transportation network. Users are free to lease vehicles to complete a trip and drop the vehicle at a station close to their destination. The shared vehicle fleet can be comprised of cars, electric vehicles, or bicycles. Such systems offer innovative solutions to the larger mobility problem and can have positive impacts on the transportation system as a whole by affecting modal choice. They do so in multiple ways. For short trips, these systems can be construed as an alternate mode of transport. Users enrolled in sharing programs have been shown to undertake fewer trips. When viewed in conjunction with transit networks, VSPs can serve to increase transit use.

Compared to the automobile, transit services in the United States do not enjoy high levels of patronage, in part due to low accessibility, and lack of flexibility and convenience. The United States has also been behind the trend in transit adoption when compared with other industrialized countries. Vehicle sharing systems have the potential to improve the accessibility of a public transit system by offering a competitive “last mile” connection, the lack of which dissuades potential transit riders. The effective catchment area of a transit line is increased by providing a vital leg of an intermodal route. By transferring control of vehicles to the user, the system becomes vastly more flexible, offering more choices with regard to departure time, destinations, and transit routes. These projected improvements can serve to attract new transit ridership.

Vehicle sharing arose from social experiments in sustainable transportation and now finds willing private participants. Public agencies positioned to leverage this increased interest from the private sector profit, because this form of transportation provides a net social benefit. In contrast to central, structured, resource-intensive solutions that are typically employed to alleviate congestion, proponents of vehicle sharing schemes claim it offers a distributed, unstructured, sustainable, and economical solution. In essence, VSPs provide a market opportunity for private entities that aids in achieving the public goal of affecting a modal shift from road to transit. To maximize transit mode share, a public-private partnership can be forged that shares the same objective of increased ridership. Several design decisions are critical for the success of such systems (pricing, station locations, fleet composition and size, etc.). Determining the optimal system configuration is vital to their success.

The researchers developed a Dynamic Rideshare Matching Optimization (DRMO) model that is aimed at identifying suitable matches between passengers requesting rideshare services with appropriate drivers available to carpool for credits and HOV lane privileges. DRMO receives passenger and driver information and preferences continuously over time and assigns passengers to drivers with respect to proximity in time and space and compatibility of characteristics and preferences among the passengers, drivers, and passengers onboard. The DRMO program maximizes total number of assignments in a given planning horizon and secures that all the constraints for vehicle occupancy, waiting time to pickup, number of connections, detour distance for vehicles, and relocation distance for passengers are satisfied. The ridesharing preferences and characteristics considered in the model are: age, gender, smoking, and pet restrictions as well as the maximum number of people sharing a ride. The next step is to work on developing solution algorithms for solving the optimization model for large-scale real-world problems.

## University of Virginia

### *Developing a Framework for the Prioritization of Infrastructure Improvements*

The state of transportation infrastructure in the United States has reached a critical point. When the interstate system was constructed, beginning in the late 1950s, bridges were typically designed for a 50-year lifespan; today, the average age of a bridge is 43 years old (AASHTO 2008). Further, freight tonnage on the highways has become much higher than was originally anticipated, and continues to increase. According to the American Society of Civil Engineers (2009), 26 percent of bridges in the United States are classified as either structurally deficient or functionally obsolete. With so many bridges in need of replacement and the cost of a new bridge so high, short-term fixes are often applied to defer the investment in a new bridge to a later date. At the same time, bridge inspections can only be so thorough, inevitably leading to failures, such as that on I-35W in Minneapolis in 2007, or unexpected closures. When such a failure occurs on such a crucial route, the transportation network suffers under the increased strain from reduced capacity, causing increased congestion and emissions.

A lot of research has been done to identify critical infrastructure to protect users and prevent potential security threats (Haimes et al. 2002, Volpe National Transportation Systems Center 2003, Haimes et al. 2004, U.S. Department of Homeland Security 2007), while other work has been conducted on infrastructure asset management (Dicdican, Haimes and Lambert, 2004). A study by Heaslip, Louisell and Collura (2009) created a methodology for testing the resiliency of a transportation network to identify areas for improvement, specifically during a disaster. Despite this work, no research has been found that sets a framework for prioritizing bridge repair and replacement based on structural need and economic importance for hauling freight traffic.

