

# research review

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*In recognition of UMTRI's 50th anniversary, a series of articles throughout 2015 will highlight the technological and cultural progress in four key areas impacting transportation safety—data collection and analysis, occupant protection, the lifecycle of driving and drivers, and connected technology.*

## Fifty Years of Occupant-Protection Research

A top-view image showing the red interior of a classic 1965 convertible fills the computer screen in research professor Matt Reed's office. Reed, head of UMTRI's Biosciences Group, catalogs the car's basic safety features, or lack thereof.

"No seatbelts. No head restraints. No airbags or knee bolsters. No penetration-resistant windshield. There's a complete absence of all the safety features we now take for granted," says Reed.

This was the era—the mid-1960s—when motor-vehicle fatality rates escalated. In 1965, 47,089 Americans lost their lives in traffic crashes (over 887 billion vehicle miles traveled) as compared to 32,719 motor-vehicle traffic fatalities in 2013 (over 2,946 billion vehicle miles traveled). Widespread alarm led to enactment of the National Traffic and Motor Vehicle Safety Act, which empowered the government to establish safety standards for vehicles.

This was also the cultural context in which the Highway Safety Research Institute—now called UMTRI—was formed.



*Courtesy of Mustangattitude.com*

At the time, crash investigations in the field were just beginning to yield data on how crashes occur and what happens to vehicle occupants during a crash. The study of human performance in operating vehicles, and the biomechanical responses to crash forces (both initially topics of interest to the military and the

(Continued on page 2)

# Physical Testing and Computer Modeling

Manufacturers, governments, and consumer-information organizations evaluate vehicle safety through crash testing. In these carefully controlled tests, crash-test dummies sit in for human occupants. But how realistic are the dummies? And do they tell engineers what they need to know to design safer cars?



UMTRI researchers have worked continuously since the 1970s to improve the realism of crash-test dummies and to ensure that they are used in the most effective ways to improve the protection of the humans they're meant to represent. They've

also been on the forefront of the development and application of computer-simulation tools to go beyond the limited number of tests that can be conducted with physical dummies.

## Crash-Test Dummy Size and Shape

UMTRI is a world leader in the esoteric art of engineering anthropometry—that is, measuring and modeling the size, shape, posture, and position of people for applications to the design of products.

Since the 1970s, UMTRI biosciences researchers have gathered detailed information for the design of crash-test dummies and other human surrogates. Dr. Richard G. Snyder and Dr. Lawrence Schneider led a large team that fanned out across the country to measure children from birth through age 18. The data from landmark studies published in 1975 and 1977 are the basis for the geometry of many of the dummies used to represent children.

In 1985, Schneider and colleagues published a comprehensive three-volume report on the anthropometry of motor-vehicle occupants that has been the basis of all adult crash-test dummies developed since that time. More recently, Dr. Matthew Reed and Sheila Ebert presented the first crash test dummy specification based on whole-body, three-dimensional measurement. The design data for the Warrior Injury Assessment Manikin will form the foundation for a new test dummy for the U.S. Army.



## Crash-Test-Dummy Posture, Position, and Belt Fit

Having a test dummy that accurately represents human size and shape is important, but a realistic posture and position in the vehicle is also essential to ensure that the belts, airbags, and other components that make up the occupant-restraint system work properly together.

Beginning in the late 1970s, biosciences researchers have measured the posture and position of thousands of men, women, and children sitting in vehicles and in laboratory mockups.

# Fifty Years of Occupant-Protection Research

(Continued from page 1)

space program) were now the major emphasis of leaders of industry, government, and consumer advocacy organizations who aimed to reduce the carnage on the nation's highways.

Motor-vehicle safety and occupant protection have been a foundational part of UMTRI research for five decades. Over the years, research methods and techniques have changed. In the early days of the institute, researchers conducted physical testing using rudimentary crash-test dummies. Beginning in the 1970s, UMTRI biosciences researchers pioneered the use of computer simulation to study occupant movements in crashes.

Today, computer simulations using complex models of realistic human anatomy enable assessment of occupant protection for a wide range of body sizes and shapes. Current research in UMTRI's Biosciences Group is aimed at improving crash safety for child passengers, wheelchair users, older drivers, obese occupants, and military personnel. Highlighted in this issue are computational human modeling, child passenger safety, and transportation safety for occupants seated in wheelchairs.

Among other outcomes, these data have enabled test engineers to place dummies in the most likely posture and position for people who are similar in size to the dummies.

Test procedures based on UMTRI research are used by the Insurance Institute for Highway Safety to position dummies for crash tests, leading all manufacturers to apply the UMTRI procedures as they optimize their restraint designs. UMTRI methods are also used by manufacturers, government agencies, and consumer information groups for child dummy position and for the measurement of belt fit.

## Beyond Crash-Test Dummies: Computational Human Models

UMTRI researchers were quick to recognize the potential of computer simulation to study and improve occupant protection. With support from the Motor Vehicle Manufacturers Association (MVMA), Biosciences researchers and programmers developed the MVMA Crash Victim Simulation Program, a set of software routines that ran on the U-M mainframe computer.

