FHWA R&T Now

A news update of research, technology, and development from the U.S. Department of Transportation (USDOT), Federal Highway Administration (FHWA)

September/October 2018

POLICY & PARTNERSHIPS

Turner-Fairbank Highway Research Center Visiting Researchers Take Home First Place at Transportation Technology Tournament

Congratulations to Britton Hammit, Rachel James, Joseph Vincent, and Dr. Mehdi Zamanipour from the Office of Operations Research and Development (R&D) and their fellow team members Venktesh Pandey and Cesar Yahia from The University of Texas at Austin, who won first place at the inaugural year of the Transportation Technology Tournament, held in Minneapolis, MN, on August 21, 2018. The winning team partnered with the District Department of Transportation (DDOT) to develop a concept of operations for solutions designed to mitigate the impact of nonrecurring congestion (i.e. traffic congestion occurring during sporting events or protests) related to permitted road closures and special events in Washington, DC.

The first suggested solution enables permitted road closure operators to provide real-time closure data to DDOT, which in turn transfers the data to navigation systems like Waze, to provide motorists with accurate travel-time data and alternative routes that avoid the nonrecurring congestion. The second suggested solution provides DDOT with a new framework for using emerging sources of data for planning for special events. *(Continued on page 5.)*

Source: FHWA

The winning team with their trophy and certificate. From left to right, Britton Hammit, Joseph Vincent, Rachel James, and Mehdi Zamanipour.

U.S. Department of Transportation
Federal Highway Administration

EXPLORATORY ADVANCED RESEARCH

Sensor System Research Aids Infrastructure

Three projects supported by the Federal Highway Administration (FHWA) Exploratory Advanced Research (EAR) Program are examining low-cost sensor systems that can deliver actionable data and be used to increase the effective management and condition of our Nation's infrastructure.

Researchers at Michigan State University (MSU) have developed and validated in-the-field wireless sensors to provide continuous and autonomous long-term monitoring of structural behavior. The researchers are using self-powered sensors—which are microscopic, inexpensive to manufacture, and obtain power from the regular mechanical dynamics of structures—attached to critical bridge components. The sensors are capable of continuously monitoring and storing the dynamic strain, acceleration, and frequency response of a structure. The sensors do not require batteries. The technology is based on piezo-floating-gate sensing. These materials can convert mechanical energy, such as strains and vibrations, into electrical energy. The generated electrical signals are directly proportional to the mechanical excitation and are used to power all electronics in the sensing system.

© Michigan State University

Self-powered piezoelectric-floating-gate sensors being attached to a bridge to monitor and store data about the structure.

Drexel University researchers have transformed commercially available wired sensors into wireless sensors that can be installed easily on structures to provide important baseline data on structural conditions and health. The sensors can establish baseline measurements at the beginning of a bridge's life cycle and then subsequently assess the health of the bridge over time. The sensors also can be installed as needed to assess damage from floods, accidents, or similar incidents that might compromise structural integrity. These wireless instruments can provide measurements with accuracies comparable to those recorded by state-of-the-art wired sensors.

Researchers at the University of Delaware and Portland State University have developed a self-sensing composite material to rehabilitate fatigue-damaged steel bridge components. The novel composite material is based on fiber reinforced plastics combined with a conductive carbon nanotube sensing layer that can be applied like a patch, strengthening bridge components while providing real-time monitoring capabilities. The patches also provide continuous feedback about the integrity of the composite and can accurately detect and monitor fatigue crack propagation.

The fact sheet, "Assessing the Structural Health of America's Highway Bridges," focuses on the MSU and Drexel projects. It is available at https://www.fhwa.dot.gov/publications/research/ear/17043/index.cfm. A fact sheet on the University of Delaware project, "Structural Carbon Nanotube-Based Composites," will be available at https://highways.dot.gov/research-programs/exploratory-advanced-research/publications.