### *Exploratory Data Analysis of the National Bridge Inventory Database*

The National Bridge Inventory Database (NBI) is the largest collection of bridge data in the world. This database contains detailed information on more than 600,000 highway bridges and large culverts over a period of several decades. The NBI is owned and maintained by the Federal Highway Administration (FHWA). The principal use of the NBI is to determine appropriations and eligibility for funding for the National Bridge Program administered by FHWA. Very little analysis has been performed on the NBI from the perspective of data mining and knowledge discovery.

The objectives of this project are to compile and consolidate all available historical NBI data into a data warehouse that will support exploratory data analysis, data mining and knowledge discovery. Using advanced statistical and analytical methods, the NBI will be used to investigate and develop new knowledge and insight into the characteristics and performance of highway bridges. The scope of the project will also include data integration using relational and geospatial tools and methods.

### Tele-robotic Platform for Bridge Inspection

Access to critical bridge components for visual inspection or testing is a recurrent problem for VDOT bridge inspectors. Such inspections often expose VDOT personnel to dangerous and difficult conditions. Such inspections also often require lane closures with resulting traffic impacts. In some cases, traffic volumes are so high that only emergency inspections are conducted. There is a need for a new tool to provide safe access to critical bridge components that would result in little or no impacts on traffic. The feasibility of a tele-robotic platform for bridge inspection will be investigated by researching similar technologies in other industries. If feasible, a conceptual design and research plan for a follow-on study to develop a prototype system will be prepared.

## Virginia Tech

***Roles of Transportation in Achieving "Green City": Options, Measurement, Priorities, and Limits***

Many cities in the UNITED STATES are embarking on "green" projects that promote environmentally sustainable lifestyles and the provision of city services. Transportation is an important component in such an effort; Transportation - "greenliness" - the quality of life are intimately connected.

Many ideas that will ultimately change the role of the automobile and regulate its use are being put forth in order to reduce negative environmental effects, reduce energy consumption, and promote healthy lifestyles, including walking and bicycling. These ideas are associated with changes in land-use pattern, changes in traffic controls and regulations, improved transit networks and services, better facilities for walking and bicycling, pricing incentives and disincentives for transportation choices, and technology developments.

What is not apparent, however, is the effectiveness of these schemes in the long run and the ultimate level of *greenliness* they can achieve. What sounds good for publicity and political purposes may not necessarily sustain its appeal in the long run. The costs (both tangible and intangible) and benefits must be analyzed and a system of decision-making developed in order for the effort to be credible.

This project examines all possibilities and options that a medium-sized city could introduce, including technologies, regulations, land-use rules, traffic controls, networks, and pricing incentives and disincentives for choices of transportation, etc. The City of Falls Church, VA, will be used for building such scenarios. Falls Church recently declared its intention to become the "Green Lab City."

The project develops the process and mechanisms that are necessary to measure the effectiveness of each of the schemes as well as the combined effects. This also identifies the necessary instrumentation for monitoring the effects. Different transportation simulation models will be used to test the feasibility of such an instrumentation and measurement of the air quality, energy consumption, vehicle use, and travel demand patterns.

Finally, based on the approach outlined above, the overall effectiveness of the Green Plan will be evaluated at different future time points. The results will help to set the priorities of implementation of green ideas and also to understand the scope of the overall "green" effects. The purpose of the project is to develop the analytical framework and the processes to evaluate the "green plans," which are being considered in many cities. The study will help provide credibility and perspectives in the planning process.

