

RESEARCH REVIEW

• UNIVERSITY OF MICHIGAN TRANSPORTATION RESEARCH INSTITUTE • OCTOBER–DECEMBER 2008 • VOLUME 39, NUMBER 4 •



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UMTRI Evaluations Lead to IIHS Child Booster Seat Recommendations

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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

UMTRI Evaluations Lead to IIHS Child Booster Seat Recommendations

UMTRI researchers, working with the Insurance Institute for Highway Safety (IIHS), recently evaluated forty-one belt-positioning child booster seats under conditions representing a wide range of second-row seats in vehicles. Matt Reed, research associate professor, Sheila Ebert-Hamilton, research area specialist, Kathy Klinich, assistant research scientist, and Miriam Manary, senior research associate, evaluated backless and high-back booster seats, under conditions representing a range of 2001-06 model vehicles. Even though all booster seats provide better belt fit for kids than vehicle belts alone, the results show that some boosters do a better job than others.

The purpose of child booster seats is to elevate children so that safety belts, which are designed for adults, are in the right position to restrain them in the event of a crash. Although crash data show that the boosters currently in use are very effective, the federal government's certification procedure does not test the belt fit provided by boosters.

The researchers, all in UMTRI's Biosciences Division, developed a procedure to measure belt fit using a crash dummy representing a typical six-year-old child. The booster seat should ensure that the seat belt fits as follows:

- The shoulder belt should cross snugly over the middle of a child's shoulder to provide



UMTRI BIOSCIENCES DIVISION

These photos show a dummy representing a six-year-old child strapped into a booster seat. The photo on the left shows good belt fit with the shoulder and lap belts crossing snugly over the middle of the child's shoulder and fitting flat across the upper thighs. The right photo shows poor belt fit with the shoulder belt too far outboard on the shoulder and the lap belt on the abdomen rather than thighs.

effective protection in a crash. The belt shouldn't chafe against the child's neck, both for comfort and so the child won't be as likely to move the belt behind the back or under an arm.

- The lap belt should fit flat across a child's upper thighs,

not across the soft abdomen, which is more likely to be injured in a crash than bony structures like the pelvis.

The data from the study showed that boosters differ widely in the belt fit that they provide. UMTRI researchers judged the belt fit in some boosters to be better than others based on well-

continued...

Best Booster Seat Fit

Booster seats should ensure that the car's seat belts fit the child so that:

- The shoulder belt crosses snugly over the middle of the child's shoulder, without chafing against the child's neck, and
- The lap belt fits flatly across the child's upper thighs, not across the abdomen.

If the booster seat does not meet these criteria, caregivers should look for another booster seat. However, for kids ages four to eight, *any* booster seat is better than *no* booster seat.

established biomechanical principles. The research shows that it is possible to design a booster that produces good belt fit regardless of the vehicle belt layout.

This evaluation is part of a broader research program in UMTRI's Biosciences Division that focuses on the safety of children who use the vehicle belt as their primary restraint, which includes most children ages four and up. The research includes detailed measurements of posture and belt fit on child volunteers, improvements to the realism of crash dummies representing children, and physical and computational crash simulations to assess the effects of booster design and belt geometry on crash outcomes.

Caregivers should examine the belt fit that their children are getting with the booster seats they currently have. If their child is not getting good belt fit, they should look for another booster seat. **Remember, for kids ages four to eight, any booster seat is better than no booster seat.**

Children under age four should always be transported in a child restraint with a harness, and older children will experience better protection in a harness restraint than in a booster.

For more information on evaluating belt fit, see the IIHS website, www.iihs.org/research/topics/child_restraints/default.html, or watch the online IIHS video, <http://www.iihs.org/news/rss/pr100108.html>. To read the IIHS news release on the study, go to www.iihs.org/news/rss/pr100108.html.

The complete study, "Evaluation of the Static Belt Fit Provided by Belt-Positioning Booster Seats," is available as a 27-page technical report at www.umtri.umich.edu/content/BoosterBeltsIIHS.pdf. Condensed study results are available as an eight-page, full-color magazine article in the IIHS journal Status Report at www.iihs.org/sr/pdfs/sr4308.pdf.