For more information about the MSU and Drexel projects, contact Fred Faridazar at 202–493–3076, fred.faridazar@dot.gov. For more information about the Delaware project, contact Frank Jalinoos, 202–493–3082, frank.jalinoos@dot.gov. For more information about the EAR Program, contact David Kuehn at 202–493–3414, david.kuehn@dot.gov.

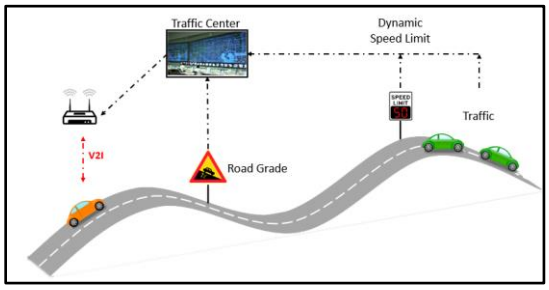
NRC Associate Wins TRB Best Paper Award for Eco-Drive Experiment

The Federal Highway Administration's (FHWA) Exploratory Advanced Research (EAR) Program supports the NRC Research Associateship Program (RAP) for associates to share new skills and approaches with FHWA intramural research programs.

The EAR Program invites postdoctoral researchers to investigate specific problems on a short-term basis across a wide range of topics and disciplines.

Over the years, associates have researched topics as diverse as nanoadditives for concrete and asphalt, alternative intersection and interchange design, and modeling to predict collisions based on driver behavior and environmental conditions.

Dr. Jia Hu, an associate who recently worked with the Saxton Transportation Operations Laboratory, and his colleagues received a best paper award from the Air Quality Committee at the 2018 Transportation Research Board Annual Meeting for the paper, "An Eco-Drive Experiment on Rolling Terrains for Fuel Consumption Optimization with Connected Automated Vehicles." Contributing to the paper were Dr. Jiaqi Ma, Ed Leslie, and Fang Zhou of the Saxton Transportation Operations Laboratory and X. Peter Huang and Joe Bared from FHWA.



Source: FHWA
Concept of vehicle-to-infrastructure-based eco-drive on rolling terrains.

The paper described research on a method to improve passenger vehicle fuel economy with connected vehicle technology. The researchers compared the eco-drive system—which optimizes speed by reducing speed uphill and increasing speed downhill with less braking—compared to conventional speed cruise control on a total of seven road segments over 47 miles under actual road conditions. Experimental data showed an ability to achieve fuel savings of more than 20 percent.

For more information about the experiment, see the summary report at https://www.fhwa.dot.gov/publications/research/operations/18037/18037.pdf.
For a complete listing of FHWA's current RAP opportunities, go to http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunities.aspx?LabCode=27.

INFRASTRUCTURE

LTPP Team's InfoPave™ Earns Achievement of the Month

The Long-Term Pavement Performance (LTPP) program received the Office of Infrastructure Research and Development's "Achievement of the Month" for the 32nd LTPP Public Data Release. This effort was led by Jane Jiang of the Long-Term Infrastructure Performance Team. In addition to Jane, members of the team include Jack Springer, Larry Wiser, Deborah Walker, and Jean Nehme.

Issued on July 5, 2018, the 32nd LTPP Public Data Release, located on the LTPP InfoPave™ Web portal, adds new pavement performance measurements, new data elements not previously released, and updates to the InfoPave™ Web interface designed to improve user access to LTPP data, which ensures that the site is 508 compliant and includes global search capabilities provided by Amazon Elasticsearch Service.

The LTPP database is the largest and most comprehensive engineering data set on modern pavement performance in the world. One of the most important missions of the LTPP program is to make the data and relevant research results available to the public. The research results allow State DOTs and Federal Highway Administration engineers, researchers, and academia to access and explore a wealth of data to solve pavement-related questions, and to complete additional studies.

The LTPP program has contributed significantly to the pavement community in cost savings and improved tools and practices. Newly collected pavement data, as well as new data elements, are needed to drive innovation and further improve pavement design and performance.