***Determinants of Bicycle Use in the Washington Metropolitan Area***

The U.S. Department of Transportation (1994, 2004) has set a goal of increasing the percentage of trips taken by bicycle while improving bicycle safety. The rationale for promoting cycling is that it would shift some trips from the car, thus reducing roadway congestion, parking problems, air pollution, noise, and energy use. Moreover, both USDOT and the Centers for Disease Control and Prevention advocate active transportation such as bicycling for physical activity that would help combat the worsening obesity epidemic. The D.C. Regions Transportation Planning Board's *Transportation Vision for the 21st Century* of 1998 and the *Bicycle and Pedestrian Plan for the Northern Capital Region of 2006* (Transportation Planning Board, 1998, 2006) call for convenient, safe bicycle and pedestrian access, reduced reliance on the automobile, and an increased bike mode share.

The project objectives are:

(1) Gain a better understanding of determinants of bicycle use in the Washington, D.C. metropolitan region—with a special focus on the role of gender, age, ethnicity, income, trip purpose, access to bicycle infrastructure, trip distance, and variability of bicycle policies across municipalities.
(2) Compare characteristics of cyclists in the Washington, D.C. region and national averages, based on the most recent 2008 regional household travel survey and the 2009 national household travel survey released in 2010.
(3) Recommendations for Washington, D.C. governments on how to best increase the share of trips by bicycle—with a focus on policies and infrastructure provision.
(4) Recommendations for Washington, D.C. region governments on which socio-economic and demographic groups to target for bicycling promotion programs.

## West Virginia University

### *Assessment of Driver Risks and Externalities of SUVs: Part II*

A common justification of ownership among SUV drivers is the increased (or perceived increase in) safety achieved through additional weight, stronger suspension, and higher seating position. This may lead to a false sense of security among SUV drivers that may result in driving behavior that could pose increased risks among conventional automobiles. This offsetting driver behavior is known as the Peltzman Effect, where consumers of a good (in this case, SUV) pose an externality on non-users (in this case, conventional automobiles).

To determine if SUV drivers take greater risks and translating this risk to occupants of non-SUV passenger car occupants, it was necessary to use a method that separates the effect of SUV driver behavior from that of the vehicle physical configuration and characteristics. The Levitt and Poter (2001) model has such characteristics and was used to determine the relative likelihood that an SUV driver causes a fatal crash compared to a passenger car driver in a two-car crash. From Part I of this work we know that the lowest, average, and highest values for $\theta$ (the relative probability that a passenger car will be in an accident with an SUV vs. passenger car) were 2.990, 5.888, and 19.134 respectively (Diosdado et al. 2009).

Since the evidence suggests that SUV drivers pose a safety externality on passenger occupants, it is necessary for policy purposes to estimate the dollar value associated with the corresponding safety externality.

By determining the safety externality that SUVs pose on passenger cars, the costs that SUV drivers impose on passenger car drivers can be determined. By determining the dollar value of this externality, an appropriate policy such as a tax equal to the marginal external cost can be implemented as a means to steer resources to measures that can increase the safety of passenger cars, thus maximizing net social benefits.

This study uses the Fatality Analysis Reporting System (FARS) data to determine the number of fatal crashes, all fatal crashes involving motor vehicles in transit, and fatalities of vehicle occupants from 1999 to 2008 at the national level. The research focused on two-vehicle crashes from FARS, since the higher probability to cause a fatal crash attributable to a Peltzman Effect or offsetting behavior by the SUV driver, was determined previously by adapting the model developed by Levitt and Porter (2001) for assessing the dangers of drinking drivers relative to SUV drivers.

### *Assessment of Distractions Using an In-vehicle Tracking System*

Deviating attention from the complex task of driving can be a distraction. Driving requires the scanning of the road environment (front, sides and back) as well as monitoring dashboard and navigational tools. Therefore, some glances away from the road are required for driving while others are due to lack of attention. In any case, the longer the glance is away from the road, the riskier and more distracted is the driving.

Previously, this research analyzed distraction defined as looking away from the center of the roadway (COR) for more than two seconds. It focused on measuring the time a driver was *distracted* (according to this definition), the percentage of time spent looking at the COR -compared to total driving time, and the number of glances away from the COR. These variables were compared among three different groups of drivers: unlicensed students, recently licensed drivers, and experienced drivers.

