

Marine Technology Program



Recovery of the underwater mass spectrometer after a long-term deployment on the seafloor of the Atlantic Ocean.

SRI accelerates technology R&D in ocean science, marine technology and port security.

SRI International's Marine Technology Program specializes in the study of surface and subsurface marine environments. Our work includes research, development, deployment and operations of advanced sensors and their systems for government and commercial clients. We are experts in

- Optical sensors and systems
- High-resolution underwater mapping and imaging
- Micro-electromechanical systems

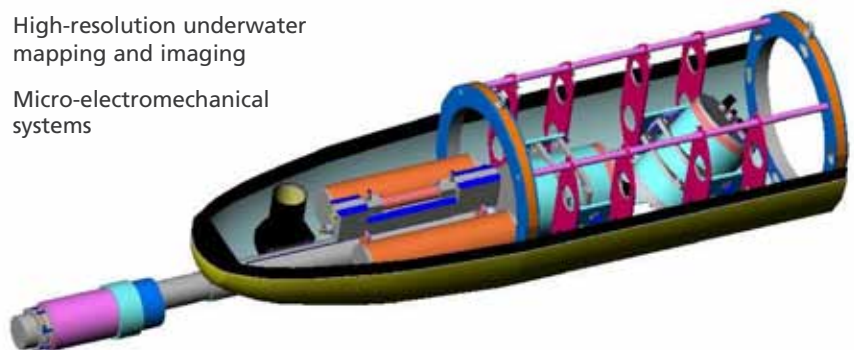
- Port and maritime security
- Underwater mass spectrometry
- Rapid test and prototyping of marine sensor systems

The program, located at SRI's St. Petersburg, Florida facility, was established in 2007 through collaboration with the University of South Florida's (USF) College of Marine Science.

CHEMICAL SENSORS

This SRI group's creation of pervasive networks of unattended high-performance marine chemical sensors is an overarching goal. The group is pursuing several parallel areas of research:

- Development and deployment of in situ mass spectrometers (MSs) for marine environments
- Miniaturization and micro-fabrication of MS components and systems
- Development of novel and miniature power sources for marine applications



Model of ROBOT's 3D imaging sensor, mounted in a nosecone of an autonomous underwater vehicle.

These research efforts should have broader-reaching impacts in other areas as well.

The group has developed portable membrane introduction MS systems for real-time, in-water chemical analysis. Both linear quadrupole mass filters and ion trap MSs have been used for mass analysis. These MS systems have been deployed in marine and freshwater environments on a variety of platforms, such as autonomous underwater vehicles, remotely operated vehicles and depth profiling frames. They are capable of sensitive, simultaneous detection of a range of dissolved gases and volatile organic compounds and can operate from the near-surface to depths in excess of 1000 meters. Two- and three-dimensional chemical maps can be created by merging in situ MS data with position-tracking data.

Current work on improved sampling interfaces should soon allow in situ detection of a wider range of compounds, such as pesticides, chemical threats and explosives.



Deployment of portable membrane introduction mass spectrometer system for real-time, in-water chemical analysis of dissolved gases and volatile organic compounds.

OPTICS

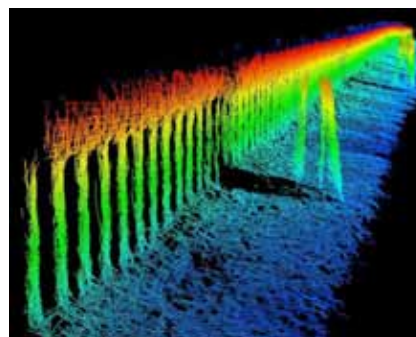
This SRI team designs and builds optically based instruments and systems for sensing, imaging and communications/tagging. Our mission is to apply and develop state-of-the-art technologies and methods towards the development of these systems. The emphasis is on developing capabilities for real-time, in situ monitoring of oceanographic and environmental processes. Technologies employed in these sensors have also been successfully applied to military applications. Staff within the Optics Group offers a broad range of experience ranging from optical and electronic design to image processing and chemical oceanography. With this unique combination of skills and modern facilities, we are able to efficiently develop and test prototype instrumentation spanning many disciplines.

Current projects include

- Spectrophotometric Elemental Analysis System (SEAS): Developed with USF, this compact, laboratory-



Remotely operated vehicle with sonar, camera and geo-positioning being readied for deployment.



3D sonar model picture of pier side St. Petersburg, Florida.

grade spectrophotometer measures chemical species with a resolution in the parts per trillion to depths of 1500 meters.

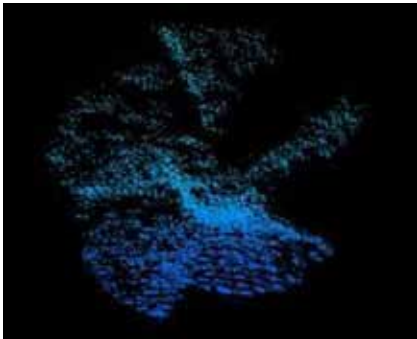
- Real-time, High-Speed, Ocean Bottom Topographer (ROBOT): Also developed with USF, this sensor produces 3D images in aqueous environments with a nominal resolution with a nominal resolution of 0.25" at working distance.
- Multi-parameter inorganic carbon system (MICA): With USF, we are developing a compact system to enable widespread measurements of parameters relevant to the global carbon cycle (i.e., global warming).

