TOWARDS A NEW WATERSIDE SECURITY SOLUTION FOR ARUBA

Waterside security in ports: an Achilles heel

Free transport of goods and persons has traditionally characterized most sea ports. After September 11, 2001 all this changed and legislation such as the International Ship and Port facility Security code (2004) was enforced worldwide. Focus has been set on implementing security measures on the landside in ports (quays, terrains, premises), so-called landside security.

However, security measures for the waterside domain are largely absent and form today’s Achilles’ heel in ports worldwide. Waterside intruders pose a terrorist threat or engage in theft or smuggling. Threats can come from small, fast boats or divers. Drugs attached to ships’ hulls for instance are routinely removed by divers. But what does that tell us about the possibilities for terrorists to attach something to a ship’s hull? Port facilities, bridges, weirs, tunnels, cargo ships, ferries and cruise liners are all potential targets.

Aruba Port Authority: a pro-active approach

Although there are no current waterside security threats in Aruba, the topic of waterside security has full attention from Aruba Port Authority. That is not surprising, as commercial port activities in Aruba are essential to the island’s economy: 90% of all imported goods enter the island through the port. Furthermore, the cruise tourism market represents an annual turnover of about 84 M$. In order to maintain the safety of tourists and cargo, Aruba Port Authority has decided to take a pro-active approach by exploring the options for waterside security solutions.

Limitations of today’s systems

Underwater intruders such as divers may pose a serious threat to port infrastructure and vessels as they can approach undetected by conventional above-water surveillance. Diver detection systems are commercially available, but they have some drawbacks. Firstly, they are quite expensive. That has not prevented their application in the defense and offshore markets, but the world of commercial ports is different: competition between ports and port facilities is fierce and the costs of security measures can have significant impact on the operational margins.
Secondly, current diver detection systems use active sonar, similar to what marine mammals use for orientation: an emitted short sound pulse reflects from anything on its path. The returned echoes provide information about the underwater environment, such as the presence of divers. However, a confined port environment is often acoustically reverberant: reflections from the sea bed, quays and ship hulls result in false alarms, severely limiting the performance of these systems.

Active sonar vs. marine life

For Aruba Ports Authority, there is an additional reason why active sonar systems are not a preferred choice. Underwater sounds sources can significantly disturb marine life, such as mammals and fish. With a coral reef just opposite the cruise terminal, continuous use of active sonar could pose a serious threat to underwater life around the reef. Since Aruba Ports Authority and Aruba Reef Care Foundation wish to restore and preserve a healthy coral reef ecosystem, they have a keen interest in an alternative solution that reliably detects underwater intruders at a minimal cost and in an environmentally friendly way.

New waterside security solutions

Since 2010, TNO (Netherlands Organisation for Applied Scientific Research) has been working on new waterside security solutions, supported by Dutch Ministry of Defense, under the name SOBEK. While the underwater environment can be quite noisy, the key capability of SOBEK is smart listening to detect almost inaudible sounds, such as those made by divers (e.g., their breathing). The research has resulted into emerging technology that offers distinct benefits for application:
**Performance**
Contrary to current market solutions, SOBEK passive sonar technology aims at detecting waterside intruders without actively emitting sound. This approach is better tuned to a challenging port environment. This approach is better tuned to a challenging port environment.

**Environmentally friendly**
SOBEK is also environmentally friendly since sounds are not emitted. Power consumption is low and marine life does not suffer from the impact of sound emission. This is very relevant as worldwide restrictions on the use of man-generated underwater sound (including active sonar) are becoming a serious limitation for many applications.

**Affordable**
Passive sonar technology makes use of components that cost substantially less than those used in active sonar products. Future SOBEK solutions can therefore be considerably cheaper than those currently offered on the market.

**Covert**
Passive sonar does not emit sound. Therefore, a SOBEK based system does not betray itself. A small boat or diver can be detected without the detection system revealing its presence. That also has a deterrent effect on intruders - the system even ‘works’ when it is absent.

**How does it work?**

The difference with existing market solutions is that SOBEK technology is based on **passive** sonar: listening to sound instead of emitting sound. The underwater domain in a port is a very noisy environment. Nevertheless, smart listening to almost inaudible sounds of, for instance, divers proves to be successful. Scuba divers emit high frequency signals when they inhale air, whereas the ambient underwater noise is mainly low frequency. All these sounds are picked up by hydro-phones (underwater microphones). Using signal processing developed at TNO, it is possible to distinguish between the diver signals and all other underwater sounds. Using a pair of hydrophones, the direction of the diver can also be determined. Even if the diver is behind a boat. Boats can also be detected, even small ones. Furthermore, by using multiple hydrophone nodes at different locations, the location of the intruder can be determined.
Prototype system
As an example, a collaboration between TNO, AVIC (Dutch SME) and Dutch customs, supported by Port of Rotterdam and Seaport Police Rotterdam has resulted in a basic prototype system for diver and boat detection, demonstrated in Port of Rotterdam in March 2012. The aim was to enhance the safety of the customs divers. The system allows them to assess whether or not a potentially non-friendly diver is present in the water, before they themselves enter the water to inspect ship hulls for drugs. This allows them to reduce the risk of undesired and dangerous encounters in the water and to perform their inspections with safety and confidence. The prototype system detects divers in an operational port environment, as well as small and big boats.

The diver and boat presence is overlaid in a Google maps environment on a smart phone or tablet. A real-time and secure connection ensures that the security information is made available to stakeholders as soon as possible, and serves a basis for counter measures.

Preparing for exotic waters – SOBEK in Aruba
While a proof of concept for SOBEK has been delivered in North-West European waters, the acoustic underwater environment in Aruba will clearly be different: temperature, salinity and sounds produced by the underwater biology all have their influence on the underwater acoustic environment. SOBEK technology needs to be adapted to these circumstances. An important first step is to record and understand the acoustic underwater environment in Aruba. TNO, supported by Aruba Ports Authority and Aruba Reef Care Foundation, will record the underwater sounds in Aruba in the period of 10 through 13 Dec 2013. The data collected can also be valuable to marine biologists that want to assess the presence and distribution of fish species in the reef area. As such, the project not only contributes to future safety of cruise vessels, but also makes steps toward a technology for monitoring coral reef health.

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