Magnetic anomaly detection of moving objects

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Magnetometry is commonly used to detect and locate stationary as well as moving objects made of magnetic materials. The problem consists of detecting and determining any anomaly in the geomagnetic field generated by the presence and/or motion of a magnetic object. The stationary problem has been widely investigated and applied for the detection of hidden objects or the study of geophysical properties. The detection of a moving object is more challenging and the proposed solutions fall under two major categories. The data collected by a sensor or an array of sensors are treated by common signal and data processing techniques or by objective base function (OBF) optimization methods. In the latter, the underlying assumption is that the anomaly is due to a magnetic object of known magnetic moment *m* moving at constant velocity *v* and the field measured by the sensor follows the Biot-Savart law [1].

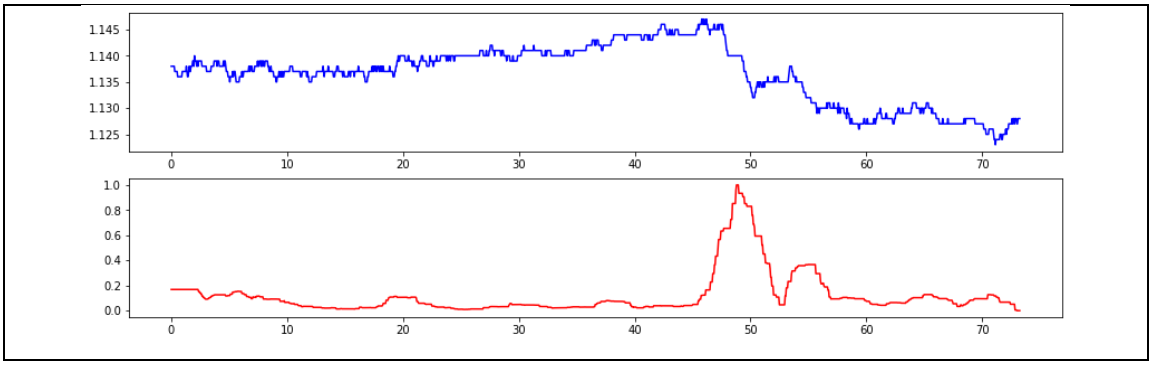

Figure 1: Fluxgate measurement of a moving magnetic object (top) and the normalized energy of the signal using OBF optimization (bottom)

In this work we present magnetic field data generated by a marine vessel and collected by a system based on an array of fluxgate sensors designed and developed by the Sensors Laboratory. Measurements have been obtained using scale models in the laboratory as well as in the field, monitoring actual marine traffic. The data have been treated using the OBF decomposition after signal processing and detrending techniques are used to account for the sensor noise and the geomagnetic background noise respectively (Figure 1). The effect of the various parameters used by the proposed method is investigated and an optimum configuration is discussed.

References

[1] A. Sheinker, L. Frumkis, B. Ginzburg, N. Salomonski, B.-Z. Kaplan: Magnetic Anomaly Detection Using a Three-Axis Magnetometer, IEEE Transactions on Magnetics, Volume 45 (1), 160-167 (2009)