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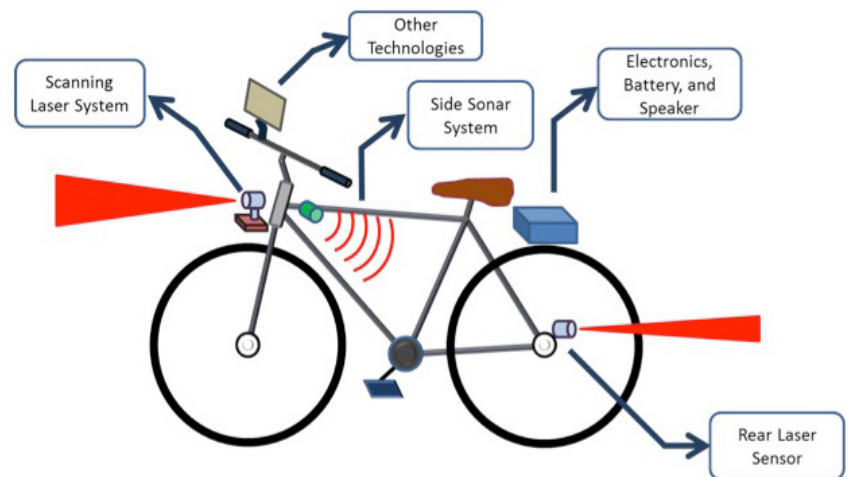
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## Research explores collision-warning system for bike riders

More than 48,000 bicycle–motorist crashes occur each year in the United States. Many of these crashes happen because the driver does not see the bicyclist or the bicyclist behaves in an unpredictable manner.

In recent years, manufacturers have begun equipping many new motor vehicles with collision-prediction systems that warn motorists of possible collisions and help them take actions to avoid a crash. Now, researchers at the Roadway Safety Institute are investigating the use of similar technology on bicycles to predict impending crashes and warn both riders and drivers.



The instrumented bicycle includes laser and sonar systems, electronics, and a small computer for evaluation.

“In this project, we are working to develop a sensor system for a bicycle that can predict imminent bicycle–motorist crashes and provide an audio warning of the bicycle’s presence to nearby drivers by sounding a loud horn,” says Rajesh Rajamani, professor of mechanical engineering at the University of Minnesota and the lead investigator on the project.

The warning system focuses on predicting two of the most common types of bicycle–motorist crashes: rear-end collisions on urban roads in which the vehicle is approaching the bicyclist from behind and collisions at traffic intersections.

Rajamani and doctoral student Woongsun Jeon are currently developing a sensor system and collision-

prediction algorithm and testing the algorithm in simulation studies. The researchers have also built an instrumented bicycle with sensors, electronics, and a small computer for evaluation.

"This project is unique in many ways," Rajamani says. "Previous projects on vehicle tracking have been developed only for cars and have mostly focused on highway scenarios. This is perhaps the first research project where tracking of vehicles at a traffic intersection has been developed and also the first project for a bicycle collision-warning system that goes beyond rear or straight-frontal collisions."

Just nine months into the project, researchers have taken a Schwinn bicycle equipped with the new warning system out for tests on the U of M campus—and seen promising results. Preliminary experiments have shown that the sensor suite on the bicycle can accurately estimate vehicle position and orientation for scenarios involving vehicles approaching cyclists from behind and vehicles turning right at intersections.

"If our final results demonstrate that the system works reliably and performs effectively, it could be commercialized into an inexpensive product sold to bicycle riders," Rajamani says. "In addition, the technology we're developing has the potential to be extended to motorcycles and pedestrians in the future."



### Technology holds promise for safer freeway merging

Merging onto a freeway can be stressful, especially when the weather or road infrastructure causes poor visibility. If a driver on an entrance ramp can't clearly see the vehicles traveling on the freeway, it can be difficult to merge safely.

In a project funded by the Roadway Safety Institute, researchers at the University of Minnesota Duluth (UMD) are investigating the use of dedicated short-range communications (DSRC)

technology to make merging from freeway entrance ramps easier and safer for drivers. Led by UMD electrical engineering professor M. Imran Hayee, the team is using DSRC-based vehicle-to-vehicle (V2V) communications to collect real-time vehicle trajectories in these merging situations—a first step toward providing merge-assist information to drivers.