Since the initial release of LTPP InfoPave™ in 2014, approximately 9,000 users have accessed the Web portal, and many national research studies currently use LTPP data.

For more information, contact Jane Jiang, 202–493–3149, jane.jiang@dot.gov.

OPERATIONS

TFHRC Researcher to Receive Award at the 2019 TRB Annual Meeting

Congratulations to Osman Altan, PhD, Research Transportation Specialist at Turner-Fairbank Highway Research Center in McLean, VA. Osman's paper, "A First Investigation of Truck Drivers' Preferences and Behaviors Using a Prototype Cooperative Adaptive Cruise Control System," was selected as the winner of the Patricia F. Waller Award. This award is given each year for the best paper in the area of safety and system users.

The paper resulted from the Exploratory Advanced Research (EAR) project with the California Department of Transportation (Caltrans)/Partners for Advanced Transit and Highways (PATH) on truck platooning. Researchers involved with the EAR project, "Partial Automation for Truck Platooning," developed an experimental Cooperative Adaptive Cruise Control- (CACC-) based platooning system for heavy trucks and conducted field tests to determine whether truck platooning will work on our Nation's highways. The tests helped to measure potential fuel savings, driver preferences for gaps, and driver information needs while in automated mode. The U.S. Department of Transportation's project partners include Caltrans, California PATH, Volvo Trucks of America, Los Angeles County Metro Authority, Gateway Cities Council of Governments, Cambridge Systematics, and Peloton Technology.

The Certificate of Award will be presented at the Thomas B. Deen Distinguished Lecture and Presentation of Awards on Monday, January 14, 2019, in Washington, DC, during the Transportation Research Board's 98th Annual Meeting.

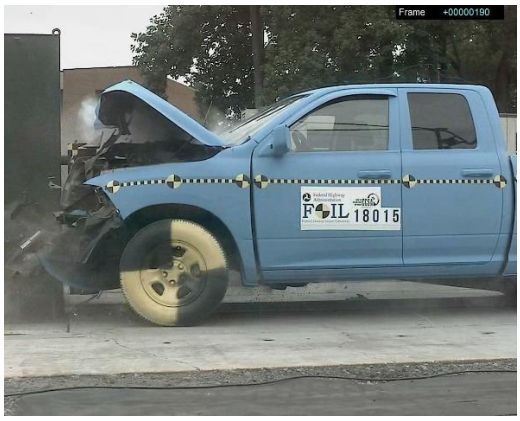
Patricia F. Waller, a former TRB Technical Activities Group Council chair and member of the Technical Activities Council, was a clinical psychologist, researcher, and advocate for policy reform in transportation safety and injury control. The award was established in 2004 in Waller's memory.

For more information, contact Osman Altan, 202–493–3291, osman.altan@dot.gov.

SAFETY

Pickup Truck Crash Test at TFHRC Will Aid in Development of Surrogate Testing Vehicles

A full-scale crash test was conducted at the Federal Outdoor Impact Laboratory (FOIL) at the Office of Safety Research and Development on July 30, 2018. The test conditions followed those in the *Manual for Assessing Safety Hardware* (MASH) where a pickup truck weighing 2270 kg (5000 lbs.) traveling at 50 km/h (31 mph) impacted head-on into a 12-inch diameter rigid steel pole, representing a worst-case scenario when impacting a rigid narrow object at a zero-degree angle.



Source: FHWA

This image captured from a video recording of the crash test shows the moment of impact.

The purpose of the test, conducted at the Turner-Fairbank Highway Research Center in McLean, VA, was to validate a finite element computer simulation model of the current MASH pickup test vehicle being used for roadside hardware testing so that analysis of crash test performance does not have to rely solely on full-scale testing. Once simulation models are validated by full-scale crash testing, they can be used to examine the potential performance of other safety hardware without the time or expense of full-scale testing.

Results from the test will also be used in the development of a bogie surrogate testing vehicle with similar frontal crush characteristics to the tested pickup truck.

Source: FHWA
The pickup truck after the crash test.

