

Decoupling Danger

Managing catastrophe by taking things apart

Approximately one-half to two-thirds of Americans killed or wounded in combat in the Iraq and Afghanistan wars have been victims of improvised explosive devices (IED) planted in the ground, in vehicles or buildings, or worn as suicide vests, according to data from the Pentagon's Joint IED Defeat Organization (JIEDDO).

That's more than 3,100 dead and 33,000 wounded.

Michael Latcha, Ph.D., an Oakland University Mechanical Engineering associate professor, and his research team have created a device to potentially reduce the deadly impact of such explosives when troops are in military vehicles. The device also has implications in other transportation systems such as reducing the catastrophic impact of automobile crashes and train derailments.

Dr. Latcha, along with other School of Engineering and Computer Science researchers — Sayed Nassar, Ph.D., OU professor of Mechanical Engineering, and Mehmet Uras, a consultant — invented a system that decouples the fasteners supporting a military vehicle floor in order to dissipate the force of a blast from an IED.

Dr. Latcha says the research project began in the fall of 2010, when the U.S. Army's Tank Automotive Research Development and Engineering Center (TARDEC) approached Oakland University to develop this false floor technology for military transport vehicles.

"When an IED hits the underbody of the vehicle, the explosion sends a shockwave that impacts the people inside. Bones are broken, pulverized, and severe injuries or death can occur," Dr. Latcha says. "This new fastening device will detect the explosion, decouple the floor from the vehicle, and significantly reduce the shock, thereby hopefully reducing injury to the vehicle's occupants."

Initially, creating a system that would deploy and decouple a structure fast enough was the team's biggest challenge.

Michael Latcha, Ph.D., is an associate professor of Mechanical Engineering. He earned his doctorate from Wayne State University, where he also studied for his bachelor's and master's degrees. On the faculty of Oakland University since 1993, his research includes modeling of multi-body dynamic systems; structural, numerical and visco thermal acoustics; vibrations; computational mechanics; machine design; and numerical methods.

Dr. Latcha is a member of the American Society of Engineering Education and the American Society of Mechanical Engineers. He is also a reviewer for the ASME *Journal of Vibration and Acoustics*. Dr. Latcha has served as a U.S. Army summer faculty research engineer, Tank-Automotive Command, in Warren, Michigan.

"In order to achieve this goal, a system had to be developed that would be able to decouple a structure bearing significant loads in no more than 400 microseconds," he says.

Dr. Latcha's team made that happen.

The OU team's rapid decoupling and isolation technology relies on small pyrotechnic devices that are included in common automotive airbag systems to provide the power necessary for structural decoupling.

"Originally, when we looked at airbag technology, the deployment time was ten times longer than our goal, yet when we had more discussions about the airbag mechanism, we were able to modify the sparking system used," he explains. "Using this technology, when an external explosion is detected, within those 400 microseconds, another smaller explosion occurs within the device, sending the drive pin out like a pistol bullet, and completely separating the floor from the vehicle."

Dr. Latcha says the rapid decoupling and isolation technology has been extensively tested under professional laboratory conditions more than a dozen times, including using drop towers to simulate underbody vehicle explosions.

"These tests clearly demonstrated that the technology was highly reliable and repeatable, with decoupling times from 130 microseconds to 240 microseconds and with peak acceleration reduction averaging nearly 60 percent from vehicle hull to false floor," he explains.

Dr. Latcha has continued to develop and refine the technology, including methods to direct and divert the energy from a catastrophic event by altering a structure during the event itself. Several types of quick-releasing structural joints have been designed and are ready for implementation, ranging from simple pin connections to telescoping joints to links that decouple through quick-acting cams, according to the team's abstract.

"This technology is remarkably mature and ready for market," Dr. Latcha says.

To do so, Dr. Latcha formed Fulcrum Engineering, LLC, and is working with the technology transfer program at Oakland University, as well as OU INC (a business accelerator) and the Macomb INCubator, to get the technology to the marketplace.



Along with military interest in the product, several military contractors and automotive suppliers have indicated possible collaborations.

In addition to the military uses, automobile structures can be designed to reconfigure in the midst of a catastrophic collision to better protect occupants from injury. Also, being able to remotely and rapidly decouple railroad cars from each other during a catastrophic event has the potential to save lives and lessen the severity of damage to the train, its passengers and cargo, and to the area surrounding the tracks.

"With this type of decoupling fastener, incidents like the recent train derailment in Pennsylvania would have been much less catastrophic," Dr. Latcha explains. "When a derailment occurs, one car pulls several others off the track. With this technology, the engineer could immediately decouple the cars … reducing damage and saving lives."

By Susan Thwing, a freelance writer.