The second part of this research concentrates on the analysis of number of glances and glance duration, varying the time that defines distraction (i.e., looking away from the COR for more than 2.0, 2.5, and 3.0 seconds), and comparing among the aforementioned groups. Particular attention is given to the recently licensed drivers (first half vs. second half year of licensed driving).

**Figure 4 Arrangement of Eye Tracking System**

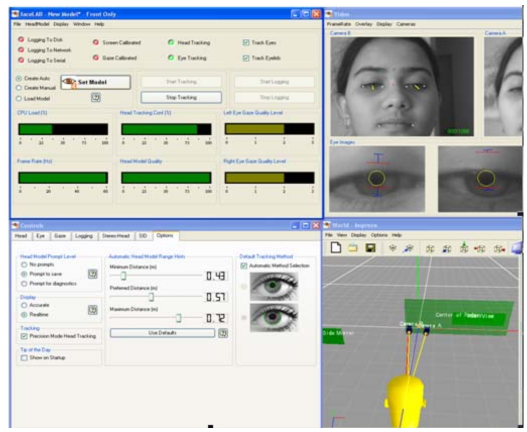


**Figure 5 faceLAB logging window**

### *Evaluation of Remote Sensing Aerial Systems in Existing Transportation Practices*

The application of small remotely-controlled (R/C) aircraft for aerial photography presents many unique advantages over manned aircraft due to their lower acquisition cost, lower maintenance issue, and superior flexibility. The extraction of reliable information from these images could benefit DOT engineers in a variety of research areas including, but not limited to work zone management, traffic congestion, safety, and environmental.

As part of a research effort at West Virginia University (WVU), an R/C aircraft was instrumented for a proof-of-concept demonstration of aerial data acquisition. Specifically, the aircraft was outfitted with a GPS receiver, a flight data recorder, downlink telemetry hardware, a digital still camera, and a R/C shutter-triggering device. Several hundred high-resolution geo-tagged aerial photographs were collected during 10 flight experiments at two different flight fields. The WVU aircraft hardware layout and a sample of aerial images are shown in Figures 6 and 7, respectively.

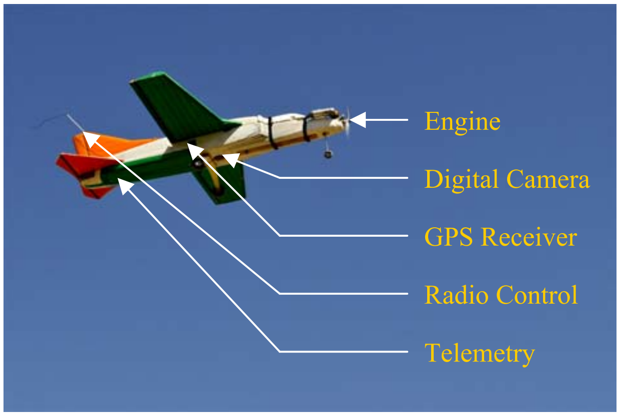



**Figure 6 Aircraft Configuration**

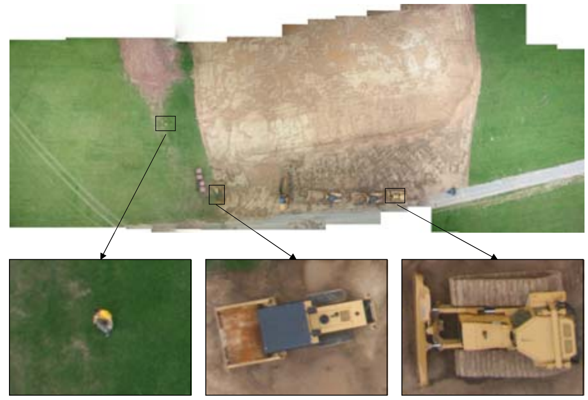


**Figure 7 Mosaic of 16 Aerial Images**

Geo-reference software was developed for measuring distances from an aerial image and estimating the geo-location of each ground asset of interest. A comprehensive study of potential sources of errors was also performed with the goal of identifying and addressing various factors that might affect the position estimation accuracy. Particularly, a GPS/INS (Inertial Navigation System) sensor fusion algorithm based on a 9-state Extended Kalman Filter (EKF) was developed to provide estimates of aircraft attitude angles and enhanced positioning information.