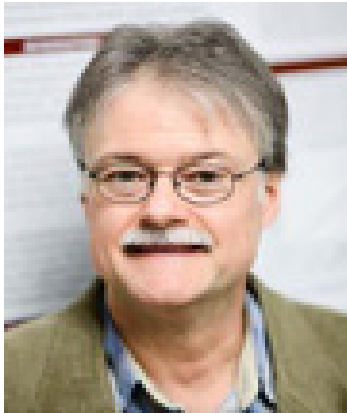
The technology works by enabling vehicles equipped with DSRC devices to communicate important details about their location, direction of travel, and speed to each other. Using that information, the system developed by the research team calculates the relative trajectories of the vehicles in real time. Eventually, these calculated trajectories will be used to predict the optimal time and trajectory for merging that the driver attempting to merge can use as guidance.

"The information and technology developed in this project could pave the way for providing merge assistance to drivers on the merging ramp," says Hayee. "It could also help facilitate automatic merging of vehicles when the DSRC market penetration reaches necessary levels."

So far, the researchers have developed software for transmitting and receiving vehicle information using the two DSRC devices, and they are working on making the technology usable across multiple devices. They have also conducted an initial round of field tests using two DSRC equipped vehicles on regular streets and freeways to test the system's accuracy.

Initial results were promising, Hayee says, indicating that the system is capable of producing the lane-level accuracy needed for future implementations of this project.

Going forward, the team plans to continue refining communication protocol and to conduct additional field tests on freeways. These field tests will include at least three vehicles, allowing the researchers to test the system's ability to collect trajectories of vehicles in multiple lanes at the same time.



Stephen Burks

### Researcher Spotlight: Stephen Burks

Stephen Burks is a professor of economics and management in Division of Social Science at the University of Minnesota Morris (UMM). One of Burks's research interests is in the economics, especially the personnel economics, of the U. S. trucking industry. Most recently, his work in this area has explored the relationship between the health status of truckers and their crash risk, turnover, productivity, and medical costs.

Burks's research interests grew out of his personal experience in the trucking industry. "I studied philosophy as a graduate student, but dropped out of a doctoral program to drive the big rigs," Burks says. He hauled steel, handled freight, and conducted city and roadwork with tractor-trailers for 10 years.

During his time as a truck driver, the trucking industry was economically deregulated, radically transforming the industry. When Burks decided it was time to return to school, he studied economics and wrote his dissertation on how deregulation changed U.S. trucking, he says. This led to his current work on the economics of motor freight, trucking labor markets, and trucking safety.

Though the rate of truck-involved crashes per mile traveled has decreased over the last decade, truck crashes are still a significant safety problem. Crashes involving large trucks kill about 3,500 people every year and injure about 100,000, Burks says. "[And] as economic activity continues to grow we have more trucks and motorists on the road," he adds.

In a project sponsored by the Roadway Safety Institute, "Exploring Links between Medical Conditions and Safety Performance in Tractor Trailer Drivers," Burks and his colleagues and students will be extending the research done in the UMM's "Truckers & Turnover Project." The new project will explore the relationship between obstructive sleep apnea (OSA) and trucker medical costs through the analysis of data from a large motor carrier that instituted the industry's first large-scale program to screen, diagnose, and treat its employee drivers for OSA.



Burks during his time as a big rig driver, Cleveland, Ohio

Burks believes that better safety regulations and managerial policies for motor carriers can help prevent injuries and deaths resulting from truck-involved crashes, and that his research will make a positive impact on this key component of highway safety. "The health and safety of the folks who move our nation's freight matters to all of us," says Burks. "Identifying medical conditions associated with crash risk among commercial truckers and improving both screening for and effective delivery of treatment for these conditions are important areas in which more can be done."

In addition to his work with the Roadway Safety Institute, as a behavioral and experimental microeconomist, Burks is affiliated with the Institute for the Study of Labor (IZA) in Bonn, Germany, and the Centre for Decision Research and Experimental Economics at the University of Nottingham, United Kingdom. He is chair of the standing technical Committee on Trucking Industry Research

at the Transportation Research Board, and he received the University of Minnesota Morris Faculty Distinguished Research award in 2014. Burks holds a B.A. in philosophy from Reed College, an M.A. in philosophy from Indiana University, and a Ph.D. in economics from the University of Massachusetts at Amherst.

### Researcher Spotlight: Greg Lindsey

Greg Lindsey is a professor at the University of Minnesota's Humphrey School of Public Affairs, where he specializes in environmental and transportation planning and management. Lindsey joined the Humphrey School in 2008 as associate dean, served as interim dean in 2011, and served as executive associate dean until September 2012.

