

UMTRI

RESEARCH REVIEW

• UNIVERSITY OF MICHIGAN TRANSPORTATION RESEARCH INSTITUTE • OCTOBER–DECEMBER 2003 • VOLUME 34, NUMBER 4 •



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Transportation Tidbits

- The American Motor League, the first organization of automobile enthusiasts, was formed in Chicago in November, 1895. It extended membership to “any man or woman, eighteen years of age or over, of good moral character and respectable standing, friendly to the motor vehicle and its interests.” The initiation fee was \$2. [Ⓜ]
- The first American automobile race was held in Chicago on November 28, 1895. Sponsored by the *Chicago Times-Herald*, the race took place on icy, snow-covered streets. A Duryea vehicle, with three forward speeds and a water-cooled, four-stroke engine, won the first place prize of \$2,000. It reached 18 miles per hour. [Ⓜ]
- On October 10, 1898, the first American automobile show was held in Boston. The Motor Carriage Exposition of the Massachusetts Charitable Mechanics’ Association hosted four exhibitors, a race, and a parade. [Ⓜ]
- On October 14, 1899, *Literary Digest* commented on the new automobiles: “The ordinary horseless carriage is at present a luxury for the wealthy; and although its price will probably fall in the future, it will never, of course, come into as common use as the bicycle.” [Ⓜ]
- The popularity of attached garages was reported in the December, 1901 edition of the British magazine *The Autocar*: “In Hampstead a number of new houses have recently been erected, the appointments of which include a motor stable.” [Ⓜ]
- John and Horace Dodge completed the first Dodge vehicle, informally known as “Old Betsy,” on November 14, 1914. The brothers gave Betsy a quick test drive through the streets of Detroit and then shipped the vehicle to a buyer in Tennessee. [⊕]
- On November 26, 1927, Ford Motor Company announced the introduction of the Model A, the first new Ford since the Model T’s introduction in 1908. By 1927, the Model T, basically unchanged for its two-decade reign, was losing ground to more stylish and powerful cars offered by other car companies. The vastly improved Model A had elegant Lincoln-like styling on a smaller scale, and used a capable 200.5-cubic-inch, four-cylinder engine that produced 40 horsepower. The cars started at \$460 and were available in several body styles and colors. [⊕]

Sources

- Ⓜ *On the Move: A Chronology of Advances in Transportation* by Leonard C. Bruno
- ⊕ This Day in Automotive History, www.historychannel.com

READY FOR THE ROAD

Software Helps Teens Drive Safely

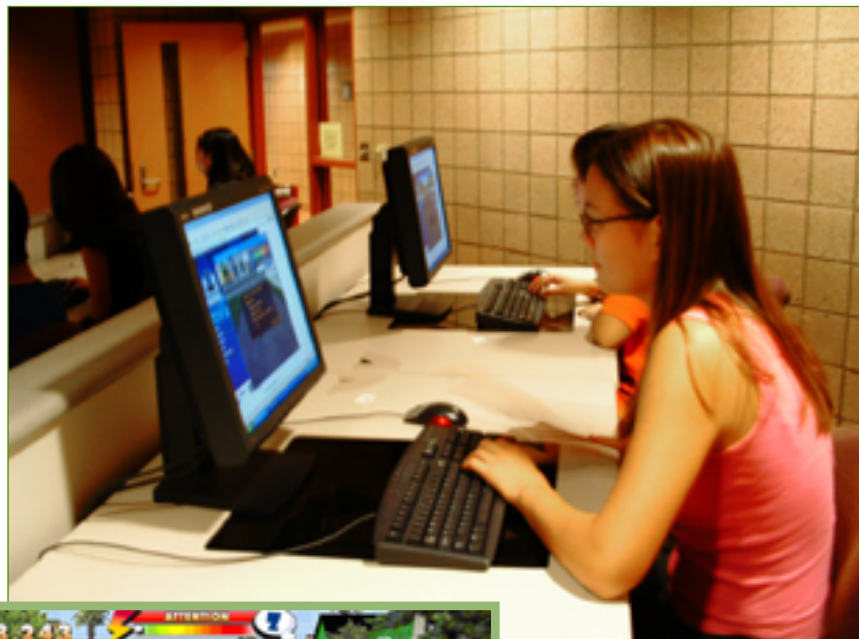


UMTRI researchers recently evaluated a video game designed to give young drivers the opportunity to practice safe driving skills in a controlled environment where mistakes don't have harmful consequences. To improve the game, C. Raymond Bingham, research associate professor, and Jean Shope, head of UMTRI's Social and Behavioral Analysis Division, obtained feedback from teens on what they liked and disliked, as well as their recommendations for changes to the software. The study was sponsored by the National Safety Council, with funding from DaimlerChrysler and project coordination by the strategic communications company GMMB.

The study evaluated the effectiveness of the *Road Ready StreetWise* game in:

- Raising teen awareness of key driving risks
- Strengthening positive attitudes toward driving safety guidelines
- Emphasizing that the experience they get through practice driving helps them become safe drivers

Bingham said, "We wanted to make sure the game helped teens gain a greater appreciation for the risks of driving, be more amenable to guidelines to help keep them safe, and to understand the importance of an extended learning period."



