Volpe
National
Transportation
Systems
Center

Volpe Center Highlights

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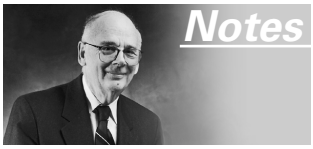
Director's Notes



Dr. Richard R. John

Anticipating Vehicle Crashworthiness Requirements

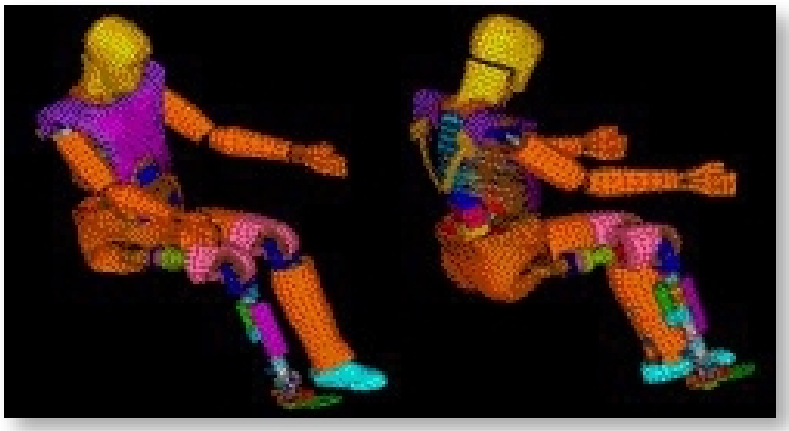
Today, highway safety is made increasingly challenging by the growing number and variety of vehicles and technologies. Keeping pace in an ever more complex and mobile world requires sophisticated tools and creative, integrated approaches to problem solving. However, here at the Center we have always known that keeping pace is not enough, that we must be able to anticipate and rapidly respond to evolving national priorities.

The first goal of safety is to prevent accidents. Nevertheless, given that some collisions will be unavoidable, it is critical to protect vehicle occupants insofar as possible. For the National Highway Traffic Safety Administration, the Volpe Center develops innovative software modeling techniques to measure vehicle crashworthiness, and applies biomechanics to analyze crash scenarios. This issue's *Focus* article discusses our work in these critical areas. As we at the Center work to anticipate the future needs of the transportation community, we see that our expertise in crashworthiness will become even more valuable, and we are taking steps to ensure that we have the right people and technology to meet the safety demands of the future.

Focus

Reducing Injuries and Deaths in Motor Vehicle Crashes (NHTSA)

Motor vehicle accidents result in more than 40,000 fatalities and three million injuries each year in the United States. To reduce deaths and serious injuries to motor vehicle occupants, the National Highway Traffic Safety Administration (NHTSA) investigates ways to increase vehicle safety. This investigation requires an understanding of how bodies physically respond in motor vehicle collisions, as well as the mechanisms that generate the forces that injure vehicle occupants during crashes. The Volpe Center supports NHTSA in both these areas.



Volpe researchers have developed a complex computational model of NHTSA's THOR crash test dummy. The model is a cost-effective tool that complements crash test results and helps evaluate injury mitigation techniques.

The Federal Motor Vehicle Safety Standards specify vehicle crash tests that measure occupant safety; automobile manufacturers are motivated to develop vehicles that perform well on these crash tests. Crash test dummies are used to examine how bodies physically respond to motor vehicle collisions. During testing, instrumented crash test dummies in the

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test vehicles collect data that can be converted into injury criteria. NHTSA performs research to improve crash tests that will result in better injury criteria and, ultimately, vehicle designs with an increased probability of occupant survival and less severe injuries. Recently, a more biofidelic crash test dummy with a more comprehensive instrumentation system was developed by NHTSA's National Transportation Biomechanics Research Center. This dummy, called THOR, could become an international standard as the global community attempts to harmonize safety standards. At the very least, the THOR design will strongly influence an eventual definition of a standard international crash test dummy.

For nearly two decades, the Volpe Center's Vehicle Crashworthiness Division has provided analytical, modeling, and simulation support for NHTSA's research programs in both biomechanics and crashworthiness.