Lindsey has been working in the area of bicycle and pedestrian traffic monitoring for more than two decades. Recently, his research has focused on using the results of this monitoring to measure and assess exposure to risk for pedestrians and bicyclists.



Greg Lindsey

"Relative to our knowledge of exposure to risk by drivers of motorized vehicles, we know and understand very little about the risks experienced by bicyclists and pedestrians," says Lindsey. "To reduce the number of accidents, injuries, and deaths of bicyclists and pedestrians we need to know how many there are, how they use transportation facilities, and what factors affect their behavior."

In an Institute-funded project, "Performance Measures for Bicycle and Pedestrian Safety," Lindsey is working with bicycle and pedestrian monitoring technologies and data to develop approaches for assessing exposure to risk and conducting several case studies in Minnesota communities to illustrate the approaches. Ultimately, Lindsey believes this research will help improve safety for pedestrians and bicyclists.

"Too many cyclists and pedestrians are hurt or killed each year, and with better information we can reduce the number of deaths," says Lindsey. "In addition, if we can make bicycling and walking safer, more people will participate, and we'll have many additional benefits including reduced congestion, reduced greenhouse gas emissions, and better physical and mental health through increased physical activity."

Lindsey says he enjoys being affiliated with the Roadway Safety Institute because of its unique interdisciplinary nature. Along with financial support, the Institute brings together researchers from a variety of engineering, planning, policy, and public health fields to foster innovative research projects that meet the needs of practicing engineers, planners, and policymakers, Lindsey says. "It's exciting to work with teams of researchers and practitioners to bring research into practice and make transportation safer for the people we serve."

According to Lindsey, the most pressing transportation-related safety issue we face today is building public and political support for allocating the financial resources needed to address and solve transportation safety problems. "We tend to underinvest in problems we're familiar with and have grown accustomed to living with," says Lindsey. "Thousands of people die every year in transportation-related accidents. If the same numbers of people were killed in an epidemic of some type, we'd mobilize efforts and invest the resources needed to halt the scourge."

Earlier this year, Lindsey was appointed as the first scholar-in-residence at the Minnesota Department of Transportation, where he is working in the agency's Office of Transit's Bicycle and Pedestrian Section until June 2016. Lindsey has previously served as associate dean of the Indiana University School of Public and Environmental Affairs (SPEA) at Indiana University-Purdue University Indianapolis. He



earned his doctorate and a master's degree in geography and environmental engineering at Johns Hopkins University. He also received a master's degree in geography and environmental studies from Northeastern Illinois University. He holds a bachelor's degree in urban planning from the University of Illinois in Urbana-Champaign.

### Institute reaches out to future engineers

Young inventors and creators—and potential transportation engineers—gathered on February 28 for a day of family fun at Tech Fest, an annual event held at The Works Museum in Bloomington, Minnesota. Celebrating National Engineers Week, Tech Fest features hands-on activities and demonstrations from the museum and its engineering, technology, and science partners from all over the Twin Cities.

The Roadway Safety Institute hosted two activities. One was designing safety road signs. “While ‘watch out for cats or dogs’ was the most common theme the kids chose, we also had warnings about ‘sharknados,’ zombies, and all sorts of other roadway dangers,” says Colleen O’Connor Toberman, CTS program coordinator.

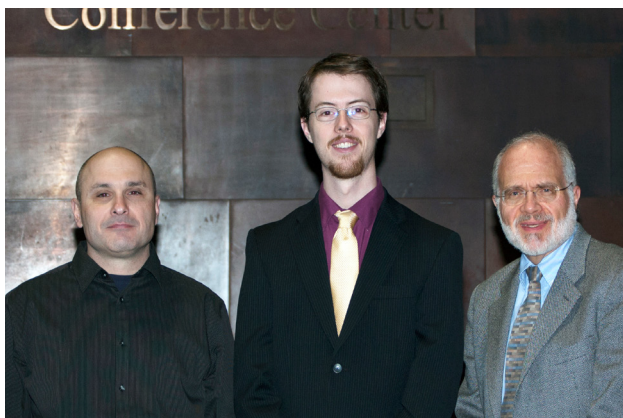


The other RSI activity allowed children to learn about bicycle and pedestrian counting technology developed by University of Minnesota researchers. “The kids had a great time trying to figure out how the sensors worked—and how to pass through without getting counted,” she says.