UMTRI / RAYMOND BINGHAM



ABOVE: Teens use the *Road Ready StreetWise* software in the UMTRI evaluation. **INSET:** This screen shot from the *Road Ready StreetWise* game shows a sample road scene with an obstacle that teens had to avoid.

WILLIAM COBIT

The game consists of six missions that require the player to drive to various locations. The player must avoid hazards, take measures to reduce distractions, and practice safe driving

skills. Each mission must be successfully completed before the next one can be attempted. Each mission increases in difficulty and requires accomplishing certain tasks while avoiding obstacles—like trucks pulling out in front of the driver and oncoming swerving traffic. One mission involves driving at night, and two require driving in bad weather.

Results

Twenty-four teens who either were within three months of beginning, or were currently taking but had not completed, driver education were evaluated before and after 50 minutes of playing *StreetWise*, and then participated in a focus group. Pregame and postgame comparisons indicated that playing *StreetWise* significantly increased perceptions of personal driving risk; however, intentions to avoid risky driving behaviors,

attitudes toward driving guidelines, and acceptance of driving guidelines did not change significantly from before the game to after the game.

Girls were more likely than boys to report increased awareness of driving risks, greater acceptance of driving guidelines, and clearer perceptions of

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personal driving risk. Prior driving experience, video-game-playing experience, risk-taking propensity, driving-risk taking, and living locale (i.e., rural versus in-town) also related to game outcomes. Asian-Americans had the lowest increase in awareness after the game because their initial awareness was already the highest.

Bingham says, "Initially, some teens hit obstacles to see what would happen, sped to get a ticket, and otherwise explored the environment before getting serious about "beating the game." Also, experienced video game players made it further into the game. They liked it less, but benefited more in terms of increased awareness."

All participants reported that the game helped them at least "a little" to understand the driving risks that they face as new drivers, and 65 percent (n=15) reported that it helped them "quite a bit" or "a lot." One teen stated that the primary messages conveyed by the game were, "You must constantly pay attention to driving. Don't talk on the cell phone while driving or load up (the car with) your friends, and night driving is harder."

Overall, the teens enjoyed playing the video game and felt it was a good teaching tool for people their age. All participants said they enjoyed the video game at least "a little," and 43 percent indicated they enjoyed the

game either "quite a bit" or "a lot." However, they also felt the video game gave too little opportunity to make driving decisions and not enough vehicle control to practice safe driving. They recommended leaving more decisions up to the drivers, such as choosing to use safety belts and turn



After completing UMTRI's evaluation of the *Road Ready StreetWise* video game, a teen commented on the experience.

"You must constantly pay attention to driving. Don't talk on the cell phone while driving or load up (the car with) your friends."

The video game, plus information for parents of teen drivers, is available at www.roadreadyteens.org.

signals, checking blind spots, choosing their own routes or following directions instead of following turn arrows, and controlling vehicle speed to follow posted speed limits. They also suggested

adding lifelike driving situations, such as realistic obstacles, oncoming traffic, opposing traffic at intersections, and executing left turns at intersections and navigating four-way stops with oncoming traffic.

The teens also requested realistic feedback about the consequences of their mistakes and choices, such as degree of injury, repair cost, damage from hitting obstacles, and consequences of their decisions about safety belt and turn signal use. They felt this type of information would help them learn safe driving skills and the benefits of safe driving habits.

The sponsors have also developed materials to involve parents in helping their kids become safe drivers, including a workbook, guidelines on making a parent-teen safe-driving contract, and suggested driving rules (similar to those prescribed in most graduated driver licensing programs).

Both the game, developed by WildTangent, and information for parents of teen drivers are available online at www.roadreadyteens.org.

UMTRI's Sled Impact Test Facility

In addition to expert researchers and specialized software tools, UMTRI has unique lab and test facilities. UMTRI's rebound impact sled, which is used to study occupant protection issues and restraint-system performance for simulated crash environments, is a good example of such a resource. To simulate a vehicle crash, the sled's 990-pound, 6.5-foot-square platform is accelerated to a desired pre-impact speed along a 55-foot track by a pneumatically powered ram. The impact event takes place at the opposite end of the track where a pneumatic piston controls the duration and magnitude of the sled's deceleration and the speed of the sled's rebound in the opposition direction. On the UMTRI rebound sled, impact severity, or delta V, is the difference between the pre- and post-impact speeds. High-speed video cameras record the kinematics of instrumented crash dummies at 1,000 frames per second and videos are available for viewing immediately after the test.

