An active electromagnetic system for underwater vehicles

Detection of buried metal objects and cables

Argeo

MARCH 12, 2024

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Outline

Argeo Listen - EM receiver system

Argeo Whisper - CSEM system

Detection of conductive objects

Positioning accuracy of inactive buried cables

Summary

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Outline

- Argeo Listen receiver system

ARGEO'S ROBOTIC TECHNOLOGY

A developed and commercial EM-receiver system

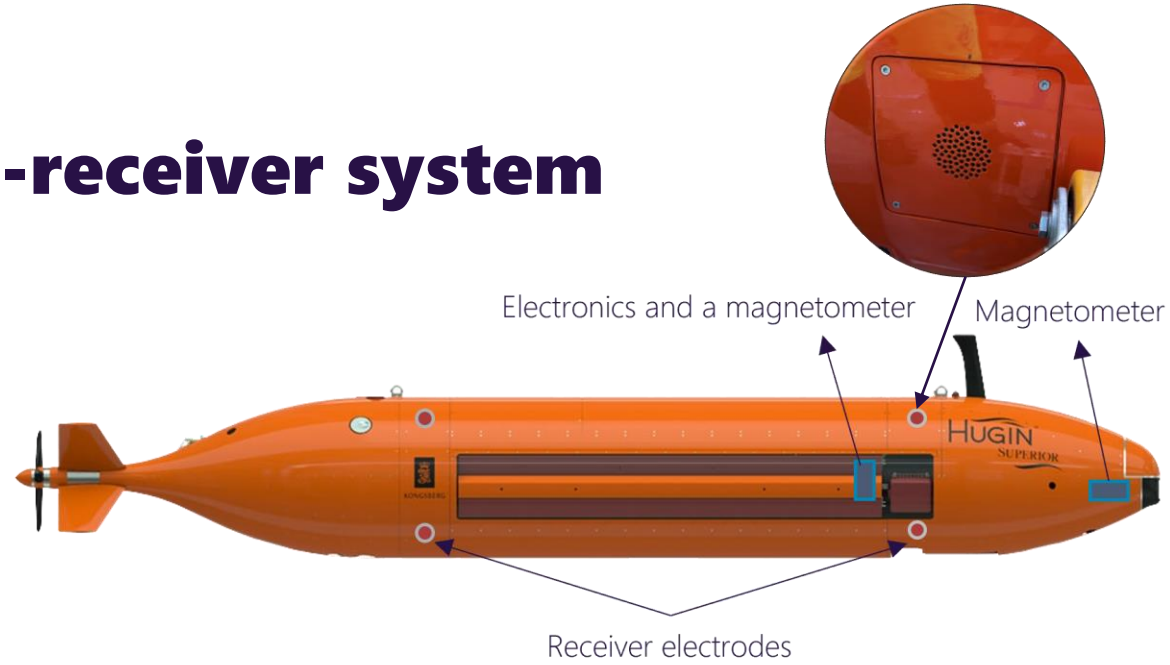
Specifications

- Fully integrated EM-receiver sensor system
- Stable AUV with accurate navigation

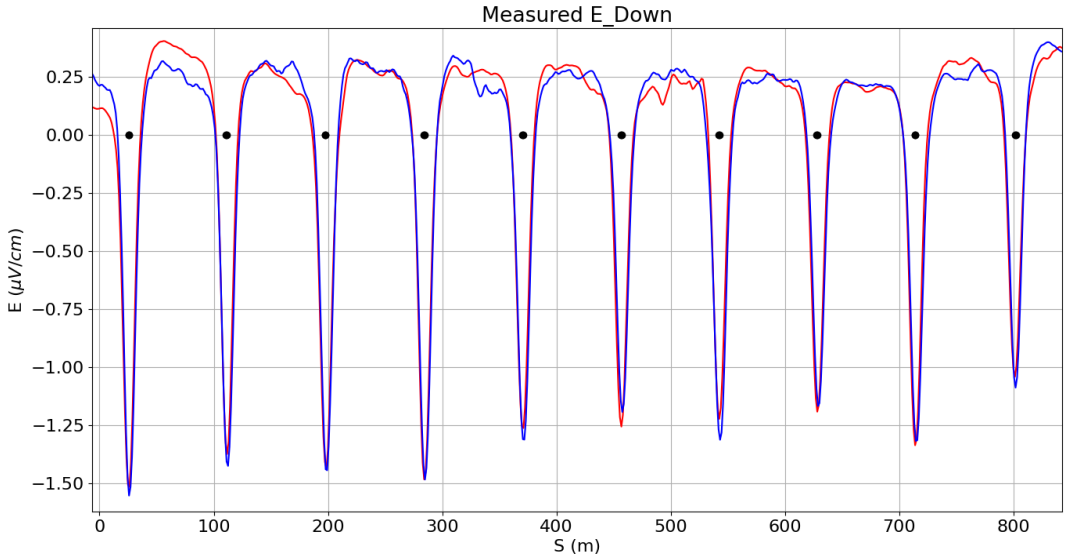
  → Reduced noise and repeatable measurements
- Flush mounted electrodes → Reduced noise
- Flush mounted electrodes → Robust system
- General noise level < $0.01\ \mu V/cm$