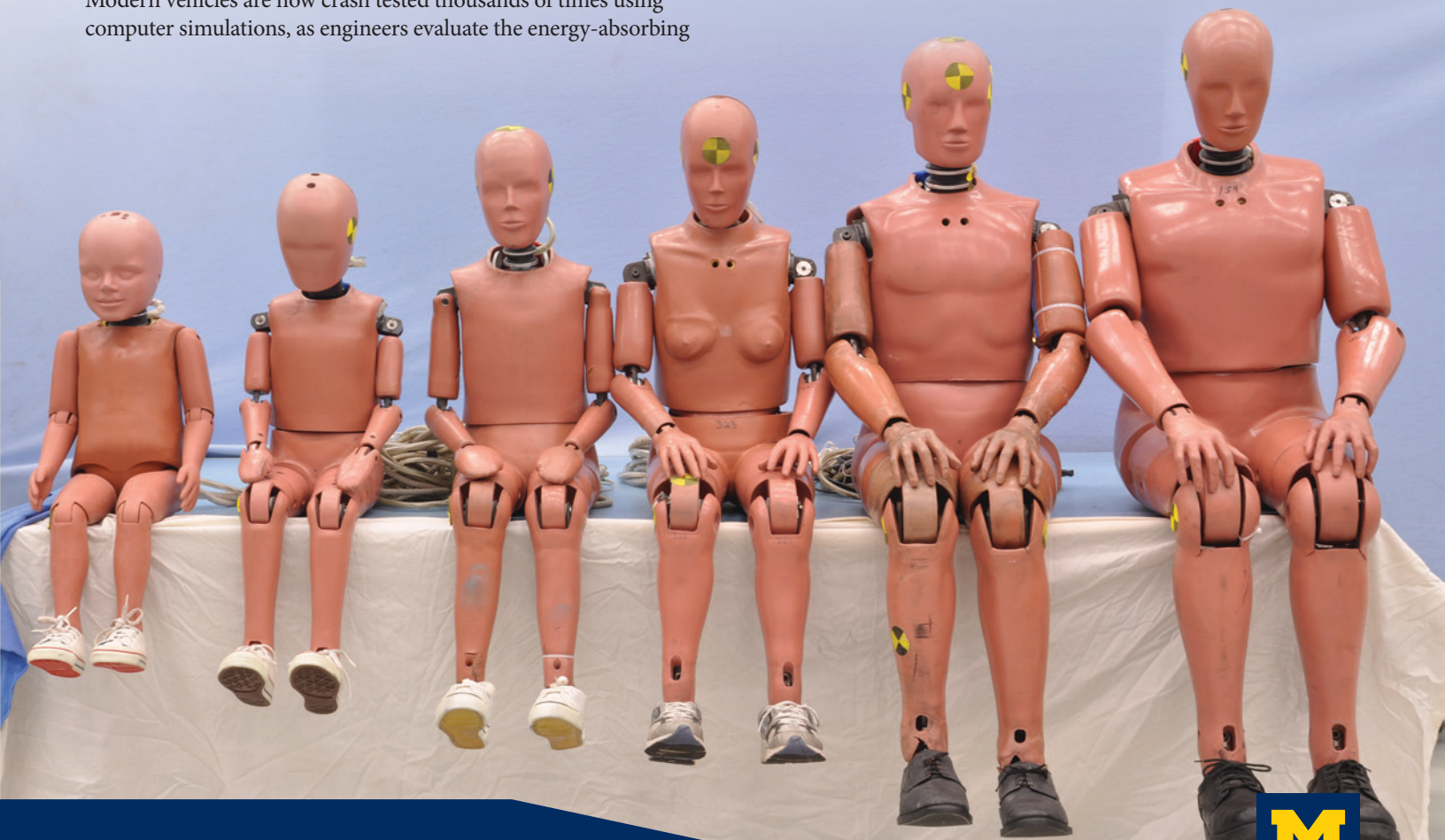
This early system represented body segments in two dimensions and used greatly simplified equations to represent human motion during crashes, but proved to be very useful for optimizing the layout of early seatbelt systems. In the 1980s, the “MVMA 2D” program was converted to run on desktop computers and eventually transitioned to three-dimensional representations.

Modern vehicles are now crash tested thousands of times using computer simulations, as engineers evaluate the energy-absorbing

characteristics of the structure, the performance of the airbags, and the injury metrics measured on the simulated occupants. Using the commercial software tools that grew out of the research from the 1970s and 80s, Biosciences researchers are developing and applying new simulation and optimization techniques to improve protection for people who are larger or smaller than the crash test dummies.

The focus of the computational modeling work in the Biosciences group is the development of “parametric human-body models.” Currently, most computer simulations of crashes use computational models of crash test dummies (a model of a model, in other words) because the primary goal is to predict what would happen in a physical test of the vehicle with a crash test dummy. However, to move beyond the limitations of the crash test dummies, models of realistic human anatomy are needed.

