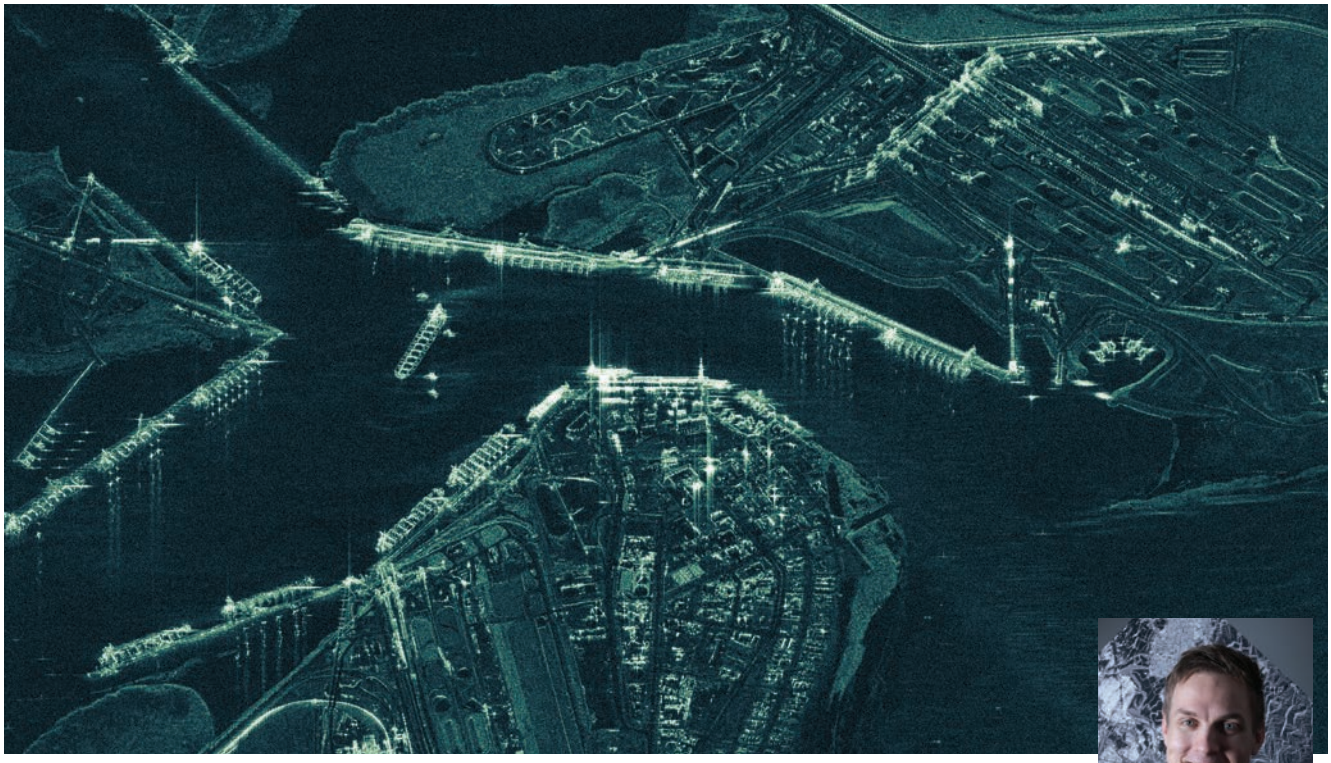


ICEYE

EFFECTIVELY COUNTERACTING SUSPECT MARITIME ACTIVITIES

BASED ON NEAR REAL-TIME SAR SATELLITE MONITORING

Pekka Laurila, CSO, ICEYE, Helsinki, Finland

The availability of timely Synthetic Aperture Radar (SAR) satellite data provides new opportunities for detecting illegally operating vessels. By matching vessels detected in satellite data with Automatic Identification System (AIS) information it is possible to identify "dark" vessels immediately and actions can be taken to stop suspicious maritime activities.

