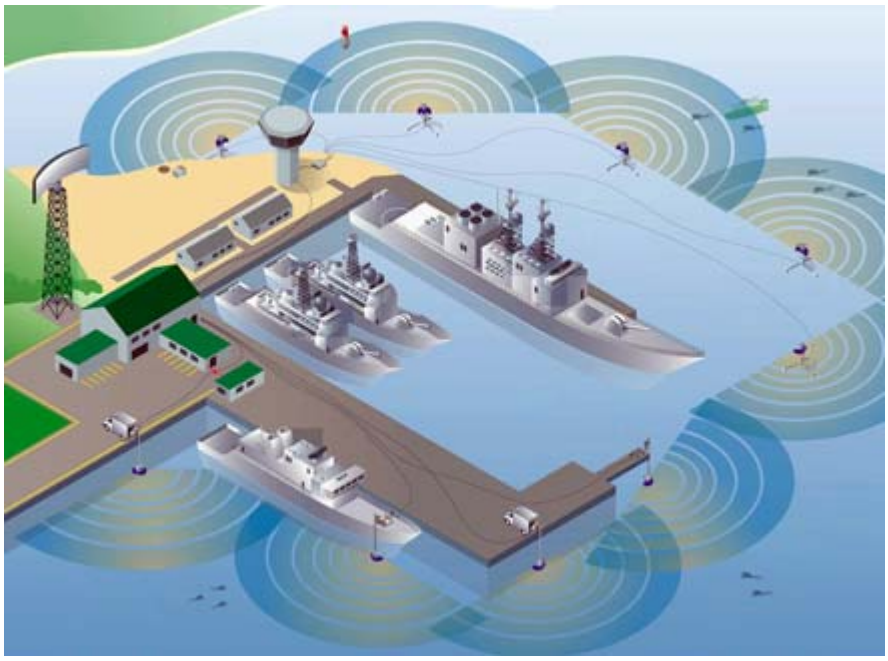
Port Security - Underwater Surveillance

The Hidden Threat Facing Military and Civilian Ports

Ports and waterside facilities are, from a security point of view, the Achilles' heel of national security. Port facilities, bridges, weirs, tunnels, cargo ships, ferries and cruise liners are potential targets. **The entrance to a port is the soft underbelly of military and civilian port defences**. These areas are not well protected against intrusion by terrorist or enemy divers. Past events, dating back to World War II confirm the sub-surface weakness of ports, when navy frogmen first began to use them as points of attack. Attacks may take the form of armed combat divers or the use of explosives against target vessels or facilities. The prospect of enemy divers entering ports or coastal waters undetected to attack naval and civilian ships or piers is a real threat, not only for navies and military forces but also in terms of the safety and security of civilian global trade and shipping. **Underwater access presents an easier way to enter ports and attack ships anchored at the dockside**. Drug smuggling and the rise of terrorist threats have increased the need underwater monitoring of the seas in the vicinity of Ports.



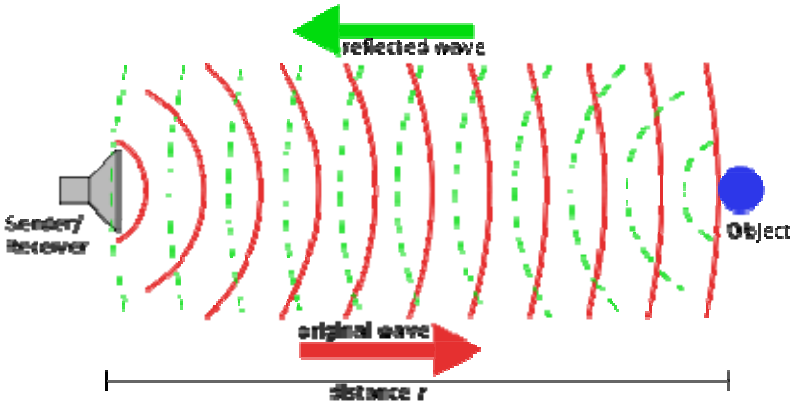
Graphic view of navy vessels moored alongside a diver-detection system set up as a security perimeter around high-value assets to protect against enemy divers and submersibles.

Underwater Security addresses the protection of land facilities and valuable assets that are vulnerable to attack from the waterside. Underwater Security also includes the examination of ships for contraband containers that may be fixed to the hull.