Prior to each test, the restraint system, vehicle seating system, and/or other components to be tested are bolted to the sled frame and platform. The sled can also be equipped with a reusable bench seat for testing to determine whether child restraints comply to FMVSS 213, with a passenger-side-airbag buck for evaluating airbag interaction with an infant dummy in rear-facing child restraints, or with a modified section from an actual vehicle. UMTRI's sled lab is also equipped with an ISO/SAE-approved surrogate wheelchair for dynamic testing of wheelchair tiedown and occupant restraint systems, as well as with a four-point strap surrogate wheelchair tiedown system for dynamic testing of compliance of wheelchairs to ANSI/RESNA WC/19, *Wheelchairs Used as Seats in Motor Vehicles*. A variety of instrumented anthropomorphic test devices (ATDs), or crash-test dummies, enable evaluation of restraint systems and vehicle components for a wide range of occupant sizes. These include:

- Six-, twelve- and eighteen-month-old ATDs for airbag interaction testing (CRABI)
- Three-, six-, and ten-year-old Hybrid III ATDs
- Small female and mid-sized male adult Hybrid III ATDs

Transducer signals from instrumentation in crash-test dummies, from sled accelerometers

and velocity transducers, and from seatbelt load cells are digitized and filtered using an on-board data-acquisition module. Data channels are processed in accordance with SAE J211 and data is downloaded via wireless communication to laptop or desktop computers for analysis and printing. Transducer data is routinely processed to

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Left to right: Charlie Bradley, Amy Klinkenberger, and Miriam Manary make final preparations for conducting a 30-mph frontal-impact test of a wheelchair.



UMTRI / LARRY SCHNEIDER

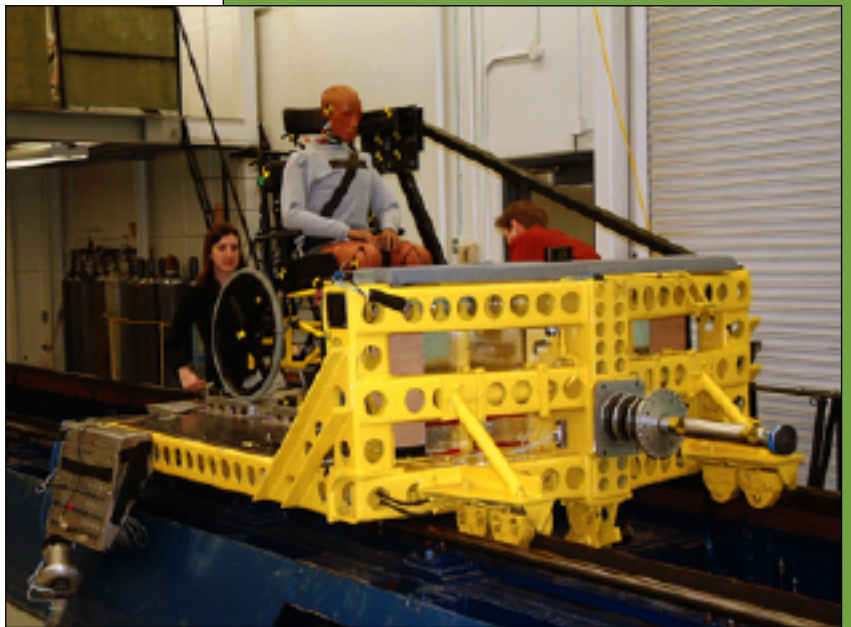
UMTRI FACILITIES

UMTRI FACILITIES

show the sled deceleration history in comparison with target corridors and to compute peak resultant head-and-chest accelerations, peak chest deflection, head injury criteria (HIC), and peak belt-restraint loads. When appropriate, upper and lower neck loads and moments are calculated and compared to standard neck injury criteria, such as Nij (a NHTSA standard). Analysis and display programs can also be tailored to the needs of a particular user to produce force-deflection plots in comparison with target corridors or other output. Printouts of signal time histories are generated within seconds of each sled test, and high-quality digital photographs document the pretest setup and post-test configuration.

The UMTRI sled facility is operated and maintained by the Biosciences Division, under the direction of its division head, Larry Schneider. Miriam Manary, a senior research associate in the Bio-sciences Division, supervises the UMTRI sled-test team, which consists of Stewart Simonett, Charles Bradley, Amy Klinkenberger, and Carl Miller. In addition, Jonathan Rupp, Nathaniel Madura, and Jeff Lehman keep UMTRI's sled operating with the latest

technology in high-speed video, data acquisition, and data processing. Skilled machinists and welders Brian Eby and Jim Whitley fabricate and repair test components and crash dummies as needed. Frequent visitors to the UMTRI sled lab help to ensure that equipment tested is configured correctly before conducting a test. They include engineers from child restraint, wheelchair, and wheelchair tiedown companies; safety engineers from automobile manufacturers; and seating and restraint-system suppliers.



Top: Amy Klinkenberger and Carl Miller check a test setup. **Above:** This photo captures the peak-of-action during a frontal impact test of a wheelchair loaded with a midsize male ATD. **Left:** Stewart Simonett adjusts the controls of the UMTRI impact sled.

PHOTOS: UMTRI / BIOSCIENCES DIVISION



ONLINE Six Sigma TRAINING

Staff from UMTRI and the

UM Center for Professional Development

Teach Green and Black Belt Courses

UMTRI / SHEKHAR RININGTON



Luis Guzman

UMTRI / KATHLEEN COCCHETTI RICHARDS



Pat Hammett

UMTRI's Office for the Study of Automotive Transportation (OSAT) and the UM Center for Professional Development offer Six Sigma training courses and certification at green and black belt skill levels. Both courses are offered online via streaming audio/video and utilize interactive course tools for testing and participant-instructor communication. Over 2,500 participants from all over the world have enrolled in the Six Sigma e-learning programs since their inception in 2000.