## EDUCATION

The five universities comprising MAUTC offer more than 50 transportation-related graduate degree programs ranging from civil engineering to systems engineering to supply chain and information systems. In academic year 2009/2010, there were 62 students enrolled in transportation-related master's programs and 96 students enrolled in transportation-related doctoral programs. Most of these students participated in transportation research activities, which enrich their classroom experience.

**MAUTC Student of the Year**

Noah Goodall is a Ph.D. student in his second year at the University of Virginia. As a research assistant with the Center for Transportation Studies, Noah has conducted research into IntelliDrive-assisted ramp metering and potential IntelliDrive applications for Virginia. In his nomination letter, Professor Brian Smith stated, "Noah's research in the area of IntelliDrive and HOT-related driver behavior modeling is ground-breaking, and offers the potential to significantly improve surface transportation. His creativity, experience, and ability to master and extend advanced analytical techniques make him an extremely capable researcher. To put it simply, he is among the very best graduate students I have worked with in my decade at the university."

Additionally, he is the lead author of a paper in review at the Transportation Research Board on driver behavior at dynamically-tolled high occupancy toll (HOT) lanes. Noah is the vice-president of the University of Virginia chapter of the Virginia Student Transportation Association.

Noah graduated from the University of Virginia in 2004 with a B.S. in Civil Engineering. As an undergraduate he worked in the Smart Travel Laboratory as an undergraduate research assistant studying the effects of precipitation on highway speeds. From 2004 to 2008 Noah worked as an engineer with Parsons Brinckerhoff and Telvent Farradyne in the Washington DC region on a variety of intelligent transportation systems consulting projects.

## EDUCATION

***Transportation Engineering and Safety Conference***

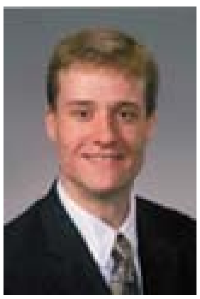
Penn State's 15th Annual Transportation Engineering and Safety Conference offered 29 sessions in four broad areas: safety, operations, design and planning. In addition, four pre-conference workshops provided more in-depth discussion of the current state of traffic signal technology, highway occupancy permits, FHWA's work zone safety and mobility policy, and land development in Pennsylvania for traffic engineers.

J. Peter Kissinger, president and CEO of AAA Foundation for Traffic Safety was the keynote speaker.

## The Pennsylvania State University

**Joel R. Anstrom, Ph.D.**
Director, Hybrid and Hydrogen Vehicle Research Laboratory and DOE Graduate Automotive Technology Education Center

**Research Interests:** Modeling of electric, hybrid electric, and fuel cell vehicles for efficiency and dynamic handling

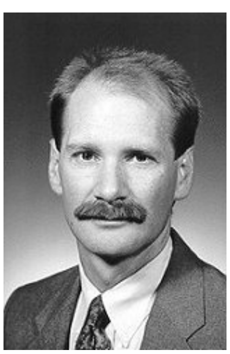


**Sean Brennan, Ph.D.**
Assistant Professor of Mechanical Engineering

**Research Interests**: vehicle dynamics and automation, mechatronics and embedded systems, modeling and control of dynamically similar systems

**Eric T. Donnell, Ph.D., P.E.**
Assistant Professor of Civil Engineering

**Research Interests:** Geometric design of highways and streets, highway safety, roadside design and management, traffic engineering