MEMS AND NANOTECHNOLOGY

This SRI group's microelectromechanical systems (MEMS) fabrication facility in Largo, Florida offers 5,000 square feet of class 1000 clean room space, plus electronics test and assembly areas. The facility provides design, fabrication and characterization of bulk- and surface- micro machined nano- and micro-scale devices. Capabilities include process development, wet and dry etching, plasma, LPCVD and physical thin film deposition, analytical capabilities (dynamic MEMS testing, film characterization), surface characterization (SEM, AFM, FIB, optical profiler) and



Sonar equipped autonomous underwater vehicle.



3D sonar image of ship propeller.

packaging for government and government-sponsored industrial partners.

We are applying MEMS technology to micro-scale devices in areas such as

- Advanced wide band gap materials (such as diamond, AlN and ZnO) to improve device performance
- Chemical/physical sensors using conductive polymers and micro- and nano-optomechanical structures
- System-level realization of low-power, free-space optical communications
- Visible imaging of nonvisible scene information (infrared, acoustic transducers, THz)
- An integrated, multiple parameter marine sensor

MARINE OPERATIONS

This SRI group specializes in integrating and deploying new technologies for field operations and evaluation.

One of its current and often-used technologies is the Mobile Inspection Package (MIP).

The MIP was developed by SRI's Marine Operations Group to create detailed and accurate 3D models of underwater objects in difficult operating environments. The MIP is platform independent and can be installed on the best vehicle for each mission

type. This permits wide area surveys in shallow or deep water using surface vessels and AUVs (Autonomous Underwater Vehicles). It also gives the capability to perform detailed, targeted surveys with tethered ROVs (Remotely Operated Vehicles).

The MIP consists of an interchangeable suite of high-resolution sensors, including 3D and imaging sonars, optical systems and chemical sensors, all integrated with survey-quality navigation systems. All data products are created in real or near-real time, and are geo-referenced and integrated into a GIS database for fast, easy access and analysis from a command and control center. The MIP is ideal for security, military applications and environmental and scientific studies.

ENGINEERING

SRI's engineering group provides expertise to the program's other teams and leads development of new technology for communications and power sources. The staff is skilled in areas such as robust packaging for marine applications; rapid prototype fabrication (with an in-house CNC machine shop); embedded system designs with low power consumption; electronics, communications and sensor systems; and power source development, including fuel cells.



Wireless data system undergoing testing.

Prototype development and systems modeling is aided by in-house expertise with industry-standard software such as SolidWorks/COSMOSWorks, OrCAD, Matlab/Mathcad and compilers and IDEs for embedded systems and PCs. Prototypes are developed for academic, government and commercial clients, have been deployed in harsh environments, and have demonstrated reliability in critical applications.

SOFTWARE ENGINEERING PROGRAM

SRI's Software Engineering Program employs software engineers, system administrators and managers from within the Engineering & Systems Division to provide software engineering services to support research, development and commercialization. Using project-appropriate software lifecycle models in pure or hybrid form as aides to managing our software development efforts, the team is committed to satisfying customer requirements using best industry practices.

Our staff is experienced in managing software development and integration efforts of many types, maintaining maximum efficiency and reuse of existing capabilities. We have a rich history in transforming research software into reliable and robust commercial-grade software. In addition, we provide expert quality assurance, build-release engineering and customer support services.

MARITIME DOMAIN AWARENESS

This SRI organization employs technology and nontechnical means to fuse maritime domain intelligence and maritime domain situational awareness in order to develop comprehensive and integrated maritime domain awareness for port and maritime stakeholders.

This group leads the Center for Maritime and Port Security (CMPS), which brings together national experts on detecting, preventing, responding to and recovering from terrorist events in the maritime domain. It provides a highly capable, collaborative institution for anti-terrorism and preparedness.

A trusted agent to the maritime industry and government, the Center is a consortium of academia, ports, the maritime industry, private companies with maritime and port security expertise and federal/state/local government entities. The Center's comprehensive approach spans research, technology development, systems integration, testing, demonstrations, deployments, evaluations, policy and training. The Center applies expert testing and analysis to advise customers on the



Persistent surveillance, detection and identification of potential threats is a key component of a comprehensive security system.

best in maritime and port security products, services, training and education.

The Center's first major project is for the U.S. Naval Air Systems Command. In a five-year initiative, the Center is developing a Maritime Domain Awareness System (MDAS) to demonstrate advanced sensing and situation awareness technologies. The project brings together surveillance sensors, marine sensors, data fusion capabilities, biometrics and automated analysis and display of fused and networked information. The Center is also working with the Naval Surface Warfare Center to share technology and extend the Joint Gulf Test Range to include Tampa Bay.

ABOUT SRI INTERNATIONAL

SRI International, founded in 1946, is one of the world's leading independent research and technology development organizations. The nonprofit institute performs client-sponsored R&D for government agencies, commercial businesses and private foundations. SRI also licenses its technologies, forms strategic partnerships and creates spin-off companies.

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