The Six Sigma course was developed by program codirectors Gary Herrin, UM professor of industrial and operations engineering and associate dean of undergraduate education in UM's College of Engineering, and Pat Hammett, OSAT assistant research scientist and UM adjunct professor of industrial and operations engineering. Hammett is the lead developer for all of UM's Six Sigma courses and their training content. Other UMTRI staff members are Luis Guzman, OSAT research investigator, and Saumuy Suriano, OSAT research associate. Guzman teaches both green and black belt programs and developed

many of the course case studies and test materials. Suriano acts as a teacher assistant for the Six Sigma courses and developed questions and exercises used in the program.

Hammett explains how the online courses were developed. "The UM College of Engineering's Center for Professional Development was having limited success offering classroom-based industry Six Sigma training, primarily due to an inability of UM faculty to travel onsite to corporate locations, as well as the relatively high costs for individuals

seeking their certification through the University." Consequently, he and Herrin proposed an Internet-based training course that could access a much broader market at significantly lower costs. Hammett continues, "During the initial course development, ITT Industries sent out a large request for international training. We were able to

quickly complete our course and exceed their training expectations."

The green belt program consists of 22 modules (40 hours of instruction) in the form of video lectures, interactive exercises, and online discussions with faculty and other participants. Green belt training introduces students to the Six Sigma methodology and provides a refresher course in problem-solving using basic, statistical, data-analysis techniques. The course is available in nine languages—English (taught by Hammett and Herrin), Spanish (taught by Guzman), Mandarin, Japanese, French, Italian, German, Swedish, and Dutch. Participants must also complete a Six Sigma project and report.

Projects aim to improve a process, generally in a manufacturing environment, such as increasing equipment efficiency. Past projects have saved companies anywhere from thousands to hundreds of thousands of dollars. The program team is currently developing a new green belt course that specializes in non-manufacturing applications, which should be online soon.

Students must become certified as a green belt before embarking on black belt training. The latter program consists of 26 modules, an industry project, and a final certification test. The industry project for black belts is more extensive than that for green belts, requires a higher level of statistics, and

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usually results in considerably higher cost savings.

UM's black belt program examines analytical and problem-solving techniques from descriptive statistics to advanced design of experiments. The program emphasizes customer-driven problem resolution and focuses on solving real-world problems that affect corporate performance in quality, lead-time, and cost. A course participant says, "The UM Six Sigma online black belt program was rigorous, lively, and filled with case study examples. The tutorial sessions at the end of each week were invaluable."

The black belt course is available both as certification only, which is the most common option, and as certification plus four hours of academic credit, which is useful for those pursuing master's degrees.

Numerous organizations have successfully applied Six Sigma strategies to increase customer satisfaction, minimize lead time, and reduce the costs of poor quality. Certified green belts serve a variety of purposes in an organization. For example, they can quantify the current state of a process, assess the capability of a measurement system, perform simple cause-and-effect analyses, and stratify output variables into potential sources of variation.

The Six Sigma process was developed by Motorola, and the American Society for Quality developed the Six Sigma certification tests. However, Six Sigma is not governed by any one organization, and various organizations offer certification.

For more information on UM's Six Sigma programs, visit <http://cpd.engin.umich.edu> or www.osat.umich.edu/sixsigma.htm.



GRAPHIC: UMTRI / SHEKHAR ERINGTON, DEVELOPED FROM SOURCE ART FROM MICROSOFT CORPORATION / MICROSOFT OFFICE CLIPART

According to isixsigma.com, Six Sigma is "a rigorous and disciplined methodology that uses data and statistical analysis to measure and improve a company's operational performance by identifying and eliminating 'defects' in manufacturing and service-related processes. Commonly defined as 3.4 defects per million opportunities, Six Sigma can be defined and understood at three distinct levels: metric, methodology and philosophy."

Desirable ACC in Traffic Streams

UMTRI researchers Paul Fancher, Zevi Bareket, and Bob Ervin, and associate professor Huei Peng from UM's Department of Mechanical Engineering and Applied Mechanics, recently completed a study of desirable adaptive cruise control (ACC) in traffic streams. The study was supported by the Federal Highway Administration, with the participation of BMW, DaimlerChrysler, and Nissan Motor Company.

The study developed an improved microscopic understanding of driver control of range-clearance and time-gap, to help in evaluating and enhancing the performance of ACC. An earlier research phase addressed the development of data gathering and data analysis procedures for characterizing the observed behavior of ACC-equipped vehicles in response to changes in speed and location of a preceding vehicle. Phase two focused on nonlinear driver modeling as an integral element of a program aimed at examining the influence of ACC systems on traffic flow containing both vehicles equipped with ACC and vehicles without ACC. The driver models developed used parametric coefficients derived from sets of data measured during human-manual driving in naturalistic situations on highways, roads, and streets. The relationships employed in the models were developed from concepts of kinematics, human behavior, and control system design.

