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Michel Dabas, Armin Schmidt, Apostolos Sarris

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KNOW YOUR ENEMY: PARAMETERISING THE DESCRIPTION OF NOISE IN GEOPHYSICAL MEASUREMENTS FOR ARCHAEOLOGY

Armin SCHMIDT¹ (a.schmidt@GeodataWIZ.com), Michel DABAS²
(michel.dabas@ens.psl.eu), Apostolos SARRIS³ (asarri01@ucy.ac.cy)

¹ Dr Schmidt – GeodataWIZ, Remagen, Germany

² École Normale Supérieure - PSL, Paris, France

³ University of Cyprus, Nicosia, Cyprus

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Prior to the interpretation of archaeological geophysical survey results it is beneficial to minimise unwanted data ('noise'). To decide what processing can be applied, such noise has to be characterised quantitatively first. This contribution describes some parameters that can be used.

Geophysical measurements contain the sought after 'signals' and a 'background' against which the signals stand out as anomalies. Both components may be affected by noise. The latter can hence be considered a third component of the geophysical measurements. It may be (i) internal, related to the instrumentation, (ii) caused by variations in the use of the instruments (e.g. while walking with a magnetometer), (iii) created by external signals entering the measurements (e.g. magnetic storms), or (iv) produced by the ground's spatial variability, usually referred to as 'soil noise' (Schmidt, et al., 2020). Once noise forms part of the measurement data it can be very difficult to remove. Therefore, all avoidable sources (e.g. (ii) – poor use of instruments) should be eliminated during survey planning and execution.

To select processing methods and parameters that help minimising noise, or to recognise and ignore it during interpretation, requires its characterisation. Some authors categorised unwanted data components as 'errors' that can be corrected and 'noise' that is unpredictable (Ghezzi, et al., 2019). Others preferred to base their discussion on the spatial appearance distinguishing between correlated and uncorrelated noise (Graham & Scollar, 1976). For the current discussion we consider all unwanted signals to be noise and focus on four particular forms: (a) random noise, (b) spatial noise, (c) non-stationary noise and (d) sampling noise.

Geostatistics is based on models of spatial data variation ('variograms') that can also be used to examine the similarity of neighbouring measurements which is related to the level of random noise. For this study, such variograms were calculated for fluxgate gradiometer data from two sites (Figure 1).



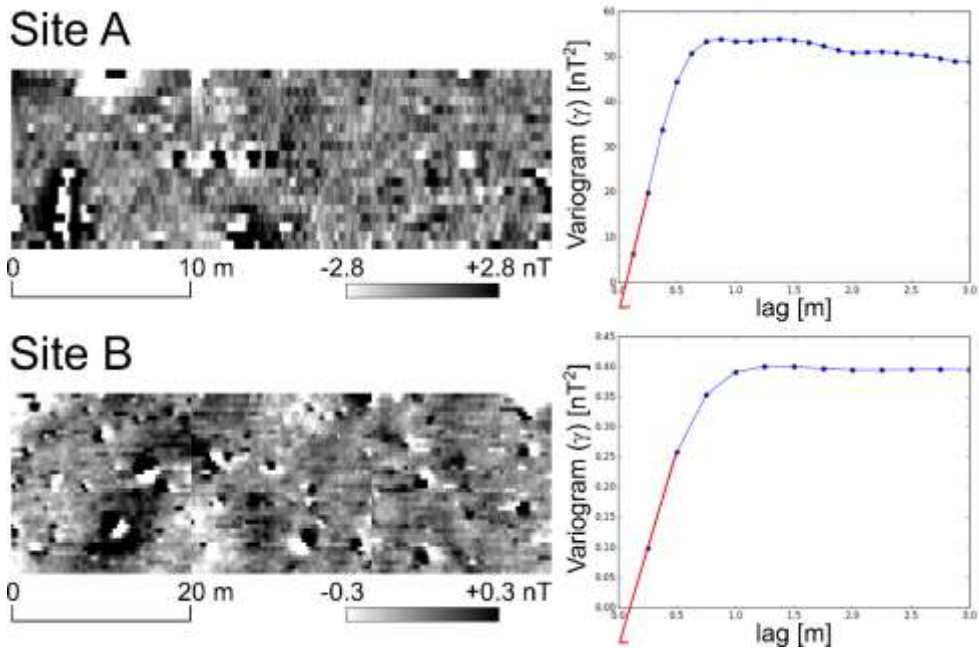


Figure 1: Variograms calculated along the horizontal (x-) axis for data from two sites.

The negligible nugget effect (vertical intercept) and a range value of 0.8 m and 1.4 m (level of correlation) for sites A and B, respectively demonstrate the minimal contribution of random instrument noise to the data and that measurements are consistent over the typical size of small scale anomalies.

A different approach to the analysis of noise uses the calculation of spatial frequencies (Figure 2). Given sufficiently high sampling rates small-scale variations generated by spatial noise can be seen as spikes of high wave-numbers and removed with a suitable low-pass filter, which is not possible if the data are under-sampled.

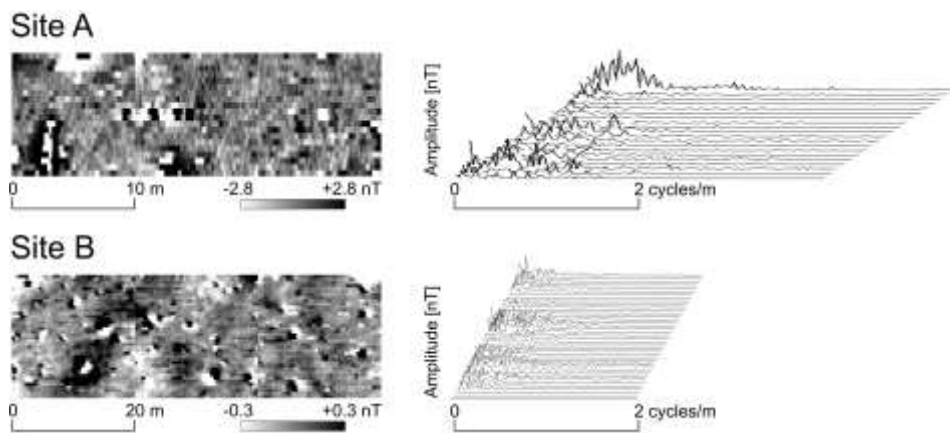


Figure 2: Spatial frequencies calculated along the horizontal (x-) axis for data from two sites.





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