

# Applied Physics

Southwest Research Institute creates sophisticated, miniaturized, low-power electronics devices, sensors and optic systems that are suitable for deployment in a variety of field operations. Other areas of expertise include autonomous systems, ranging from vehicle systems to unmanned aerial vehicles to small tactical intelligent robots, as well as geophysical modeling and characterization of oil, gas and groundwater reservoirs. The Institute also has innovative microelectro-mechanical capabilities, and state-of-the-art facilities include an advanced electronics laboratory and an acoustic test facility.

One example of SwRI's ability to trim system size is a 13-pound portable biometrics collection system that we designed for the U.S. Navy to replace a system weighing 75 pounds and carried in two large backpacks. In 2008, we developed an even smaller version called the System for Intelligence and Identity Management OperatiONs, which weighs only four pounds and can be carried in one hand. SIIMON allows warfighters to quickly capture iris images, mug shots, and fingerprints and compares these data to a criminal database, or watch list. Within seconds, SIIMON provides "detain or pass through" information about a suspect.

With internal funding, SwRI prototyped a magnetometer on a chip using quantum-level sensors, a miniaturized gradiometer and a laser-based optical absorption technique. This technology was integrated into a handheld device that can detect minerals and power lines and can also be used for defense applications such as locating unexploded ordnance, underground facilities and improvised explosive devices.

To support vehicle autonomy initiatives, we developed the

*Seven teams demonstrated and evaluated their autonomous vehicles on a route developed on the SwRI grounds. Our site helped qualify vehicles developed by Team Berlin from the Free University of Berlin, Germany, and three others to compete in the DARPA Urban Challenge National Qualification Event held in Victorville, California.*



*SwRI designed and built a portable electronic circuit test bed to evaluate the function of specific circuit board components under harsh conditions. The system includes functional electronic circuit boards as well as data acquisition and power and measurement modules to monitor the performance of board components, serving as the metric for systems operating in harsh environments.*

DARPA Urban Challenge Experimental Site on our grounds, allowing participating teams to

demonstrate and evaluate their autonomous vehicles in a safe, realistic, repeatable and flexible environment. The SwRI site served as an official DARPA Urban Challenge Site Visit location and, of the seven Urban Challenge teams that used the site, four qualified for the DARPA Urban Challenge National Qualification Event held in Victorville, California.

For the oil and gas industry, the largest maintenance cost associated with reciprocating compressors is valve replacement. In 2008, we demonstrated the dramatically longer life offered by a semi-active compressor valve developed by a multidivisional team. SwRI's valve design includes an electric inductive motion sensor and velocity control electromagnets that sense the start of valve motion. In response, a power amplifier produces motion-control pulses that adjust, allowing the valve to close without hard

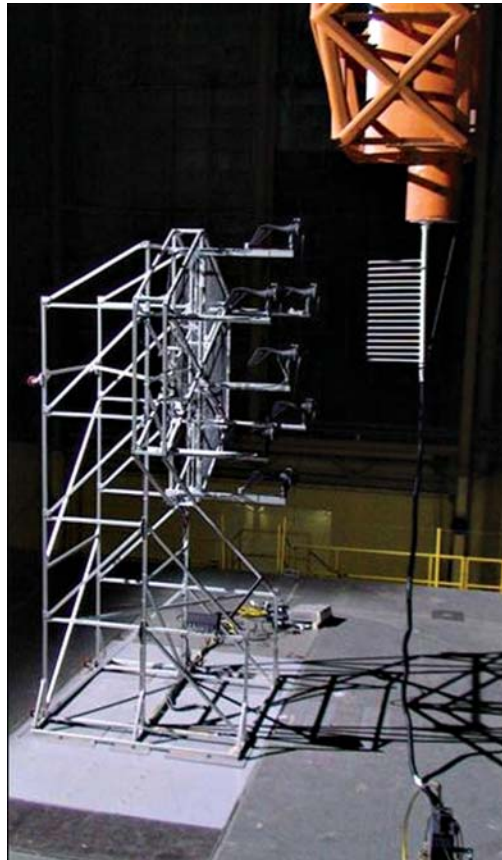


*digital & analog electronic systems development • RF systems • laser, fiber & electro-optics • sensors  
mechanical systems & design • acoustics & ultrasonics • reservoir characterization • biometric systems  
packaging • robotic vehicle evaluations • hardware & component analyses • advanced microelectronics  
microelectromechanical systems (MEMS) • rapid prototyping • miniaturization technologies*

impact or vibration. Our valves have accumulated in excess of 4,200 operating hours at full load and full speed, during which time conventional valves have been replaced more than 40 times.

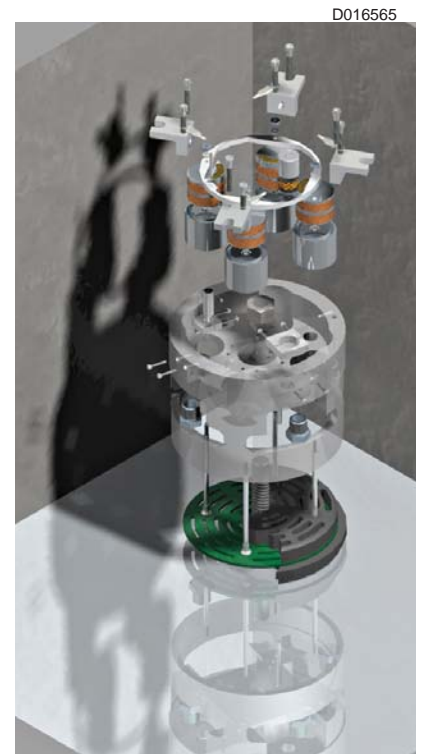
To help characterize the degree of fracturing in petroleum and groundwater reservoirs, SwRI developed borehole inversion techniques to accurately interpret the anisotropy of a formation, in addition to its permeability and porosity. Cross-dipole sonic tools record acoustic waves as they travel orthogonally through inhomogeneous reservoir rock, revealing shear wave velocity in two directions. Anisotropy correlates to fracturing — the greater the difference in wave velocities, the more highly fractured the rock. SwRI has demonstrated an exact match between observed and simulated cross-dipole waveforms using the inversion algorithm. ❖

Visit [applied-physics.swri.org](http://applied-physics.swri.org) for more information or contact Vice President Ed Moore at (210) 522-2739 or [ed.moore@swri.org](mailto:ed.moore@swri.org).



D016580

*To assess a new wind energy concept, a multidivisional team designed and built this scaled-down, seven-turbine array. In addition to using numerical modeling techniques, we evaluated the 22-foot array in a wind tunnel using a variety of performance and flow visualization studies. These evaluations supported the array concept, allowing the client to pursue full-scale prototyping.*



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*In 2008, we demonstrated the dramatically longer life offered by our semi-active compressor valve compared to conventional devices. Valve control electronics sense the start of valve motion and a power amplifier produces motion-control pulses that close the valve without hard impact or vibration.*



D01644-1119

*In 2008, SwRI developed the second-generation System for Intelligence and Identity Management Operations, or SIIMON (left), which weighs only four pounds and can easily be carried in one hand. SIIMON allows warfighters to quickly capture iris images, mug shots and fingerprints and compares these data to a criminal database or watch list. This lightweight system replaces the first-generation biometrics collection system (right) SwRI developed for the U.S. Navy, which weighed 13 pounds.*