This year’s Tech Fest drew just over 1,000 attendees. The Works, a hands-on science and technology museum, offers exhibits, programs, and design challenges to engage kids in science, technology, and engineering and make learning memorable and fun.

### Zitzow receives Outstanding Student of the Year

The U.S. Department of Transportation’s Office of the Assistant Secretary for Research and Technology presents an outstanding student of the year award to each of its University Transportation Centers (UTCs). Students receive their awards at the Transportation Research Board annual meeting in January.



John Hourdos, Stephen Zitzow, and Max Donath

The recipient of the 2015 award for the Roadway Safety Institute is Stephen Zitzow, a master’s candidate in civil engineering. His thesis focuses on the layout of high-occupancy toll lanes, culminating in a tool for practitioners to design facilities for either an open- or closed-access framework. He received his bachelor’s degree in civil engineering from the University of Minnesota with a focus on transportation engineering.

Zitzow also serves as laboratory manager and researcher at the RSI-affiliated Minnesota Traffic Observatory (MTO), where he has been involved with a wide variety of traffic safety projects under

his advisor, MTO director John Hourdos. Most recently, Zitzow concluded a project investigating the safety impacts of active traffic management systems used along the I-94 corridor in Minneapolis. Research sponsors have included MnDOT, the Metropolitan Council, and other state and regional agencies.

## Focus group gives insight about kids and safe travel

On May 12, staff from the Roadway Safety Institute (RSI) and The Works Museum met with students from Bancroft Elementary, Minneapolis, as part of a development process for a roadway-safety-related museum exhibit. The students, in grades 4 and 5, participated in a focus group to help RSI staff understand students' experiences with and perspectives about safe travel. In particular, students discussed walking on and crossing streets. They shared stories about learning to cross streets, teaching younger family members about safety, near-collisions with cars, and safe biking.

Several themes emerged from the focus group. Most students learn safe road behavior at a young age, particularly from their parents and preschool teachers. Students were aware of times when they disregarded these lessons and made unsafe choices, such as "taking a risk" by crossing against a light. Students also spoke about the challenges of making split-second decisions such as deciding when it's safe to cross a street between oncoming cars.

Students' feedback will be used to develop an interactive museum exhibit that reinforces the safety lessons being taught at home and school. For instance, students might examine the science behind reaction time, distractions, or perceptions of distance and speed. This exhibit will be developed over the coming months, with a goal of having it displayed at The Works, a hands-on science and technology museum located in Bloomington, Minnesota, by the spring of 2016.



### Tribal Safety Initiatives

Current research shows the rate of deaths and injuries from motor vehicle crashes is much higher for American Indians than for other populations in the United States. Tribal transportation leaders and federal agencies agree that this is an area of elevated concern and priority. Unfortunately, there is very little research to guide strategic policies and investments to improve safety. The Roadway Safety Institute, a regional University Transportation Center based at the University of Minnesota, is collaborating with tribal governments on these projects to better address these challenges.

**Collaborating with American Indian Communities to Re-interpret and Strategize about Transportation Safety Risks on Tribal Lands**  
This study aims to get a better picture of the nature of transportation safety concerns in tribal governance areas, analyze the nature of safety risks and problems, identify successful programs and policies, and generate recommendations about policies and investments. Tribal government leaders, transportation coordinators, and other key community members can offer extremely valuable insights in this analysis. Therefore, this study centers around qualitative data collection and a problem-oriented approach to collaboration with tribal governments. Our goal is to provide a more nuanced, informative, and fair picture of the problem and strategies to improve safety.

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**GIS Data Acquisition and Spatial Analysis of Factors Affecting Traffic Crashes on Tribal Lands**  
This study is investigating the potential for new advances in Geographic Information Systems (GIS) to enhance the collection, availability, and use of information related to transportation safety. Conducted in partnership with Epi, the study includes a preliminary assessment of geo-related traffic safety information. Through collaborative analysis with tribal communities, the study will also develop prototypes for potential use that will be evaluated through a series of stakeholder assessments.

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## New publications highlight Institute research at a glance

Check out overviews of RSI research in the areas of tribal roadway safety and rail grade crossing safety in a quick-to-digest format. Fact sheets are available for download at [www.roadwaysafety.umn.edu/publications](http://www.roadwaysafety.umn.edu/publications).

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