SITUATION OVERVIEW

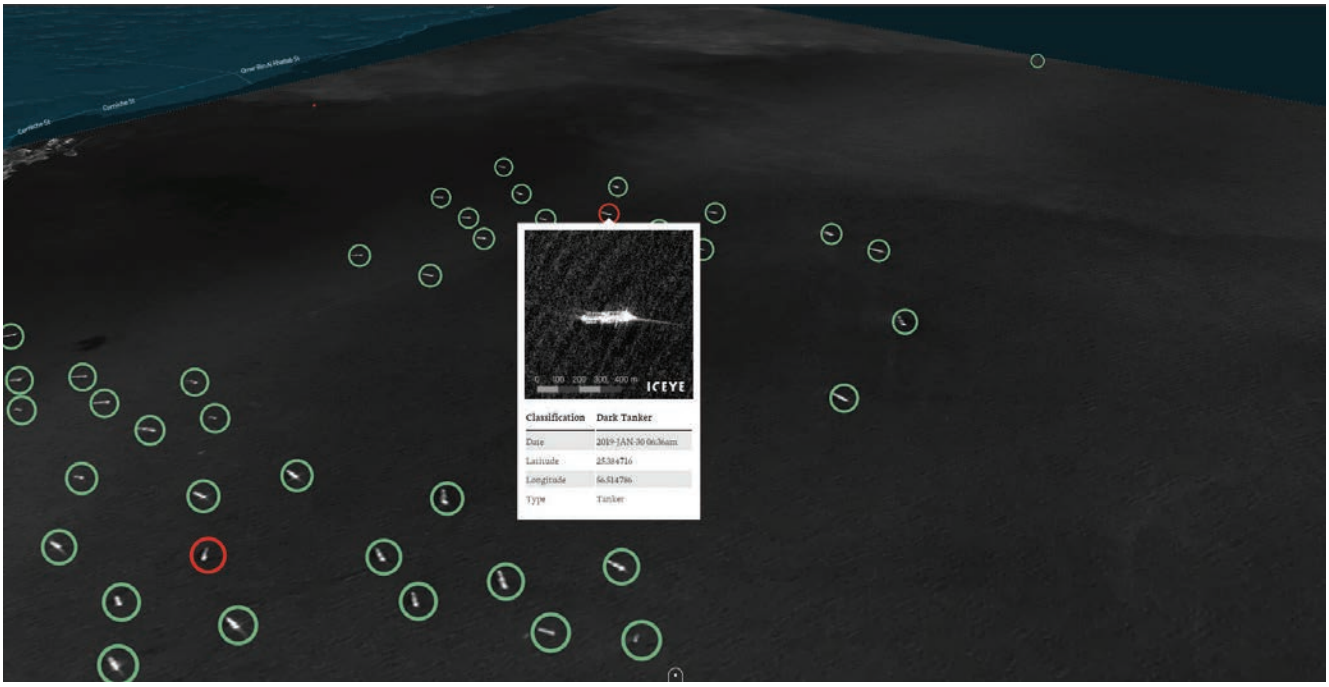
Every year vessels conducting illegal activities cause severe damages to economies worldwide, including lowering the security of national sea areas. Virtually all countries along coastlines are facing the threat of illegal fishing, ocean dumping, illegal immigration, unauthorized transshipment, smuggling of people, arms, and drugs. These illegal activities are serious risks to legal sea operations, especially in the vicinity of ports. According to the outcomes of the United Nations "Review of Maritime Transport 2019", the global marine trade volumes in 2018 reached 11 billion tonnes, and in the 2019-2024 period, will continue rising a 3.4% per year. This development increases the pressure on the authorities, shipping companies and port operators to guarantee unobstructed processes since they still suffer from a lack of proper and comprehensive information to effectively counteract the security threats caused by vessels conducting illegal activities. A robust system to identify and track suspicious ships and boats is of great importance to ensure smooth and safe operation processes.

LIMITATIONS OF CONVENTIONAL METHODS

The localization of vessels that do not identify themselves through AIS or Vessel Monitoring Systems (VMS) is a rather complex and demanding challenge. There are no effective tools in place that enable the monitoring of remote sea areas frequently, nor are they detailed enough to set up an alert system for taking effective actions on dubious activities. Coastal radar, as used by national control systems, is limited in range covering coastal waters only. A comprehensive, reliable near real-time monitoring of vast sea areas is needed.