Applications

- Cathodic protection measurements
- Deep Sea Mineral exploration
- Tracking/burial depth of active power line cables
- General site surveys



EM data test



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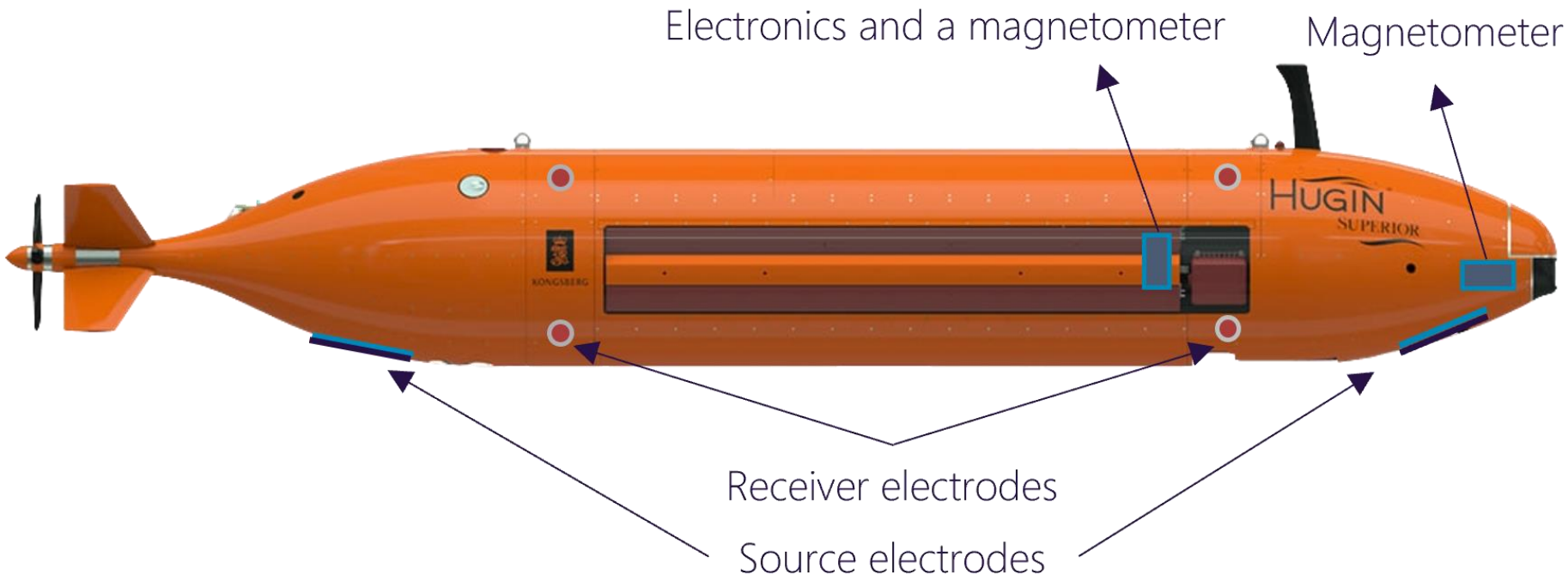
Outline

- Argeo Whisper CSEM system

ARGEO'S ROBOTIC TECHNOLOGY

An active Electromagnetic system for subsea vehicles



Specifications

- Max output current 20 A, Max power 300 W
- Possibility to transmit frequency contents between 0.5 -100 Hz
- Electrode plate separation 5.5 m
- Can be implemented on ROV/AUV

Applications

- Detection of buried conductive objects (**UXO** etc.)
- Tracking/burial depth of **passive** power line cables
- Deep Sea Mineral exploration

