

RESEARCH REVIEW

• UNIVERSITY OF MICHIGAN TRANSPORTATION RESEARCH INSTITUTE • APRIL-JUNE 2011 • VOLUME 42, NUMBER 2 •



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Thinking Globally

*U-M Students Design
Low-Cost Child Restraint for
Use in Developing Countries*

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UMTRI RESEARCH REVIEW

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UMTRI's Strategic Intent

To be the leader in transportation systems research integrating vehicles, people, and infrastructure to achieve a highway transportation system where:

- Fatalities and injuries are eliminated
- People and goods flow efficiently
- Reliance on nonrenewable energy is reduced

Thinking Globally

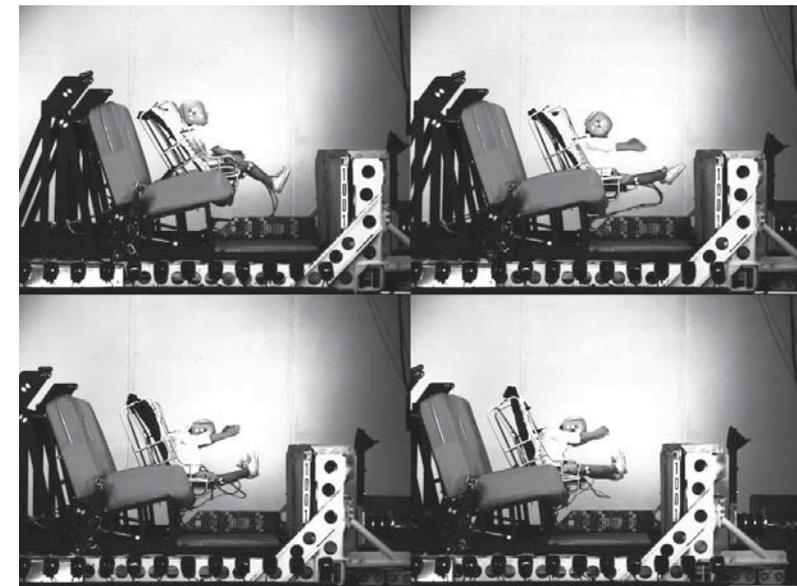
U-M Students Design Low-Cost Child Restraint for Use in Developing Countries

As the use of passenger cars becomes more common around the world, the transition also brings safety concerns. Children are one particularly vulnerable group. According to the National Highway Traffic Safety Administration (NHTSA), 93 percent of child deaths involving vehicles occur in low- and middle-income countries.

While child pedestrians account for most of the deaths, an increasing number of children are injured or killed in vehicle crashes. Part of the reason is that the use of child restraints in vehicles has lagged behind. Often child restraints are either not available or, when they are, they're relatively expensive. That's a problem that University of Michigan biomedical engineering students Megan Bland and Rachel Strauss decided they could do something to fix.

Bland and Strauss, along with fellow U-M student Adam Biddle, began working with faculty advisor and UMTRI research associate professor Matthew Reed to design and develop a low-tech child restraint for use in developing countries. The goal of the project was to create a child restraint that can be constructed using low-cost materials and low-technology manufacturing techniques while providing excellent crash protection.

"Although many other factors influence the use of child restraints, particularly legislation and enforcement, cost is one barrier that we can address



COURTESY OF UMTRI BIOSCIENCES GROUP

The first prototype of the child restraint undergoes dynamic testing in UMTRI's sled lab.

with engineering," said Reed.

In the United States, child restraints are typically made of engineered plastics, which makes sense for high-volume manufacturing but has steep start-up costs. To create a design suitable for low-volume manufacturing with minimal equipment costs, the team chose steel for the child restraint frame. Steel is widely available as well as recyclable. Hand welding is a relatively low-cost manufacturing option at low volumes and in places where labor is inexpensive.