Biosciences researchers have pioneered new methods to “morph” highly detailed human models to represent a wide range of occupants. Elderly and obese occupants, who field data analyses show are at increased risk in crashes, are the major focus. The parametric models are based on extensive data on exterior body shape and interior anatomy gathered in a series of studies over the past ten years. The use of these human models will accelerate in the coming years as advances in computer technology enable vastly more complex simulations to be conducted far faster than could be done with the simple two-dimensional models of the 1970s.





# Child Passenger Safety

UMTRI Biosciences Group

UMTRI has been instrumental in gathering and organizing the latest research on child passenger safety in one volume: *Crash Protection for Child Passengers: Rationale for Best Practice*. The widely-cited booklet was first published in 2000 and updated in 2012. See: [www.cpsbestpractice.org](http://www.cpsbestpractice.org).

Most baby boomers can remember a time when it was relatively common for young children to ride in the front seats of vehicles, often without seatbelts. For infants and toddlers, child-safety seats were almost nonexistent. When they did appear, early versions of car seats were simply intended to contain children rather than protect them in crashes.



Fortunately for the traveling public, child-passenger safety has improved dramatically in the last fifty years, thanks in large measure to the ground-breaking work of researchers in UMTRI's Biosciences Group.

"UMTRI was the first to develop dynamic testing of child safety seats, with seats subjected to simulated crashes with dummies representing the occupants," explains UMTRI senior research engineering associate Miriam Manary. "That's been a consistent theme at UMTRI—improving the ways seats are tested and the tools and techniques used."

Many researchers in the Biosciences Group at UMTRI have contributed to research projects targeted toward improving child-passenger safety. Former researcher Kathleen Weber led the UMTRI team to develop and validate one of the first instrumented, infant, crash-test dummies in response to the infant airbag fatalities that followed the introduction of mandatory frontal-impact airbags in vehicles in the early 1990s.

Prior to this time, crash-test dummies used in vehicle-impact testing resembled bean bags of correct shape and mass distribution, says Manary, who explains why this was a problem:

"Children are not small adults. Their bodies have different proportions, most notably disproportionately large heads, and they're vulnerable to different types of injuries because their skeletal systems are not fully developed. Children need specialized systems to provide crash protection in automobiles."

Since the 1970s, UMTRI biosciences researchers have been leaders in taking precise measurements of children to determine realistic data on body shape and size. The latest incarnations involve development of parametric human models representing children of different sizes that can be used to optimize fit and protection of restraint systems that work with a wide range of children.

UMTRI researchers were also among the first to quantify seat-belt fit on children and improve compatibility between child restraints and vehicles. This research has led to industry-wide changes that have helped inform vehicle-interior design and have resulted today in vehicles that can better accommodate and protect children.

Associate research scientist Kathleen Klinich has led several studies to examine factors associated with child-restraint-installation errors, because misuse remains common. Despite that, says Klinich, motor-vehicle fatalities of child passengers dropped by 41 percent since 1996:

“Children are not small adults. Their bodies have different proportions, most notably disproportionately large heads, and they’re vulnerable to different types of injuries because their skeletal systems are not fully developed. Children need specialized systems to provide crash protection in automobiles.”

“The drop in fatalities coincides with revisions of state laws requiring more kids to use child restraints, as well as improved child-restraint designs.” Current research involves using crash data to examine how to prioritize next steps for continuing to reduce child injuries and fatalities in crashes.

Manary agrees that much has been accomplished: “When I first entered field in 1988, 55 percent of children killed in motor-vehicle crashes were not using any occupant restraint system. Now that number is down to approximately 30 percent. Even with all the misuse, if we could get every kid in an age-appropriate restraint, we could reduce the number of injuries and fatalities dramatically.”

Manary adds that it is important for parents to realize that motor-vehicle crashes are still the leading cause of death for children in the United States, and child restraints are highly effective in preventing child fatalities.



