Smart Vehicle Concepts (SVC) Center

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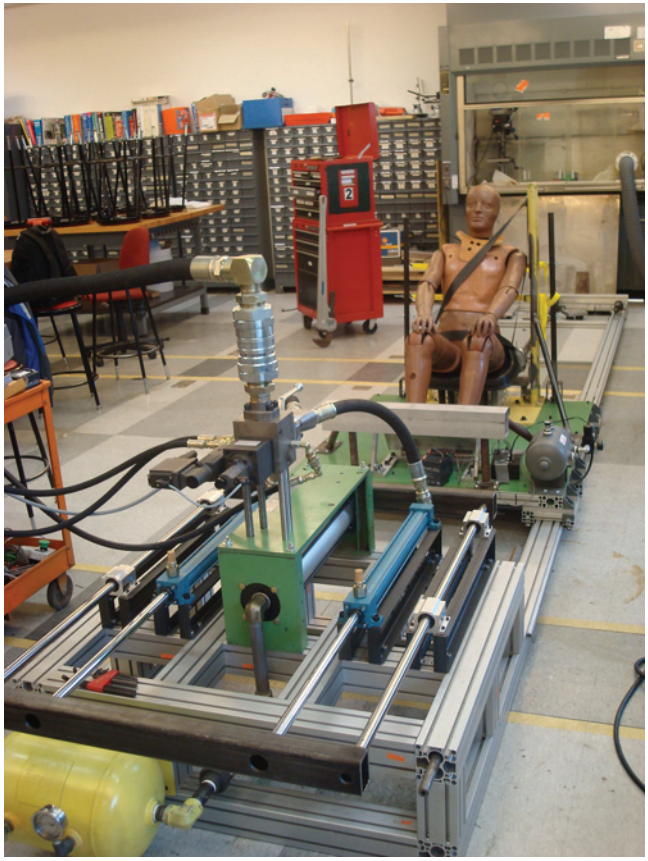
Center website: http://www.SmartVehicleCenter.org

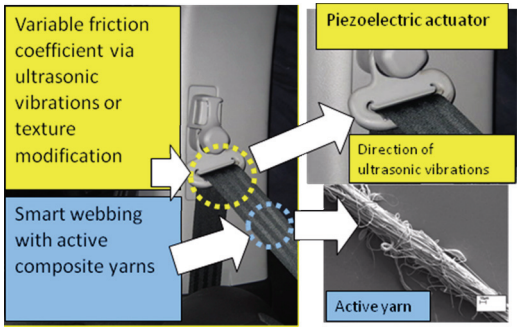
Design Concept for Smart, Adaptive Seat Belts

Current seat belt systems use a compromise design for the median sized individual in an average collision. These systems rely on mechanisms that have a limited capacity to adapt to varying conditions and are massive and complex. Under the direction of Marcelo Dapino at the Ohio State University Researchers at the Smart Vehicle Concepts (SVC) Center have developed an innovative design concept for a new generation of automotive seat belts.

The research is focused on the enabling technologies for the adaptive seat concept: friction reduction via piezoelectrically-induced ultrasonic vibrations next-generation flexible sensors. By using "smart" materials these adaptive seat belts promise enhanced crash safety along with a reduction in the mass and complexity of the seat belt system. Smart materials rely on externally applied stimuli such as magnetic fields, electric fields, heat, or light.

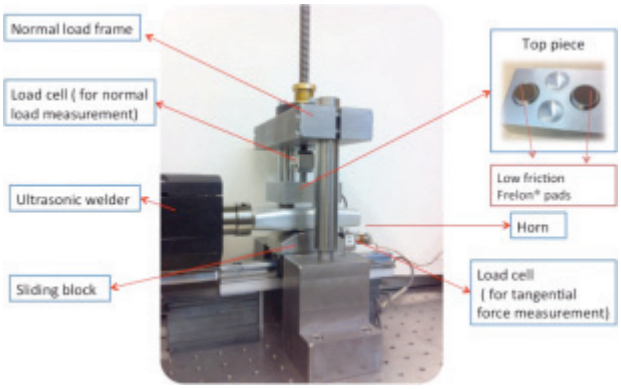


Testing an adaptive seat belt.



Concept for adaptive seat belt based on smart materials.

Crash data suggest that small changes in friction forces at the D-ring have a large effect on the chest force. Smart seat belts measure chest force by using flexible smart polymer sensors that are woven in the seat belt webbing. These sense ultrasonic vibrations, then small piezoelectric actuators embedded in the D-ring automatically adjust the friction force and maintain the desired constant chest force during a crash. The critical benefit over existing seat belts is that the system modulates the chest force independent of webbing displacement. The fundamental technologies investigated in this research, ultrasonic friction control and flexible polymer sensors, are directly applicable to adaptive seat belts and numerous vehicle components such as suspension links, steering, powertrains, and human-machine interfaces.



Experiment for fundamental characterization shows part of the experiment developed to quantify and understand the fundamental mechanisms of Poisson-effect ultrasonic lubrication.

Economic Impact: Adaptive seat belts can change the economics of vehicle safety by greatly increasing the effectiveness of seat belts and associated reduction in injury and insurance claims, while simultaneously facilitating fuel economy due to lower bulk and mass of the overall seat belt system. Use of solid-state lubrication can eliminate the need for lubricants that can be expensive. Economic gains can also be achieved in hydraulic systems in agricultural and construction equipment, commercial vehicles, ships and aircraft; thus greatly reducing the size of batteries needed for powering mobile devices.

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