U.S. Department of Transportation
Office of the Secretary of Transportation

UTC Spotlight

University Transportation Centers Program

This month: Michigan State University | August 2015

Michigan State University Drives Pavement Preservation with Research and Education

The National Center for Pavement Preservation was established in 2003 by Michigan State University (MSU) and the Foundation for Pavement Preservation as the national pavement preservation clearinghouse for practitioners throughout the United States.

Michigan State University

As director of the Center for Highway Preservation at Michigan State University, Karim Chatti blends research activities with educational outreach.

MSU is the first university in the country to have a University Transportation Center (UTC) for Highway Pavement Preservation. The U.S. Department of Transportation designated Michigan State's Center for Highway Pavement Preservation (CHPP) as a Tier 1 UTC in 2013.

"The main focus of the center is the infusion of science and innovative technology to pavement preservation," said CHPP director Karim Chatti, an MSU professor of civil and environmental engineering. "The center sponsors research, education, outreach, and technology transfer activities."

Chatti said training the next generation of technology-savvy workers who can develop integrated solutions for highway pavement preservation is an important aspect of the CHPP's mission.

One of MSU's current students is Shabnam Rajaei, who came from Iran to pursue Ph.D. studies in pavement preservation.

"The complexity of the pavement structure and behavior in different conditions makes pavement engineering an exciting path to follow," Rajaei said. "The cost-effective approach is to maintain and improve the functional capacity of the pavement and control its deterioration. It's the only way you can avoid extensive and expensive reconstruction."

Rajaei is working on a CHPP research project that is studying how to optimize the tradeoff between grip and rolling resistance on pavement preservation treatments. The project focuses on the functionality of pavement treatments while seeking to improve safety, energy savings, and environmental benefits. For the average U.S. consumer the economic impact of grip and rolling resistance on the country's 3.95 million miles of public roads can be significant.

Rolling resistance is a major factor in fuel consumption, Rajaei explained. A 3 percent annual reduction in fuel consumption would save U.S. consumers an estimated 4 to 6 billion gallons of fuel per year.

Michigan State University

Shabnam Rajaei, a Ph.D. student at Michigan State University, is studying how to optimize the tradeoff between grip and rolling resistance to help create a roughness spectrum that could improve the sustainability of pavement without jeopardizing safety.

"So understanding the tire-pavement interaction in the contact patch on different pavements is of great significance," she said.

Rajaei is part of a research team at the MSU College of Engineering that is designing a surface profile that balances the tradeoff between friction, adhesion, and hysteresis (loss of energy). She works under the supervision of Chatti and Roozbeh Dargazany, assistant professor of civil engineering at MSU, who are the project's principal investigators.