## IMPACTS:

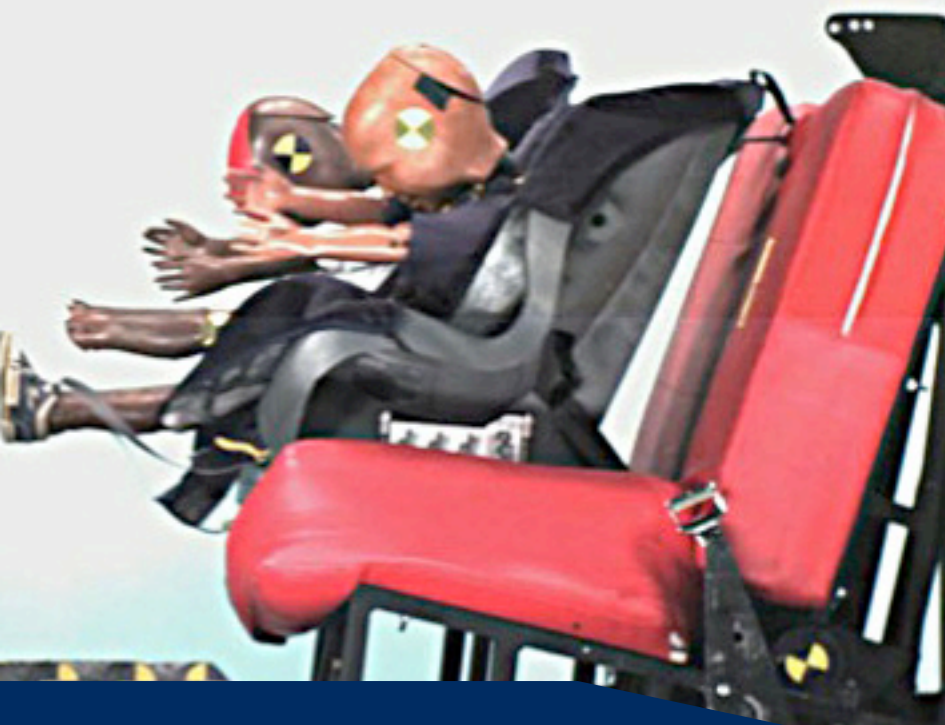
UMTRI research has had a significant impact on child-passenger safety.

Biosciences researchers have:

- ▶ Contributed extensively to recent revisions in the Federal Motor Vehicle Safety Standards related to child impact protection, including test procedures for child safety seats and belt-positioning booster seats, as well as for securement systems for child restraints.
- ▶ Developed the first methodology for measuring seatbelt fit using child crash-test dummies, validated the method using data from child volunteers, and assisted the Insurance Institute for Highway Safety in implementing the method for rating of belt-positioning boosters.
- ▶ Quantified the effects of various types of child restraint misuse on biomechanical outcomes, enabling a focus on mitigating the most important types of misuse.

UMTRI’s Behavioral Science Group led by research professor David Eby has helped to improve the proper use of child restraint systems.

- ▶ The group’s survey of Michigan’s statewide child safety seat use and misuse helped to draw nationwide attention to the high use/high misuse rates that have led to the more convenient LATCH (Lower Anchors and Tethers for Children) system for installing child safety seats.
- ▶ A statewide survey of booster seat use showing extremely low use of booster seats by children helped to pave the way for stronger laws in Michigan requiring use of proper child restraint devices.
- ▶ The results of an evaluation of two community-based booster seat promotion programs are used nationally in the development of similar programs.



# Improving Transportation Safety for Occupants Seated in Wheelchairs

For children and adults who require the use of a wheelchair for daily mobility, traveling in motor vehicles can present a serious challenge. For some, it is often not safe or possible to transfer from their wheelchair to the vehicle seat or to a child-safety seat. These travelers are therefore not able to benefit from federally regulated occupant-protection systems.