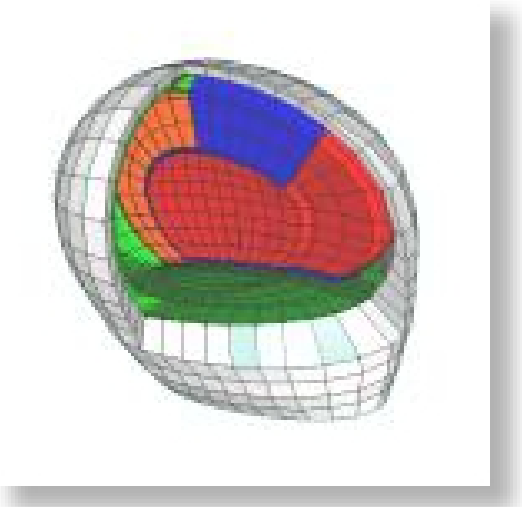
Biomechanics – Studying how bodies respond to and are injured in collisions

Computer simulations of crash scenarios using mathematical models of crash test dummies are a cost-effective way to carry out meaningful research. Such simulations complement crash test results and are used to better evaluate injury mitigation techniques being assessed by the government and other research organizations in industry and academia. Computational models also are used to improve instrumentation and biofidelity of the dummy hardware and to prioritize crash scenarios for physical testing. In turn, crash tests help validate the modeling. To develop such models, Volpe experts use the latest modeling and simulation technology.

The Vehicle Crashworthiness Division has developed a mathematical model of the THOR crash dummy. Dr. David Jeong provided analytical support for material modeling that was essential for the THOR model development. Currently, the THOR model is complete except for validation, and the major components have already been validated with test data. In June 2001, four Technical Information Exchanges documenting the results of these validation studies were submitted to NHTSA by the THOR model development team. The lead authors of these reports were Mr. Peter Kwok of the Division and Dr. Marisol Medri and Dr. Hailing Yu of EG&G Technical Services (a Volpe Center contractor). When validation is complete, the mathematical model can be made available to other research organizations.

On July 30 and 31, 2001, a Neck Research Meeting was held at NHTSA Headquarters. Mr. George Neat, Chief of the Division, and Dr. Medri, Dr. Yu, and Dr. Calvin Zhou also of EG&G participated in the meeting. Dr. Medri and Dr. Yu presented results of the THOR mathematical neck modeling project. Test results were presented by Harborview Hospital, the Japanese Automotive Research Institute, the Medical College of Wisconsin, Duke University, and GESAC, Inc.

Volpe experts also have developed human models, which, unlike dummies or models of dummies, simulate bodily injury. The majority of fatalities and serious injuries that occur in motor vehicle accidents result from damage to the head and chest of the occupants; the Division has developed internationally recognized mathematical models of the human head and thorax. The head model, developed by Mr. Frank DiMasi, provides the basis for a new standardized analytical tool called SIMon (Simulated Injury Monitor). SIMon provides simplified versions of head, thorax, neck, and lower extremities models of occupants, including women and children. These models of humans can be driven by instrumentation data from dummies used in crash tests.



A Volpe-developed mathematical model of the human head provided the basis for NHTSA's standardized analytical tool called SIMon.

Crashworthiness – Helping to define vehicle design characteristics

Volpe also conducts research for NHTSA to identify vehicle design characteristics that will reduce injuries and fatalities in motor vehicle crashes. These studies provide supporting data for federal rulemaking activities to improve motor vehicle testing requirements. Volpe's crashworthiness research includes examining occupant protection systems and occupant behavior, analyzing crash statistics, studying vehicle aggressivity and fleet compatibility, crash testing vehicles, and modeling and simulating vehicles and systems.

