Homeland Security
Science and Technology

# TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

RKB/SAVER Telephone: 877-336-2752
E-mail: SAVER@dhs.gov
Website: https://www.rkb.us/saver

This SAVER TechNote was prepared by the Space and Naval Warfare Systems Center Atlantic for the SAVER Program.



## Underwater Hull Scanning with Remotely Operated Vehicles

When ships arrive in U.S. ports, hull inspections are sometimes conducted prior to berthing. Law enforcement agencies tasked with conducting these inspections typically employ a dive team to physically examine the hull and running gear of a ship for explosives or contraband.

When circumstances such as poor water quality prevent a dive team from entering the water, underwater imaging technologies, including sonar and video cameras, can be used to inspect the hull of a ship. These underwater imaging technologies have different features and can complement each other when used together.

A sonar system uses underwater sound waves to produce acoustic images. This technology works well even in the low-visibility conditions that may be experienced during hull inspections. Video cameras are capable of capturing visual images in a variety of water conditions as well as in confined spaces.

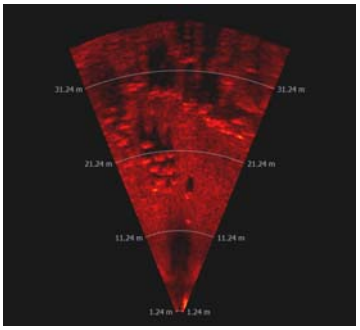

**Figure 1 Acoustic Image**

Remotely operated vehicle (ROV) systems can support sonar and video technologies simultaneously for side-by-side visual and acoustic image display. ROV systems can be used in place of a dive team or with a dive team. When used with a dive team, the ROV system can increase diver safety by assisting in the identification of potential hazards before the dive team enters the water. In many cases, an ROV system can perform an operation more quickly than a dive team.

### Technology Overview

The main components of an ROV system used for port security applications are a submersible ROV, tether cable, and control console. ROVs vary in size, shape, and weight. Law enforcement personnel typically employ either a Micro-ROV or Mini-ROV for hull scanning. These smaller systems can be deployed by one or two individuals and are usually powered with a standard 110 volt or 220 volt AC outlet. Some manufacturers include a 12 VDC inverter for use with a battery.

**Figure 2 ROV System Components**

ROVs used for port security applications come equipped with light emitting diode (LED) illuminators, cameras, and thrusters. LED illuminators provide underwater illumination. Cameras include high resolution color video cameras and black and white video cameras. Black and white video cameras typically provide better-quality images in low-light conditions. Cameras used in port security applications should have pan-tilt-zoom (PTZ) capabilities for maximum utility. Thrusters are propulsion devices for the ROV. They provide thrust to move the ROV in all directions. Thrusters typically have the power necessary to maintain control of the ROV in currents up to 5 knots.

The tether system consists of the tether cable and a slip ring reel. The tether cable physically connects the control console to the ROV. It provides power to the ROV, allows the ROV and control console to communicate, and facilitates handling the ROV.

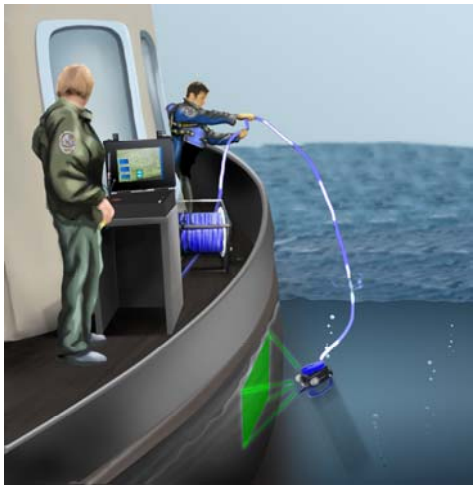

**Figure 3 A Deployed ROV System**

The ROV system is operated via a control console, typically on a boat or pier. Control console components include a laptop computer, display screen(s), and an ROV controller. These components are housed in a watertight case. The main display screen displays video with overlay information, such as date, time, depth, and heading, to help the operator navigate the ROV.

The ROV controller can be hand-held or remain in the control console. The ROV controller allows the user conducting the inspection to control ROV functions such as the thrusters, PTZ capabilities of the video cameras, and optional sonar system.

## Optional Features

A wide variety of optional features are available for ROV systems. Those recommended for port security applications include video enhancement software, a sonar system, a crawler skid, a positioning system, and a tool kit. An ROV system with all of these optional features will cost around $140,000.

Video enhancement software improves images in low-visibility conditions. Image enhancement can be done in real-time to suit various underwater environments.

ROV systems are often equipped with a sonar system that provides acoustic images of underwater objects. The sonar system includes a sonar head, cables, and software. The sonar head is plugged into the ROV for integration. The sonar system software is typically accommodated by the control console laptop.

The crawler skid is a platform, often equipped with wheels, that attaches to the ROV. It adds stability to the ROV and enables it to follow the hull of a ship with increased precision.

Positioning systems use either acoustic or global positioning system (GPS) technology to calculate the location of the ROV and software to interpret and display this information to the operator. Acoustic technology measures the position of the ROV relative to a framework of devices at known locations. Acoustic signals are exchanged between the ROV and these devices during an ROV operation; these signals are used to determine the ROV's location. GPS technology uses orientation and depth sensors embedded in the tether cable along with GPS information to calculate the position of the ROV.

An ROV tool kit includes spare parts and tools that allow the user to perform basic repairs on the ROV system.

Before purchasing a system, an ROV demonstration should be requested from the manufacturer. This demonstration should be conducted in the waters where the ROV will be used and using a typical application. Once a system is purchased, training is recommended on the operation and maintenance of the ROV system.

## Applications

ROVs are used in port security applications, including hull and pier inspections. Using an ROV system, law enforcement personnel have been successful in finding contraband attached to large shipping vessels during hull inspections.

ROV systems have also been used by law enforcement in search and recovery operations, such as locating drowning victims where it is unsafe to send divers into the water. Because of their video recording capabilities, ROV systems are also useful for underwater crime scene investigations.