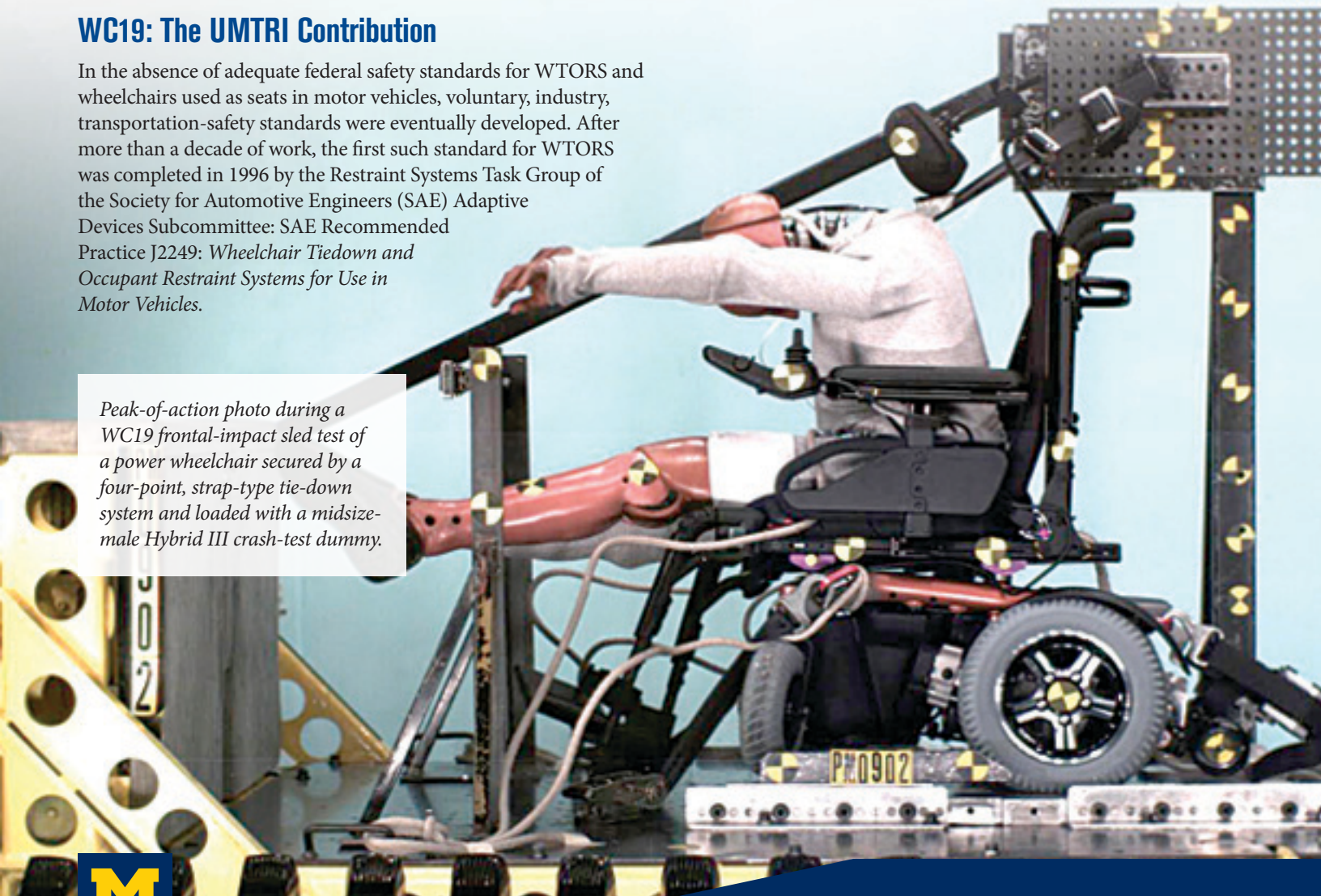
Instead, to be provided with a reasonable level of transportation safety, occupants seated in wheelchairs generally need to ride in specially modified vehicles equipped with an after-market belt-restraint system and a wheelchair-securement system. Together these add-on systems are commonly referred to as wheelchair tiedown and occupant-restraint systems, or WTORS. The problem? For many years, there has been a lack of adequate safety standards governing these systems.

This work was followed four years later by the first transportation-safety standard for wheelchairs that was developed by a Working Group of the Wheelchair Standards Committee in the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA). This first transportation wheelchair standard was Section 19 of Volume 1 of RESNA wheelchair standards, *Wheelchairs for Use as Seats in Motor Vehicles*, and soon became known simply as WC19.

## WC19: The UMTRI Contribution

In the absence of adequate federal safety standards for WTORS and wheelchairs used as seats in motor vehicles, voluntary, industry, transportation-safety standards were eventually developed. After more than a decade of work, the first such standard for WTORS was completed in 1996 by the Restraint Systems Task Group of the Society for Automotive Engineers (SAE) Adaptive Devices Subcommittee: SAE Recommended Practice J2249: *Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles*.

*Peak-of-action photo during a WC19 frontal-impact sled test of a power wheelchair secured by a four-point, strap-type tie-down system and loaded with a midsize-male Hybrid III crash-test dummy.*



The development of these initial WTS standards, as well as a revised and enhanced set of WTS standards in a new Volume 4 of RESNA standards, *Wheelchairs and Transportation*, are due in large part to the leadership and work of UMTRI biosciences researchers Larry Schneider, Miriam Manary, and Nichole Orton. These three UMTRI researchers form the current leadership team for the RESNA Committee on Wheelchairs and Transportation, or COWHAT.

“These WTS standards represent a significant step forward in providing people with disabilities the opportunity to travel with a level of safety and crash protection that is comparable to people who use vehicle seats and federally regulated occupant-protection systems,” says UMTRI research professor Larry Schneider. “The current versions of the standards reflect more than three decades of standards-development effort by people from many stakeholder groups.”

## Partnering for Safety

Schneider explains that back in 1985, he and others knew there were problems with providing safe transportation for occupants seated in wheelchairs but no one had any answers as to how to provide these travelers with a reasonable level of crash protection.

“Now I am able to tell people how they can travel safely if they remain seated in their wheelchairs,” says Schneider. However, he adds, “the extent to which safe transportation for occupants in wheelchairs is implemented in practice depends on the extent to which wheelchair and WTORS manufacturers make, market, and promote products that comply with the WTS standards.”

“It also depends on other stakeholders, such as clinicians who prescribe wheelchairs, transport providers, third-party payers, and consumers and their caregivers being aware of the standards and products that comply with the standards, as well as knowledge of best practices in providing safe transportation for people who must remain in their wheelchair when traveling in motor vehicles.”