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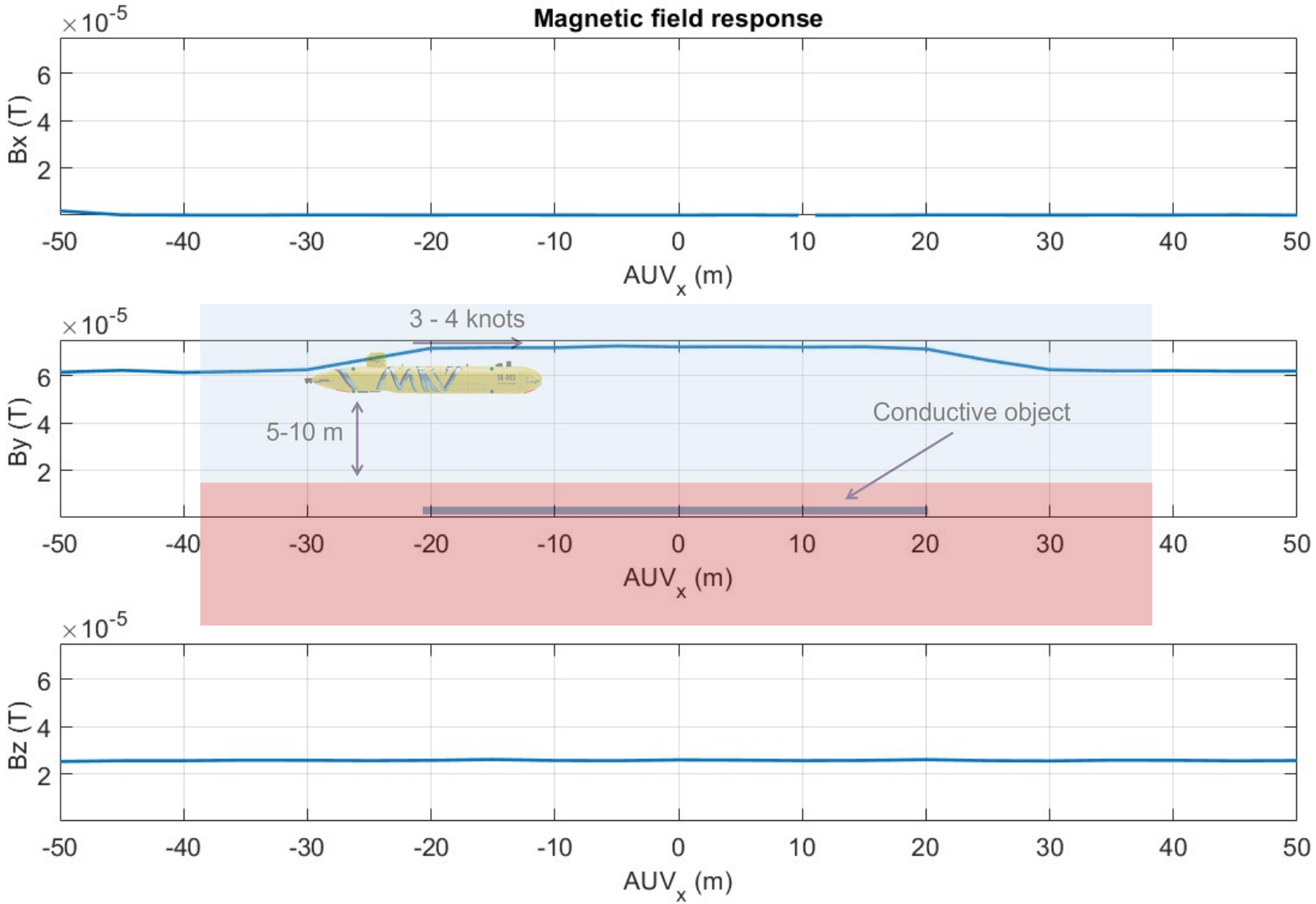
Four different patents granted

