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Child Passenger Safety

UMTRI-IIHS study shows easy-to-spot anchors boost tether use

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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-IIHS Study Shows Easy-to-Spot Anchors Boost Tether Use

If a vehicle's tether anchors are easy to find, parents are more likely to use top tethers when installing a child restraint, according to a study performed by UMTRI for the Insurance Institute for Highway Safety.

This is most often the case in sedans. Most tether anchors in sedans are on the rear shelf, behind the back seat, where they are easy to see. In SUVs and minivans, parents usually have to search for the anchors because they are typically on the floor, middle or lower seat back, in the cargo area, or on the ceiling.

Tethers are part of a child-restraint-attachment system called Lower Anchors and Tethers for Children, or LATCH. All forward-facing child restraints made since 1999 have a built-in top tether typically located just behind the upper back of the child restraint. Top tethers should be used with all forward-facing child restraints, whether they are secured by safety belts or with a vehicle's lower anchors.

Previous studies have established that parents only use top tethers with forward-facing child restraints about half the time despite the fact that passenger vehicles have had corresponding anchors to attach the straps for more than a decade.

UMTRI associate research scientist Kathleen Klinich led the current study.

"We also found room for improvement in the owners-manual instructions for using the tether," said Klinich. "Providing better directions for how to route different styles of tethers could help reduce errors."

In the study, researchers recruited thirty-seven parents and specifically told them to use LATCH to install two different forward-facing child restraints in four different vehicles for a total of eight installations. The sixteen vehicles used in the study had a range of tether anchor characteristics.

Parents used the top tether in 89 percent of the 294 forward-facing child restraint installations and attached the tether correctly 57 percent of the time. Because the instructions were designed to encourage tether use, the rate of tether installations was higher than recorded in field observations. Tether-use rates improved from 83 percent to 95 percent after researchers in the study gave parents specific instructions on using LATCH and tethers halfway through their installations.

In sedans with tether anchors located on the rear shelf, 95 percent of parents used tethers, compared with 79 to 89 percent of parents when the anchors were located on the floor, ceiling, or seat back. What's more, parents in the study were more likely to use tethers correctly when anchors were on the rear shelf or at the middle of the seat back than those located in other spots in the vehicle.

Additionally, the researchers noted that when vehicles had hooks for tying down cargo or other confusing hardware that could be mistaken for a tether anchor, the chances that parents would use and correctly install tethers were lower than in vehicles without such gear. This was most often the case in SUVs and minivans, while sedans were less likely to have confusing hardware. If parents did use top tethers in vehicles with confusing hardware, just 47 percent of the straps were attached correctly, compared with 70 percent of installations when there was no confusing hardware.

The study findings complement earlier UMTRI and IIHS research of the key vehicle factors that make lower LATCH anchors easier to use.

Read the full report: ***http://hdl.handle.net/2027.42/106031***

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COURTESY UMTRI BIOSCIENCES GROUP

USDOT Gives Green Light to Connected-Vehicle Technology

A twenty-first-century transportation system that relies on wireless communication between vehicles moved a step closer to reality in February following a decision by the U.S. Department of Transportation's (USDOT) National Highway Traffic Safety Administration (NHTSA) to proceed with the technology for light vehicles. This technology would improve safety by allowing vehicles to "talk" to each other and ultimately avoid many crashes altogether by exchanging basic safety data, such as speed and position, at a rate of ten times per second.

"Vehicle-to-vehicle technology represents the next generation of auto-safety improvements, building on the life-saving achievements we've already seen with safety belts and air bags," said USDOT Secretary Anthony Foxx.

On the Streets of Ann Arbor

The decision to move forward with vehicle-to-vehicle (V2V) communication technology hinged in part upon data collected by UMTRI as part of the USDOT-funded Safety Pilot Model Deployment. The USDOT launched the model deployment at UMTRI in August 2012.