The U-M students began working on the project at UMTRI in January 2010. During the summer, the students designed and built a prototype child restraint intended to provide crash protection for children from birth to 40 pounds (approximately through age 3). The design includes a frame, seating

surface, swinging arm, cushion, and harness. The frame of the prototype uses half-inch steel tubing.

Prototype Testing

The team conducted dynamic sled tests of the first prototype in both forward- and rearward-facing modes following the procedures of U.S. Federal Motor Vehicle Safety Standard (FMVSS) 213. Results of the testing showed that the structure of the prototype performed well, but the restraint slightly exceeded one of the specifications limiting the forward excursion of the passenger's head.

After testing the first prototype, Bland and Strauss submitted an abstract on the project as part of the Enhanced Safety of Vehicles (ESV) International Student Safety Design Competition. The competition is held biannually to promote student involvement in traffic

continued...

Continued from page 1

safety research. As a result, Strauss and Bland were awarded seed funding to continue their work.

The students built a revised prototype of the child restraint in the winter of 2011 and conducted testing with assistance from UMTRI's sled lab team—Quentin Weir, Jun Wu, Brian Eby, Rahul Singh, and Miriam Manary. The second prototype they tested met the dynamic criteria specified in FMVSS 213 for the two tests, which became a learning experience for the students.

“Throughout the process of developing the prototypes, we’ve been able to learn about the importance of child vehicle occupant safety and how child restraints protect children effectively,” said Strauss.

And the results, said Reed, prove the design concept is feasible.

“These students have dedicated themselves to improving access to high-quality child restraints for caregivers in the developing world,” said

Reed. “They have demonstrated that it is possible to pass the tough dynamic criteria of the U.S. child-restraint standards with a simple design that can be manufactured with minimal technology.”

ESV Competition

Strauss and Bland presented the low-cost child-restraint concept to judges from NHTSA in March 2011 as part of the regional Enhanced Safety of Vehicles competition.

The team was notified in April that they were selected as one of three winners from the North American region. The project team, along with the teams from the University of Central Florida and Virginia Tech—Wake Forest University Center for Injury Biomechanics will represent North America at international competition held in conjunction with the ESV Conference in Washington, D.C. in June.

After the new child restraint has been tested successfully to both U.S. and European standards, the team intends to make the entire design specification available for free to entrepreneurs across the world.



Side view of the child-restraint prototype.

To watch a U-M video of the project, go to <http://www.youtube.com/watch?v=cqdwZuTvZsg> 

Children in child restraint systems are 67 percent less likely to suffer fatal injury during severe motor vehicle collisions than children traveling unrestrained, according to a 2009 study in the *American Journal of Public Health* (10.2105/AJPH.2007.131128, February 2009, vol 99, no. 2, pp. 252-257).

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Megan Bland works with the steel tubing that makes up the frame of the child restraint.

Understanding India's Auto Industry

India's strong economic outlook is creating significant opportunities for the automotive industry, according to speakers at UMTRI's first conference focused on the Indian auto industry. The conference, titled "Inside India: Understanding India's Current and Future Automotive Industry," took place April 20 at the University of Michigan.

UMTRI assistant research scientist Bruce Belzowski welcomed conference participants and highlighted India's growing segment of young, technologically savvy vehicle buyers and the advantage of India's mature financing systems.

"India's new vehicle buyers are similar to China's in that they are buying their first new vehicles, but they are different because they have better access to financing options than do Chinese buyers," said Belzowski.

Other speakers at the daylong conference provided insight into the Indian consumer market, the manufacturers and suppliers selling in India, the role of government in supporting the auto industry, and the challenges facing the future of the Indian industry.

The next event in the Focus on the Future conference series will be "Powertrain Strategies for the 21st Century" on July 13, 2011, at the University of Michigan.