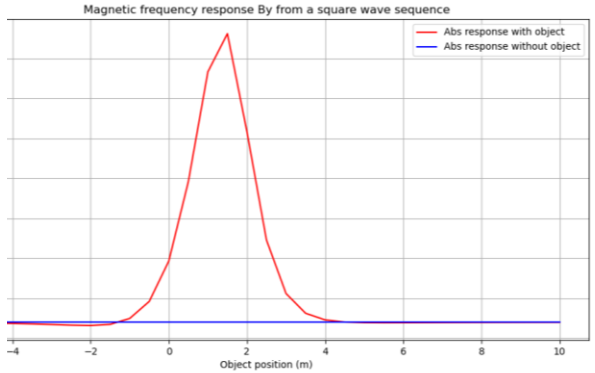
Outline

- Detection of conductive objects

METHODOLOGY

Detection of conductive objects - Basic principles





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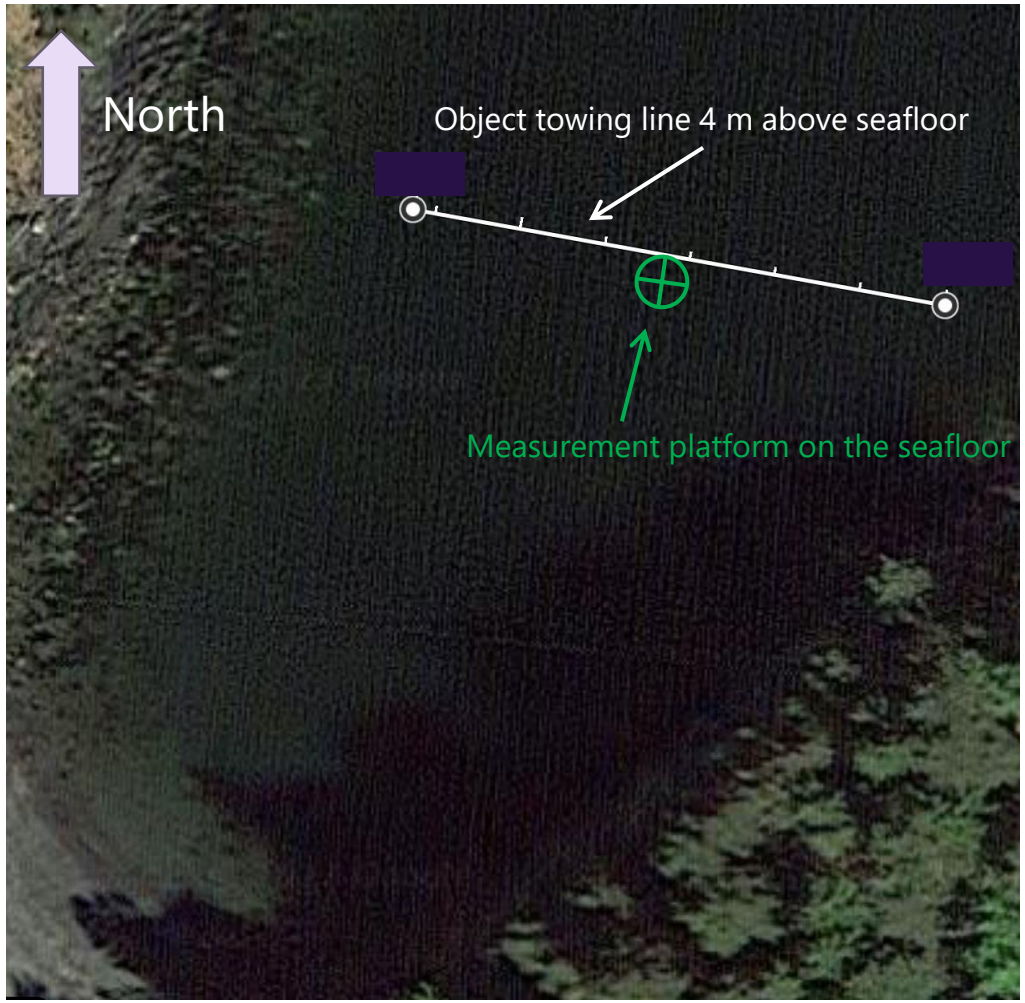
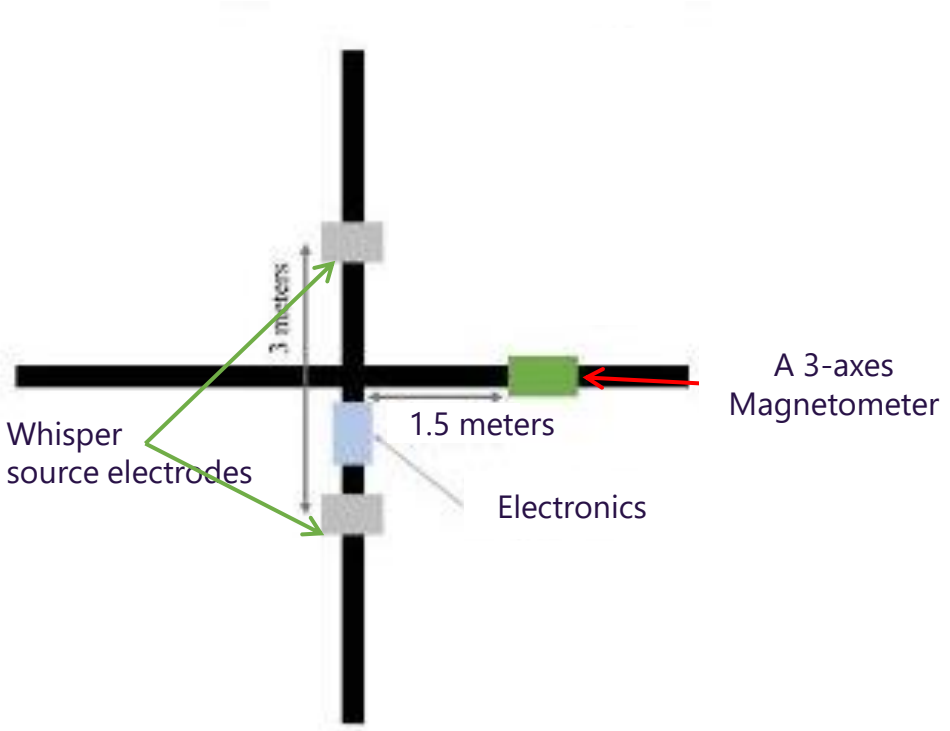
Detection of conductive objects - A concept test

Test site



Measurement platform



- Metal object towed 4 m above seafloor
- Object = stainless steel cylinder 2 m length and 0.5 m diameter
- Closest lateral distance from object to sensor platform was 3 m