**Jeffrey A. Laman, Ph.D, P.E.**
Associate Professor of Civil Engineering

**Research Interests:** Bridge monitoring, bridge dynamics, bridge analysis and load distribution, substructures and foundations, integral abutment bridges, bridge load models, fatigue loading, steel structure design, weigh-in-motion, optical fiber sensors

**Daniel G. Linzell, Ph.D., P.E.**
Associate Professor of Civil Engineering and Director, Protective Technology Center

**Research Areas:** Bridge engineering, curved and skewed bridges, construction design and analysis, force protection, advanced materials and structures, steel structures, advanced finite element analysis, field testing, structural health monitoring, large-scale laboratory testing

**Martin T. Pietrucha, Ph.D., P.E.**
Director, The Larson Institute; Professor of Civil Engineering; Chair, Transportation Engineering and Safety Conference

**Research Interests:** Highway safety, ergonomics, highway traffic operations, traffic impact analysis, highway design, older drivers, and pedestrians

**Zoltan Rado, Ph.D.**
Research Associate, The Larson Institute

**Research Interests:** Vehicle dynamics, vehicle-surface interaction, surface characteristics, friction, braking, crash safety

**Venky Shankar, Ph.D, P.E.**
Associate Professor of Civil Engineering

**Research Interests:** Transportation planning and programming, access management, travel demand modeling, traffic flow modeling, ITS evaluation, traffic safety, design policy, freight planning, pedestrian and bicycle safety, infrastructure pricing, environmental issues in transportation, urban simulation

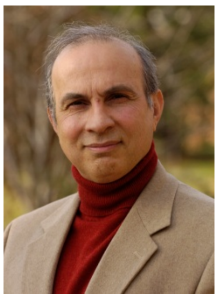
**Mansour Solaimanian, Ph.D, P.E.**
Director, Northeast Center of Excellence for Pavement Technology
Senior Research Associate, The Larson Institute

**Research Interests:** Pavement materials, pavement instrumentation, asphalt pavement construction, testing and characterization of asphaltic materials, finite element modeling of asphalt, concrete behavior, moisture damage in asphalt, recycled materials in pavements

## University of Maryland

**Cinzia Cirillo, Ph.D.**
Assistant Professor of Civil Engineering

**Research Interests:** Discrete choice analysis, advanced demand modeling, activity based models, revealed and stated preference surveys, large scale model systems, and value of time studies



**Ali Haghani, Ph.D.**
Professor and Chairman, Department of Civil and Environmental Engineering

**Research Interests:**
Large scale network optimization, emergency preparedness and response, logistics and freight transportation analysis, public and private sector fleet management, traffic control and optimization, transit operations, port operations and water transportation

**Elise Miller-Hooks, Ph.D.**
Associate Professor of Civil Engineering

**Research Interests:** Stochastic and dynamic network algorithms, optimization and mathematical modeling in transportation, routing and scheduling, hazardous materials transport, intermodal goods transport, regional and building evacuation, emergency preparedness, response and recovery, collaborative and multi-objective decision-making, concurrent flow lane operations, freeway service patrols


**Gang Len Chang, Ph.D.** Professor of Civil Engineering

**Research Interests:** Network traffic control, freeway traffic management and operations, real-time traffic simulation, dynamic urban systems

**Paul Schoenfeld, Ph.D.** Professor of Civil Engineering

**Research Interests:** Transportation Engineering

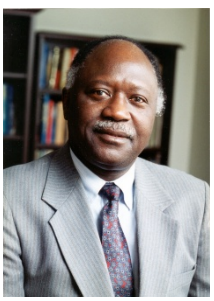
**Lei Zhang, Ph.D.**
Assistant Professor of Civil Engineering

**Research Interests:** Transportation and urban systems analysis, land use and transportation planning, transportation economics and policy, innovative pricing and financing, infrastructure project and policy evaluation, traveler information systems, mathematical and agent-based simulation models with applications in ITS, demand forecasting, and network dynamics.