Vivek Kumar of Maruti-Suzuki highlighted the passenger vehicle market in India. He said the Indian market is unique, with a high customer preference for compact cars that are easy to maneuver in bumper-to-bumper traffic and easy to park. These cars also have a lower cost of ownership than a typical U.S. car because they are more fuel efficient and less mechanically complicated. Traditionally, said Kumar, Indian consumers keep their vehicles longer than most other consumers.

With a population of over 1.2 billion people, India is the second most populous country in the world. Brazil, Russia, India, and China are

collectively referred to as the BRIC countries. According to Charles Chesbrough of IHS Automotive, BRICs will outpace advanced economies in terms of world economic growth. He noted that sales of light vehicles in India are forecast to reach 3.1 million units in 2011, up 19 percent over last year.

Yong Yang, senior economist at Asia-Pacific, Ford Motor Company, discussed Indian auto-industry trends. He gave an overview of India's infrastructure conditions and volume outlook. According to Yang, India's demographic and economic fundamentals will provide support for future robust industry growth.

Jayendra Parikh, executive director, Ashok Leyland, discussed India's heavy-truck industry and his company's connected-vehicle activity. India is the world's third largest passenger-vehicle market, according to Parikh, and fourth largest commercial-vehicle market.

Kevin Fisher of Tata Technologies highlighted engineering innovations used in making the company's compact cars for the Indian market, and Mohan Bachhav of IBM India presented his company's view about the Indian automotive industry and how it is using information technology differently than other countries.

To see speaker presentations, visit <http://www.umtri.umich.edu/divisionPage.plp?pageID=47>. **RR**

Sustainable Worldwide Transportation: A Global Research Consortium

Sustainable Worldwide Transportation (SWT) is a consortium of international members formed in 2005 at UMTRI. Its mission is to address important safety, environmental, economic, and social issues related to road transportation.

SWT researchers include experts from UMTRI, other U.S. research organizations, and premier research organizations worldwide. Their approach involves analysis of unique social, cultural, and economic circumstances in individual countries, future motorization trends, and emerging technologies.

UMTRI research professor Michael Sivak is the head of SWT. Current consortium members include Aramco Services, Autoliv Electronics, Bosch, China FAW Group, FIA Foundation for the Automobile and Society, General Motors, Honda R&D Americas, Meritor WABCO, Nissan Technical Center North America, Renault, and Toyota Motor Engineering and Manufacturing North America.

In addition to the latest two SWT reports (summarized on pages 4 and 5), SWT has recently released publications that have examined such topics as the mechanisms for the recent large drop in U.S. road fatalities; road safety in China, India, and Brazil; variations in fuel efficiency among individual drivers; recent reductions in carbon dioxide emissions from new vehicles; and the future of personal transportation in megacities of the world.

The English, Japanese, and Chinese abstracts of all SWT publications are listed at <http://www.umich.edu/~umtriswt/publications.html>.

For more information about SWT see <http://www.umich.edu/~umtriswt>.

SWT Report: Unemployment Rate, Cost of Gas Predict Fuel Economy of Purchased Vehicles

Average fuel economy of purchased new vehicles has increased by more than 12 percent since late 2007, due mainly to high unemployment and gas prices, according to this SWT study.

The average fuel economy of purchased, new, light-duty vehicles (cars, pickup trucks, minivans and SUVs) improved from 20.1 mpg in October 2007 to 22.6 mpg in February 2011—the highest it has ever been.

The report by Michael Sivak and Brandon Schoettle found that the national unemployment rate (currently around 9 percent) and the price of gasoline (currently around \$4.00 a gallon) together account for 83 percent of the variance in the average fuel economy of new cars purchased.

“Our present findings are consistent with those in our two previous studies on the relationship between the unemployment rate and the price of gasoline, and the average fuel economy of purchased new vehicles,” says Sivak, who is head of UMTRI’s Human Factors Group.

Sivak and Schoettle performed a regression analysis on monthly data from October 2007 to February 2011 to examine the relationship between the unemployment rate and the price of gasoline on one hand, and the fuel economy of purchased new vehicles on the other hand.