The two technologies available for underwater surveillance are video cameras and sonar. However, in most harbours, **underwater vision is limited due to the turbidity of the waters.** Coastal waterways are naturally turbid because of strong tidal currents. **'Sonar' technology is the preferred choice as it is not affected by water clarity or murkiness**. Sonar can be used to scan areas to ensure they are clear of foreign objects such as mines, Improvised Explosive Device (IEDs), or contraband. Multi-beam sonar can be used to detect the presence of divers, whether in a secure area within a defined perimeter or an underwater area under surveillance. Sonar altimeters can be used to create an "acoustic fence", which, when breached, could trigger an alert for further investigation.

Sonar

An acronym for **SO**und **N**avigation **A**nd **R**anging **is a technique that uses sound propagation to detect objects**, such as vessels, on or under the surface of the water. There are two main types of sonar systems - active and passive. In active sonar, a pulse of sound is sent out and the operator waits for echoes. When a sound signal is sent into the water, part of it will be reflected back when it hits an object. The distance to the object can then be determined by measuring the time between when the signal was sent and when the echo is received. In passive sonar, the operator listens to sounds emitted by the object one is trying to locate. Passive sonar uses the sounds emitted by objects such as ships, submarines and creatures such as marine mammals and fish to determine their location.



The threat

- Un-authorised divers (frogmen)
- Explosives of contraband attached to the Hull
- Explosives attached to the berth

Solution

Typical underwater detection systems consist of a real time sonar that scans the underwater environment in zero visibility waters. The system can be mounted on a small boat to scan harbour walls, piers, bridges for an underwater threat. The system can also be used to complement long range diver detection systems. These systems have built-in intelligence, to distinguish humans from marine animals, based on their different shapes and typical underwater movements. The performance of these systems is not impeded by darkness or fog or low underwater visibility.

Detection of un-authorised divers.

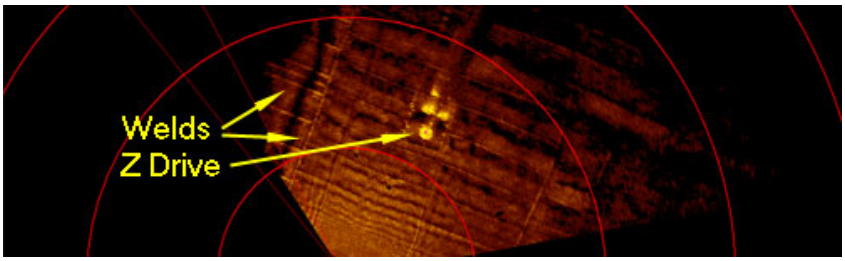
This could be achieved by having a crew of combat divers in a high-speed craft patrolling the undersea area on a 24x7 basis. However this is an expensive and time-consuming task. Sonar is used to detect divers, rapidly and effectively. Underwater detection systems generally operate up to a range of 800 meters. At ranges less than 200 metres, higher frequency sonar can be employed. High-frequency, multi-beam sonar technology is the most effective approach for protecting high-value targets from underwater threats. For restricted, high-reverberation environments where multi-beams cannot operate effectively, e.g., canals, narrow single-beam scanning sonar is deployed. Single-beam operates much like radar sweeping an area, with a narrow, high intensity beam that provides high-resolution images. Multi-beam sonar, on the other hand, “fires” a number of beams simultaneously to cover a broader field of view. Some sonar technologies have the ability to adjust the vertical field of view, enabling the beam to be expanded or narrowed in the vertical dimension and even “steered” up or down to address various monitoring challenges and range conditions.

Diver detection sonar

Further single beam sonar can be used in conjunction with multi-beam technology, to provide coverage in confined areas and as an imaging tool for providing short-range diver confirmation.