Since then, the pilot study has involved nearly 3,000 vehicles equipped with wireless devices operating on the roadways of northeast Ann Arbor. During the past eighteen months, more than 30 billion basic safety messages have been collected, and more than 60,000 interactions between participating vehicles have occurred.

"UMTRI has been a leader in connected-vehicle-technology research for more than a decade," said UMTRI director Peter Sweatman. "Safety Pilot Model Deployment is emblematic of the large-scale, visionary research that UMTRI is able to deliver."

NHTSA is currently finalizing its analysis of the data gathered as part of its pilot program and will publish a research report on V2V communication technology for public comment in the coming weeks. The report will include an analysis of the department's research findings in several key areas including technical feasibility, privacy and security, and preliminary estimates on costs and safety benefits.

V2V: The Next Generation of Vehicle Safety

Safety applications using V2V technology can potentially address a large majority of crashes involving two or more motor vehicles. With safety data such as speed and location flowing from nearby vehicles, vehicles can identify risks and provide drivers with warnings to avoid other vehicles in common crash types such as rear-end, lane change, and intersection crashes. These safety applications have been demonstrated with everyday drivers under both real-world and controlled test conditions. The safety applications currently being developed provide

COURTESY SAFETY PILOT MODEL DEPLOYMENT

warnings to drivers so that they can prevent imminent collisions but do not automatically operate any vehicle systems, such as braking or steering.

V2V communications can also be used to provide the vehicle and driver with 360-degree situational awareness to address additional crash situations – including those, for example, in which a driver needs to decide whether it is safe to pass on a two-lane road (potential head-on collision), make a left turn across the path of oncoming traffic, or in which a vehicle approaching an intersection appears to be on a collision course. In those situations, V2V communications can detect threats hundreds of yards from other vehicles that cannot be seen, often in situations in which on-board sensors alone cannot detect the threat.

"V2V crash-avoidance technology has game-changing potential to significantly reduce the number of crashes, injuries and deaths on our nation's roads," said NHTSA acting administrator David Friedman. "Decades from now, it's likely we'll look back at this time period as one in which the historical arc of transportation safety considerably changed for the better, similar to the introduction of standards for seat belts, airbags, and electronic-stability-control technology."

Reimagining Transportation

USDOT's support of connected-vehicle technology also comes as good news for the newly formed Mobility Transformation Center (MTC) at the University of Michigan. The MTC works with government and industry to lay the foundations for a commercially viable ecosystem of connected and automated vehicles. A key element is to develop vehicle deployments that will allow researchers to test emerging approaches in both off-road and on-road settings.

"Connected and automated vehicles provide a new platform for safety improvements, better traffic movement, emissions reduction, energy conservation and maximized transportation accessibility," said Peter Sweatman, director of the MTC.

In October 2013, the U-M Board of Regents approved plans to proceed with the design of a unique environment for testing connected and automated vehicles. Current plans call for the facility to be completed by fall 2014 at a cost of about $6.5 million.

The facility is a critical element of the U-M Mobility Transformation Center's goal to develop and implement an entire system of connected and automated vehicles on the streets of southeast Michigan by 2021. RR

UMTRI BRIEFS

Lowering the Cost of Human-Body Measurement

UMTRI researchers use data on the size and shape of the human body to improve vehicle safety and comfort. In several recent studies, the Biosciences Group has used a state-of-the-art laser scanner to capture up to 500,000 data points describing human-body contours of more than 700 people. These valuable data are being used to create more accurate computer models to simulate vehicle occupants in crashes and to guide the development of new crash-test dummies.

The challenge? Amassing a broader range of data. Specifically, more data are needed from adults and children with a wide range of body sizes. While the laser scanner is accurate, it has its limitations.

"The laboratory laser scanner is very accurate, but it's large—over ten feet tall—and costs over $100,000," explains research professor Matthew Reed, head of the UMTRI Biosciences Group. "We need a more-portable, less-expensive measurement system that can be sent out into schools and workplaces."

