

Simulator of magnetometer and gradiometer to evaluate detection and classification algorithms

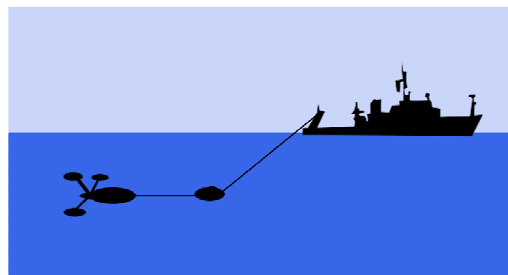
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Objective:

develop a simulator of the output of a magnetometer or magnetic gradiometer towed behind a ship in the vicinity of a metal object, from survey to map generation

Motivation:

- compare different sensor and survey configurations
- assess detection/classification algorithms in controlled conditions



Simulator features:

- Model targets by magnetic dipoles
- Model sensors that provides intensity of the total magnetic field (target field plus Earth's magnetic field) at sensor location
- Model errors in the estimation of the position and orientation of the sensor
- Display total field, target field, anomaly field (projection of target field on Earth's magnetic field)
- Model magnetometers and several gradiometer configurations (two or three magnetometers)
- Include recovery of vertical gradient and upward continuation from two magnetometers

Example of use #1: comparing sensor configuration: What do you lose by using two magnetometers instead of three?

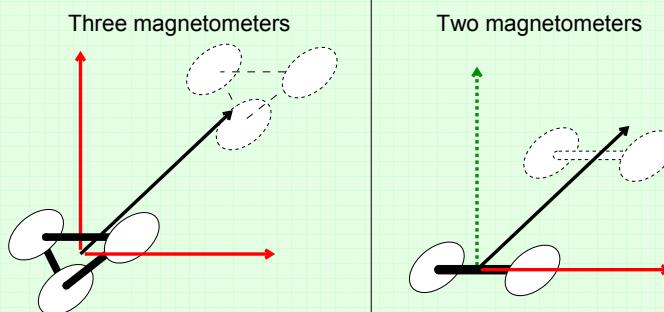
Method: is it possible to recover the vertical gradient with only two magnetometers?

With three magnetometers, vertical gradient from difference of sensor measurements

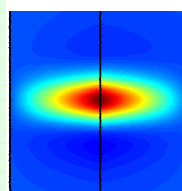
With two magnetometers, horizontal gradient from filtering of horizontal data (e.g. in Fourier space)

Conclusions:

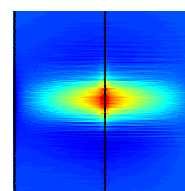
- Recovering the vertical gradient is theoretically possible by filtering in the Fourier space
- Sensitive to re-sampling of sparse data collected during survey



Magnetic maps over a target (with trajectory)



Elongated shape due to poor data sampling



Artifacts due to re-sampling of sparse data before filtering

Example of use #2: Algorithm evaluation

Method: Compare performance of different detection and classification algorithms based on the same controlled conditions

Future work:

- State-of-art-the interface
- Improved model of position and orientation errors
- More re-sampling algorithms

Acknowledgement:

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