The Ohio State University (lead institution)

A National Science Foundation Industry/University Cooperative Research Center since 2007

The SVC Center investigates smart material-based solutions to future vehicle requirements and develops adaptive vehicle components and systems with superior dynamic response and multifunctional operation.

**Center Mission and Rationale**

The mission of the SVC is as follows: (1) Conduct basic and applied research on the characterization of smart materials, and the development of adaptive sensors, actuators and devices (based on active materials and control methods) for application to vehicle sub-systems and components; (2) Build an unmatched base of research, engineering education, and technology transfer with emphasis on improved vehicle performance; and (3) Develop well-trained engineers and researchers (at the MS and Ph.D. levels) with both experimental and theoretical viewpoints.

The Center focuses on novel and emerging trends in vehicle design where smart structures, next-generation suspension or mounting devices, vastly improved actuators or valves, and intelligent sensors are integrated to develop ground and aerospace vehicles of the future. Fundamental and applied research is conducted to analyze, model, characterize and design innovative engineered components capable of providing built-in actuation, precision motion control features, self-diagnostics, and self-healing capabilities while satisfying increasingly stringent vehicle design requirements.

**Research Program**

In cooperation with its industrial and government partners, the Center conducts R&D projects in the following four distinct but related thrust areas:

- Interfacial Mechanisms: Advanced electro-hydrostatic actuators, adaptive powertrain mounts, interfacial force sensors, torque sensing and actuation, etc.
- Adaptive Noise Vibration and Harshness (NVH): Active micro and nano-composites, gear noise control, vibration control of vehicle systems, acoustic micro-sensors, panels with tunable stiffness, etc.
- Safety: Distributed force sensors, air bag sensors, adaptive seat belt systems, advanced energy absorbing foams, etc.
- Energy: Energy harvesting devices, adaptive fuel management concepts, powertrain breathing systems, friction control, efficiency enhancement, etc.
The lead institution (Ohio State) focuses on active material based composites, piezoelectric and magnetostrictive materials, ferromagnetic shape memory alloys, and magnetorheological fluid based devices with the ultimate goals of achieving force, motion, noise & vibration control performance targets, including superior spectral bandwidth and improved transient responses. In addition to conducting relevant research, the Center provides advanced industrial education (short courses, web based tutorials and conceptual demonstrations) to improve the knowledge and skill base of practicing engineers.

Current and anticipated research projects include the following (but not limited to):

- Electro-Hydrostatic Actuation and Sensing (E-HAS)
- Design, Modeling and Development of Self-Tuning Magnetorheological Fluid Based Engine Mounts
- Comparative Design Tool for Examining the Feasibility and Performance of Smart Engine Mounts
- Multifunctional Composites with Embedded Sensing and Stiffness Control
- Development of Interfacial Force Sensing Systems using Experimental and Computational Methods
- Panel Stiffness Control Using Embedded Actuators
- Smart Material Database Compilation and Material Selection Tool Development
- Silent Gearbox Concepts
- Development of Smart Engine Mount Actuation Mechanism and Active Elastomers
- Adaptive Seat Belt System Using Smart Material Technologies
- Critical Assessment of Passive and Active Noise and Vibration Technology for Rotorcraft Gearboxes and Airframes
- Micro-Sensors for Sound Measurement
- Development of Contactless Torque Sensor
- Joining of Shape Memory Alloys and Structural Materials
- Fuel Injector Design with Magnetostrictive Galfenol Alloys

**Special Center Activities**

In addition to providing relevant research results to industry and government, the SVC is a source of information and education, not only to university students, but also to practicing engineers. The SVC is the only major center in the U.S. that can provide to industry and other educational institutions world-class information, thereby enabling the mechanical forces and motions necessary for 21st century vehicle systems.

As evidenced by an increasing number of patents and the growing strategic research thrust in this area, smart materials will have a significant influence in future vehicle sub-systems and components. This research area is relatively new and there is a steep learning curve for new entrants into the field. By providing not only technical results and solutions but also being a major educational and advanced training source, the SVC will help the U.S. automotive and aerospace industries to remain competitive in an increasingly challenging global economy.

The lead institution (Ohio State) has an excellent track record in research, education, and cooperation with automotive and aerospace industries. Current efforts represent a unique synergy in research and education that benefits not only the students, academia, and the community, but also industry and the U.S. economy at large. The researchers are working to recruit women and minority undergraduate and graduate students to participate in the SVC through existing outreach campus organizations.
Facilities and Laboratories

Research is conducted in the new Scott Laboratory of The Ohio State University, located at 201 West 19th Avenue, Columbus, Ohio. Scott Laboratory is a $72.5M state-of-the-art facility with a total surface area of 240,000 square feet exclusively devoted to mechanical engineering instruction and research. Scott Laboratory is home to several state-of-the-art laboratories that are central to the SVC.

The Smart Materials and Structures Laboratory, established in 2001, is a 1500 square foot facility at Ohio State focused on creating experimental and theoretical methods to study active and magnetic materials, mechanical vibrations, and system design, from both a fundamental and applied viewpoint. Major equipment include digital data acquisition and control systems, magnetic field measuring equipment, vibration and general testing equipment, amplifiers, and other instrumentation.

The Intelligent Structures and Systems Laboratory is a 1500 square foot facility at Ohio State. The laboratory has been operational since 1996 and has secured significant grants from government and industry. Key facilities include digital data acquisition and control, sensors, power supplies, oscilloscopes, materials testing, electronics processing, and antenna measurement.

The Acoustics and Dynamics Laboratory (over 2,500 square foot facility at Ohio State) houses dedicated experimental and computational facilities in noise and vibration, acoustic chambers, dynamic signal processing equipment, sensors and exciters, and state of the art computer software.

Membership

Refer to the Center web site <www.SmartVehicleCenter.org> for a list of the current members, affiliates and observers, along with other pertinent information.

Center Location

Headquarters

Smart Vehicle Concepts Center (SVC)
Department of Mechanical Engineering
The Ohio State University
201 West 19th Avenue, Columbus OH 43210
Phone: (614) 292-9044
Fax: (614) 292–3163
Homepage: <www.SmartVehicleCenter.org>

Center Director:
Rajendra Singh, The Donald D. Glower Chair in Engineering and Professor of Mechanical Engineering
Email: singh.3@osu.edu