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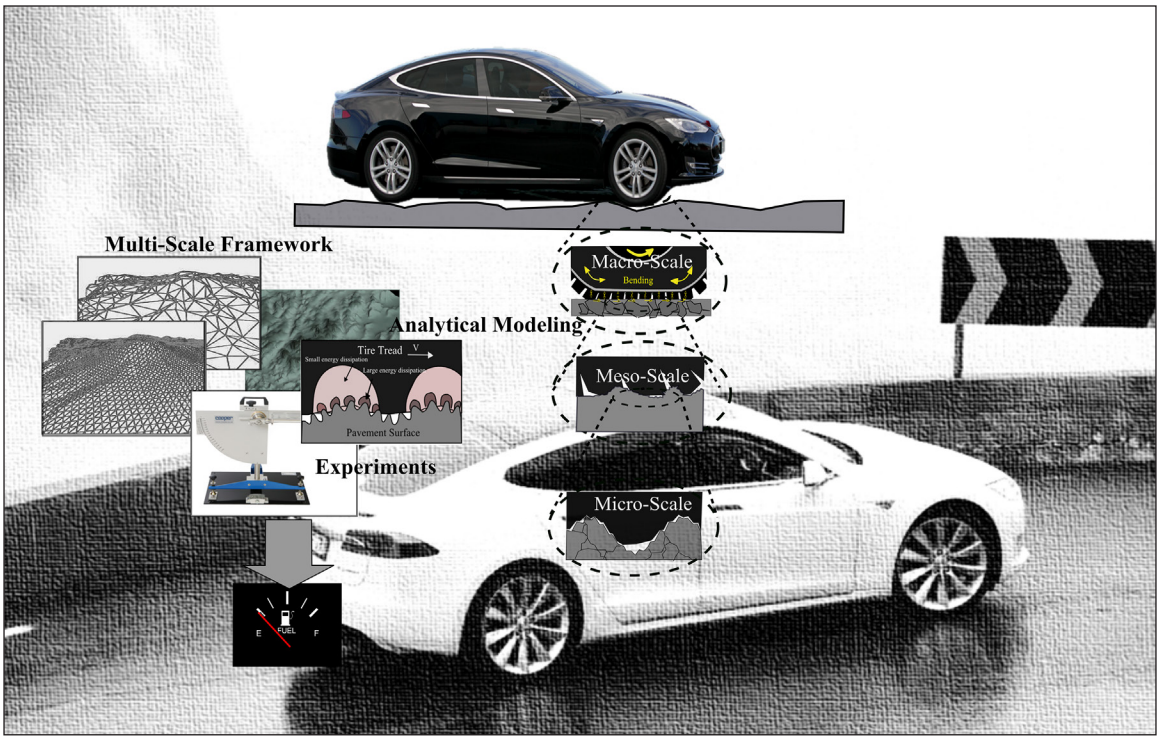
When Imen Zaabar of Michigan State University isn't doing research as an assistant professor of civil engineering, she helps students build a road in a box to help them explore engineering design.

The research team's proposed roughness spectrum should lead to pavement mixture designs that ultimately improve the sustainability of pavement preservation treatments while maintaining safety.

Imen Zaabar, an assistant professor of civil engineering at MSU, also assists on the project. Zaabar's expertise is on the effect of pavement condition (roughness, texture, and structure) on rolling resistance.



Michigan State University

Coupling analytical models and experimental results of tire-pavement interaction in a multi-scale framework.

"We are working to understand what happens between the tire and the pavement in that contact patch," Zaabar said. "It's important if we want to understand the mechanism of rolling resistance and grip. To find the answers, we're going to have to make the pavement 'talk.'"

Researchers are assembling a multi-scale framework to optimize a pavement texture that would reduce rolling resistance without sacrificing grip. They already know that at high speeds rolling resistance appears to be dominated more by macro-scale parts of a pavement profile, while at low speeds grip is affected more by the small-scale asperities of a textured surface.

Using computer simulations and experimental analysis, the researchers are studying the effect of tire properties and pavement surface characteristics. The goal is to quantify an optimized rolling resistance on the roughness spectrum, which ranges in texture from mega to macro, meso, micro, and eventually nano.

The work summarizes existing models in macro- and mega-scales. It also creates a bridge to the developed concept in micro-scale that can predict the optimized pavement surface for a given traffic condition. Positive results will quantify the best surface properties in the rubber-pavement interface.

Field studies already suggest that reductions in rolling resistance can directly increase fuel efficiency by 2 to 6 percent.

This 2-year research project is currently at its midway point.

When completed, the proposed roughness spectrum will assist highway engineers in analyzing the tradeoff between pavement grip and rolling resistance and facilitate the ranking and rating of current pavement preservation treatments. Ultimately, this could lead to new pavement preservation treatment mix design specifications that will contribute to a better balance between safety and sustainability.

For more information, visit www.chpp.egr.msu.edu

About This Project

The Center for Highway Pavement Preservation is a Tier 1 UTC in the Michigan State University College of Engineering. MSU leads a team of collaborators that includes the University of Illinois, Urbana-Champaign; the University of Texas, Austin; the University of Minnesota; North Carolina A&T State University; and the University of Hawaii. A variety of pavement preservation research highlights are available at http://bit.ly/1fudC2K.