Average fuel economy improved rapidly from 20.1 mpg in October 2007 to 21.7 mpg by May 2008, but dropped to 20.7 mpg by November 2008. It then improved gradually through August 2009, but leveled off thereafter through the end of 2010.

Meanwhile, the price of gasoline peaked at around \$4 in summer 2008, while the unemployment rate peaked at about 10 percent in fall 2009.

“Overall, our results provide support for the hypothesis that decisions of U.S. buyers concerning the fuel economy of purchased new vehicles are strongly influenced by both the unemployment rate and the price of gasoline,” Sivak says.

—Bernie DeGroat, *U-M News and Information Service*

SWT Report: Out-of-State Drivers Involved in High Rate of Crashes out West

With the summer tourist season upon us, out-of-state drivers may want to be extra careful if they're planning to vacation in the American West.

A new SWT study by Michael Sivak and Brandon Schoettle, which appears in the June issue of *Traffic Injury Prevention*, shows that a larger percentage of drivers involved in fatal crashes in several Rocky Mountain and Great Plains states are from out of state relative to other areas of the United States.

Sivak and Schoettle examined data from the Fatality Analysis Reporting System for about 50,000 fatal crashes nationwide in 2008.

They found a wide variation across the 50 states in the percentage of drivers involved in fatal crashes who are from out of state. While the West Coast states are near the bottom of the range (only 5 percent in California—the lowest rate overall—and 9 percent in Washington), most of the rest of the western states are near the top.

Wyoming has far and away the highest proportion of drivers involved in fatal crashes who are from out of state—41 percent. South Dakota (27 percent) and New Mexico (24 percent) rank second and third, respectively. Montana (23 percent), Nevada (21 percent), Idaho (20 percent), Nebraska (17 percent) and Kansas (16 percent) also rank among the top dozen or so states with the highest percentage of fatal crashes involving drivers from other states.

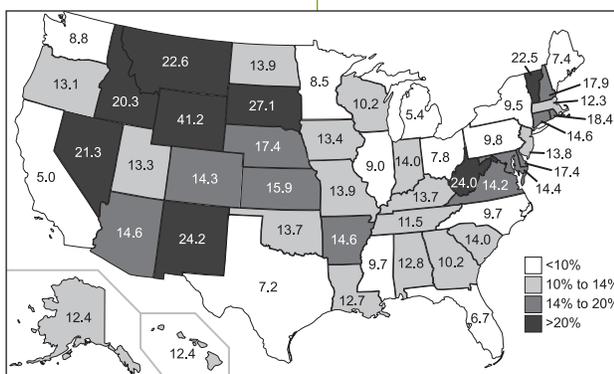
According to Sivak and Schoettle, several coastal states have lower rates of fatal crashes involving out-of-state motorists (California, Washington, Florida, Maine) partially because they are not fully surrounded by other states.

However, several New England states rank in the top 15, including Vermont (23 percent), Rhode

Island (18 percent), New Hampshire (18 percent) and Connecticut (15 percent). Other eastern states, such as Delaware, Maryland and Virginia rank in the top 20, and West Virginia is fourth overall with 24 percent of fatal crashes involving out-of-state drivers.

The Midwest has four of the bottom 10 states for fatal crashes involving motorists from other states: Michigan (5 percent), Ohio (8 percent), Minnesota (9 percent) and Illinois (9 percent).

The UMTRI researchers also used 2008 data from the National Highway Traffic Administration to correlate the percentages of drivers involved in fatal crashes who were from out of state with the states' fatality rates per distance driven and found a positive correlation.



Percentage of all drivers involved in fatal crashes who were out-of-state drivers.

