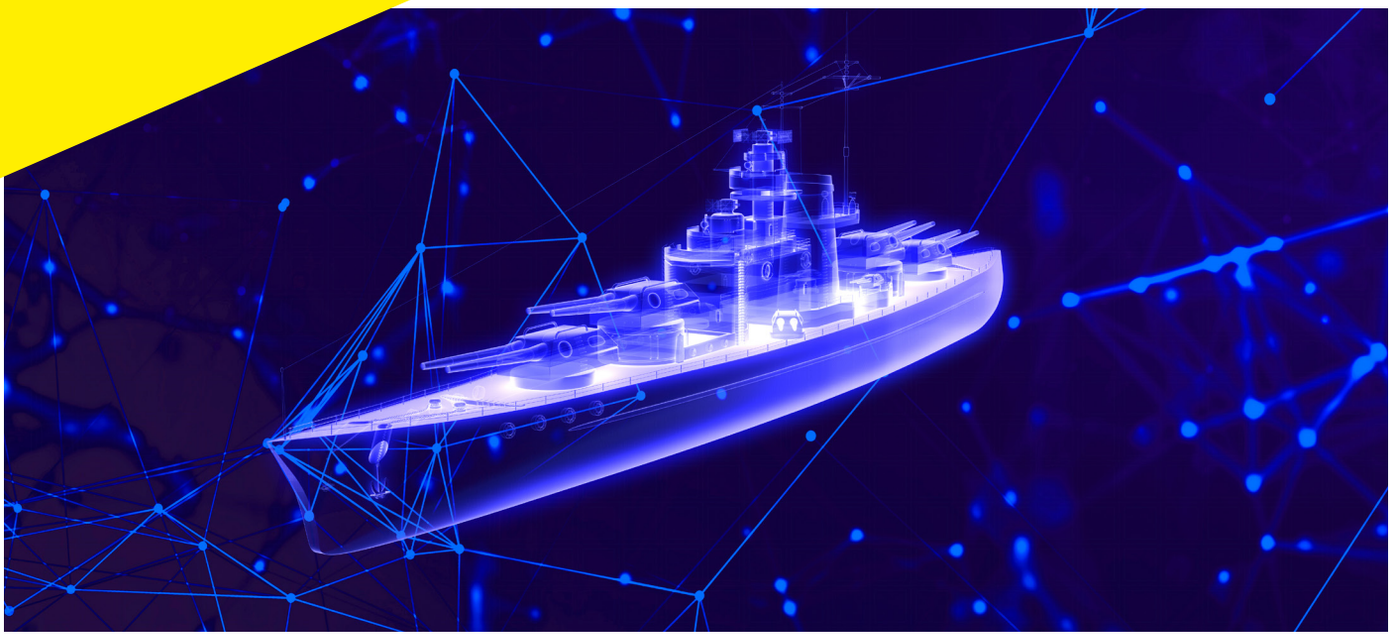
VEC VIRTUAL ENGINEERING CENTRE / [dstl]



Using data to TRACK, ANALYSE and PREDICT global maritime movement

The Virtual Engineering Centre's (VEC) Simulation Team has developed a state-of the art Virtual Engineering Systems Laboratory (VESL) which is used to develop a wide range of digital test-beds to support client projects and research collaborations.

The VEC was approached by the Defence Science and Technology Laboratory (Dstl), in conjunction with the University of Liverpool's Professor Simon Maskell from the School of Electrical Engineering and Computer Science, to develop a system which would improve existing methods used to track, analyse and predict global maritime movement. In particular, to help to identify and combat illegal maritime activities such as pirating and coopering (where a bigger vessel stages a rendezvous with smaller vessels to engage in smuggling or other activities).

THE CHALLENGE

With more than 80% of the world's goods being transported by sea, a secure maritime environment is essential for the free flow of global trade. But, with illegal maritime activities and piracy on the increase, Dstl was keen to develop a system to improve tracking of ship behaviours and detect inconsistent, misrepresented and potentially illegal activities.

The VEC needed to create a system architecture which gathered and processed a combination of AIS (Automatic Identification System) and ELINT (Electronic Intelligence) data from global maritime surveillance. AIS is used to automatically send identification information and is often used to track ships or to coordinate their movement to avoid conflicts. These systems are mandated by the International Maritime Organisation for any qualifying ship.

The system needed to cover functions including tracking, classification, clustering, searching, alerting and learning, in order to be relevant to the National Maritime Information Centre (NMIC), a source which disseminates information aimed at stopping illegal maritime activities.

THE SOLUTION

The first hurdle was to tackle the phenomenon of spoofing where multiple ships share the same Maritime Mobile Service Identity (MMSI), often masking illegal activity. The VEC team began by feeding a number of AIS and ELINT data sources into Dstl's software framework. This enables tracks using the same MMSI to be differentiated.