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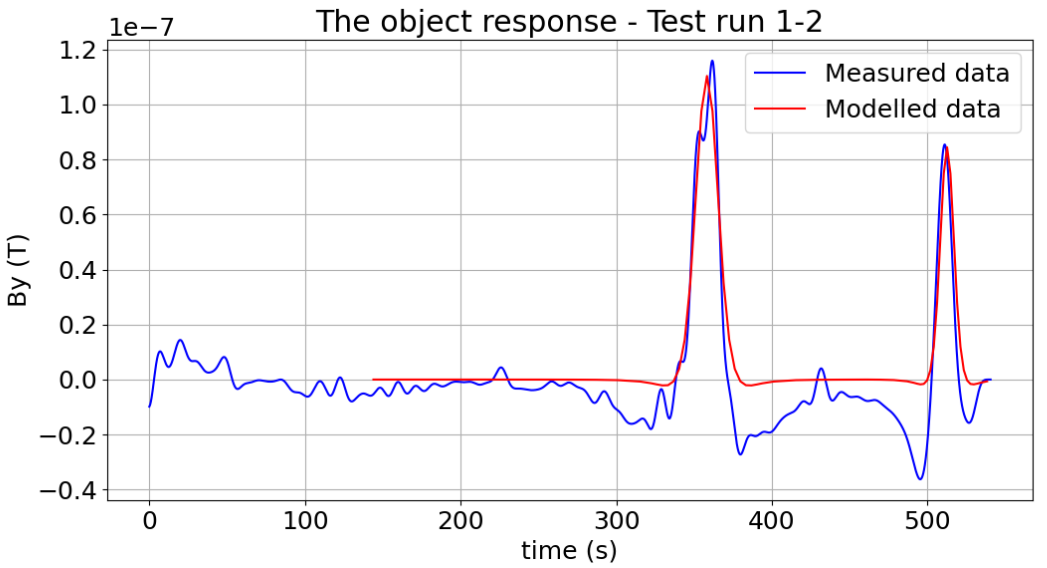
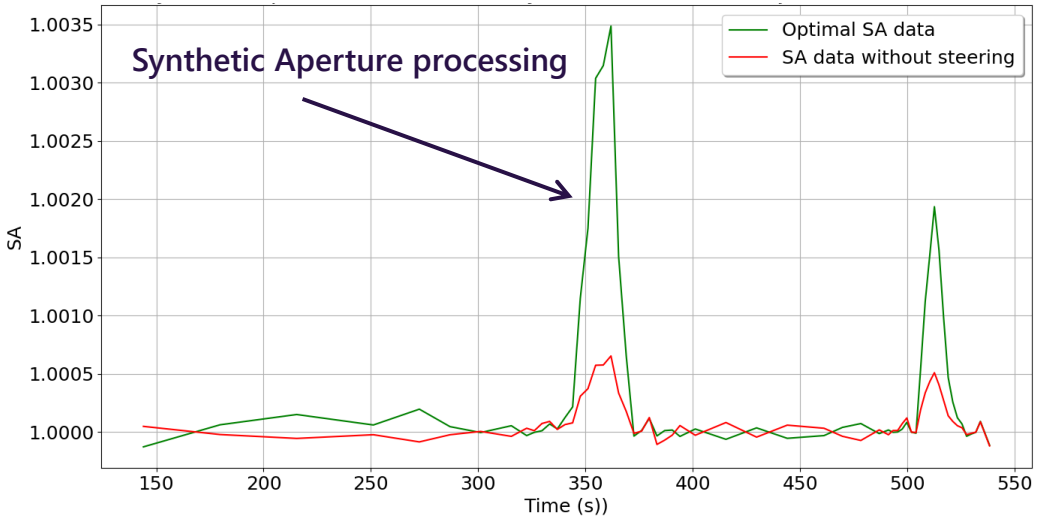
Test results