Research Methods

Data for 143 drivers was used to develop findings about the drivers' steady-following characteristics and their lack of an inherent capability of sustaining steady following in a string of similar driver-vehicle combinations. The equations for

the model were based on the premise that drivers follow other vehicles in a way they consider safe for avoiding rear-end crashes, but the driving characteristics vary greatly among drivers. A constant deceleration analysis was used to generate basis functions that were used to fit actual naturalistic driving data and to yield parameter values that captured each driver's personal style. The basis function was:

$$R = A + TV + GV^2$$

where: **R** is the steady following range clearance
V is the velocity at steady following
A is the stopped vehicle clearance
T and **G** are parameters whose values represent the driving characteristics of individual drivers

The model also contains a free flow speed, **Vset**, which drivers seek when the range clearance and roadway characteristics are viewed as appropriate for that speed. (Drivers select a free-flow speed for each road, apparently depending on their assessment of that road and its environment.) The researchers found that **Vset** and the steady-following parameter **T** both vary widely depending on the driver. The parameters **T** and **G** are approximately related by **G = -0.025 T + 0.013** for human-manual driving. The value of **G** was less than zero for all 143 drivers.

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The researchers analyzed individual sets of steady-following characteristics, which show the influences of **T** and **G** on the flow capacity. For example, the capacity for a typical **G=0** case is 0.79 vehicles/s, but for **G = -0.01 s²/m**, it is a phenomenal 1.03 vehicles/s.

Researchers observed that if **G < 0** and **T** less than approximately 2.5 s, the lead and damping term associated with the human-manual driving data was not likely to be large enough to prevent overshoot or undershoot. For drivers with values of **T** greater than approximately 2.5 s, their time histories frequently indicated a nonlinear tendency to limit their response to positive (or even very slightly negative, **Rdot < 0**) range-rate errors. This means that these drivers have a tendency to avoid closing on a preceding vehicle; instead of hanging back and letting their time gap increase.

The research employed the concept of “inherently sustainable” string performance, which occurs when there is no overshoot or undershoot of range and velocity from vehicle to vehicle in a simulated or tested string of nearly identical driver-vehicle combinations. The modeled driver has been completed by adding constraints that require that range, **R**, does not become less than the stopped vehicle clearance, **A**, and that **V** does not become less than zero.

Results

Results show major differences in capacity and flow sustainability depending upon the characteristics of the individual driver. Overall, however, drivers operate with limited accuracy in perceiving range, range-rate, and velocity. They tend to overshoot or undershoot the velocity of the preceding vehicle and the steady following value of range clearance. Furthermore, driver intentions and stresses change from time to time, causing them to adjust their style of driving.

Numerical analyses showed that theoretically more vehicles could get on the road without stop-and-go driving if drivers were capable of an inherently sustainable flow. In a typical example, there was an almost 50 percent increase in density compared with that attained by restricting density at a comparable flow level.

Data implies that for a traffic stream involving a mixture of driver types, drivers with the lowest values of **F_c** (flow at capacity) would likely control the overall capacity. (As traffic density increases, the opportunity to pass a slower moving vehicle is eliminated and the trailing vehicle is forced to travel at the speed of the preceding vehicle.)

The research produced discoveries and findings about ACC system characteristics that may significantly influence traffic flow. The driver-modeling work advances our ability to predict and evaluate results for mixed traffic involving both ACC and manually controlled vehicles. These new capabilities are now available to use in experimenting with models (i.e., simulation) and challenging their validity. In particular, the subject and utility of the concept of inherently sustainable strings and its relevance to mixed traffic flow can be studied.

Proposed ideas for phase-three research include developing and utilizing an enhanced simulation capability as well as a mobile laboratory that can be used to gather data while traveling in traffic streams. Results from phase-three research will help OEMs determine which ACC characteristics they need to consider collectively for ensuring sustainable traffic flow.

PROFILER PERFORMANCE FOR CONSTRUCTION QUALITY CONTROL

Steve Karamihas, engineering research associate, and Tom Gillespie, research professor, recently assessed profiler performance for construction quality control in a study sponsored by the American Concrete Pavement Association and the Michigan Concrete Pavement Association. The study tested the performance of inertial profilers, devices that measure road textures, on four pavement sections. It focused on the repeatability and reproducibility of lightweight profilers on new concrete with coarse texture. The study examined six lightweight inertial profilers, three high-speed inertial profilers, two walking-speed profilers, a rod and level survey, and a profilograph. Tests were performed on four types of surfaces: moderately rough asphalt with a typical surface texture, new longitudinally tined concrete, new transversely tined concrete, and moderately rough broom-finished concrete.

The results of phase one demonstrated that high-speed and lightweight inertial profilers were sufficiently repeatable for measuring the International Roughness Index (IRI) on a moderately rough asphalt site of typical texture and a moderately rough concrete site of unusually smooth surface texture. However, repeatability was compromised on a smooth concrete site with transverse tining and was inadequate on a smooth concrete site with longitudinal tining. The study also showed that high-speed and lightweight profilers are not

able to reproduce profiles sufficiently when special distribution of roughness is of interest. In other words, the profilers did not agree on the position and severity of localized rough features.