From here, using a cross-platform document database tool, ships were classified (as Cargo, Fishing, Passenger, Pleasure Craft, Tanker and Tug) according to their behaviour patterns, and an anomaly detection algorithm was applied to help detect inconsistent behaviours.

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An intuitive graphical user interface was developed to create and run complex data queries to identify a whole host of inconsistent and mispresented ship activities, including:

- Coopering events – where vessels hover side-by-side or meet others for questionable purposes
- Change Point - where sudden changes in ship activity in specific regions are detected, such as a sharp decline in the number of vessels in a certain point, which indicates an unknown threat
- Outlier detection – vessels displaying inconsistent group behaviour
- Ship type mismatch – vessels whose reported ship type does not match their actual behaviour
- Destination – where the self-reported destination appears different to the intended destination
- Multiple criteria – for example vessels that behave as a fishing ship, self-report as cargo and are involved in coopering events

The resulting solution successfully combines these multiple plat-forms to track, analyse and subsequently predict ships' class, behaviours and destinations. This then allows alerts to be raised when inconsistent or suspicious behaviour is detected.

BENEFITS

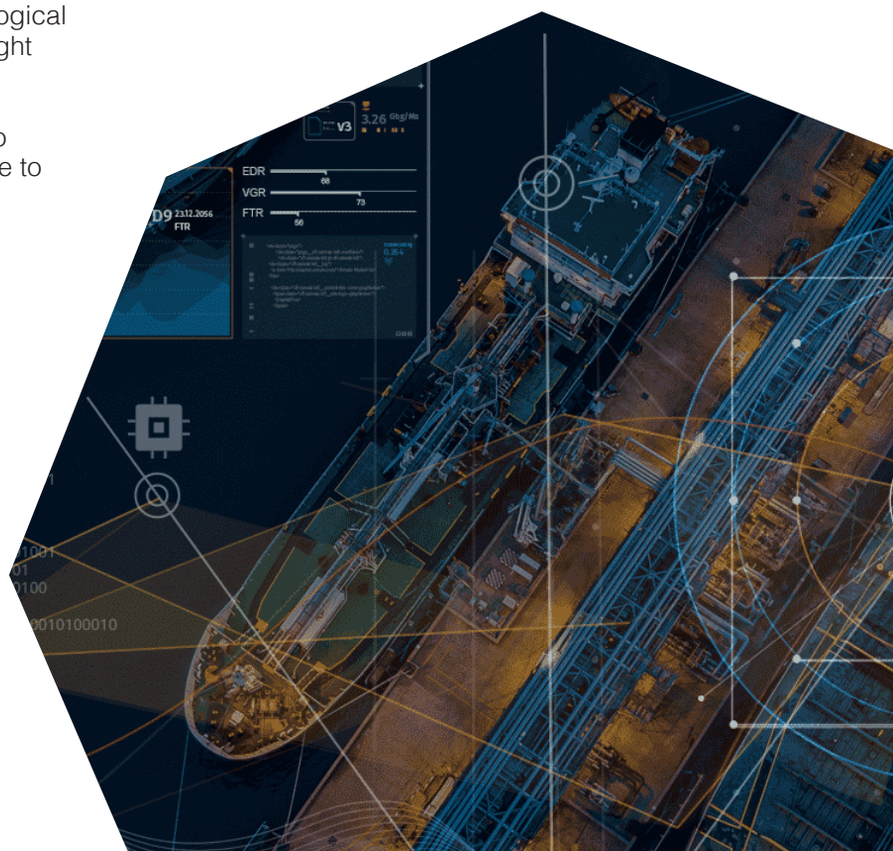
By working closely with Dstl and using its expertise and knowledge of the challenges and existing solutions, the VEC team was able to focus on areas which would add value to the analysts and help them in their daily roles. The system developed brings intelligence to existing data by allowing automatic ship tracking and the differentiation of multiple data sources.

It identifies potential illegal activities such as coopering and pirating, by enabling predictions – bringing unrecognised behaviour to the attention of analysts; calculating actual ship types versus self-reported ship types and discovering intended destinations rather than self-reported destinations.

This allows data analysts to quickly build complex logical queries with multiple criteria, leading to greater insight compared to a manual system. Improved detection rates and confidence levels of suspicious activities and increased time available to respond to alerts allows resources such as the UK Border Force to make more informed decisions on deployment and ultimately help to reduce illegal maritime activities.

Alasdair Hunter, Senior Mathematician at Dstl, said:

"Working with the Virtual Engineering Centre on this project has been invaluable in helping us to enhance the UK MOD's and wider Government's analytical capability across the globe. It has helped The National Maritime Informa-tion Centre (NMIC) to collect key real-time information to monitor activities in UK and worldwide waters, to ensure safety for all. We are now looking at working with the VEC to further develop the system."



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