UMTRI researchers may have found the solution in their own living rooms. They discovered that Kinect sensors used with the popular Xbox gaming console offer a promising option. These sensors use a "depth camera" that tracks the distance of objects from the sensor. Biosciences researchers and collaborators from the U-M College of Engineering and the Medical School are adapting this gaming technology to create an inexpensive and portable body-measurement system. A team of four undergraduate students created a hardware design integrating two Kinect sensors as part of a senior design project. Biosciences postdoctoral fellow Daniel Park has developed a software suite that gathers data through the sensors and turns the depth information into three-dimensional points.

A critical innovation has been a statistical methodology for interpreting the low-resolution output from the Kinect sensors using the extensive knowledge about body shapes learned from the high-resolution data gathered from the laser scanner.

"We search the space of possible human body forms to find the shape that best matches the data from the Kinect sensors," said Reed. "This allows us to overcome the limitations of the sensors and generate high-quality output very quickly."

The researchers anticipate a wide range of applications for the new technology. In addition to adding to UMTRI's database of child body shapes for transportation-research purposes, Reed has partnered with Dr. Carey Lumeng and Dr. Julie Lumeng of the U-M Medical School to explore use of the system to track treatments for pediatric obesity. This collaboration, funded under the University's innovative MCubed program, aims to develop clinical applications for body-shape measurement. RR

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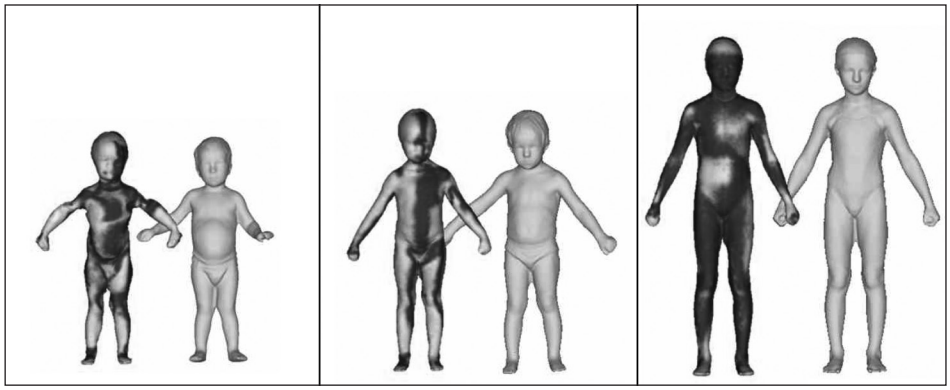


Comparison of scan data from Kinect and laser-scan systems.

FHWA, MDOT, UMTRI Use Sensors to Detect Weather and Road Conditions

Difficult winter-weather conditions in January and February have underscored the need for research into more efficient methods to improve winter travel conditions.

One promising method is called integrated mobile observations (IMO). Michigan is one of three states conducting IMO research using sensor technology to collect road and weather data to prioritize winter maintenance. The IMO research is a joint effort by the Federal Highway Administration (FHWA) Road Weather Management Program, Michigan Department of Transportation (MDOT), and UMTRI.

The research involves outfitting MDOT fleet vehicles with customized smartphones mounted on the vehicle's dashboard to collect data on atmospheric conditions and pavement condition as the vehicle travels down the road.

MICHIGAN DEPARTMENT OF TRANSPORTATION

Data collected from MDOT fleet vehicles is sent every five minutes to a secure server at UMTRI and then on to the National Center for Atmospheric Research (NCAR) in Colorado and to four other weather-analyst groups throughout the United States. NCAR is using the data to explore and develop applications to provide near-real-time advisory warnings for motorists and provide snowplow drivers with improved weather forecasts and road-treatment recommendations.

Bruce Belzowski, research area specialist lead, coordinates the UMTRI portion of the project. The IMO project follows up on previous work with MDOT and is now part of UMTRI's connected-vehicle research.