## University of Virginia

**Michael J. Demetsky, Ph.D.**
Chair and Professor of Civil Engineering

**Research Interests:** Intermodal freight transportation planning and operations, evaluation of ITS deployments, decision support systems for transportation systems management, performance analysis of transportation systems



**Nicholas J. Garber, Ph.D., P.E.**
Henry L. Kinnier Professor of Civil Engineering

**Research Interests:** Traffic operations and highway safety, intelligent transportation systems, speed management on high-speed roads, work zone safety, large truck safety

**Lester A. Hoel, D. Eng., P.E.**
L.A. Lacy Distinguished Professor of Engineering
Director, Center for Transportation Studies

**Research Interests:** Management, planning and design of surface transportation infrastructure with emphasis on highway and transit systems

**Brian L. Smith, Ph.D.**
Associate Professor of Civil Engineering
Director, Smart Travel Laboratory

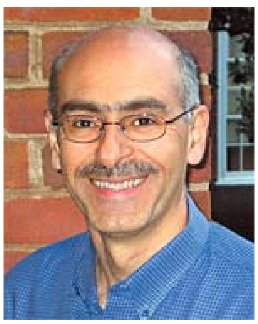
**Research Interests:** Intelligent Transportation Systems, particularly in advanced transportation management; statistical modeling, traffic flow theory, software engineering, simulation, data mining, geographic information systems, and artificial intelligence

**Byungkyu (Brian) Park, PhD.**
Assistant Professor of Civil Engineering

**Research Interests:** Stochastic Optimization of Traffic Signal Timing Plan, ITS Evaluation Using Simulation Model, Travel Time Estimation, and Traffic Flow Theory

**Steven B. Chase**, Research Professor of Civil Engineering

**Research Interests:** Nondestructive Evaluation of Civil Infrastructure, Sustainable Infrastructure Engineering, Infrastructure Asset Management



**Saeed Eslambolchi**
Director of Research Administration, Center for Transportation Studies

## Virginia Polytechnic Institute and State University

**Kyoungho Ahn, Ph.D.**
Senior Research Scientist

**Research Interests:** Transportation environmental modeling, traffic flow theory, and traffic modeling and simulation. He is also knowledgeable in the areas of operations research, urban planning, and transportation planning

**Hesham A. Rakha, Ph.D.**
Leader, Transportation Systems and Engineering

**Research Interests:** Traffic flow theory, traffic modeling and simulation, intelligent transportation systems and optimization, traffic control, energy and environmental modeling, and safety modeling

**Ihab El-Shawarby, Ph.D.**
Research Scholar

**Research Interests:** Operations research, optimization, modeling and simulation

**Alejandra Medina, Ph.D.**
Senior Research Associate

**Research Interests:** Network traffic modeling, traffic simulation, identification of driver errors, pavements, and infrastructure management

**Mazan Arafeh, D.Eng.**
Senior Research Associate

**Research Interests:** Travel time analysis, automatic vehicle identification tag readers, interstate planning, truck management, and traffic evacuation strategies. Specific projects include "The Reliability of Trip Travel Estimations," an ITS implementation project, and the I-81 Planning Study sponsored by the Virginia Department of Transportation (VDOT)

## West Virginia University

**L. James French, Ph.D., P.E.**
Research Assistant Professor

**Research Interests**: Traffic engineering, highway design, and intelligent transportation systems

**David M. Martinelli, Ph.D., P.E.**
Chairman and Associate Professor, Department of Civil and Environmental Engineering

**Research Interests:** Structural dynamics, finite element modeling, pavement dynamics, measurements and instrumentation, digital signal processing, mechanical design, and intelligent structures

**Samir N. Shoukry, Ph.D.**
Professor, Departments of Civil and Environmental Engineering and Mechanical and Aerospace Engineering

**Research Interests:** Application of advanced technologies in transportation, pavement modeling and evaluation, transportation systems analysis, and transportation planning and economics

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**The Thomas D. Larson Pennsylvania Transportation Institute**
**The Pennsylvania State University**
**201 Transportation Research Building**
**University Park, PA 16802**

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