ULTRA MARITIME

Command and Control Systems

Multi-influence Systems for Surveillance and Harbour Protection Applications

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Overview

An integrated Maritime Surveillance System is critical to enable a nation or a republic to provide local, regional and international Law Enforcement, Maritime Security, Border Security, Policing and Counter Trafficking operations. National Security Ministries typically have a range of assets for different operational needs. For example, this could include coastguard, naval and border guard assets, such as small inshore vessels, Fast Patrol Boats (FPB), Fast Interceptor Craft (FIC), Offshore Patrol Vessels (OPV), Helicopters (Helo), Rigid Inflatable Boats (RIBs), Coastal Surveillance sites and Maritime Patrol Aircraft (MPA).

Long-range assets, such as an OPV or MPA, act as force multipliers, through the provision of continuous maritime extended range, mobile surveillance. However, the power projection of these assets must be harnessed, in order to fully realize the capability of such assets. The extended range tactical and radar pictures that these assets produce must be fused with all available surveillance assets, including coastal radar sites, to build and maintain a comprehensive Recognised Maritime Picture (RMP). This RMP can be extended still further through the integration of land sensors to build a multi-domain Common Operating Picture.

The RMP would provide early warning of approaching Contacts of Interest (COIs) including traffickers, terrorists, and illegal vessels, and would allow timely intercepts to be conducted by a variety of assets. Dissemination of the RMP must be distributed in real or near-real time, to allow timely strategic and tactical prioritization and decisions to be made.

Asset tracking (position of own assets – Blue forces tracking) enables the positions of all assets to be tracked and tasked for intercept, security, or Search and Rescue (SAR) operations. The full benefits and operational advantage of all maritime and coastal assets can only be fully realized and utilized by providing a totally integrated maritime surveillance system that fuses data from all assets across a wide area. If the information from all assets and surveillance systems is combined and shared, a comprehensive picture across the complete area of operation can be achieved. Thus, providing enhanced maritime domain awareness, early warning, and quicker reaction times, to combat and control emerging threats, illegal activities, and SAR incidents; guaranteeing security in a changing world.

Integrated Maritime Surveillance Systems

Ultra's Surveillance Systems enable total communication between all sensors, surveillance systems, C2 centres, ships, aircraft, and vehicles deployed on land, in the air, and at sea. Our systems are designed to enforce and enable Border, Perimeter, and Site Security of national boundaries and critical installations, along with Coastal and Maritime Surveillance and networking solutions to protect a nation's EEZ and Territorial Waters.

Ultra's integrated Security & Surveillance Systems ensure that essential information is readily available, both centrally and locally, to enable the operator to easily monitor the area, take effective action, and rapidly deploy interceptor assets. Ultra's Coastal Surveillance Systems enable total surveillance coverage of a nation's coastline, integrating high-performance, optimized surveillance radars with sophisticated signal processing and powerful trackers. Radar tracks are combined with AIS tracks, transponders, long-range EO sensors, DF sensors, ESM, and relayed via any communications link to all land and sea assets and C2 centres. The integrated system design results in a network enabled Coastal Surveillance System that ensures unknown vessels are detected at range, allowing them to be identified and monitored. This critical information is then made readily available, centrally, to enable the operator to easily monitor the area, take effective action and to rapidly deploy assets for subsequent vectoring and interception.

In this paper we will review the ability of underwater multi-influence sensor technology to enhance underwater surveillance barriers and harbour protection applications.

Underwater multi-influence detection

Underwater multi-influence sensor systems can be used to provide enhanced detection capability of covert underwater platforms. The use of a combination of acoustic, magnetic and electric influences can provide benefits of enhanced discrimination between targets and advanced tracking capability.

Systems can include several networked multi-layered barriers at various distance offshore and water depths. The sensing elements can be embedded within robust underwater cable which can be easily deployed on the seabed using a cable laying vessel.

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Acoustic detection

Acoustic detection using hydrophones and sonar systems is a well-known sensing method used for both shallow and deep water detection systems.

Magnetic detection

Magnetic sensing technology is a proven element found in covert underwater barriers designed to detect underwater platforms with either ferromagnetic material content or corrosion induced magnetic signatures.

The magnetic sensors can be used in total field or 3-axis technologies. The use of 3-axis magnetic sensing technologies allows tracking of vessels which allows calculation of target platform depth, speed and heading.