The level of reproducibility between inertial profilers demonstrated on smooth concrete with coarse texture needs improvement for such profil-



UMTRI / STEVE KARAMIHAS

A rod used in the rod and level method of pavement measurement at a site in Bay City, Michigan.

ers to find acceptance for use in construction quality control and quality assurance. Researchers attributed the poor reproducibility and reduced repeatability to the fact that the depth of tining and joints on new concrete are of the same scale as the height of longer wavelength features relevant to vehicle vibration response. This issue is likely to adversely affect the measurement of any profile-based index, such as IRI or the simulated profilograph index, and should be addressed so that profile measurements can better represent the experience of the traveling public.

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UMTRI / STEVE KARAMIHAS

A lightweight profiler manufactured by Surface System Instruments is tested at a site in Lansing, Michigan.



UMTRI / STEVE KARANIKAS

A view of the test pavement, looking upstream, at a site in Novi, Michigan. Workers are using a walking profiler to obtain road surface measurements.

The authors recommended two potential solutions:

- ◆ Altering the sensor footprint of inertial profilers to better represent the enveloping and bridging behavior of vehicle tires. This could improve the relevance of profile measurement over joints, transverse tining, and longitudinal tining.
- ◆ Using a “tire bridging filter” in conjunction with a very small sensor footprint. If this filter is customized to ignore narrow downward features (such as cracks and grooves) that do not affect vehicle ride vibrations, it could replace the moving average in IRI and ride number (RN) calculation procedures. This could improve the reproducibility and relevance of profile measurement over joints and transverse tining.

The authors conclude that despite the current performance of profilers on new concrete, they hold great promise for efficient and meaningful construction quality control.

Note: For more detailed information on road profiling technology, see “The Shape of Roads to Come: Measuring and Interpreting Road Roughness Profiles” in Volume 33, Number 1 of *UMTRI Research Review*.

25th Winter Road Congress
February 11–12, Vaasa, Finland
www.tieyhdistys.fi/talvitiepaivat2004/eng

Transportation Systems Planning
February 18–20, Chennai, India
www.civil.iitm.ac.in/transpo2004

Traffic 2004
February 24–27, Madrid, Spain
www.trafic.ifema.es/ferias/trafic/default_i.html

Australian Roads Summit
February 24–25, Sydney, Australia
www.roadf.com.au/Conferences.htm

National Road Safety Congress
March 1–3, Cardiff, Wales
www.rospace.org.uk/road

SAE 2004 World Congress
March 8–11, Detroit, Michigan
www.sae.org/congress

Integrated Intelligent Transport Solutions
March 8–11, London, England
www.iir-conferences.com/iits

Making Work Zones Better
March 11–12, Charlottesville, Virginia
March 24–25, Fargo, North Dakota
April 6–7, Augusta, Maine
April 27, Davis, California
ops.fhwa.dot.gov/wz/workshops/workshops.htm

Heavy Vehicle Weights and Dimensions
March 14–18, Gauteng Province, South Africa
www.8ishvwd.co.za

World of Asphalt 2004
March 15–18, Nashville, Tennessee
www.worldofasphalt.com

Second European Pavement and Asset Management Conference
March 21–23, Berlin, Germany
www.fgsv.de/pms/title.html

First International Workshop on Intelligent Transportation
March 23–24, Hamburg, Germany
wit.tu-harburg.de

National Conference on Highway Safety Priorities
March 28–30, San Diego, California
www.lifesaversconference.org

ITE 2004: Intersection Safety
March 28–31, Irvine, California
www.ite.org/meetcon

GIS for Transportation Symposium
March 28–31, Rapid City, South Dakota
www.gis-t.org

Eighth International Level Highway/Railroad Crossing Symposium
April 14–16, Sheffield, England
www.levelcrossing2004.com

Frontiers of Automotive Telematic Systems Symposium
April 20–21, Troy, Michigan
www.sae.org/contedu/tt_frontiers.htm

Road Transportation Information and Control
April 20–22, London, England
conferences.iee.org/RTIC

29th IRU World Congress: Transport and Technology of Tomorrow
April 22–24, Yokohama, Japan
www.iru.org/events/Welcome.E.html

ITS America 2004 Conference
April 26–29, San Antonio, Texas
www.itsa.org/annualmeeting.html

Bus and Paratransit Conference
May 2–6, Denver, Colorado
www.apta.com/meetings/bus

Transportation Research Conference
May 4–5, St. Paul, Minnesota
www.cts.umn.edu/events/rescon

Book Chapters

- Green, P. 2002. "Why safety and human factors/ergonomics standards are so difficult to establish." Michigan University, Ann Arbor, Transportation Research Institute, Human Factors Division. 19 p. Waard, D. de, ed., *Human Factors in Transportation, Communication, Health, and the Workplace*. Maastricht, Netherlands: Shaker Publishing, 2002, pp. 9–26.
- Waller, P.F. 2003. "Future developments in mobility for older citizens: the view of an American scholar." Michigan University, Ann Arbor, Transportation Research Institute. 9 p. Schaie, K.W., ed., *Aging Independently: Living Arrangements and Mobility*. pp. 302–310.

