FEMA

TechNote

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

The Federal Emergency Management Agency (FEMA) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. The SAVER Program conducts objective operational tests 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).

Information provided by the SAVER Program will be shared nationally with the responder community providing life- and cost-saving assets to federal, state, and local responders.

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, please see the SAVER website or contact the SAVER Program Support Office.

Telephone: 877-347-3371
Fax: 443-402-9489
E-mail: FEMA-ASKTS@fema.gov
Website: https://saver.fema.gov

Opinions or points of view expressed in this document are those of the authors and do not necessarily represent the view or official position of the U.S. Government.

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

SPAWAR Systems Center Charleston

Protecting Maritime Assets with Underwater Swimmer Detection Systems

Background

Maritime organizations, such as the U.S. Navy, the U.S. Coast Guard, and port security agencies, have a long standing interest in the detection of underwater swimmers. Underwater swimmers could deliver explosive, chemical, or biological weapons to ships and other critical maritime assets without detection. Swimmers using underwater propulsion devices, such as underwater scooters, can carry heavy payloads capable of causing large-scale damage. An underwater swimmer detection system can mitigate this threat to port operations and maritime security.

Concerns over the vulnerability of maritime assets to terrorist attacks have resulted in a new generation of sonar systems capable of automated detection, of an underwater swimmer. Underwater swimmer detection systems use high frequency sonar to detect and track underwater targets and sophisticated algorithms to determine if the target is a swimmer, or some other object. If a swimmer is detected, the system operator is alerted and provided with the swimmer's location. These sonar systems can be active (emits high frequency sound and listens for reflections) or passive (only listens). This TechNote discusses active sonar systems.

Technology Overview

Underwater swimmer detection systems are typically comprised of three key components: a sonar device, processor platform, and command workstation.

Underwater Swimmer Detection System Operations

The sonar device is the core of the swimmer detection system. The sonar device is deployed underwater and is connected to the processor platform by a power and data communications cable. The sonar device emits high frequency sound and uses sound reflections to locate targets in its field of view of up to 360 degrees and may, under ideal conditions, detect a target up to 1500 meters away.

Detection range can be affected by variations in water temperature, stratification (or layering) of the water column, and salinity, In addition, targets can be masked by acoustic shadowing that can occur near the water surface, the sea floor, plant life, and underwater structures. Acoustic shadowing is an area where sound waves fail to propagate due to topographical obstructions.

Some systems have the capability to network multiple sonar devices for synchronized coverage of a designated zone. Systems can also be integrated with other sensors and surface surveillance equipment (such as radar and infrared, closed circuit, and low-light TV cameras) to enhance port security personnel's situational awareness of a specific area.

The processor platform receives the data from the sonar device and converts the raw sonar data into an appropriate format for the tracking software to read. It then uses target tracking software that contains sophisticated classification algorithms that take into account speed, direction, and behavioral patterns to classify targets. This software can differentiate valid targets from noise and marine life, and some target software can distinguish between target types (e.g., surface swimmers, divers with closed-circuit breathing systems, divers with open-circuit breathing systems, swimmer delivery vehicles, and surface craft). The processor platform also powers the sonar device.

The command workstation collects and displays target positions from single or multiple sonar devices. The command workstation generates an image, such as a navigation chart, of the area being monitored along with the location of a swimmer. Using the command workstation, the operator is able to zoom in on specific sections of the monitored area for further interpretation.

Underwater Swimmer Detection System Interface Display

Once the target has been detected, tracked, and classified as a swimmer, the command workstation operator is alerted visually and/or audibly by an alarm, followed by range, bearing, and tracking information of the swimmer. The command workstation is typically hosted on a standard personal computer.

Swimmer Response Methods

Response methods vary among maritime agencies and may include deploying a response boat, a remotely operated vehicle, or divers to assess the alarm. Some underwater swimmer detection systems have integrated response mechanisms to alert the intruding swimmer either audibly or visually that he is trespassing. These alerts can be automatic and may include a visual alert such as a dazzler (i.e., a direct beam of intense light) that can cause temporary blindness or disorientation, or an audible alert that can cause discomfort to the swimmer.

The U.S. Coast Guard uses an underwater loudhailer to communicate with the swimmer. Organizations, such as the NATO Underwater Research Centre (NURC), are advancing new detection responses, including semiautonomous crafts that warn and closely observe the swimmer before further actions are taken.

Applications

Underwater swimmer detection systems can be an important element in protecting ports and harbors. Systems can be installed on fixed harbor structures, such as piers, permanently fixed on the sea bed, or deployed from the side of a ship. Applications for an underwater swimmer detection system include:

- Protection of vessels at anchor or in harbor, and vessels in high-risk locations, such as foreign ports.
- Underwater perimeter security for sensitive coastal assets, such as navy bases, power plants, ports, and harbors.
- Protection of high-value offshore assets, such as oil rigs.

Implementation of an underwater swimmer detection system requires careful planning and a thorough understanding of the system capabilities, application, and environment in which it will be used.

Emerging Developments

Refinements to detection and classification capabilities continue to improve system performance in order to better distinguish humans from marine life. Vendors are working to develop smaller and lighter sonar devices that allow quick one-man deployment.

Resources

NATO Underwater Research Centre
www.nurc.nato.int/research/emp_hp.htm

University of Texas at Austin Advanced Technology Laboratory
www.arlut.utexas.edu/atl/

Swimmer Detection, Special Operations Technology, September 12, 2005
www.special-operations-technology.com/article.cfm?DocID=1133

Responder Knowledge Base
www.rkb.us