For more information, contact Eduardo Arispe, 202–493–3291, eduardo.arispe@dot.gov.

Canada Transportation Officials Visit Turner-Fairbank Highway Research Center for V2I and V2V Information Exchange

On August 22, members of Transport Canada; the Innovation, Science and Economic Development Agency; and a representative of the Canadian Embassy visited the Turner-Fairbank Highway Research Center (TFHRC) for demonstrations of the latest vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) applications and capabilities. The visit also included a presentation on Canada's research efforts on connected vehicles.

The visit focused on the fundamentals and unique challenges of connected vehicle technology in a highly mobile and dynamic transportation environment, as well as an overview of the United States Department of Transportation's (USDOT's) research approach regarding communications interference and plans for testing the technology in Canada under different environmental conditions.

The communication for safety applications can be established in the 5.9 GHz band (5.850 GHz to 5.925 GHZ), which is part of the spectrum allocated for public safety. The USDOT has a very detailed research program regarding V2V and V2I communications.

With the notion that spectrum is becoming scarce, a number of technology concepts have emerged for sharing this spectrum with unlicensed users.

To understand the opportunities for sharing as well as understand how to mitigate potential interference by other users, USDOT has been researching the interference issue in cooperation with multiple Federal agencies, including the United States Army Test and Evaluation Command in Aberdeen, MD, and the National Telecommunication and Information Administration (NTIA) in Boulder, CO.

USDOT was the first agency to perform this type of interference research and it expects the results to be of great interest to other governments as well as to the private sector around the world.

For more information, contact Volker Fessmann, 202–493–3322, Volker.Fessmann@dot.gov.

Turner-Fairbank Highway Research Center Visiting Researchers Take Home First Place at Transportation Technology Tournament
(continued from page 1)

The team was comprised of five students and an academic advisor. Britton Hammit is a PhD student at the University of Wyoming and is an Eisenhower Graduate Research Fellow in the Office of Operations R&D. Rachel James is a PhD student at The University of Texas at Austin and is a Pathways Student Intern in the Office of Operations R&D. Venktesh Pandey is a PhD student at The University of Texas at Austin. Joseph Vincent is a recent graduate of the University of Kansas and is a two-year Summer Transportation Internship Program for Diverse Groups Intern (2017 Office of Operations R&D; 2018 Office of the Assistant Secretary for Research and Technology). Cesar Yahia is a PhD student at the University of Texas at Austin, and Dr. Mehdi Zamanipour, National Research Council Post-Doctoral Fellow in the Office of Operations R&D, served as the academic advisor to the team.

This event was hosted by the Intelligent Transportation Systems Joint Programs Office Professional Capacity Building team, Volpe,

and the National Operations Center of Excellence.

The competition allows for students to work directly with State and local DOTs to solve real-world transportation problems using intelligent transportation systems and transportation systems management and operations solutions.

For more information, contact Rachel James, 202–493–3205, rachel.james@dot.gov.

RECENT PERIODICALS

***Public Roads*—Fall 2018**

Self-Enforcing Roadways; Better Information for Better Roadway Safety; 20 Years of Creative Problem Solving; Boosting Pavement Resilience

For more information, contact Lisa Shuler, lisa.a.shuler@dot.gov.

***Innovator:* Accelerating Innovation for the American Driving Experience—September/October 2018**

This issue includes: On-Ramp to Innovation; Building Community Connections, Big and Small; Maryland Modernizes Bidding Process with e-Construction and Partnering; Agencies Deploy Road Weather-Savvy Strategies; Puerto Rico Traffic Incident Management App Shines During Disaster; States Innovate; and First Look at EDC-5 Innovations.

The issue is available online via https://www.fhwa.dot.gov/innovation/innovator/issue68/3dIssue/.

LINKS

Turner-Fairbank Highway Research Center: https://highways.dot.gov/research/

Resource Center: www.fhwa.dot.gov/resourcecenter/

National Highway Institute: www.nhi.fhwa.dot.gov/home.aspx

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