"IMO allows us to refine the smartphone application DataProbe to make it more responsive and accurate in collecting data that changes very quickly," said Belzowski. "We are also using this platform for collecting road-roughness data for MDOT."

Making Winter Driving Safer

The IMO project involves collecting data from sixty fleet vehicles traveling on portions of I-94 on a regular basis, including twenty snowplows and eleven light vehicles on the southwest portion of I-94 in Berrien, Van Buren, Kalamazoo, and Calhoun counties; fifteen light fleet vehicles on the middle portion of I-94 in Jackson and Washtenaw counties; and fourteen light fleet vehicles on the southeast portion of I-94 in Wayne, Macomb, and St. Clair counties.

"This technology has the very real potential to make winter driving safer and winter road maintenance more efficient and effective," said State Transportation Director Kirk T. Steudle.

MDOT IMO project manager Steve Cook emphasized the research is being done to develop technology that will prioritize winter maintenance to improve safety, save money, and have less of an impact on the environment by reducing the amounts of salt and chemicals being used to clear roads.

"Information from these vehicles is important in three ways," said Cook. "The data will allow us to provide better forecasts and information for the operators who are managing the storm, make roads safer for drivers, and help protect the environment." RR

UMTRI Highlights from 93rd TRB Meeting

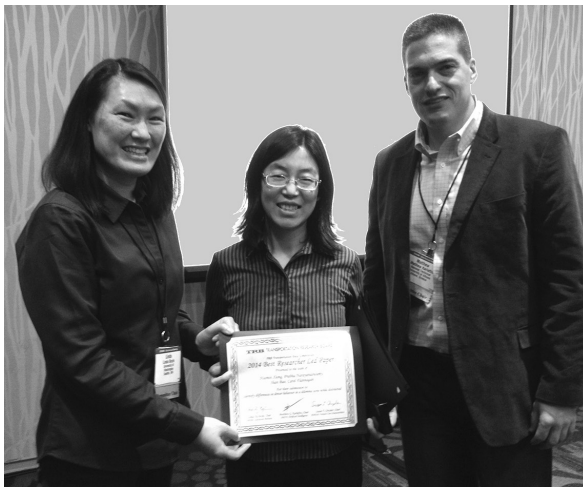
A number of UMTRI researchers joined transportation professionals from around the world in Washington, D.C., recently at the 93rd annual meeting of the Transportation Research Board (TRB).

The theme for the 2014 TRB meeting was Celebrating Our Legacy, Anticipating Our Future. More than thirty sessions and workshops focused on this theme with others devoted to such critical transportation issues as performance measurement, automated driving and connected vehicles, extreme weather events, and big data.

UMTRI highlights include the following:

In the TRB Transportation Data Competition workshop, an UMTRI team won the 2014 Best Researcher-Led Paper. UMTRI team members included research fellow Huimin Xiong, statistician Prabha Narayanaswamy, assistant research scientist Shan Bao, and associate research scientist Carol Flannagan. The competition required researchers to "identify differences in driver behavior in a dilemma zone while distracted."

Many other UMTRI researchers participated in sessions and workshops as presenters and coauthors on scientific papers including the following:



Linda Ng Boyle, Statistical Methods Committee chair; UMTRI research fellow Huimin Xiong; and Matthew G. Karlaftis, Artificial Intelligence Committee chair.

