

SONICWORKS™

Innovation in Underwater Robotics

What is the SonicWorks Underwater Security System (USS)?

The USS is an underwater detection system for ports, harbors, coastal facilities and ships at port-of-call. The system combines SonicWorks' core technology with existing systems to produce a state-of-the-art security system. The USS is unique in its ability to support a non-lethal deterrent to water borne intruders. The active system is designed to work in waters around piers, docks and ships where no previous Sonar was capable of operating. It excels in shallow water and leaves no holes. A passive component of the system looks out from the protected zone to identify impending threats. The USS is designed to be integrated into existing shore based security systems to achieve a high level of automated protection. Applications range from waterside security to wide area traffic monitoring for harbors.

A mobile version of USS is designed to protect ships at port-of-call, detecting and interdicting intruders at a safe distance. The system is rapidly deployable at dock or anchorage.

Who would use it?

The US Coast Guard, tasked under the Homeland Security Initiative, has identified 1400 port and coastal facilities for underwater security. The International Maritime Organization has identified 2100 additional sites worldwide that require an underwater security component. These sites range from oil and gas terminals, chemical storage and processing plants, power plants (conventional and nuclear), to high threat dams.

Naval vessels operating at ports-of-call (other than home base) number 800; all of these vessel are potential users of this type of a system. Cruise ships are a prime use of this technology and number around a hundred.

How does it work?

The system uses a combination of active and passive sonar arrays. The active arrays form a precision network on the bottom of the zone to be protected. Each array element (station) oversees a volume of water or surveillance area, much like the lighting illuminating a parking area. The stations are arranged to overlap coverage for reliability. The active sonar stations take a 360 degree snap shot of their surveillance areas 10 times per second (timing is dependent upon spacing). The acoustic picture is parallelprocessed to subtract the background environment and enhance any new objects. The system then studies the characteristics of any new object to determine if it is a threat or potential threat. The computing process has the ability to define the physical outline of the security area accommodating complex underwater structures without degrading the detection capability. The system includes extensive self-monitoring and access control to insure system security.

Are there similar systems in use today?

No, the core technology of USS is based on precision underwater acoustic positioning science. The level of precision required to form the underwater array has been made possible by the development of SonicWorks Acoustic Positioning and Navigation System (APNS). While it has been possible to use closely spaced array sonar to image underwater, the distances covered are but a few meters. The APNS has made it possible to cover any volume of water with a network of transceivers, much like cell phones.

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What is the non-lethal deterrent system?

An optional component to the USS is a special underwater vehicle that delivers a non-lethal acoustic weapon that forces a diver or swimmer to surface and contains them. The system can also deploy concussion devices to ward off vessels. The primary surface deterrent will be a water borne security team.

The vehicle is an extremely high performance robot that when launched by the security operator will guide itself to the intruder and assume a standoff position. The operator will then have a visual of the intruder, he then has the option to warn off the intruder or fire the weapons.

How secure is the system? What are the limitations?

The threat of water borne attack, either surface or underwater, has become reality. Surface detection can be accomplished with Radar, video, thermal imaging and personnel on watch with reasonable certainty. The effective detection of a diver, swimmer or underwater vehicle has been non-existent. SonicWorks USS technology detects anything in the water column that moves, an ability that is unparalleled. This ability is coupled to detection and classification technology to detect and identify the intruder. The more advanced forms of detection and classification are currently classified military systems. SonicWorks USS, as applied in commercial environments, will have a subset of these capabilities in an unclassified form. The system has been designed to be self-repairing and self monitored to insure maximal operational reliability and system security.

The configuration of the USS ultimately determines the level of security the system provides; a densely arrayed system provides the most comprehensive protection. In typical application, the density is varied to concentrate on specific areas while optimizing the system costs.

What about maintenance and support?

Installed systems will require periodic maintenance to remove excessive sea growth from the protection zone; the analog would be "mowing the grass". The growth removal would be carried out by a robotic vehicle similar to the interdiction robot (described above), carrying a water jetting system and guided by the security system's built-in navigation system. The stations themselves are designed for long-term deployment and have special anti-fouling to insure optimal performance at all times.

What about product liability?

Any security system exposes the manufacturer to higher levels of liability. The USS is being registered with the Department of Homeland Security under a special program that limits manufacturers' liability. Military versions of the system carry their own liability exclusions and limits under DOD programs.

What will it cost?

Site cost varies depend on a number of factors, including area covered, density required and integration effort. We have broken down the basic system into an area of typical coverage with a ROM (rough order of magnitude) at \$380K per segment. Typical facilities will require one to three segments for adequate coverage. The mobile units ROM will range from \$300K and up. The cost to integrate the system is the most variable, driven by the shore-based components in place. The goal is to deliver to the customer a highly reliable system with the maximum level of automation.

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What is the passive detection component of the SonicWorks Underwater Security System (USS)?

The passive detection functions as an early warning for the system by detecting the approach of intruders. It is designed as the first line of defense for the SonicWorks active detection system. It does this by listening to sound in the water and triangulating the location of the source. Once a target vessel is identified by the system, it tracks the position and movement. The system analyzes movement to determine if a target vessel is a potential threat. An example: a vessel that picks up speed while changing course for the protection zone, the rate of closure is calculated and the security operator is notified.

How is it used?

The passive detection is designed to be used with other sensor systems to form a fusion of intruder detection. The systems currently in use in ports, harbors and coastal facilities are a combination of Radar, video and infrared imaging. Each of these systems has its limitations and the fusion of multiple sensors is designed to fill in the gaps. Radar is limited by line of sight, cannot see around objects, it is also degraded in rain and snow, and may be blinded by other Radars. Video and infrared imaging are also line of sight limited and rendered blind in heavy rain, snow and fog. The underwater passive detection adds the ability to look at the world from under the water. By operating multiple sensors with various points of view, blind spots and other limitations are overcome. When combined with the SonicWorks active detection system the sensor fusion forms a state of the art security system.

How does SonicWorks passive detection work?

The system uses the acoustic (noise) energy produced by vessels outside the immediate protection zone. The primary sources of these noises are the propulsion system, flow noise produced by the hull moving through the water and bubble generation. Since the majority of this noise is low frequency (within range of human hearing), it travels great distances underwater before dissipating. The system selectively listens to bands of frequencies that contain vessel-specific noises to enhance its ability to operate in high noise environments. The sound is received at multiple stations arrayed on the bottom and triangulated by special algorithms to rapidly locate and track these sources.

Is this technology new, how is SonicWorks passive detection unique?

The use of passive detection goes back to before World War II. The technology is in extensive use world wide in submarine detection and as trip line detection for drug intervention. These systems provide simple detection and approximate location; other information is derived from the sound to help identify the target. These systems are used in open water where there is little other traffic or noise to interfere with detection. What makes SonicWorks passive detection unique is the use of a fixed array in precise locations to triangulate exact position. It listens in selected bands of frequencies that allow it to operate in active traffic zones like harbors. It locks on and actively tracks target vessels.

What are the practical limitations to passive detection?

Because the system is passive and relies on the vessel or vessels to produce the detected signal, extremely noisy vessels or overwhelming traffic will degrade the system's ability to distinguish individual sources. Wind and rain will also produce some degradation. This loss, or degradation of the system, reduces its effective range. Because of the use of selected frequency bands and special detection and tracking algorithms, the degradation is substantially less than any previous system. Even in the worst conditions, the passive system can be relied upon to provide early warning of approach to the protection zone.

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