Conference Papers

- Blower, D. 2002. "Vehicle condition and heavy truck accident involvement." Michigan University, Ann Arbor, Transportation Research Institute, Truck and Bus Safety Analysis Division. 12 p. Zacharia, Z.G., ed. *Proceedings: International Truck and Bus Safety Research and Policy Symposium*. Knoxville, Tenn., 2002, pp. 311–322.
- Craft, R.; Blower, D. 2002. "The U.S. Large Truck Crash Causation Study." Federal Motor Carrier Safety Administration, Washington, D.C./ Michigan University, Ann Arbor, Transportation Research Institute, Truck and Bus Safety Analysis Division. 9 p. Zacharia, Z.G., ed. *Proceedings: International Truck and Bus Safety Research and Policy Symposium*. Knoxville, Tenn., 2002, pp. 153–161.
- Putcha, D.; Blower, D.; Campbell, K.L. 2002. "Bus accidents in the United States." Michigan University, Ann Arbor, Transportation Research Institute/ Michigan University, Ann Arbor, Transportation Research Institute, Truck and Bus Safety Analysis Division. 12 p. Zacharia, Z.G., ed. *Proceedings: International Truck and Bus Safety Research and Policy Symposium*. Knoxville, Tenn., 2002, pp. 261–272.

Journal Articles

- Brookes, C.; Wang, S.; McWilliams, J.; [MacWilliams, J.] 2003. "Maxillofacial injuries in North American vehicle crashes." Blackpool Victoria Hospital, NHS Trust, Lancashire (England)/ Blackpool Victoria Hospital, Trauma/Burn Centre, Lancashire (England)/ Michigan University, Ann Arbor, Transportation Research Institute, Biosciences Division. 5 p. *European Journal of Emergency Medicine*. Vol. 10, no. 1 (2003), pp. 30–34.
- Waller, P.F.; Hill, E.M.; Maio, R.F.; Blow, F.C. 2003. "Alcohol effects on motor vehicle crash injury." Michigan University, Ann Arbor, Department of Psychology/ Michigan University, Ann Arbor, Transportation Research Institute/ Detroit University, Department of Psychology, Mich./ Michigan University, Ann Arbor, Injury Research Center/ Michigan University, Ann Arbor, Medical School, Department of Psychiatry. 9 p. *Alcoholism: Clinical and Experimental Research*. Vol. 27, no. 4 (Apr. 2003), pp. 695–703. Sponsor: National Institute on Alcohol Abuse and Alcoholism, Bethesda, Md.; Michigan University, Ann Arbor, Transportation Research Institute; Michigan University, Ann Arbor, Alcohol Research Center; Michigan University, Ann Arbor, Department of Emergency Medicine.

Technical Reports

- Automotive collision avoidance system field operational test: ACAS/FOT third annual report*. 2003. General Motors Corporation, Warren, Mich./ Delphi Delco Electronics Systems, Kokomo, Ind./ Delphi Chassis Systems, Dayton, Ohio/ Hughes Research Laboratories, Malibu, Calif./ HE Microwave, Tucson, Ariz./ Michigan University, Ann Arbor, Transportation Research Institute. 112 p. Sponsor: National Highway Traffic Safety Administration, Washington, D.C. Report No. DOT HS 809 600. UMTRI-97019.
- Automotive collision avoidance system field operational test: phase I interim report*. 2002. General Motors Corporation, Warren, Mich./ Delphi Delco Electronics Systems, Kokomo, Ind./ Delphi Chassis Systems, Dayton, Ohio/ Hughes Research Laboratories, Malibu, Calif./ HE Microwave, Tucson, Ariz./ Michigan University, Ann Arbor, Transportation Research Institute. 303 p. Sponsor: National Highway Traffic Safety Administration, Washington, D.C. Report No. DOT HS 809 453. UMTRI-97208.
- Eby, D.W.; Kostyniuk, L.P. 2003. *Driver distraction and crashes: an assessment of crash databases and review of the literature*. Michigan University, Ann Arbor, Transportation Research Institute, Social and Behavioral Analysis Division. 44 p. Sponsor: John A. Volpe National Transportation Systems Center, Cambridge, Mass.; National Highway Traffic Safety Administration, Washington, D.C.; Delphi Delco Electronics Systems, Kokomo, Ind. Report No. UMTRI-2003-12. UMTRI-97314.

Fancher, P.; Bareket, Z.; Peng, H.; Ervin, R. 2003. *Research on desirable adaptive cruise control behavior in traffic streams; [Research on desirable ACC behavior in traffic streams]* Michigan University, Ann Arbor, Transportation Research Institute, Engineering Research Division. 62 p. Sponsor: Federal Highway Administration, Washington, D.C. Report No. UMTRI-2003-14/ P/G M000131-080578/ DRDA 03-0331. UMTRI-96639.

Fatality Analysis Reporting System (FARS). 2001 codebook. Version 27Aug02; [Fatal Accident Reporting System (FARS). 2001 codebook. Version 27Aug02]; FARS 2001—Version 27-Aug-02. Annual report file. 2002. Michigan University, Ann Arbor, Transportation Research Institute, Transportation Data Center. 266 p. UMTRI Transportation Data Center Data Set Codebook, No. 2002-3, September 2002. UMTRI-43157 A40.