Ultra's magnetic sensors offer low drift and high stability the most important factors in an accurate sensor for detection barriers. The sensors require low power and can be packaged in a housing of 50mm diameter enabling deployment embedded in underwater cables.

Electric detection

The E-field detection method is the latest technology in underwater detection. It has been developed to provide an additional detection method which can supplement existing acoustic and magnetic technologies.

Both electric and acoustic methods can detect features such as propeller shaft rate but the two methods are differently affected by the environment providing alternative detection methods or confirmation of one another in certain situations.

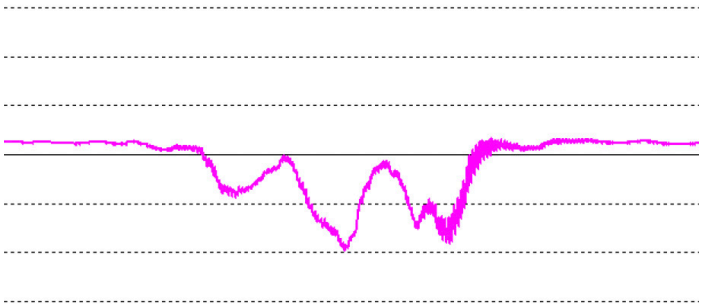
Electric fields sensors have proven for measurement purposes in the rapidly developing hydrocarbon mapping market and in military vessel signature measurement applications.

Typically the electric fields that are measured in the sea have a frequency range from quasi-DC up to a few kilohertz and amplitudes that vary from millivolts per metre to nanovolts per metre. These electric fields arise from many different sources in the environment including corrosion of different metal types in seawater and electromagnetic sources onboard platforms.

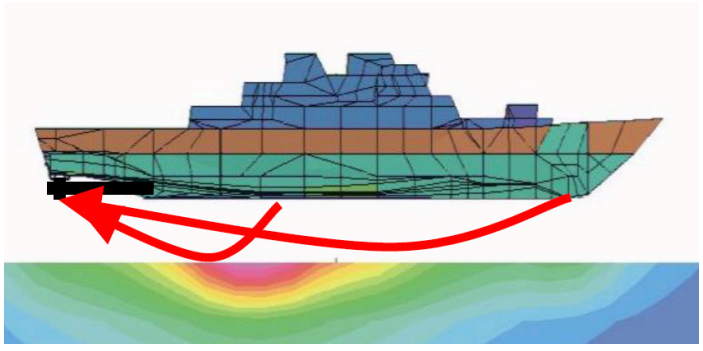
Typically man-made sources that can produce measurable fields include shipping activity and ROV / AUV / UUV, divers as well as marine cathodic protection systems, oil pipelines, shore based power utilities and electromagnetic surveying.

An example vessel signature is shown below showing both corrosion and shaft rate signatures.

Ultra Maritime electric field element



Measured Electric Signature of a ship's cathodic protection system



Schematic showing the Electric Signature of a ship's cathodic protection system

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Sensor Array Configurations

Networked sensor arrays can be configured in many different configurations: from singles lines of sensors across naval harbour mouths to multi-layer detection “barriers” several many kilometres in length protecting bays. Longer arrays can be generated using several junction boxes or linked Ethernet hubs to create barriers. Barriers which include sensors with magnetic, electric and acoustic sensors provide increased capability creating additional chances for detection and characterisation of transiting vessels.

Permanent installations use buried cables or fixed seabed mounting point (e.g. concrete bases).

Data processing

Magnetic and electric field modelling software can analyse data from any system configuration. Noise rejection is included as part of the algorithm package to enhance detection of vessel signatures within environmental noise.

The data processing includes modelling software which allows signatures from different water depths including tidal variations and different headings to be corrected for allowing accurate comparisons with known platform types aiding identification of incoming underwater vessels.

The use of modelling can also offer magnetic tracking algorithms which calculate vessel draught, track and heading without the use of GPS or other tracking systems.