Credit: Figure previously published in the Taylor and Francis journal *Traffic Injury Prevention* <http://www.informaworld.com/openurl?genre=article&issn=1538-9588&volume=12&issue=3&page=220>

“This finding is consistent with the hypothesis that states with higher fatality rates tend to have a higher percentage of out-of-state drivers among the persons involved in fatal crashes,” Sivak said. “However, whether this relationship is causative cannot be ascertained from the available data because we do not have the information about

the relative distance driven in each state by out-of-state drivers.

“Future research should attempt to delineate the types of fatal crashes that have overinvolvement of out-of-state drivers. Research along these lines would not only provide better understanding of crashes on unfamiliar roads, but also likely yield avenues through which to address these types of crashes.”

—Bernie DeGroat, *U-M News and Information Service*

RR

M-CASTL Conference Explores Older Driver Safety and Mobility, Teen Driver Safety

The Michigan Center for Advancing Safe Transportation throughout the Lifespan (M-CASTL) hosted the fourth annual Transportation Research and Education Conference at the University of Michigan on May 3.

The conference attracted approximately 130 people from across the country and abroad as both speakers and participants. Sessions focused on research and best practices for older-driver safety and mobility, and research and best practices for teen-driver safety. M-CASTL Director David W. Eby welcomed guests, and Alfred Franzblau of the University of Michigan gave opening comments.

David Sleet of the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, gave a keynote address on translating research findings into best practices. According to Sleet, many effective interventions exist to prevent road-traffic injuries, but they are often not available or are simply not used to save lives. This is a problem of translation. "Translation is critical," said Sleet. "It's the process of moving from research to practice."



Jeffrey Halter of the Geriatrics Center and Institute for Gerontology at the University of Michigan, and Elin Schold Davis of the American Occupational Therapy Association speak at the M-CASTL conference.

Following the first keynote presentation, several conference speakers highlighted emerging research on older-driver safety and mobility. Discussion focused on research projects related to vision-care specialists and driving, distraction and drowsy driving, naturalistic-driving patterns among older adults, and a longitudinal study of older-adult health and driving. Implications of study findings cut across several areas including screening and assessment, education and training, licensing, and roadway/vehicle design.

In the session on best practices for older-driver safety and mobility, discussion focused on how communities and vehicles can be designed to accommodate older road users and the general population, programs to help drivers compensate for declining driving abilities and to facilitate the transition to nondriving, and programs to help older drivers with cognitive impairment (e.g., dementia).

Other conference sessions featured emerging research on teen-driver safety. Discussion centered on licensing, personality, and sociodemographic factors associated with an elevated crash risk among young drivers; risk perception and driving behaviors; factors associated with increased use of seat belts; and naturalistic observations of distracted driving among teens. UMTRI research professor Ray Bingham, head of the Young Driver Behavior and Injury Prevention Group, was among the speakers.

In the session on best practices for safe teen driving, discussion focused on driver education and training, parental monitoring, computer-based tools for promoting safe driving skills, and several statewide initiatives. UMTRI senior research associate Jennifer Zakrajsek was among the speakers.

To conclude the conference, Toni Antonucci, Elizabeth M. Douvan Collegiate Professor of Psychology and Research Professor, U-M Institute for Social Research Life Course Development Program, gave a keynote address on Bridging the Gap between Research and Practice: The Sample Case of the Society 2030 Consortium.

To see Powerpoint presentations and videos of each speaker, please visit the M-CASTL website, <http://mcastl.org>.

RR

Steudle Named Chair of UMTRI External Advisory Board

Kirk T. Steudle, director of the Michigan Department of Transportation (MDOT), was elected as chair of UMTRI's External Advisory Board (EAB) during the board's semi-annual meeting at UMTRI on May 11.



MICHIGAN DEPARTMENT OF TRANSPORTATION

As chair of UMTRI's EAB, Steudle will lead the twenty-member board in providing UMTRI with key guidance and advice on the institute's strategic direction and goals.