Vehicle aggressivity and fleet compatibility are particularly timely areas of concern. Volpe researchers are addressing a safety problem resulting from the disparate types of motor vehicles operating on the highways: vehicle designs intended to protect the occupants of motor vehicles have resulted in "aggressive" vehicles that cause excessive injuries and fatalities to the occupants of the other vehicle in various crash scenarios. In the United States, the emergence of large sport utility vehicles (SUVs) and the increase in sales of vans and pickup trucks have exacerbated the problem. Volpe research will help determine the best combination of vehicle characteristics to reduce fatalities and injuries in motor vehicle crashes between dissimilar types of vehicles. Mr. Neat is participating in international working groups addressing this problem.

Most recently, the Vehicle Crashworthiness Division has developed a prototype Fleet Systems Model to evaluate the impact of vehicle design changes and the introduction of new safety systems on the U.S. automobile fleet. This model uses the results of other ongoing research that includes crash testing, mathematical modeling, occupant modeling, and analysis of crash statistics. Ultimately, the Fleet Systems Model will incorporate projections of the U.S. fleet into future years, optimization features, and capabilities to determine the best combination of vehicle characteristics to reduce fatalities and serious injuries in motor vehicle crashes. The Fleet Systems Model development is a team effort coordinated by Ms. Alexandra Kuchar. Frontal vehicle modeling and simulation is led by Dr. John Brewer, occupant modeling and simulation support is led by Mr. Larry Simeone, and side-impact modeling and simulation support is led by Ms. Yim Tang.

The vehicle crash test program is managed by Mr. John Guglielmi, who is overseeing 11 side-impact crash tests. The data from these tests will be used to validate and complement the analytical and modeling studies addressing the increased presence of SUVs, pickup trucks, and vans in the U.S. fleet.

During each side-impact crash test, a moving deformable barrier designed to represent an SUV impacts a passenger car in the side at the driver's door.

Ongoing and Future Support to NHTSA

The Center will continue to provide modeling support to the process of crash test dummy development. It is expected that the next dummy developed will be a small female dummy, followed by improved child dummies. Modeling of the human body also is an ongoing activity; ultimately, as sufficient resources become available, a full human mathematical model will be developed.

The introduction of lightweight, fuel-efficient vehicles to a fleet with an increasing percentage of light trucks and vans poses new challenges to fleet compatibility. Improvement of the Fleet Systems Model will provide a tool for government and industry to better evaluate the impacts of these changes in the motor vehicle fleet.

Promote the public health and safety by working toward the elimination of transportation-related deaths and injuries.

Working with Germany on Maglev Technology (FRA)

On July 10 and 11, 2001, Mr. Robert Dorer, Chief of the Railroad Systems Division, and Mr. Paul Bousquet of the Division participated in the first working group meetings of the bi-national Organization of Cooperation (OOC). The OOC was formed by the U.S. DOT and the German Federal Ministry of Transport, Building, and Housing to enable cooperation in Maglev research and development. It is jointly led by Maglev Program Officers from the Federal Railroad Administration (FRA) and the Eisenbahn-Bundesamt, the German federal government's railway administration. In support of the FRA, Mr. Dorer is the U.S. Co-chair of the Working Group on Safety, Environment, and Legal Affairs, one of two working groups established within the OOC. The responsibilities of this working group include coordinating exchange of technical information between the two countries, exchange of ideas on the regulatory process of each country, and familiarization of U.S. technical experts with the latest German Maglev technology. The meeting was held in the FRA offices in Washington, D.C.

Supporting the Track Systems Research Program (FRA)

The Federal Railroad Administration's (FRA) Track Systems Research Program develops tools and conducts investigations to assess the likelihood that track defects will cause a train derailment. As part of the Volpe Center's ongoing support to this program, Dr. Theodore Sussmann of the Structures and Dynamics Division contributed to a position paper for the Surface Transportation Board (STB) regarding the reintroduction of passenger rail service between Boston, Massachusetts, and Portland, Maine. The STB is an independent, adjudicatory body within the DOT responsible for the economic regulation of interstate surface transportation, primarily railroads, within the United States.

The Surface Transportation Board twice quoted Volpe's memorandum in its decision.