The efforts and expertise of Schneider, Manary, and Orton have made UMTRI a world leader in the science of transportation safety for occupants of motor vehicles seated in wheelchairs. Through a broad series of national and international collaborations, UMTRI biosciences researchers have:

- ▶ Used in-depth field investigations of crash and non-crash events involving drivers and passengers seated in wheelchairs and in-person interviews with drivers of personal vehicles seated in wheelchairs to identify key issues that are unique to providing safe transportation for this population of motor-vehicle occupants.



UMTRI Biosciences Group

## RideSafe Brochure and Website

UMTRI, with support from RESNA and the U-M Health System, was instrumental in developing online and print materials that describe and illustrate the key steps to providing safer transportation for passengers of motor vehicles seated in wheelchairs. For more information, see [www.travelsafer.org](http://www.travelsafer.org) and [WC-transportation-safety.umtri.umich.edu](http://WC-transportation-safety.umtri.umich.edu).

- ▶ Led and participated in multiple interdisciplinary research efforts that have addressed issues related to providing effective wheelchair securement in vehicles, to designing wheelchairs that will facilitate proper use and positioning of seatbelts on occupants in wheelchairs, to the design, development, and evaluation of improved occupant-restraint systems for people seated in wheelchairs during front and rear impacts, and to understanding conditions under which the risks of serious injuries from deploying airbags for drivers seated in wheelchairs outweigh the injury risks associated with deactivating the driver airbag.
- ▶ Used their research findings and knowledge of basic principles of injury biomechanics and occupant crash protection to author national and international standards that establish design requirements, performance criteria, and associated test methods, for wheelchair tiedowns and occupant-restraint systems and for wheelchairs and wheelchair seating systems that are suitable for use in motor vehicles.

AUTOMATED VEHICLES:

# Monitoring the People Inside

## Enhancements to UMTRI driving simulator allow researchers to study human behavior in the context of automated driving



Push a small button on the steering wheel of UMTRI's driving simulator, and a voice announces, "Automated mode engaged." The instrument cluster takes on a green background, and the car centers itself in the lane and cruises forward at a steady speed. The steering wheel turns by itself to keep the vehicle in the lane during curves and turns.

While the vehicle "self-drives" through the simulated urban landscape, UMTRI assistant research scientist Anuj K. Pradhan explains that progress toward fully automated vehicles is happening rapidly, but there are many unknowns and some major hurdles to be addressed.

"Some of the pressing issues are those related to human factors," says Pradhan, who is part of the UMTRI Young Driver Behavior and Injury Prevention Group. "Until vehicles are fully automated, 100-percent of the time, humans will still play an active and important role in the driving loop. So for automation levels 2 and 3, the human factor is critical."

According to the National Highway Transportation Safety Administration, a fully automated vehicle allowing unmanned operation is designated as level 4. In level 3, a vehicle is essentially self-driving and controls all safety-critical functions but may need

humans in various situations that would require transition back to driver control. Level 2 automation represents combinations of multiple functions that enable a car to drive itself but require constant monitoring by the driver with potentially rapid transitioning between automated and human control. (See the NHTSA policy on automated vehicle development.)

These transitions may not be as simple as they sound.

"When you're driving (normally), one is expected to possess a certain degree of situational awareness, especially with regard to the driving scene, traffic flow, and other driving related factors," explains Pradhan. "But when a vehicle is in automated mode, the person inside may be reading, texting, or even napping. He or she may not be prepared to suddenly and safely take control of the vehicle when control is handed back from the automation."

So the question for researchers is this: How can you safely and economically conduct empirical research to better understand the human-factors issues inherent in automated driving? One approach is to do vehicle testing in an off-roadway setting, such as M City. Given that access to self-driving cars even for research purposes is very limited, an alternate approach is to use high-fidelity driving simulators with automated-vehicle capabilities, such as the one at UMTRI.





“The driving simulator, as is, is a very powerful and versatile tool that is used to study driver behavior. . . By adding self-driving capabilities, it allows us to significantly extend human-factors research on vehicle automation. . . .”

With seed funding from U-M’s Mobility Transformation Center (MTC) and in collaboration with industrial partner Realtime Technologies Inc., Pradhan is working with programmer Christopher Atkins and lead electronics engineer Mark Gilbert to enhance UMTRI’s driving simulator to provide different levels of automated-driving capabilities. The software and hardware enhancements will provide for various customizations and experimental setups and designs that will allow researchers to study human behavior in the context of automated driving with a high degree of ecological and internal validity.

“The driving simulator, as is, is a very powerful and versatile tool that is used to study driver behavior,” says Pradhan. “By adding self-driving capabilities, it allows us to significantly extend

human-factors research on vehicle automation and to start examining a host of new questions that have been raised about vehicle automation in relation to the human driver or operator.”

Pradhan gives some examples of issues related to transfer of control:

- How do people react when control of the vehicle is transferred back to them from automation during different circumstances? How does this differ if the driver is already monitoring the roadway versus engaged in something else?
- How do individual driver characteristics (such as age or experience) affect behaviors related to automation, including acceptance of technology, and expectations of automation? Are alerts related to transfer of control best relayed by single or multiple modes (audio and seat vibrations) depending on the driver’s age or experience?