In addition to being MDOT director, Steudle is the 2010-11 vice president of the American Association of State Highway and Transportation Officials (AASHTO) and will become president of AASHTO this fall. He is a national expert in connected-vehicle technology, a high-tech highway operations technology that enables highway vehicles to communicate with roads and each other to improve safety and mobility. Steudle is on the board of directors for the Intelligent Transportation Society of America (ITS America) and the Engineering Society of Detroit.

Steudle replaces Chuck Gulash, senior executive engineer at the Toyota Technical Center, who served a two-year term as chair of the UMTRI EAB. Under Gulash's leadership, the EAB has played a pivotal role in guiding UMTRI through the process of developing a strategic plan that will shape UMTRI's institutional priorities over the next five years. **RR**

Manary Conducts CPS Certification Training

Miriam Manary, senior research associate in UMTRI's Biosciences Group, was lead instructor for the National Standardized Child Passenger Safety Training Program offered at UMTRI in May.



COURTESY OF MIRIAM MANARY

The four-day program teaches the basics of child-passenger safety and correct child-restraint use. It combines classroom instruction, hands-on work with car seats and vehicles, and a community safety-seat checkup event. Successful completion of this course certifies the individual as a CPS technician for two years.

According to the SafeKids website, tens of thousands of individuals have been certified as Child Passenger Safety Technicians and Instructors since the standardized curriculum and certification program began in 1997.

To learn more about current courses being offered, visit <http://cert.safekids.org/> **RR**

Most UMTRI reports are available in full text online. See the website address at the end of the citation. Please contact the UMTRI Library at 734-764-2171 or umtridocs@umich.edu to inquire about the availability of other publications listed here.

Journal Articles

Barretto, A.; Bingham, C.R.; Goh, K.G.; Shope, J.T. 2011. "Developing a Web-Based Health Promotion Intervention: A Case Study from a Brief Motivational Alcohol Program." *Journal of Health Promotion Practice*, vol. 12, no. 2, pp. 193-201, DOI: 10.1177/1524839909353740.

Blower, D.; Green, P.E.; Matteson, A.M. 2010. "Condition of Trucks and Truck Crash Involvement: Evidence from the Large Truck Crash Causation Study." *Transportation Research Record*, vol. 2194, pp. 21-28, DOI: 10.3141/2194-03.

Hoffman, S.G.; Reed, M.P.; Chaffin, D.B. 2011. "A study of the Difference between Nominal and Actual Hand Forces in Two-Handed Sagittal Plane Whole-Body Exertions." *Ergonomics*, vol. 54, no. 1, pp. 47-59, DOI: 10.1080/00140139.2010.535021.

Lo, V. E-W.; Green, P.A.; Franzblau, A. 2011. "Where Do People Drive? Navigation System Use by Typical Drivers and Auto Experts." *Journal of Navigation*, vol. 64, no. 2, pp. 357-373, DOI: 10.1017/S0373463310000561.

Sivak, M.; Schoettle, B. 2010. "Toward Understanding the Recent Large Reductions in U.S. Road Fatalities." *Traffic Injury Prevention*, vol. 11, no. 6, pp. 561-566, DOI: 10.1080/15389588.2010.520140.

Sommers, B.D.; Fargob, J.D.; Lyons, M.S.; Shope, J.T.; Sommers, M.S. 2011. "Societal Costs of Risky Driving: An Economic Analysis of High-Risk Patients Visiting an Urban Emergency Department." *Traffic Injury Prevention*, vol. 12, no. 2, pp. 149-158, DOI: 10.1080/15389588.2010.536599.

Sullivan, J. M. 2011. "Trends and Characteristics of Animal-Vehicle Collisions in the United States." *Journal of Safety Research*, vol. 42, no. 1, pp. 9-16, DOI: 10.1016/j.jsr.2010.11.002.

Sullivan, J. M.; Flannagan, M.J. 2011. "Differences in Geometry of Pedestrian Crashes in Daylight and Darkness." *Journal of Safety Research*, vol. 42, no. 1, pp. 33-37, DOI: 10.1016/j.jsr.2010.11.005.

