UXO SURVEY TECHNOLOGY

At a recent meeting of the Hydrographic Society in Scotland/ NOSP looking at ***The Next Steps in UXO Survey Technology & Techniques***, Chris Almond from PanGeo Subsea recently looked at 3D acoustic surveys to mitigate the target visualisation

The first stage of any survey focusses on conducting a desktop study. This collates a variety of information sources, such as known maps of munitions dumps, pipelines, wrecks and other seabed data that has been collected over the years from a variety of sources such side scan sonar, multibeam sonar echo sounders etc..

Armed with this information and the proposed route of the cable to be laid, the operator can commission a geophysical survey. Perhaps the most common tool used is a magnetometer which is towed across the planned area to produce a magnetic anomaly map highlighting ferrous metals on the seabed.

"A wind farm development could highlight targets revealing everything from debris to munitions and cable/pipelines depending on the location" said Almond. ROVs are then sent to carry out visual investigation. In 24 hours, they can look at around 5-10 targets, with more than 90% of targets found not to be UXOs.

A typical identification campaign could last 3 to 6 months and look at thousands of targets. This has prompted companies to use complementary tools to reduce the number of false positives."

PanGeo has developed a 3-D sub bottom imaging tool that produces a continuous high-resolution 3-D volume acoustic image in real-time with a subsea resolution of 5cm.

"The PanGeo Sub-Bottom Imager (SBI) measures acoustic impedance or more importantly, the boundary between different impedances that represents a surface or buried structure. It detects everything from ferrous pipelines and cables to nonferrous bodies such as boulders or concrete mattresses

When coupled with a magnetic UXO survey , the data can be combined to reduce the number of targets.

"It is particularly good at finding the shape and dimensions of the target," said Almond."The accuracy is also dependent on the speed of the survey and the natural distribution of the targets

"With reference to a magnetic anomaly map, it is possible to overlay the three-dimensional acoustic shape map to eliminate targets. It can mean the difference between looking at a munition or a clump of wire.

"One reason that some magnetic data produces false positives is that there was perhaps metal there once, but it has long since corroded away yet some sort of ferrous presence remains. It will still produce a magnetic response although the original metal body has disintegrated.

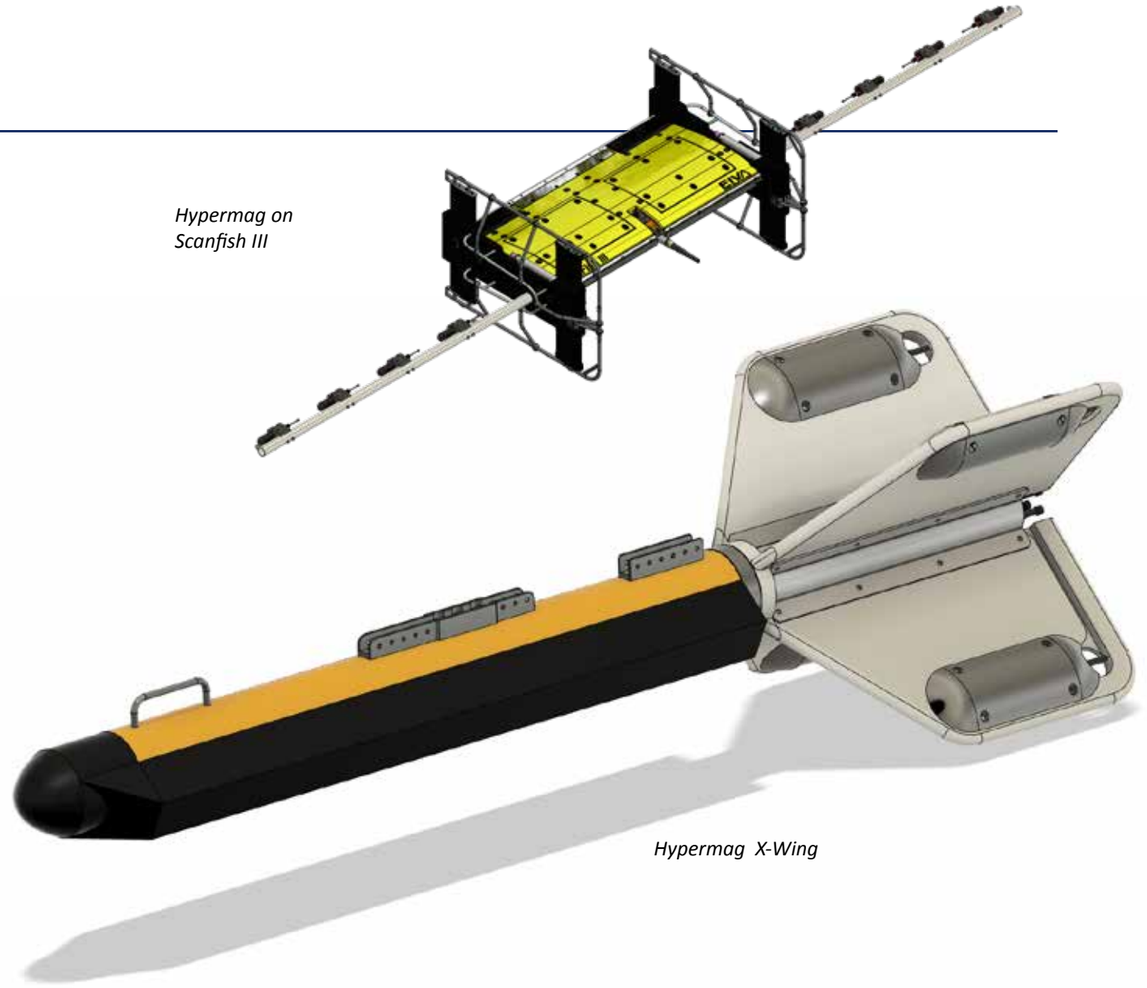
By acquiring the acoustic data, you are able to confirm that there is no acoustic anomaly associated with the magnetic anomaly, confirming a false positive reading in the magnetic data. Should an acoustic anomaly be present, by comparing the shape and dimensions to known munitions the overall magnetic target listing which requires visualisation can be reduced by a significant volume, driving down the time spent on site and as a consequence, the cost.