Dr. Sussmann supported the FRA in developing the technical background for the paper. In June and July of 2001, he reviewed the pertinent documents provided by the parties to the motion, and provided fundamental technical concepts to guide the STB in making its decision. In the decision, the STB twice quoted the Volpe Center memorandum and indicated, "We see FRA's analysis as an invaluable interpretation that supports the clarification provided in this decision." The recent STB decision provides for Amtrak to conduct tests to determine the suitability of rehabilitated track for the introduction of 79-mph passenger service.

Exchanging Railway Engineering and Technology Ideas at International Seminar (FRA)

On behalf of the Federal Railroad Administration (FRA) and at the request of the Association of American Railroads (AAR), Dr. Andrew Kish of the Structures and Dynamics Division attended the AAR/Mexico Mechanical Seminar on Derailment Prevention in Mexico City from July 30 through August 2, 2001. The seminar was sponsored by AAR's Transportation Technology Center, Inc., in Pueblo, Colorado. Dr. Kish presented "Track Buckling Derailment Prevention" at a session on Derailment Prevention and Accident Investigation.

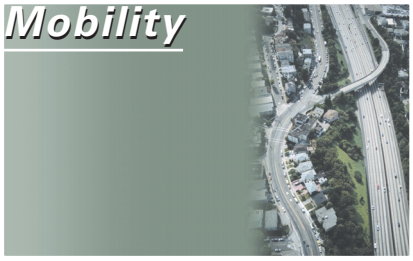
The purpose of this seminar was to facilitate an international exchange of technical information, ideas, and solutions to problems in the field of railway engineering and technology – to be not only a platform for the dissemination of current research results, but also to engage leading U.S. and Mexican railway experts in addressing new railway safety and performance issues.

Chicago Riverwalk Study (Chicago DOT)

The Chicago Riverwalk is a scenic waterfront area of recreational and commercial attractions developed to enhance the vitality of downtown Chicago and the Chicago River. Chicago DOT wants to further develop the south side of the river, including extending the Riverwalk. Although other associated modifications have already begun, the Riverwalk extension is scheduled to begin in 2003. Some users of the river have raised concerns about the proposed Riverwalk – that planned buildouts into the river and increased boating traffic would create an unnecessary safety hazard on the river. At the recommendation of the U.S. Coast Guard Captain of the Port, Chicago DOT asked the Volpe Center to perform an independent analysis of the Riverwalk plan. The Volpe team, which was led by Mr. Jackson Royal of the Service Assessment Division, included Ms. Melissa Laube of the Division and Mr. Michael Dyer of the Technology Applications and Deployment Division.

Volpe's recommendations focus on alleviating safety concerns while maintaining the quality of the design.

On June 27, 2001, Mr. Royal presented the findings of the study to the Chicago River Safety Committee, an ad hoc committee made up of commercial and recreational organizations that use the river as well as the Coast Guard, marine police, U.S. Army Corps of Engineers, and the Chicago DOT. Decisions made at committee meetings are not necessarily binding on any official actions, but these meetings act as a forum to discuss issues and policies that affect the Chicago River System. Mr. Royal's presentation outlined suggested recommendations and changes to the original plan that would minimize the effects of the Riverwalk on vessel traffic transiting the river, while maintaining the quality of the design for pedestrian traffic and commercial development. One Volpe recommendation involves reducing the extent of one buildout from 100 feet to no more than 70 feet, and performing "trial runs" in the river with buoys marking the 70-foot extensions into the river to ensure that the allotted space would safely accommodate barge traffic. The final design will not likely be determined until the results of these tests are available.



Shape an accessible, affordable, reliable transportation system for all people, goods, and regions.

Enabling Distance Learning for ITS Professional Capacity Building (FHWA)

The Intelligent Transportation Systems (ITS) Professional Capacity Building (PCB) Program was established by the DOT in 1996 to provide training and education for transportation professionals in ITS technologies. Since then, the Volpe Center has worked closely with the ITS PCB Program Coordinator to design and implement a comprehensive, nationwide program, including the delivery of training over the Internet. The National Highway Institute (NHI), part of the recently established Office of Professional Development of the Federal Highway Administration (FHWA), will host all the Web-based courses.