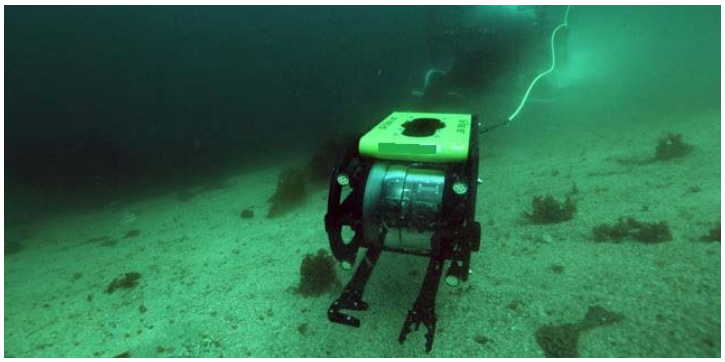
Inspection of the Hull

Ship hulls are scanned to determine if explosives or contraband (usually narcotics) have been attached. Magnetic mines may be attached anywhere to a steel hull below the waterline. Containers for smuggling narcotics are often secured to bow thrusters or rudder structures. High Resolution Scanning Sonar can examine a ship's hull in a short period of time and are able to spot raised objects on the hull only a few centimetres high. When properly deployed, details as fine as weld seams are visible as shown in this scan.



Hull Scan of Barge

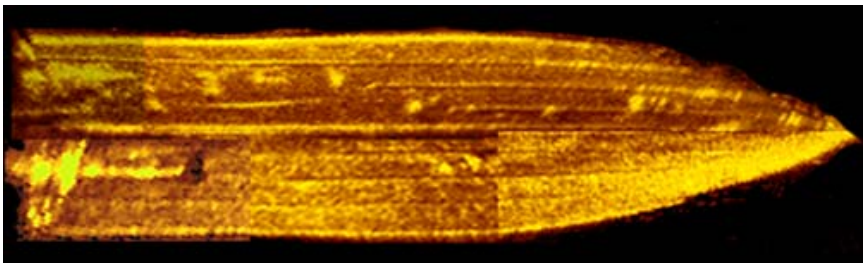
These systems can be mounted on **remotely operated vehicles (ROVs)** to create 3D ship hull scans to detect small mine size objects. Scanning sonar is positioned most easily by using a ROV with sufficient power to hold against currents and to press firmly against the hull. This provides a steady platform for the high resolution scanning sonar and enables high quality scans that readily define features such as a small container attached to the hull of a ship.



Remotely operated vehicle (ROV)

High resolution sonar is capable of rendering complete vessel hull imagery that can detect foreign objects as small as a few centimetres. **Vessel inspections, using sonar, can be completed in far less**

time than diver searches and with little or no risk. Software package are available that can stitch together multiple scans to provide a complete picture of the ship's hull.



Bow to stern vessel hull inspection.

Inspection of the Berth.
High resolution scanning sonar is used to examine a ship's berth in the greatest level of detail. It helps determine if a berth is clear of objects that could represent a threat to a visiting warship, cruise liner or other high value asset. Berth inspections can be conducted in real time and comparisons made to previous scans. Commercially available products enable a single person to easily provide a complete security inspection of a vessel pier and the surrounding underwater terrain. The sonar head can be oriented to provide horizontal coverage (for the seafloor near the pier) and may be vertically oriented to provide vertical coverage for inspection of pier walls.

Challenges.

Reduction of false alarms: One of the biggest challenges in diver detection has been to reduce the number of false alarms triggered by marine life. Most systems available have built-in algorithms that incorporate elements of artificial intelligence to logically select only those targets with the characteristics of underwater or surface swimmers. Advances in these technologies have led to better reliability and fewer false alarms.
Shortage of qualified personnel: Manufacturers are incorporating advances in technology to fill this gap.
Environmental concerns: There is growing concern over the effect of sonar surveillance systems on marine life. Manufacturers are taking care to ensure that the effect is minimal.
Training: Effective and efficient training of sonar operators is essential. **Even the most sophisticated sonar system is only as good as the quality of its operators.**

Trends

Reliability: Technology improvements in sonar systems over the past decade have focused on improvements in the reliability and consistency of detection.
Greater effectiveness: Operating at lower frequencies than scanning sonar, but with higher energy, results in a multi-beam sonar with a longer reach, increasing its effectiveness in diver detection.
Use of a small ROV's that can be launched, at the push of a button, to investigate a threat.
Underwater "loudhailers" to warn innocent divers who may have breached the security zone.
Integration: In addition to the auto-detection and tracking of targets, advancements in software make it possible to route alarms to other command and control systems. All tracking data on targets can thus be merged on a single display screen for fast action. This offers early warning against an impending attack.