Technical Reports

Luoma, J.; Sivak, M. 2011. Interactions of Environmental and Safety Measures for Sustainable Road Transportation. Report no. UMTRI-2011-3.

<http://hdl.handle.net/2027.42/83156>

The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

Sivak, M.; Schoettle, B. 2011. Benefits of Daytime Running Lights. Report no. UMTRI-2011-6.

<http://hdl.handle.net/2027.42/83221>

The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

Sivak, M.; Schoettle, B. 2011. U.S. Road Fatalities per Population: Changes by Age from 1958 to 2008. Report no. UMTRI-2011-9.

<http://hdl.handle.net/2027.42/83325>

The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

Sivak, M.; Schoettle, B. 2011. Unemployment Rate and Price of Gasoline Predict the Fuel Economy of Purchased New Vehicles. Report no. UMTRI-2011-13.

<http://hdl.handle.net/2027.42/83358>

The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

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CONFERENCES & EVENTS

June

International Bridge Conference
June 5-8; Pittsburgh, Pennsylvania
www.internationalbridgeconference.org/

Using National Household Travel Survey
Data for Transportation Decision Making: A
Workshop
June 6-7; Washington, D.C.
[www.trb.org/Calendar/Blurbs/
Using_National_Household_Travel_Survey_
Data_for_Tr_162113.aspx](http://www.trb.org/Calendar/Blurbs/Using_National_Household_Travel_Survey_Data_for_Tr_162113.aspx)

GeoHunan International Conference
II: Emerging Technologies for Design,
Construction, Rehabilitation, and Inspections
of Transportation Infrastructures
June 9-11; Hunan, China
<http://tti.tamu.edu/conferences/geohunan11/>

ITS Canada Conference
June 12-15; Vancouver, Canada
[www.itscanada.ca/english/annualconfer-
ences.htm](http://www.itscanada.ca/english/annualconferences.htm)

Symposium on Mileage-based User Fees
June 13-14; Breckenridge, Colorado
<http://utcm.tamu.edu/mbuf/>

National Association of Regional Councils
(NARC)
June 13-15; San Diego, California
www.narc.org/

Driving Assessment 2011
June 27-30; Lake Tahoe, California
<http://drivingassessment.uiowa.edu/>

International Symposium on Highway
Capacity and Quality of Service
June 28-July 1; Stockholm, Sweden
www.congrex.com/ishc/

July

TRB Joint Summer Meeting
July 10-12; Boston, Massachusetts
[www.trb.org/Calendar/Blurbs/2011_TRB_
Joint_Summer_Meeting_164066.aspx](http://www.trb.org/Calendar/Blurbs/2011_TRB_Joint_Summer_Meeting_164066.aspx)

National Summit for Rural Traffic Safety
Culture
July 11-13, 2011; Big Sky, Montana
www.ruraltscsummit.org/

Southern African Transport Conference
July 11-14; Pretoria, South Africa
[www.up.ac.za/academic/civil/satc/index.
php?year=home](http://www.up.ac.za/academic/civil/satc/index.php?year=home)

Sixth SHRP 2 Safety Research Symposium
July 14-15; Washington, D.C.
<http://safety Symposium.eventbrite.com/>

STN Expo
July 23-27; Reno, Nevada
www.stnonline.com/expo

Biomass '11: Renewable Power, Fuels, and
Chemicals Conference
July 26-27; Grand Forks, North Dakota
www.undeerc.org/biomass11/

International Forum on Traffic Records
July 31-August 3; Charlotte, North Carolina
www.atsip.org/

August

ITE Annual Meeting and Exhibit
August 13-16; St. Louis, Missouri
www.ite.org

National Rural ITS Conference
August. 28-31; Coeur d'Alene, Idaho
www.nritsconference.org/

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