RR

M-CASTL Moves Forward

On October 22, the Michigan Center for Advancing Safe Transportation throughout the Lifespan (M-CASTL) completed its 2008 annual report, which can be downloaded at <http://m-castl.org/files/2008AnnualReport.pdf>.

M-CASTL staff also recently conducted a survey of the educational needs of transportation professionals. Results of the survey

(available at <http://m-castl.org/files/ProfEdReport.pdf>) will be incorporated into M-CASTL's Professional Education Program.

Respondents pinpointed their highest-priority educational topics and their preferred methods of receiving training (e.g., on-site education, web-casting, video streaming, smart boards, etc.). RR



UMTRI Participates in \$2-Million PHEV Grant

Plug-in electric vehicles (PHEVs), which are expected to be on the market in 2010, could not only provide vehicle fuel savings but could also route power back into the electricity grid during peak usage.

The National Science Foundation awarded a \$2 million grant to University of Michigan (U-M) scientists, including UMTRI's John L. Sullivan, to explore every aspect of how PHEVs will perform and interact with the electrical grid. This concept of vehicle-to-grid (V2G) integration is part of a larger effort to embrace large-scale changes needed to improve the sustainability and resilience of the transportation and electric power infrastructures.

Electric plants excel at generating power, but generally are not equipped to store it. Stored electrical energy has a number of advantages including buffering against transient surges in electricity demand or interruptions in supply, and permitting deployment of electricity-generating assets (based-load versus spin-up reserves) that lead to a more uniform power generation profile day and night. Unfortunately, massive storage systems can be costly and problematic. If V2G integration succeeds, it will enable the grid to utilize PHEV batteries as an energy store to be used by utilities when needed, such as during peak hours. Such a system is particularly valuable for storing renewable energy from wind and the sun. PHEV owners would be compensated for this usage.

Sullivan, research scientist and lead of UMTRI's Sustainable Transportation Systems Group, will employ agent-based modeling to create a virtual automotive marketplace. The model will be made up of thousands of autonomous virtual decision makers — mostly consumers, but also auto manufacturers, energy providers, and government officials. The model will be applied to study the penetration of PHEVs into the auto marketplace and their impact on the electricity grid. Sullivan says, "This is particu-

larly important as PHEVs are a potential energy resource for the electricity industry. The cost to drive a mile using electricity is four to five times lower than the cost for gasoline, which has important implications to the acceptability of these vehicles in the marketplace. During peak demand time, it would make sense to pull power from thousands of vehicles rather than having to build a new power generator."

The research team also includes Hosam Fathy, Zoran Filipi, Hwei Peng, and Jeff Stein of U-M's Department of Mechanical Engineering, Duncan Callaway and Greg Keoleian of U-M's School of Natural Resources and Environment, Jing Sun of U-M's Department of Electrical Engineering and Computer Science, Carl Simon of the U-M Gerald R. Ford School of Public Policy, and Mariesa Crow of the Missouri University of Science and Technology.

This is the third PHEV contract awarded to UMTRI in 2008. (For information on a \$30-million grant from the U.S. Department of Energy and a \$5-million grant from DTE Energy, see the July-September and April-June editions of *UMTRI Research Review*, respectively.) **RR**

IVBSS Wins Best of ITS Award

An UMTRI-led crash-avoidance program has won the Intelligent Transportation Society (ITS) of America's 2008 Best of ITS Award for Best Innovative Product or Service. The award, presented to Visteon Corporation on November 17 at the ITS World Congress in New York, recognizes projects that have demonstrated specific and measurable outcomes and exemplified innovation by establishing a "new dimension" of performance.

The award honors crash warning technology for light vehicles developed by Visteon as part of the Integrated Vehicle-Based Safety Systems (IVBSS) program, which is led by UMTRI. Jim

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Sayer, program director and UMTRI researcher, says “We appreciate ITS America’s recognition of the program’s efforts, and particularly the development of IVBSS for the light-vehicle platform by Visteon.”