In a related project recently awarded by the MTC, Pradhan will examine these types of behavioral issues and gain a better understanding of the role that the driver’s attentional state plays during vehicle automation. “It appears that when a human is in a self-driving car, it becomes important for the automation to also monitor the driver,” says Pradhan. “That’s the next step.”

## UMTRI 50th Anniversary Seminar Series

UMTRI's 50th Anniversary Seminar Series began this spring with featured presentations by experts from the University of Michigan, Texas A&M Transportation Institute, and Virginia Tech Transportation Institute.

### ► **Sarter on human interaction with automation in aviation, lessons learned**

UMTRI's 50th anniversary seminar series began April 23 with a presentation by **Nadine Sarter**, professor in the University of Michigan Center for Ergonomics and in Industrial and Operations Engineering. Dr. Sarter is an expert on human interaction with automation in aviation and other environments. The seminar provided perspective on lessons learned from aviation that are relevant for ground vehicles.



### ► **Manser showcases TTI automated-and-connected-vehicle research**

As part of the ATLAS Center Symposium, and in conjunction with UMTRI's 50th Anniversary Seminar Series, senior research scientist and human factors program manager **Michael Manser, PhD**, of the Texas Transportation Institute (TTI) presented "An Overview of TTI Automated and



Connected Vehicles Research" on May 19 in UMTRI's McCormick conference room. Dr. Manser summarized TTI's current efforts and potential future directions within the automated and connected vehicles domain with a particular emphasis on human-technology interaction.

### ► **Fitch highlights driver distraction research**

**Gregory Fitch** is a research scientist and user experience group leader in the Center for Automated Vehicle Systems at the Virginia Tech Transportation Institute. He is an experienced researcher of driver performance with technology. He presented his research on driver distraction, driver performance with collision-avoidance systems, and operator interaction with automated vehicles on June 16. His talk, titled "Driver Distraction and Mitigation," covered research methods pertaining to naturalistic-driving-data collection, reduction, and analysis, as well as human-performance testing using a controlled test track.



## TTI Traffic Safety Conference

ATLAS Center once again cosponsored the Texas A&M Transportation Institute (TTI) Traffic Safety Conference, held in Corpus Christi, Texas, June 8–10, 2015. Many ATLAS Center and UMTRI researchers presented at sessions on this year's theme, "Things that Work."



### Contributions include the following:

- **Ray Bingham**, research professor and head of the Young Driver Behavior and Injury Prevention Group, UMTRI: *Helping Teens be Safer Drivers: What Works?*
- **Dan Blower**, associate research scientist, UMTRI: *Shiny-Side Up: Advanced Technologies That Can Reduce Heavy Truck Crashes*
- **Lisa Buckley**, assistant research scientist, UMTRI: *A Neurological Understanding of the Social Influence of Teen Passengers*
- **David W. Eby**, ATLAS director, research professor, and head of Behavioral Sciences Group, UMTRI: *The Potential Benefits of Transit Travel Training*
- **Melisa Finley**, research engineer, TTI: *The Moth Effect – Is it Real?*

- **Lidia Kostyniuk**, research scientist and ATLAS research coordinator, UMTRI: *Measuring Safety Effects of Commercial Motor Vehicle Driver Training Program*
- **Lisa Molnar**, ATLAS associate director and associate research scientist, UMTRI: *A Statewide Strategy for Supporting the Safe Mobility of an Aging Population*
- **Chiara Silvestri-Dobrovolny**, associate research scientist, TTI: *Use of Finite Element Simulations to Parametrically Evaluate and Compare Seat Belt Restraint Systems and Related Injury Risk in Heavy Truck Frontal Crash Conditions*
- **Renée St. Louis**, ATLAS education coordinator, UMTRI: *Evaluation of Bis-Man Clicks: An Employer-Led Seatbelt Promotion Program*
- **Mike Manser**, senior research scientist, TTI: *Older Driver Support System*
- **Nicole Zanier**, ATLAS technology transfer coordinator, UMTRI: *Evaluation of Michigan's TACT Program.*

**ATLAS Center:** [www.atlas-center.org/](http://www.atlas-center.org/)

# 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](mailto:umtridocs@umich.edu) to inquire about the availability of other publications listed here.