"In the Second World War some munitions had aluminium casings. These cannot be detected by magnetometers but can be detected by acoustic systems assuming the exterior is not corroded, said Almond. The presence of non-ferrous munitions is a small but growing issue however these acoustic surveys can and previously have located LMB mines within the sub-seabed.

PanGeo's Sub-Bottom Imager

PanGeo's Sub-Bottom Imager on a ROV

CABLES



Hypermag on Scanfish III

Hypermag X-Wing

At the same event, Matthew Kowalczyk from Oceanfloor Geophysics talked about RM Hypermag, a multi-vector gradiometer for UXO, Cable and Pipeline depth of burial

Canadian company Ocean Floor Geophysics Inc. (OFG) has developed the RM Hypermag, a multi-vector magnetic gradiometer suitable for UXO detection and for locating cables and pipelines and measuring their depth of burial.

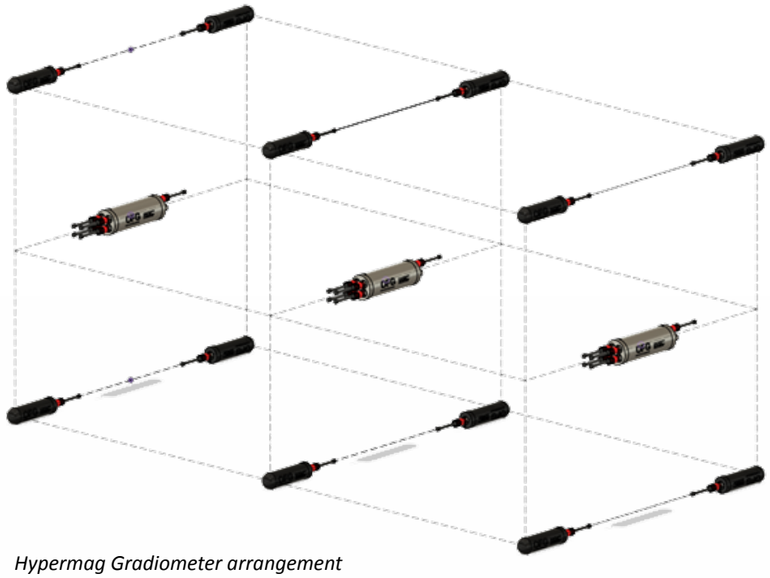
Sensitive total field magnetometers are often towed behind vessels or AUVs. OFG originally developed a self-compensating magnetometer that compensated for static and dynamic magnetic field created by the vehicle. This self-compensating magnetometer typically goes inside AUVs, ROVs, and more recently, USVs for shallow water detection.

Now, OFG has developed the much more sensitive RM Hypermag. The system is currently being integrated into an EIVA Scanfish ROTV (actively controlled towfish) for deployment in the USA in May.

"With the new RM Hypermag, it is possible to deploy multiple magnetometers in an array that gives a combined sensitivity of at 4pTrms/rthz, similar to a caesium vapour towed magnetometer," said Matthew Kowalczyk.

“It is a combination of subsea magnetometer sensor arrays, processor/data logger, calibration procedures, and proprietary software algorithms to provide compensated and corrected magnetic data in real-time. Individual sensors are tightly synchronized to provide magnetic gradiometer measurements. The gradiometer directions are dependent on installation configuration and can be designed for the application, be it vertical, horizontal or inline gradients. Total field and vector field data, without dead zones, is also produced for a comprehensive magnetic data product.

An RM HyperMag array comprises four individual 3-vectormagnetometers, each residing within their own subsea bottle, connected to a central subsea interface bottle, which acquires, processes, and communicates via a high bandwidth protocol to a central receiver or switch. The individual sensing units are very small, and multiple arrays can be combined into larger arrays making the whole system easily scalable.



Hypermag Gradiometer arrangement

It also features a 1kHz bandwidth for fast sampling, simple connectivity (Ethernet or RS 232) and very low power, less than 4 W per Hypermag unit.

Because they don’t have the same power draw as other marine magnetometers, they are well suited to AUVs and other low power systems. As AUVs and active towfish house increasingly more instrumentation, the low hotel load from the RM Hypermag conserves valuable power and enables easy integration into the vehicle systems.

Other options include a single towed body system with an integrated IMU, depth, altitude and USBL responder trigger passthrough for improved positioning at lower costs.

When trying to identify magnetic seafloor objects the absolute sensitivity of a magnetometer is not the only important measure. Having vector and gradient information potentially allows for better discrimination of objects such as UXO, cables or pipelines.

An important consideration is the control and measurement of the sensor position. For example, if a magnetometer array is towed on lines behind an ROTV the magnetometers may fly at different or changing heights so measured magnetic field from the objects of interest will change in magnitude.

This can cause errors and artefacts in the data. Operating the RM Hypermag as a strap down instrument on a well-positioned subsea vehicle or towfish and coupling better position control with the additional data from multiple vector and gradient measurements provides excellent target discrimination. It may also allow for wider line spacing. Good data, well controlled, can drive down survey costs while maintaining client confidence that the survey objectives have been met.

Hypermag on Scanfish III