Smart Tracking of Information for Maritime Domain Awareness

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***Abstract*— Maritime surveillance systems are used to detect threats early enough to take appropriate actions. We describe a concept that uses information fusion, anomaly detection and semantic technology to integrate information from surveillance systems with background knowledge on normal conditions to help users detect and visualize anomalies in vessel traffic.**

I. Introduction

We present the results of a study on maritime domain awareness (MDA) financed by the Swedish Emergency Management Agency. The purpose of the study was to investigate how information-fusion and anomaly-detection methods can be used to facilitate worldwide surveillance of maritime activities

Today's surveillance systems and data sharing initiatives within the maritime domain offer an opportunity to collect huge amounts of data on vessels worldwide. This opportunity doesn't necessarily mean that all data are, in fact, available, permitted or true. There is a need to develop intelligent data processing functionality that highlights unusual behaviors and inconsistencies in the large dataset. Interesting events or threats are often camouflaged and hidden in regular traffic patterns, which means that available data mostly appears quite uneventful to the user. To remedy this, we need to increase the level of automation at higher fusion levels, which aims to support operators with limited resources by giving them early warnings about worldwide approaching threats.

We introduce the concept system SMARTracIn [1] – Surveillance of Maritime Activities by Robust Tracking of Information – with an aim to track vessels worldwide using *all available information* – or smart tracking of information. By including information from ship and crew records, cargo details, records of ship ownership and details about the activities of ship-owners as well as intelligence reports about the ships, it is possible to track all existing information about the vessel rather than just its geographical position. This enables information-fusion and anomaly-detection methods to discover more threats, at an earlier time, than a purely position-driven approach. SMARTracIn explicitly aims at allowing users to follow vessels ocean-wide, and to detect suspect behaviors globally. While this makes the project more challenging scientifically and technically, it also allows for a larger increase in user effectiveness than focusing merely on coastal regions.

II. Results

No single system or sensor has a complete overview of all vessels within a certain area, but MDA can be improved by combining the information gathered from different surveillance systems in use by different authorities with information from intelligence records.

Figure 1 shows the system architecture, involving Information Fusion and Anomaly Detection using the Common Information Set. Information Fusion and Anomaly Detection processes are performed at several levels of abstraction as well as geographically distributed, and interact with various existing systems at information suppliers and end users. The anomalies need to be displayed to decision-makers at different levels as well as to the analysts actually performing the anomaly detection. Before this can be done, the system needs to align the data in space and time, a non-trivial problem in itself, and establish the quality of the available data. The potentially very large amount of information available to a monitoring node needs to be automatically filtered and sorted for efficient usage. To this end, metadata and semantic tags aligned with the shared ontology can be exploited to query available sources for relevant information.

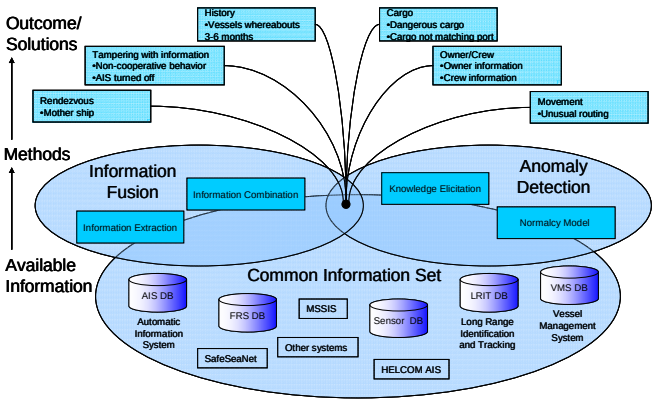

Figure 1. System architecture

References

[1] Sten F. Andler, Mikael Fredin, Per M. Gustavsson, Joeri van Laere, Maria Nilsson, Pontus Svenson , SMARTracIn -- A concept for spoof resistant tracking of vessels and detection of adverse intentions, Proceedings SPIE, Vol 7305, 2009