General Estimates Systems (GES) 2001 codebook—version 30Aug02; NASS [National Accident Sampling System] GES 2001: version 30-Aug-02. 2002. Michigan University, Ann Arbor, Transportation Research Institute, Transportation Data Center. 178 p. UMTRI Transportation Data Center Data Set Codebook, No. 2002-5, September 2002. UMTRI-88993 A14.

Hardy, W.N.; Schneider, L.W. 2002. *Identification of injury mechanisms resulting in injuries to the upper extremities in frontal crashes; Project D.4: identification of injury mechanisms resulting in injuries to the upper extremities in frontal crashes.* General Motors Corporation, Warren, Mich./ Michigan University, Ann Arbor, Transportation Research Institute, Biosciences Division. Published by Ann Arbor, Mich.: University of Michigan, Transportation Research Institute. 75 p. Sponsor: General Motors Corporation, Warren, Mich. Report No. UMTRI-2002-35. UMTRI-95652.

Karamihis, S.M. 2002. *Development of cross correlation for objective comparison of profiles.* Michigan University, Ann Arbor, Transportation Research Institute, Engineering Research Division. 156 p. Sponsor: Federal Highway Administration, Western Federal Lands Highway Division, Vancouver, Wash. Report No. UMTRI-2002-36. UMTRI-97199.

Karamihis, S.M.; Gillespie, T.D. 2002. *Smoothness criteria for WIM scale approaches; [Smoothness criteria for weigh-in-motion scale approaches]* Michigan University, Ann Arbor, Transportation Research Institute, Engineering Research Division. 90 p. Sponsor: Turner-Fairbank Highway Research Center, McLean, Va. Report No. UMTRI-2002-37. UMTRI-97202.

Kostyniuk, L.P.; Eby, D.W.; Miller, L.L. 2003. *Crash trends of older drivers in Michigan: 1998-2002.* Michigan University, Ann Arbor, Transportation Research Institute, Social and Behavioral Analysis Division. 63 p. Sponsor: Michigan Office of Highway Safety Planning, Lansing. Report No. UMTRI-2003-22. UMTRI-97252.

Matteson, A.; Blower, D. 2003. *Buses involved in fatal accidents factbook 1999.* Michigan University, Ann Arbor, Transportation Research Institute, Center for National Truck Statistics/ Michigan University, Ann Arbor, Transportation Research Institute, Truck and Bus Safety Analysis Division. Published by Ann Arbor, Mich.: University of Michigan, Transportation Research Institute. 62 p. Sponsor: Federal Motor Carrier Safety Administration, Washington, D.C.; Michigan University, Ann Arbor, Transportation Research Institute, Center for National Truck Statistics, Affiliates Program. Report No. UMTRI-2003-15. UMTRI-96746.

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Molnar, L.J.; Eby, D.W.; Miller, L.L. 2003. *Promising approaches for enhancing elderly mobility*. Michigan University, Ann Arbor, Transportation Research Institute, Social and Behavioral Analysis Division. 68 p. Sponsor: Michigan Office of Highway Safety Planning, Lansing; National Highway Traffic Safety Administration, Washington, D.C. Report No. UMTRI-2003-24. UMTRI-97337.

Rumar, K. 2002. *Night vision enhancement systems: what should they do and what more do we need to know?* Michigan University, Ann Arbor, Transportation Research Institute, Human Factors Division. Published by Ann Arbor, Mich.: University of Michigan, Transportation Research Institute ; Springfield, Va. : National Technical Information Service. 52 p. Sponsor: Michigan University, Ann Arbor, Transportation Research Institute, Industry Affiliation Program for Human Factors in Transportation Safety. Report No. UMTRI-2002-12. UMTRI-95648.

Schoettle, B.; Sivak, M.; Flannagan, M.J.; Adachi, G. 2002. *The illuminated surface areas of HID and tungsten-halogen headlamps in the U.S.; [The illuminated surface areas of high intensity discharge and tungsten-halogen headlamps in the United States]* Michigan University, Ann

Arbor, Transportation Research Institute, Human Factors Division. 14 p. Sponsor: Michigan University, Ann Arbor, Industry Affiliation Program for Human Factors in Transportation Safety. Report No. UMTRI-2002-32. UMTRI-96270.

Vivoda, J.M.; Eby, D.W. 2002. *Direct observation of safety belt use in Michigan: Fall 2002*. Michigan University, Ann Arbor, Transportation Research Institute, Social and Behavioral Analysis Division. 68 p. Sponsor: Michigan Office of Highway Safety Planning, Lansing. Report No. UMTRI-2002-28. UMTRI-71544 A25

Vivoda, J.M.; Eby, D.W. 2002. *Safety belt use in Wayne County communities: Fall 2002*. Michigan University, Ann Arbor, Transportation Research Institute, Social and Behavioral Analysis Division. 55 p. Sponsor: Michigan Office of Highway Safety Planning, Lansing. Report No. UMTRI-2002-29. UMTRI-96267.

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