Ship tracking capability

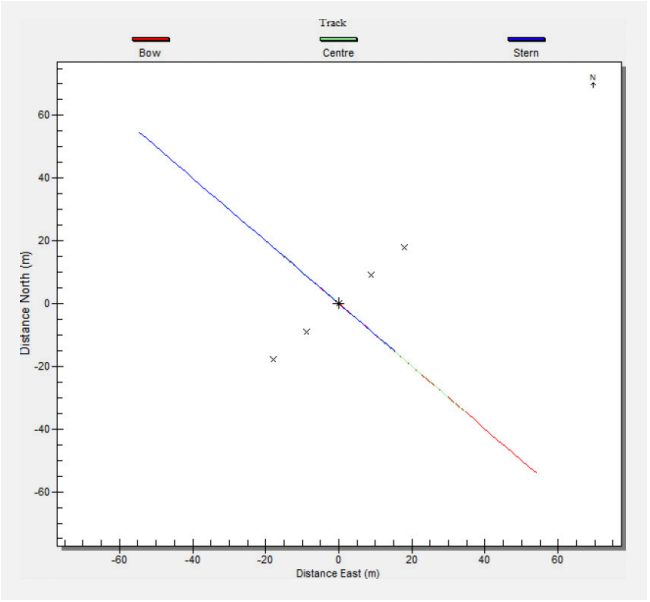
Ultra’s proven magnetic tracking algorithm is especially useful in situations which prohibit the use of trackers such as covert data gathering operations and on harbour entrance ranges (HER) where data gathering occurs on a continuous basis determining the signatures of many different vessels.

On detection barriers electromagnetic tracking can be used to determine the heading, track depth and approximate size of vessel entering the protected area or on harbour entrance ranges designed to record vessel signatures.

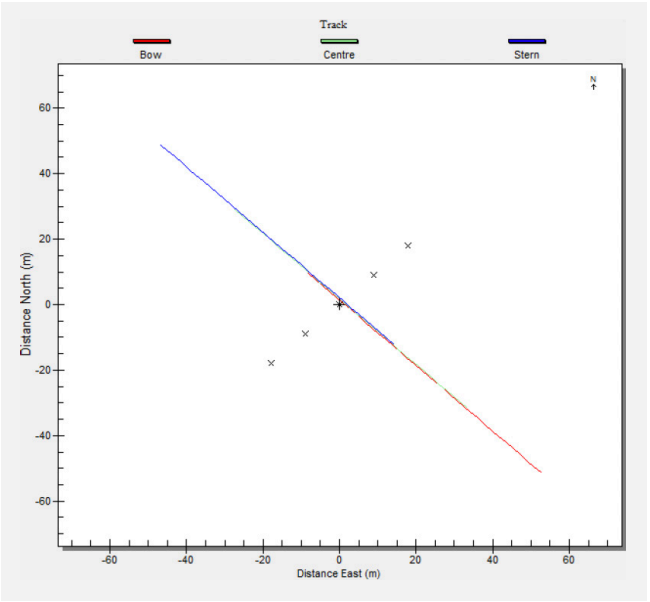
All data is continuously gathered and processed. The presence of a vessel is indicated by an increase in the measured magnetic field level. The magnetic signature data is passed to the magnetic tracking algorithm.

The algorithm allows detailed knowledge of its track and depth as well as guidance on the type of platform.

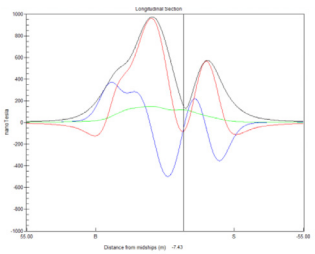
Once a vessel track has been calculated the vessel’s magnetic and electric signatures can be assessed enabling identification of likely platform type.



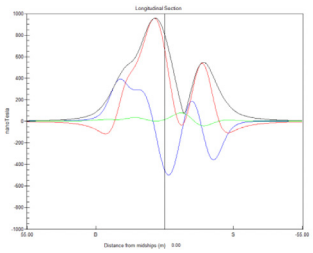
Measured Track



Calculated Track



Tracked signature



Signature calculated using barrier algorithm

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Buoy Configurations

Seabed barriers can be supplemented by buoys for marine surveillance. Typically buoys employ acoustic sensors for target detection the efficacy of the detection system can be enhanced by using electromagnetic elements.

Summary

Multi-influence harbour protection barriers provide enhanced capability for identifying and tracking incoming underwater platforms.

Contact Information

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System Overview

Integrated Maritime Surveillance System

Sensor options:

- Magnetic
  - 3-axis
  - Total field
- Electric
- Hydrophone system
- Buoy sensors

Barrier options:

- Single or multiple barrier
- Water depth 0.5m – 200m
- Barrier length 10m – 20km

Track parameters:

- Heading
- Speed
- Underwater platform depth

Vessel characterisation:

- Characteristic frequencies
- Ferromagnetic content