Test site





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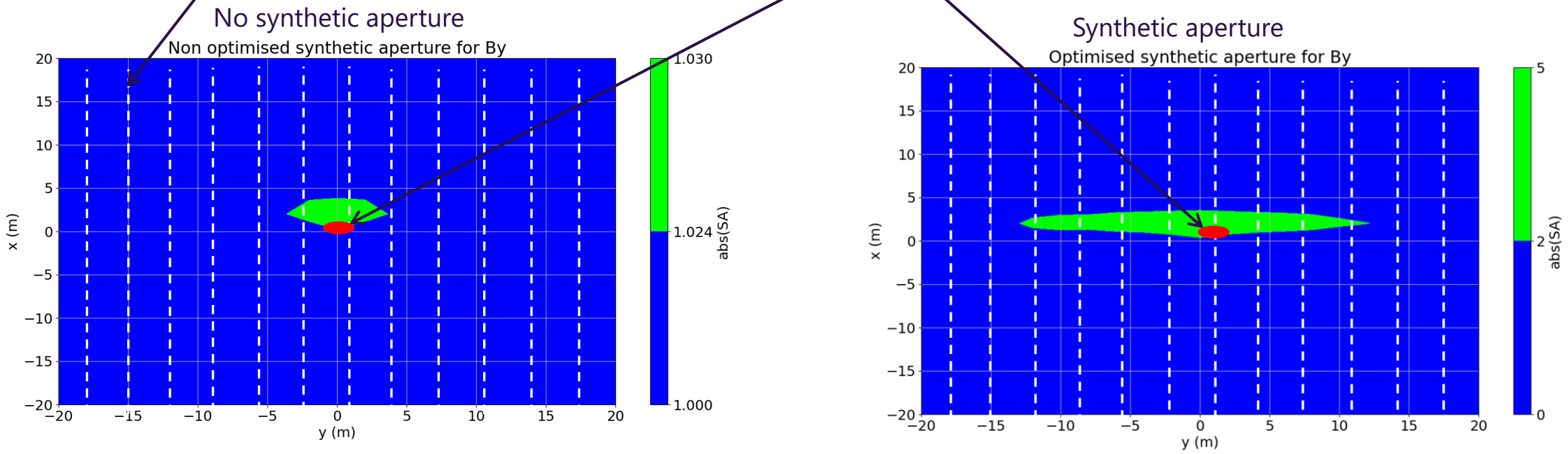
Detection of conductive objects - Synthetic Aperture processing

*Zhdanov M, Yoon D and Mattsson J, Rapid Imaging of Towed Streamer EM Data Using the **Optimal Synthetic Aperture Method**, IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 14, NO. 2, FEBRUARY 2017.*

Survey lines 5 m above seafloor

A buried metal object in black



Detection range and amplitude in green

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Outline

- Positioning accuracy of inactive buried cables

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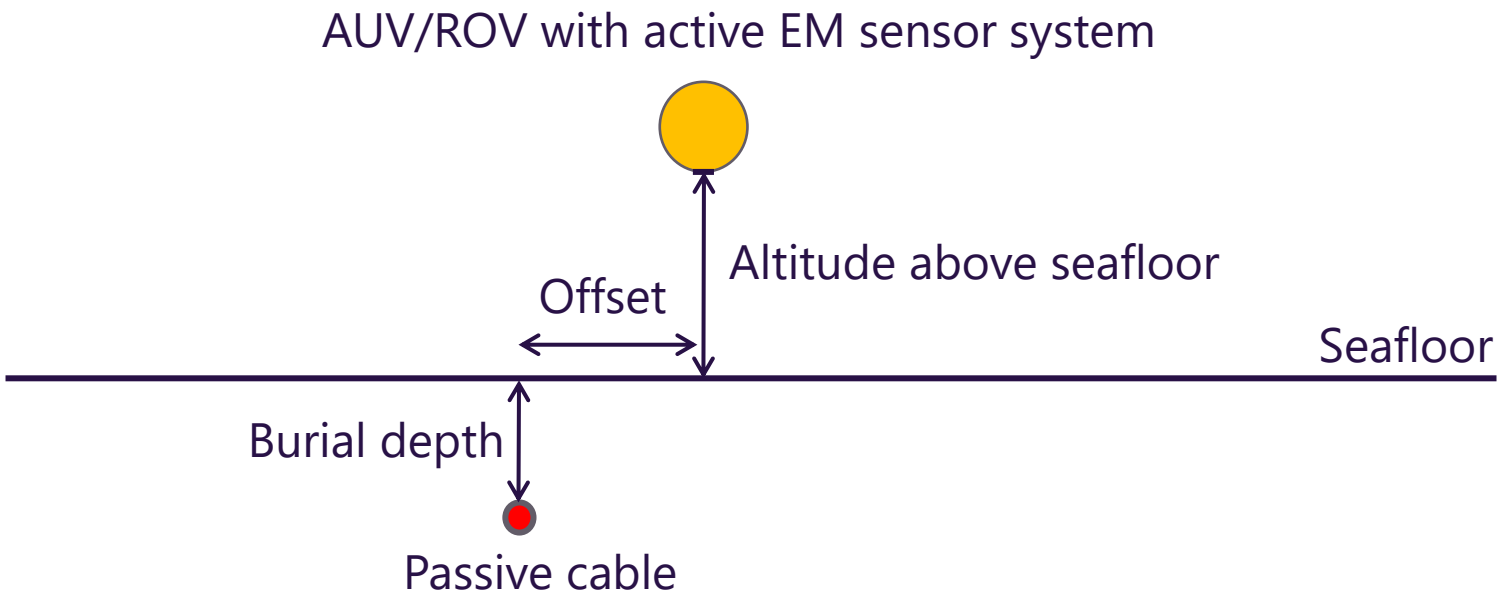
APPLICATION

Positioning of passive cables using Whisper



Question:

- What is the maximum burial depth we can determine with sufficient accuracy?