The technology fully integrates a suite of crash-warning features, including forward-collision and road-departure warnings, lane-change-merge alerts, and blind-spot detection. The system provides drivers with situational awareness of the vehicle’s surroundings, and warns drivers when they are about to leave the roadway, are in danger of colliding with another vehicle while attempting a lane change, or are at risk of colliding with the vehicle ahead.

“While these features cannot substitute for safe driving, they can potentially increase the driver’s awareness of road conditions and improve response time to potential hazards,” explains Debby Bezzina, Visteon electronics program manager for the program. “This is very important as driver distraction and congestion are increasing.”

The system uses information gathered by inertial, video, and radar sensors, plus a global positioning system, to warn drivers of potentially dangerous situations to prevent or lessen the impact of crashes. The winning technology was developed for use in passenger cars, though the IVBSS program also incorporates similar technologies for heavy trucks. Both light-vehicle and heavy-truck systems are currently being tested on the road by lay drivers and commercial truck drivers, respectively.

ITS America is the leading advocate for technologies that improve the safety, security, and efficiency of the nation’s surface transportation system. Its annual meeting is the largest event

in the world for ITS leaders, policy makers, and other industry professionals. The ITS Award honors the most innovative, effective, and influential achievements in the intelligent transportation systems industry.

In addition to UMTRI and Visteon, IVBSS program partners include Eaton Corp., Honda R&D Americas, Inc., Cognex Corp., International Truck and Engine Corporation, Con-way Freight, Battelle, and the Michigan Department of Transportation. The National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) are conducting the IVBSS initiative, funded as part of the U.S. DOT’s Research and Innovative Technology Administration’s (RITA) Intelligent Transportation Systems (ITS) Technology program. **RR**



UMTRI Researchers Receive Publication Awards

The 2008 UMTRI Best Publication Award winners were announced in September. The winning paper was “Traffic Safety in the U.S.: Re-Examining Major Opportunities,” authored by Michael Sivak, division head, Juha Luoma, visiting researcher, and Mike Flannagan, research associate professor, all of UMTRI’s Human Factors (HF) Division, Ray Bingham, research associate professor, and David Eby, division head, both of UMTRI’s Social and Behavioral Analysis Division, and Jean Shope, research professor and associate director of UMTRI. The article was published in volume 38 of the *Journal of Safety Research*.

Two articles also received Research Excellence Awards:

- “Economic Theory Trumps Conventional Detroit Wisdom” by Walter McManus, head of UMTRI’s Automotive Analysis Division, which was published in the January 2007 edition of *Business Economics*.
- “Body-Pillar Vision Obstructions and Lane-Change Crashes” by Sivak, Brandon Schoettle, research associate in the HF Division, Matt Reed, associate research professor in the Biosciences Division, and Flannagan. The article appeared in volume 38 of the *Journal of Safety Research*. **RR**

UMTRI DSP Student Wins Stapp Award

Chia-Yuan (Mark) Chang, a student in UMTRI’s Doctoral Studies Program (DSP), won a Stapp Student Award at the fifty-second Stapp Car Crash Conference in November. Chang’s paper was awarded second place among the nine papers submitted. The paper, “Development of a Finite Element Model to Study the Effects of Muscle Forces on Knee-Thigh-Hip Injuries in Frontal Crashes,” was coauthored by Jonathan Rupp, assistant research scientist in UMTRI’s Biosciences Division, Larry Schneider, head of the Biosciences Division, and professor Noboru Kikuchi of the University of Michigan (U-M) Department of Mechanical Engineering.

Chang is pursuing a Ph.D. in mechanical engineering at U-M and is conducting his research in UMTRI’s Biosciences Division with the support of UMTRI’s DSP. The DSP was established by the U-M Office of the Vice President for Research in conjunction with UMTRI to support doctoral students who conduct their dissertation research at UMTRI in collaboration with U-M and UMTRI faculty. Chang’s doctoral committee is cochaired by Kikuchi and Schneider.