Ms. Suzanne Sloan of the Economic Analysis Division helped to establish the distance learning mechanism for all future Web-based NHI courses. Ms. Sloan drafted a Cooperative Agreement between NHI and the University of Maryland for a two-year pilot. The Agreement has been accepted by NHI, and the pilot is being established through the Maryland FHWA Division Office. Division staff also supported the development of NHI's first Web-based course, "Roadway Design," one of the institute's most popular courses. Mr. Doug Rickenback and Mr. Jonah Soolman performed the necessary translations to a Web-based format, including the recent Web-related requirements of the Americans with Disabilities Act. This new course was delivered to NHI at the end of July 2001.

Installing an Enhanced Traffic Management System Remote Site in Mexico (FAA)

From July 22 to 28, 2001, Mr. Matt Maki and Mr. Tony Colon of the Automation Applications Division were in Mexico City, Mexico, completing the installation of a remote site for the Federal Aviation Administration's

(FAA) Enhanced Traffic Management System (ETMS). ETMS is the real-time, operational computer system developed by the Volpe Center that the FAA uses to detect, predict, and handle airspace congestion problems. Aviation authorities from the FAA and Mexico requested special assistance from Volpe's technical staff to get the Mexican site up and running. Mr. Maki's and Mr. Colon's specialized skills in ETMS application configuration, telecommunications, and computer security were essential in helping to solve subtle technical problems. The site is the first ETMS installation in Mexico; it will provide FAA traffic managers with detailed flight plans and flight position information for flights destined for U.S. airspace from Mexico. The U.S. – Mexican air traffic management connection via ETMS followed President Bush's visit to Mexico in February 2001, where he pledged to integrate Mexico into the mainstream of North American economic activity.

Protect and enhance communities and the natural environment affected by transportation.

Supporting the Introduction of Alternative-Fuel Vehicles at the Cape Cod National Seashore (NPS)

The Volpe Center is supporting the National Park Service (NPS) in improving transportation to and in our national parks; this work includes planning, systems modernization, and fleet modernization. A recent project involved the specification and acquisition of alternative-fuel shuttle buses for the Cape Cod National Seashore.

The increasing popularity of the Cape Cod National Seashore, in combination with a growing local population, has resulted in serious traffic problems that affect local residents, damage park resources, and degrade park visitors' experience. The Seashore, established by the NPS to protect the cultural and natural resources of Cape Cod, Massachusetts, offers six swimming beaches, 11 self-guided nature trails, and a variety of picnic areas and scenic overlooks.

About a year ago, staff from Volpe's Advanced Vehicle Technologies Division, led by Mr. David Spiewak, began supporting both the NPS and the Cape Cod Regional Transit Authority in comprehensive transportation planning activities, which included improvements to existing systems, such as shuttle service to some beaches.

On July 20, 2001, the Seashore introduced a new fleet of five propane-powered buses to be used in a shuttle service to the Seashore's outer beaches from the towns of Truro and Provincetown on Cape Cod. This is a joint project, with funding provided by the participating towns, service provided by the Cape Cod Regional Transit Authority, and the vehicles provided by the NPS.

The propane buses replace a fleet of smaller, diesel-fueled buses that were used last year to introduce the shuttle service, which served more than 50,000 visitors. As a result of this popularity, the original buses were nearly always at or over capacity. The benefits of the new buses recommended by Volpe - in addition to their clean-burning fuel - include more passenger capacity, compliance with the Americans with Disabilities Act, and bicycle racks. Despite their larger size, the new buses are able to negotiate Provincetown's narrow streets.

The clean-burning, propane-fueled shuttle buses passed the "white glove" test.

Ensure the security of the transportation system for the movement of people and goods, and support the National Security Strategy.

Expediting Army Shipments in the European Theater (U.S. Army Theater Support Command)

For more than six years, the Volpe Center has been providing logistics support to the U.S. Army 21st Theater Support Command's Theater Distribution Center (TDC) in Kaiserslautern, Germany. As part of this effort, Volpe developed and supports the Shipping, Tracking, and Redistribution System (STARS) software. STARS is a freight transportation and distribution system designed to improve the operation of the Army's "hub-and-spoke" distribution system, by which goods are transported daily between the TDC (the hub) and its customer sites (the spokes) in the European Theater. STARS improves the accuracy and speed of the TDC's redistribution shipping, receiving, planning, and documentation activities by integrating manual input/output with automated identification technologies such as radio frequency tags and optical memory cards. The software can be operated on a laptop computer for use during military deployments.