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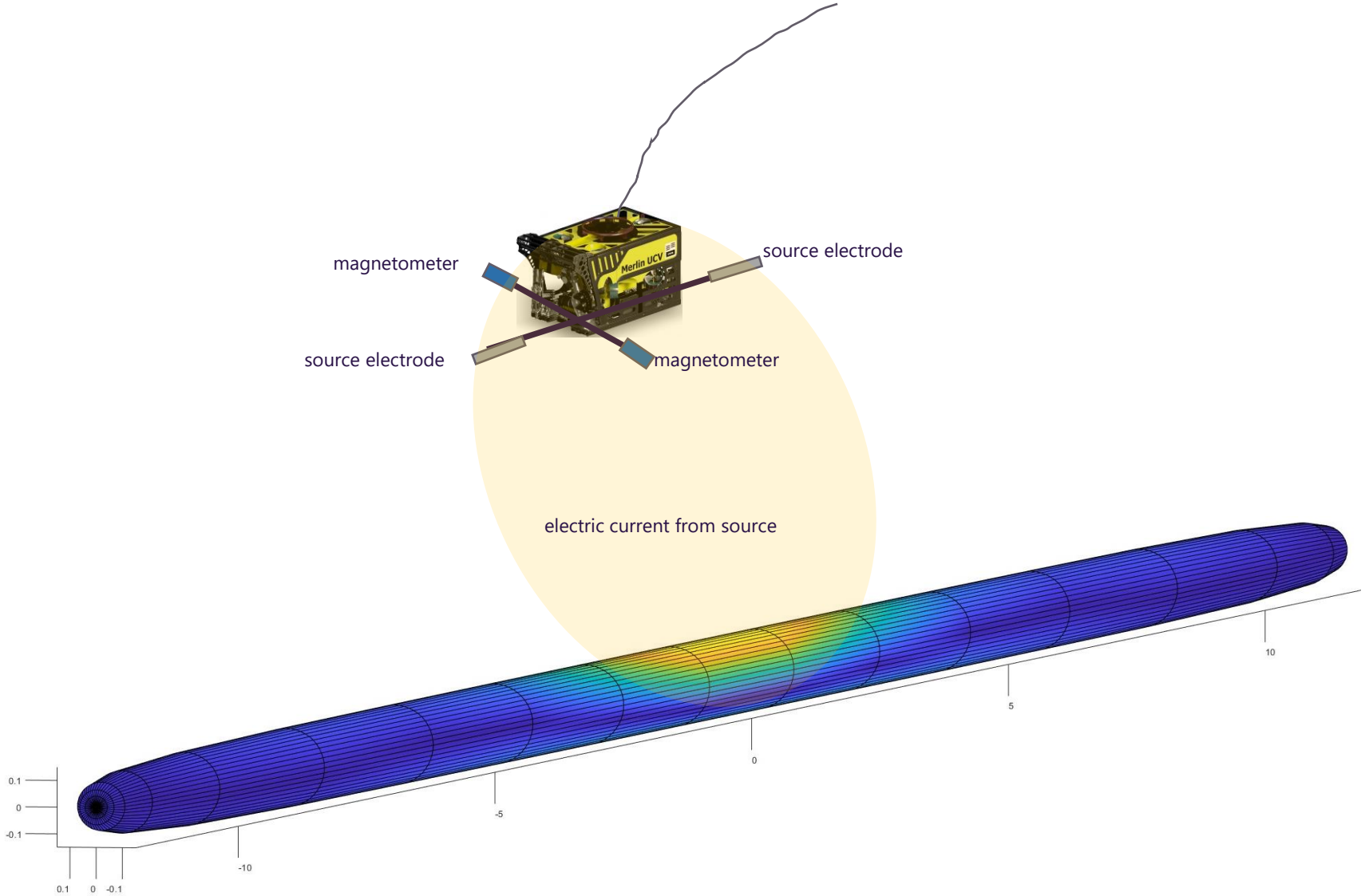
APPLICATION