Also at the conference, Rupp presented the paper “Characterization of Knee-Thigh-Hip Response in Frontal Impacts Using Biomechanical Testing and Computational Simulation,” which was coauthored by Biosciences colleagues Carl Miller, engineer in research, Matt Reed, associate research scientist, Nathaniel Madura, engineer in research, Kathy Klinich, assistant research scientist, and Schneider.

The Stapp Car Crash Conference is the premier forum for presentation of research in impact biomechanics, human injury tolerance, and related fields that advance the knowledge of land-vehicle crash injury protection. **RR**

COURTESY OF THE STAPP ASSOCIATION



UMTRI Doctoral Studies Program student Chia-Yuan (Mark) Chang (right) receives the second place Stapp Student Award from Albert King, general conference chair.

UMTRI BRIEFS

Peter Sweatman Addresses U.S. House Committee

COURTESY OF ITS AMERICA



UMTRI Director Peter Sweatman addressed the U.S. House of Representatives Transportation and Infrastructure Committee on September 25 as part of a Congressional briefing. He discussed how vehicle technologies, especially intelligent transportation systems (ITS), can be employed to improve traffic safety.

Sweatman highlighted how UMTRI is leveraging its long-standing links to the auto industry, and its contribution to making driving safer. He discussed the Integrated Vehicle-Based Safety Systems (IVBSS) program, the nation's largest independent effort to integrate crash-avoidance systems into vehicles to help drivers avoid intersection and lane-departure crashes, in particular. The UMTRI-led IVBSS program is a prime example of government, industry, and university collaboration (see related story on page 3).

He stated how vehicle safety technology has been developed to focus more on crash prevention and noted that we now have the opportunity to create a truly intelligent transportation system by connecting drivers, vehicles, and infrastructure. ITS can address many problems such as unacceptably high fatality and injury rates, unreliable travel times, traffic congestion, freight bottlenecks, homeland security, and the overall lack of sustainability in personal mobility. Sweatman advocated creating "cooperative highways" by establishing permanent communication among vehicles (and their drivers) and the infrastructure. Each vehicle would no longer need to develop its own situation awareness in total isolation, but vital information would be shared.

Finally, Sweatman suggested that as the world leader in these technologies, the United States must adopt a target to reduce annual fatalities

from 42,000 to 20,000 by 2025.

You can read a transcript of the talk at www.umtri.umich.edu/content/SweatmanHouseAddress.pdf. **RR**

Ray Bingham Appointed Visiting Professor

UMTRI/SHEKHAN ERKINSON



Ray Bingham, research associate professor in UMTRI's Social and Behavioral Analysis Division, spent five weeks this fall in Australia as a visiting professor at the Queensland University of Technology Center for Accident Research and Road Safety-Queensland (CARRS Q).

During his stay, Bingham consulted with CARRS-Q faculty, mentored graduate and post-doctorate students, and delivered a keynote presentation on parental influences on children's driving at the annual meeting of the Australasian Road Safety Conference. He also spent time in Sydney at the George Institute for International Health, giving a talk on teen drivers and parental monitoring, and consulting on several teen driver projects.

Bingham's research interests are adolescent development, with a focus on adolescent driving and alcohol use, longitudinal research methodology, and multivariate statistics. He has utilized various theoretical approaches to examine psychosocial development, with particular attention to those factors that relate to driving risk and driving-related injury.

Bingham also holds research associate professor positions in the University of Michigan (U-M) Department of Psychiatry and in the U-M Department of Health Behavior and Health Education. **RR**

Stapp Car Crash Conference
November 3-5, San Antonio, Texas
www.stapp.org/2008.shtml

International Driving School Convention
November 6-8, Las Vegas, Nevada
<http://thedsaa.org/conference-detail.asp?id=3>

Roads and the Environment
November 10-11, Geneva, Switzerland
www.irfnet.org

ITS America World Congress
November 16-20, New York, New York
www.itsworldcongress.org

Airbag 2008
December 1-3, Karlsruhe, Germany
www.ict.fraunhofer.de/VuM/Airbag/index.jsp

Transportation Finance Summit
December 7-9, Washington, D.C.
www.ibtta.org

Transportation Engineering & Safety
Conference
December 10-12, State College, Pennsylvania
www.outreach.psu.edu/programs/transportation