## Journal Articles

- ▶ Carter, P.M.; Flanagan, C.A.; Bingham, C.R.; Cunningham, R.M.; Rupp, J.D. 2015. "Modeling the Injury Prevention Impact of Mandatory Alcohol Ignition Interlock Installation in All New US Vehicles." *American Journal of Public Health*, vol. 105, no. 5, pp. 1028-1035. DOI:10.2105/AJPH.2014.302445
- ▶ Cascio, C.N.; Carp, J.; O'Donnell, M.B.; Tinney, F.J.; Bingham, C.R.; Shope, J.T.; Ouimet, M.C.; Pradhan, A.K.; Simons-Morton, B.G.; Falk, E.B. 2015. "Buffering Social Influence: Neural Correlates of Response Inhibition Predict Driving Safety in the Presence of a Peer." *Journal of Cognitive Neuroscience*, vol. 27, no. 1, pp. 83-95. DOI:10.1162/jocn\_a\_00693.
- ▶ Klein, K.F.; Hu, J.; Reed, M.P.; Schneider, L.W.; Hoff, C.N.; Rupp, J.D. 2015. "Development and Validation of Statistical Models of Femur Geometry for Use with Parametric Finite Element Models." *Annals of Biomedical Engineering*, published online March 26, 2015. DOI:10.1007/s10439-015-1307-6
- ▶ Liu, D.; Tran, V.; Pradhan, A.K.; Li, K.; Bingham, C.R.; Simons-Morton, B.G.; Albert, P.C. 2015. "Assessing Risk-Taking in a Driving Simulator Study: Modeling Longitudinal Semi-Continuous Driving Data Using a Two-Part Regression Model with Correlated Random Effects." *Analytic Methods in Accident Research*, vol. 5-6, January, pp. 17-27. DOI:10.1016/j.amar.2014.12.001
- ▶ Park, B.K.; Lumeng, J.C.; Lumeng, C.N.; Ebert, S.M.; Reed, M.P. 2015. "Child Body Shape Measurement Using Depth Cameras and a Statistical Body Shape Model." *Ergonomics*, vol. 58, no. 2, pp. 301-309. DOI:10.1080/00140139.2014.965754
- ▶ Twisk, D.; Vlakveld, W.P.; Commandeur, J.F.; Shope, J.T.; Kok, G. 2015. "Relationships among Psychological Determinants, Risk Behaviour, and Road Crashes of Young Adolescent Pedestrians and Cyclists: Implications for Road Safety Education Programmes." *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 30, April, pp. 45-56. DOI:10.1016/j.trf.2015.01.011
- ▶ Wang, Y.; Bai, Z.; Cao, L.; Reed, M.P.; Fischer, K.; Adler, A.; Hu, J. 2015. "A Simulation Study on the Efficacy of Advanced Belt Restraints to Mitigate the Effects of Obesity for Rear-Seat Occupant Protection in Frontal Crashes." *Traffic Injury Prevention*, vol. 16, suppl. 1, June, pp. S75-S83. DOI:10.1080/15389588.2015.1010722

## Technical Reports

- ▶ Schoettle, B.; Sivak, M. 2015. *Potential Impact of Self-Driving Vehicles on Household Vehicle Demand and Usage*. Report no. UMTRI-2015-3. <http://hdl.handle.net/2027.42/110789>  
The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.
- ▶ Sivak, Michael; Schoettle, B. 2015. *Fuel-Economy Distributions of Purchased New Vehicles in the U.S.: Model Years 2008 and 2014*. Report no. UMTRI-2015-4. <http://hdl.handle.net/2027.42/110907>  
The research documented in this report was sponsored by UMTRI's Sustainable Worldwide Transportation program.





Indeed, in the past, Taliban gunmen have killed or threatened tribal leaders who defied them, and the American military and the Afghan government have largely been unable to protect them.

# NEWS

The pact appears to be the first in which an entire Pashtun tribe has declared war on Taliban insurgents.

## UMTRI In The News

► **Motion sickness in autonomous cars: Don't read and ride**

<http://bit.ly/1JrHXeC> 4-9-15

► **Thinking of drinking and driving? What if your car won't let you?**

<http://bit.ly/1xFzESv> 3-19-15

► **Want to save energy? Fly the environmentally friendly skies**

<http://bit.ly/1Kf1LAY> 4-27-15

► **Getting to work: Cities with the longest commutes**

<http://bit.ly/1FZNxB9> 5-27-15

► **U-M to open hub for testing self-driving cars**

<http://on.freep.com/1Qc1u70> 5-30-15

► **Vehicle fuel economy rose in May**

<http://bit.ly/1FBU3dW> 6-3-15

## Upcoming Events

### TTI Traffic Safety Conference

June 8–10; Corpus Christi, Texas  
<http://tti.tamu.edu/group/cts/>

### RESNA Annual Conference

June 10–14; Denver, Colorado  
[www.resna.org](http://www.resna.org)

### International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design

June 22–25; Salt Lake City, Utah  
<http://drivingassessment.uiowa.edu/>

### Automated Vehicles Symposium 2015

July 21–23; Ann Arbor, Michigan  
<http://www.automatedvehiclessymposium.org/home>

### CAR Management Briefing Seminars

August 3–6; Traverse City, Michigan  
<http://www.cargroup.org/>

### National Rural ITS Conference

August 9–12; Snowbird, Utah  
<http://www.nationalruralitsconference.org/>

### UMTRI Transportation Safety Research Symposium

October 15; Michigan League Ballroom, University of Michigan  
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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