Session: Citywide Sustainability Policy Development, Practice, and Evaluation: International Perspective
"Challenges of and Opportunities for Developing Sustainable Transportation Systems in Beijing"
Sue Zielinski, managing director, SMART

Session: Crash Severity Analysis
"Sampling Serious Injuries in Traffic Crashes at the State Level"
Associate research scientist Carol Flannagan, Michael Elliott, University of Michigan; Clay Mann, University of Utah; UMTRI research associate professor Jonathon Rupp

Session: Naturalistic Driving Data and Driver Behavior
"Factors Affecting Drivers' Decisions to Use a Cell Phone: Implications from Naturalistic Study"
Research fellow Huimin Xiong; assistant research scientist Shan Bao; research professor James R. Sayer

Session: Predictors of Teenage Driving Risk
"Psychosocial Characteristics of Young Drivers and Their Association with Crash Risk: A Review"
Research professor C. Raymond Bingham; assistant research scientist Lisa Buckley; assistant research scientist Anuj Pradhan; research professor emerita Jean Thatcher Shope.

Session: Standardization of Measurement of Driving Performance
"Society of Automotive Engineers Recommended Practice J2944: Operational Definitions of Driving Performance Measures and Statistics"
"Implementation and Dissemination of Recommended Practice"
Research professor Paul A. Green

Session: Statistical Challenges in the Analysis of Naturalistic Driving Data
"Challenges in Analysis of Naturalistic Driving Data to Understand Safety"
Associate research scientist Carol Flannagan

Session: Truck and Bus Safety
"Truck and Bus Safety: Key Research Past, Present and Future"
Associate research scientist Daniel Blower.

The TRB Annual Meeting program covers all transportation modes, with more than 4,500 presentations in nearly 800 sessions and workshops. RR

Automotive Cybersecurity Expert Joins UMTRI

Automotive cybersecurity expert André Weimerskirch joined UMTRI on January 1, 2014, as an associate research scientist. Weimerskirch is an internationally known expert in the area of automotive cybersecurity, vehicle-to-vehicle (V2V) communication security and privacy mechanisms both in the United States and Europe.

Weimerskirch will play a key role at UMTRI as a leader of research in cybersecurity and privacy as it relates to critical areas of transportation safety and future mobility systems.

"Transportation cybersecurity is essential for today's vehicles with an increasing number of wired and wireless interfaces, and it will be even more important for future vehicle technologies such as connected vehicles and automated transportation systems," said UMTRI director Peter Sweatman. "André will work with UMTRI's Engineering Systems Group and will establish a security group at UMTRI to perform research to better understand the risks and to develop solutions, and make UMTRI a leader in the area of automotive and transportation security."

Before joining UMTRI, Weimerskirch cofounded the automotive cybersecurity company ESCRYPT (acquired by Bosch in 2012), where he was in charge of ESCRYPT's American and Asian operations, which have offices in the United States, Japan, and Korea. Weimerskirch led ESCRYPT's work for the Michigan-based Crash Avoidance Metrics Partnership (CAMP) to define and implement a vehicle-to-vehicle (V2V) communication-security strategy that was eventually used for the UMTRI-led Safety Pilot Model Deployment to define the security concept of operation and to establish ESCRYPT's V2V software security stack.

Weimerskirch holds a PhD from Ruhr-University Bochum, Germany, in applied data security and an MS in computer science from Worcester Polytechnic Institute. He is active in all areas of automotive and transportation cybersecurity and privacy, has published numerous articles in the area of automotive and embedded cybersecurity, and is cofounder of ESCAR USA, a key U.S. collaboration on embedded security in cars.

"I am excited to join UMTRI and I believe UMTRI provides the perfect environment for advancing automotive cybersecurity due to its experience and reputation as well as close proximity to Detroit's car makers," said Weimerskirch. "I want to support UMTRI in becoming a leader in automotive and transportation cybersecurity and I look forward to exciting projects and collaborations." RR

Recent UMTRI Publications

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.

Book Chapters

Fancher, P.; Macadam, C. 2014. "Longitudinal Control." In *Road and Off-Road Vehicle System Dynamics Handbook,* edited by Giampiero Mastinu, Manfred Ploechl. CRC Press, ISBN 978-0-8493-3322-4.