On August 3, 2001, Ms. Ruth Hunter of the Intermodal Logistics Systems Planning and Integration Division electronically transmitted the STARS Maintenance Release #5 software and associated documentation to the TDC. The latest STARS release provides the Army with the capability to produce an itemized cargo-packing list, which will expedite Army shipments crossing the Macedonian border.

PAPERS AND PRESENTATIONS

- A paper titled "Increasing Airport Capacity with Modified IFR [Instrument Flight Rules] Approach Procedures for Close Spaced Parallel Runways" coauthored by Dr. James Hallock, Aviation Safety Division, was recently published in the Air Traffic Control Quarterly (v. 9, #1, 2001). The paper addresses how parallel runways can be used more effectively under certain conditions when wake turbulence would not be the restricting factor.
- Members of the Vehicle Crashworthiness Division presented three technical papers at the 17th International Technical Conference on the Enhanced Safety of Vehicles in Amsterdam, The Netherlands on June 6, 2001. In the technical session on Compatibility in Frontal and Side Collisions, Ms. Alexandra Kuchar presented "A Systems Modeling Methodology for Estimation of Harm in the Automotive Crash Environment." In the same session, Dr. John Brewer presented "Effects of Angles and Offsets in Crash Simulations of Automobiles with Light Trucks." In the session on Biomechanics: Injury Criteria and Dummy Development, Dr. Faris Bandak presented "SIMon; A Simulated Injury Monitor: Application to Head Injury Assessment." The paper was co-authored by Mr. Frank DiMasi.
- June 24 through 28, 2001, Dr. Aviva Brecher of the Office of Environmental Preservation and Systems Modernization and Mr. Mark Raney of the Environmental Engineering Division participated in the annual Conference of the Association of Environmental Professionals in Washington, D.C. Volpe presentations featured the papers "Electromagnetic Fields, Electromagnetic Radiation and Environmental Health" by Dr. Brecher, and "Ecological Impact of Hovercraft Transportation in Alaska," delivered by Dr. Stephen Petron of CH2M HILL on behalf of Dr. Paul Valihura of the Environmental Engineering Division.
- On July 3, 2001, Mr. Larry Berk, Aviation Safety Division, delivered a comprehensive report to the Bureau of Transportation Statistics for the Safety Data Action Plan (SDAP). The report, "Accident Casualty Reporting and Recording by DOT Modal Agencies," was written in support of the SDAP working group responsible for the project "Develop Common Criteria for Reporting Injuries and Deaths." The report describes, across DOT modal agencies, reporting criteria for accidents/incidents and database conventions for recording fatalities and injuries.
- The Volpe Center is supporting the Aquatic Nuisance Species (ANS) Program of the U.S. Coast Guard Office of Operating and Environmental Standards. ANS have rapidly gained prominence in recent years as a serious environmental threat; on-board treatment of ballast water is one of three preventive strategies under investigation by the international maritime community. Mr. Michael Dyer of the Technology Applications and Deployment Division participated in the Biennial Pacific Congress on Marine Science and Technology held in San Francisco, California, July 8 through 11, 2001. He presented the paper "Performance Tests of Alternative Ballast Water Treatment Systems."
- The Volpe Center is supporting the Federal Highway Administration (FHWA) Office of Natural Environment in the development and maintenance of the FHWA Traffic Noise Model (TNM). Mr. Gregg Fleming and Dr. Judith Rochat of the Environmental Measurement and Modeling Division participated in the Summer Meeting of Committee A1F04, Transportation Related Noise and Vibration, of the Transportation Research Board, held in New Orleans, Louisiana, July 22 through 25, 2001. Mr. Fleming served as the Chairman of the meeting, and Dr. Rochat presented the paper "Update on the TNM Validation Study."

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