Security Upgrade for Ports (SUPPORT)
Sea Side Intrusion Detection

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Organised crime and terrorism are threats to ports - hubs for international trade and shipping. Systems incorporating modern sensor technology, information sharing and autonomous alarm functionality to detect potential risks can improve security in ports, keystones of the world economy. Below, sea side intrusion detection is discussed.

I. Introduction And Background

The SUPPORT project is funded by the 7:th Framework Programme of the European Union. The project scope ranges from security personnel training and factors affecting the information exchange between port stakeholders to sensor systems and information fusion. One of the focus areas, where many ports need to improve, is detection of security hazards arriving from the water onto the ships at berth or onto the berth itself. The monetary resources and armed response capability of a port are tiny compared with military harbour protection.

II. Results

Our aim is to enhance port security by processing vast amounts of data in streams. We define a unifying ontology to model sensors and events in the context of port security. The model is a basis for our decision support system architecture. This approach relies on introduction of relevant sensors (for underwater and surface intrusions) and signal processing algorithms that convert the sensor signals to information within the ontology. Anomaly detection is used for locating surface objects of interest. A probabilistic model is estimated for the dynamic infrared image background, and foreground objects are detected as observations of low probability according to the background model.

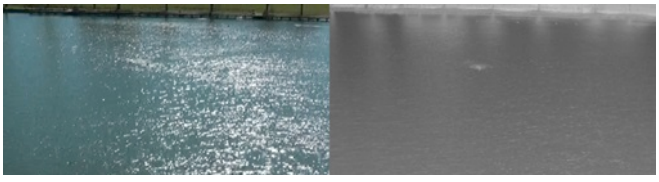

Figure 1. Illustration of the hard task of detecting swimmers; video image (left) and IR image (right).

The information fusion architecture comprises the Sparkwave [1] (stream processor) and Impactorium [1] (decision support) tools. The aim is to reduce noise in the data stream, cope with heterogeneities, detect patterns, fuse data streams and provide decision support.

The system has been tested in a use-case that focuses on the problem of detecting intruders from the sea-side of the port. FOI has developed and tested a passive acoustic tripwire (PAT) designed to detect divers [2] (A conventional approach would be to use active sonars). In a simulated scenario an underwater passive tripwire is placed in the Port of Gothenburg. The models are based on results from real trials. The tripwire holds a number of acoustic sensors continuously sending their readings to the Sparkwave processor (see figure 2), which searches the stream for specific patterns. When a diver enters the observed location, an intrusion pattern is activated and Sparkwave builds and transfers a report including location and concrete sensor readings.

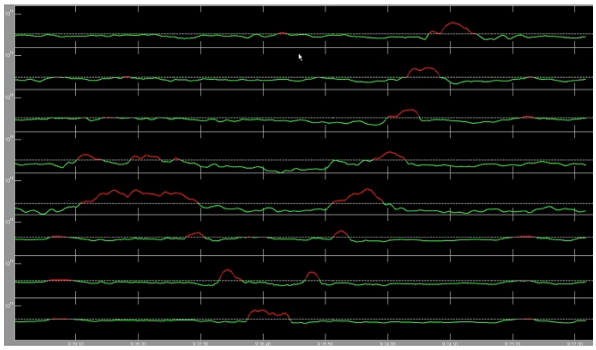

Figure 2. PAT detector output, from the eight hydrophones in the tripwire (time on the x-axis). The results are from a trial in the port of Gothenburg in May 2013. Graphs are red when detector output is above the threshold.

As the port is a busy and noisy environment false alarms can be expected. To ensure that the report generated by Sparkwave is not a false alarm, it is fused with information from other sources, for example surface sensors that may give indications strengthening or weakening the hypothesis of underwater intrusions. In the use-case we assume that the port authorities have received an intelligence report a week before saying that there is an increased risk of an intrusion on one of the ships in the port. The two pieces of information are automatically fused by Impactorium, resulting in the assessment that there is an increased risk of an on-going intrusion from the sea-side.

In the future, we plan to extend gradually the experimental setting with additional sensors, patterns and threat models.

Live demonstrations in the Port of Gothenburg are planned for the beginning of April 2014.

References

[1] Fensel et al., ”Semantic Data Management: Sensor-based Port Security Use Case”, European Intelligence and Security Informatics Conference (EISIC), IEEE, 2013.

[2] R.K. Lennartsson, E. Dalberg and S. Petrović, “Underwater Intruder Detection with Passive Tripwires,” Proc. Water Side Security 2012, Singapore, May, 2012.