SATELLITE-BASED SEA MONITORING

Satellite technologies are already used to observe sea areas. However, the limited revisiting capability of most satellite



Detection of suspicious vessels: the vessels highlighted in red are detected in the radar satellite data but not visible to AIS receivers.

constellations do not allow the use of the imagery as a reliable source to build an effective sea surveillance system on them.

ICEYE is developing a SAR satellite constellation that will guarantee complete, near real-time monitoring over large sea areas not just in coastal but also in remote sea areas. The current ICEYE SAR satellite constellation consists of three satellite units in orbit, ready to image locations at short notice. Over the next few years, the number of satellites will constantly grow and provide more and more frequent information that maritime authorities and port management can benefit from.

The reason for the reliability of SAR data is due to the fact that the data can be acquired at any time: during day and night-time and under all-weather conditions. The global revisit rates of the ICEYE satellite constellation will be capable of offering information multiple times each day, over any area of interest, with fast delivery for maritime response operations.

APPROACH

The most reliable method to track down illegally operating vessels is to combine timely SAR satellite information and AIS transponder signals in chosen sea areas. Automated SAR imagery analysis methods are in place to detect vessels and deliver their locations precisely. These results can be matched with the recorded AIS signals of the area under surveillance. Each vessel detected in the SAR imagery that cannot be linked to an AIS signal is classified as "dark".

For all those dark vessels the latitude and longitude, together with a timestamp is provided. Additionally, the satellite imagery of each vessel will be made available as an image chip suitable for further, more detailed visual analysis.

ICEYE's Dark Vessel Detection approach has been successfully tested and is validated to detect vessels as small as 9m x 20m and targets as small as 3m, confirmed by AIS. An algorithm is under development at ICEYE to be able to locate small, fast-moving vessels through detection of wakes visible on the sea surface.

IMPLEMENTATION

The process for detecting dark vessels is implemented at ICEYE as a monitoring service. Its architecture makes it a suitable solution that can be implemented for multiple-use cases. The rate of how often information is updated and the period of monitoring are defined based on the situation and customers' requirements. The delivery to the customer is a series of near real-time reports documenting the current activities of dark, non-self-identifying vessels at sea at a certain time. Before submission, all results will have passed an intensive quality check.

SERVICE IN PLACE

The service for detecting dark vessels to counteract illegal maritime activities is already in use by a number of ICEYE customers. The deliverable consists of a KMZ file, XML file, and ICEYE satellite image (GRD). Importing the ICEYE data into a larger maritime domain awareness system is made easy with standardized data formats.

An interactive demo can be viewed at the IECYE website. It shows an example of the Dark Vessel Detection solution in the Pacific Ocean and the Gulf of Oman. Additionally, example data is offered for download.

ABOUT THE AUTHOR

Pekka Laurila is the Chief Strategy Officer and Co-founder of ICEYE, the first company that has successfully miniaturized a SAR satellite to make the World's largest SAR satellite constellation possible. Since beginning the company, he has been establishing and directing the company's strategy, including raising initial funding for ICEYE. Prior to co-founding ICEYE, Laurila played a significant role in Finland's Aalto University Nanosatellite Program Aalto-1, where he studied Engineering and Geoinformation Systems program.

ABOUT THE ORGANIZATION

ICEYE is building and operating its own commercial constellation of radar imaging satellites, with SAR data already available to customers. ICEYE empowers others to make better decisions in governmental and commercial industries by providing access to timely and reliable SAR satellite imagery. The company is tackling the current crucial lack of actionable information with world-first aerospace capabilities and a New Space approach. ICEYE's radar satellite imaging service, designed to deliver coverage every few hours, both day and night, helps clients resolve challenges in sectors such as maritime, disaster management, insurance, and finance.

ENQUIRIES

Email: sales@iceye.com
Website: iceye.com