Whisper on an ROV – Working principle



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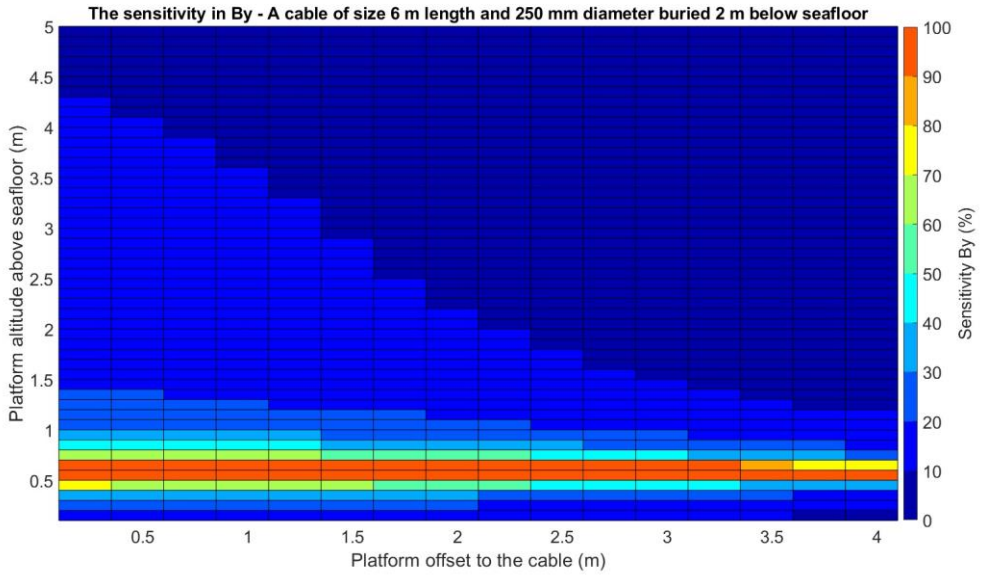
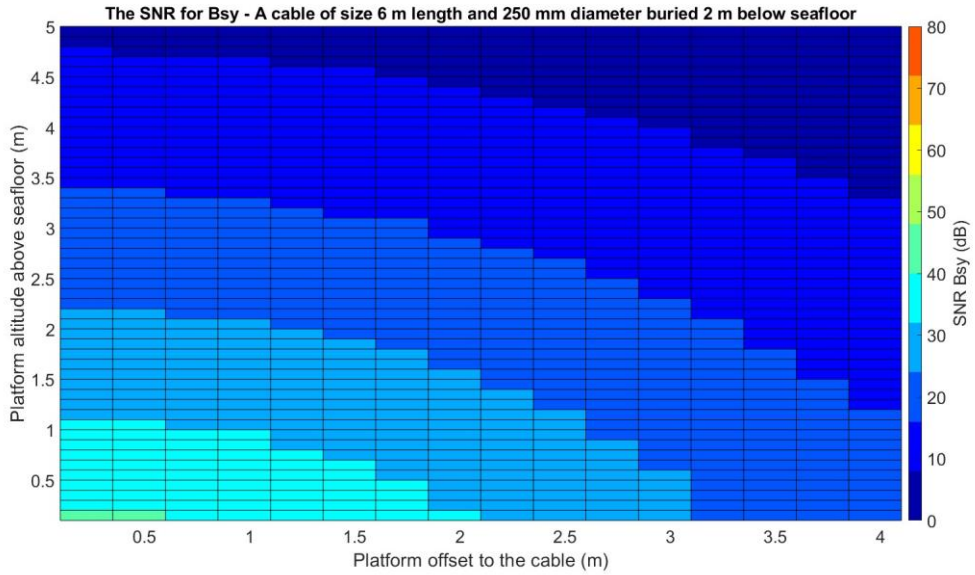
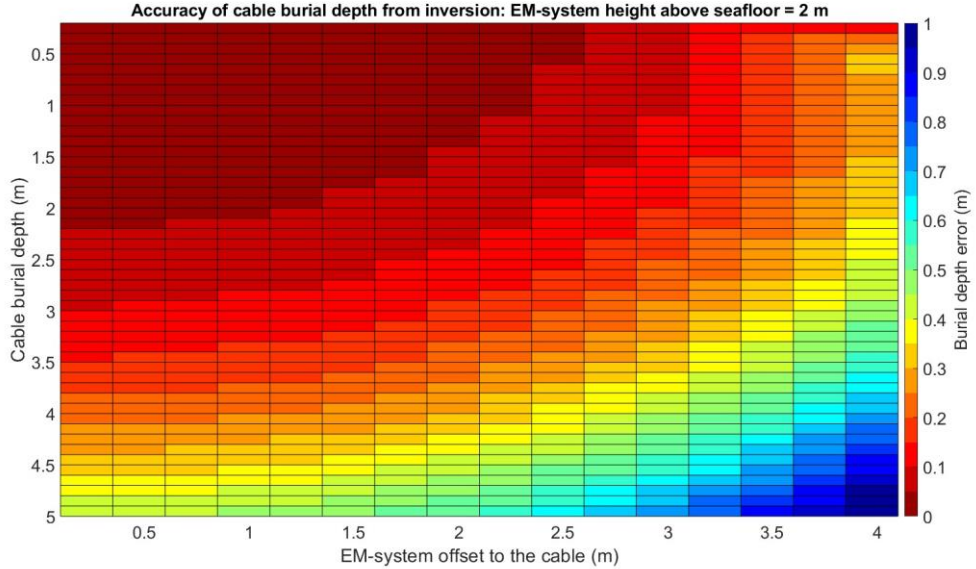
APPLICATION

Cable burial depth accuracy







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Outline

- Summary

Summary

In commercial use

- A low noise EM receiver system developed and integrated on AUVs

In development

- An electric dipole source tested with a magnetometer on a stationary platform
- Promising results demonstrates an alternative method for conductive object detection
- A new method for buried pipelines and inactive power cables positioning and burial depth