ITS International Best Practices Workshop:
Transit Applications
December 9-10, San Francisco, California
www.apta.com/conferences_calendar/itsbest

Integrated Transport for Sustainable Urban
Development
December 15-17, Beijing, China
www.trb.org/calendar

TRB 88th Annual Meeting
January 11-15, Washington, D.C.
www.trb.org/meeting

North American International Auto Show
January 17-25, Detroit, Michigan
www.naias.com

NAPA Annual Convention
January 18-21, San Diego, California
www.hotmix.org

MITA Annual Meeting
January 21-23, Mt. Pleasant, Michigan
www.mi-ita.com

Crash Data Retrieval User's Conference
January 26-28, Houston, Texas
www.crashconferences.com

International CAR Symposium
January 27-28, Bochum, Germany
www.fh-gelsenkirchen.de/fb11/homepages/CAR

Seventh World Mobility Forum
January 28, Stuttgart, Germany
www.worldmobilityforum.com

National Biodiesel Conference
February 1-4, San Francisco, California
www.biodieselconference.org

ATSSA Convention and Traffic Expo
February 1-5, San Jose, California
www.atssa.com/cs/atssa-2009-traffic-expo

World of Concrete
February 2-6, Las Vegas, Nevada
www.worldofconcrete.com

American Trucking Association Meeting
February 9-12, Orlando, Florida
www.truckline.com

Hybrid Vehicle Technologies Symposium
February 11-12, San Diego, California
www.sae.org/events/training/symposia/hybrid

Expanding the Vision of Sustainable Mobility
February 17-19, Pasadena, California
www.artcenter.edu/summit

TransITech 2009
February 18-20, Toronto, Canada
www.apta.com/conferences_calendar/trantech/

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CONFERENCES & EVENTS

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.

Conference Papers

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Technical Reports

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TRANSPORTATION TIDBITS

- On November 23, 1897, in Lansing, Michigan, Ransom Eli Olds was issued a U.S. patent for his “motor carriage,” a gasoline-powered vehicle built the previous year. Two months before receiving his patent, Olds formed the Olds Motor Vehicle Company, which later became Olds Motors Works. After designing various prototypes, Olds settled on the Olds Runabout which began production in 1901. The small, motorized buggy had a curved dashboard and lightweight wheels, and was powered by a one-cylinder engine capable of reaching 20 mph. In contrast to other car builders who individually hand-crafted each vehicle, Olds contracted other companies to construct parts for the Runabout. This idea served as the prototype for assembly line production that Henry Ford popularized.
- England issued its first license plate on December 24, 1903, to Earl Russell. The license number was A1 and Earl was the brother of philosopher Bertrand Russell.
- On October 2, 1947, the Federation Internationale de l'Automobile (FIA) formally established Formula One racing in Grand Prix competition. Technological progress made during World War II had made prewar racing rules obsolete. Rule changes included reducing the minimum race distance from 500 km to 300 km, a change that allowed the famous Monaco Grand Prix to be reintroduced into official Grand Prix racing.
- On November 15, 1977, the 100,000,000th Ford was built at the Mahwah plant in New York. The car was a Ford Fairmont four-door sedan. The Fairmont series was introduced at the beginning of the 1978 model year, to replace the discontinued Ford Maverick, and continued being built through 1983.
- On December 5, 1977, the Plymouth Horizon was introduced. It was the first American-made small car with front-wheel drive. Technical advances in drive technology had reduced the size and cost of front-wheel drive systems.
- On October 22, 1987, Canadian Garry Sowerby and American Tim Cahill completed the first trans-America drive. Their drive started in Ushuaia, Tierra del Fuego, Argentina, and ended in Prudhoe Bay, Alaska, and spanned 23 days, 22 hours, and 43 minutes. The pair drove the 14,739-mile distance in a 1988 GMC Sierra K3500 four-wheel-drive pickup truck powered by a 6.2-liter V-8 Detroit Diesel engine. **RR**

Source:

This Day in Automotive History, www.historychannel.com/tdih



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