

# Automation and Data Systems



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D016709-4967



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D017157-9701



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D017126-0224



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D17232

*In collaboration with local universities, SwRI is developing a bioreactor system that provides continuous nutrition to mesenchymal stem cells as well as precise control of the temperature, oxygen, carbon dioxide tensions and perfusion flow to mimic the bone marrow environment. The bioreactor provides an important tool to study cell-to-cell and cell-to-matrix interactions, mesenchymal stem cell migration, and growth factors and cytokines that regulate MSC self-renewal and multi-lineal differentiations within the bone marrow environment.*

enterprise software • cyber & application security • automated inspection • smart grid • process re-engineering  
embedded systems & security • image & signal processing • radar & remote sensing • machine vision  
autonomous vehicle technologies • orthopedics • reconfigurable communications • biomedical research  
network modeling & simulation • robotics • SEI CMMI® Level 5 software design • network-centric systems  
intelligent transportation systems • cooperative vehicle technologies • green efficient manufacturing  
control center software • aerospace networks • MEMS & microfluidics • data management & mining  
lean manufacturing • medical device development • tactical networks

**S**outhwest Research Institute is developing and applying the latest digital, communications and automation technologies in such diverse areas as green energy and manufacturing applications, intelligent transportation, human health, and information and network security.

In addition to ongoing research in application, network and system security, we are helping to secure our nation's critical infrastructure. For example, although smart grid applications hold promise for saving energy, reducing costs and increasing reliability of electric power, this emerging technology must overcome several challenges. SwRI developed techniques to conduct security penetration testing for multiple utilities to identify and mitigate system vulnerabilities. This testing requires an interdisciplinary set of security knowledge and skills including wireless networking, serial interfaces, encryption, bus sniffing, software reverse engineering and physical device security — capabilities that we also apply to other embedded devices such as vehicle controllers, communications devices and weapon systems ([systemsecurity.swri.org](http://systemsecurity.swri.org)).

Through our Texas Manufacturing Assistance Center, we helped more than 60 small- and medium-sized companies become more globally competitive and employ more green efficient manufacturing technologies in 2009. We launched a first-of-its-kind Lean, Clean Energy program where, in cooperation with CPS Energy, we provided assessments and training allowing local manufacturers to measurably improve energy efficiency and reduce waste. Manufacturers implementing our recommendations fully recover their costs through rebates, incentives and utility cost savings. TMAC also began a focused program to help aerospace suppliers implement lean practices and meet AS9100 quality systems ([tmac.swri.org](http://tmac.swri.org) and [manufacturing.swri.org](http://manufacturing.swri.org)).

Our machine vision experts developed a video-based system that uses digital signal processing algorithms to automatically detect human behavior, specifically identifying bed-exiting in a nursing home environment to help prevent falls. SwRI is enhancing the bed exit detection system, which is part of a long-term care management system, with additional algorithms to detect bed entry, room entry, wheelchair exiting and other behaviors ([machinevision.swri.org](http://machinevision.swri.org)).

Our engineers continue to create and implement intelligent transportation system applications, such as a variable tolling system for Florida's express lanes and a statewide data infrastructure to support the 511 traveler information system deployment. In Texas, we consolidated various systems and software components to form a new product called the

Lonestar™ system ([its.swri.org](http://its.swri.org)). With the next phase of ITS focusing on vehicle autonomy and cooperative vehicle technologies, SwRI is using internal funds to investigate how autonomous vehicle algorithms perform in urban environments that are difficult for piloted vehicles to maneuver effectively. We are also prototyping the use of dedicated short-range communications for vehicle-to-vehicle and vehicle-to-roadside communications ([ivs.swri.org](http://ivs.swri.org)).

Collaborating with the University of Texas Health Science Center in San Antonio, the University of Texas at San Antonio and SwRI chemists, our bioengineers developed a mesenchymal stem cell bioreactor. This system uses a three-dimensional scaffold with a bone-like porous architecture to mimic the bone marrow environment and supplies continuous nutrition and environmental control. The *in vitro* system could potentially provide a continuous source of blood cells for transfusion as well as MSCs for tissue regeneration and wound healing applications ([bioengineering.swri.org](http://bioengineering.swri.org)). ❖

Visit [autodata.swri.org](http://autodata.swri.org) for more information or contact Vice President Susan Crumrine at (210) 522-2089 or [susan.crumrine@swri.org](mailto:susan.crumrine@swri.org).

1. Through an internal research project, SwRI engineers developed a software-based robot abstraction library, enabling many different types of robots to be controlled from a standard interface. This technology eliminates the need for platform-specific operator training and encourages reuse of high-level software control modules, reducing the cost of developing and deploying new robotic applications.
2. In support of smart grid applications, we are performing embedded systems and network security penetration testing for multiple utilities to identify and mitigate system vulnerabilities. In addition, we are addressing other smart grid planning, design and development issues, such as modeling and simulation, as well as communications infrastructure and enterprise system data management and analysis.
3. Our engineers apply network technologies to improve scalability and flexibility of systems in a wide variety of industrial and government domains. Recent systems include a network-centric data acquisition and recording system for flight testing of commercial airplanes and a network-based communication data bus architecture that integrates various military communication and electronic warfare equipment on tactical and combat vehicles.
4. The multidivisional Mobile Autonomous Robotics Technology Initiative continues developing cooperative vehicle and automation technologies. In 2009, we implemented and demonstrated new, cost-effective hardware options and military-style maneuvers to our MARTI™ autonomous vehicle platform, including vehicle platooning control algorithms that allow fleets of vehicles to share information and travel more efficiently and cooperatively.