Journal Articles

Divekar, G.; Pradhan, A.K.; Masserang, K.M.; Reagan, I.; Pollatsek, A.; Fisher, D.L. 2013. "A Simulator Evaluation of the Effects of Attention Maintenance Training on Glance Distributions of Younger Novice Drivers inside and outside the Vehicle." *Transportation Research Part F: Traffic Psychology and Behaviour,* vol. 20, September , pp. 154-169. DOI:10.1016/j.trf.2013.07.004

Schoettle, B.; Sivak, M. 2014. "The Reasons for the Recent Decline in Young Driver Licensing in the United States." *Traffic Injury Prevention,* vol. 15, no. 1, pp. 6-9. DOI:10.1080/15389588.2013.839993

Twisk, D.A.M.; Vlakveld, W.P.; Commandeur, J.J.F.; Shope, J.T.; Kok, G. 2014. "Five Road Safety Education Programmes for Young Adolescents: A Multi-Programme Evaluation in Field Settings." *Accident Analysis & Prevention,* vol. 66, May, pp. 55-61. DOI:10.1016/j.aap.2014.01.002

Technical Reports

Klinich, K.D.; Orton, N.R.; Flannagan, C.A.C.; Manary, M.A.; Malik, L.M.; Narayanaswamy, P. 2014. Factors Affecting Tether Use and Misuse. Report no. UMTRI-2014-7.
http://hdl.handle.net/2027.42/106031
The research documented in this report was sponsored by the Insurance Institute for Highway Safety.

Sivak, M. 2014. Has Motorization in the U.S. Peaked? Part 4: Households without a Light-Duty Vehicle. Report no. UMTRI-2014-7.
http://hdl.handle.net/2027.42/102535
The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

Sivak, M. 2014. Mortality from Road Crashes in 193 Countries: A Comparison with Other Leading Causes of Death. Report no. UMTRI-2014-6.
http://hdl.handle.net/2027.42/102731
The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

Sivak, M.; Schoettle, B. 2013. Road Safety in 170 Low-, Middle-, and High-Income Countries. Report no. UMTRI-2013-37.
http://hdl.handle.net/2027.42/100256
The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.

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Conferences & Events

March 2014

Transportation Planning, Land Use and Air Quality Conference
March 3-4; Charlotte, North Carolina
www.ucs.iastate.edu/mnet/tpluaq/home.html

Aging in America Conference
March 11-15; San Diego, California
www.asaging.org/aia

UMTRI-Toyota Leadership in Transportation Seminar Series
March 13; Ann Arbor, Michigan
www.umtri.umich.edu/

April 2014

SAE World Congress & Exhibition
April 8-10; Detroit, Michigan
www.sae.org/congress/

Global Symposium on Connected Vehicles and Infrastructure
April 21-23; Ann Arbor, Michigan
www.umtri.umich.edu/

Lifesavers National Conference on Highway Safety Priorities
April 27-29; Nashville, Tennessee
www.lifesaversconference.org/

National Conference on Transportation Asset Management
April 28-30; Miami, Florida
www.trb.org/calendar

May 2014

GIS for Transportation (GIS-T) Symposium
May 5-8; Burlington, Vermont
www.gis-t.org/

June 2014

RESNA Annual Conference
June 11-15; Indianapolis, Indiana
www.resna.org/conference/

July 2014

Automated Vehicles Symposium
July 15-17; San Francisco, California
www.trb.org/calendar

Transportation Planning for Small- and Medium-Sized Communities
July 21-23; Burlington, Vermont
www.trbtoolsofthetrade.org/

August 2014

CAR Management Briefing Seminars
August 4-7; Traverse City, Michigan
http://www.cargroup.org/

National Rural ITS Conference
August 24-27; Branson, Missouri
www.nritsconference.org/

International Symposium on Naturalistic Driving Research
August 25-28; Blacksburg, Virginia
http://www.vttindrs.org/

September 2014

ITS World Congress on Intelligent Transport Systems
September 7-11; Detroit, Michigan
www.itsworldcongress.org

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