Polarisation of radio-frequency magnetic fields in magnetic induction measurements with an atomic magnetometer

L. M. Rushton, L. M. Ellis, J. D. Zipfel, P. Bevington and W. Chalupczak

National Physical Laboratory, Hampton Road, Teddington, TW11 0LW, United Kingdom

The sensitivity of the rf atomic magnetometer [1] to the polarisation of oscillating magnetic fields is discussed with the aid of theoretical and experimental studies [2]. This aspect is particularly relevant to magnetic induction tomography (MIT) measurements, where the magnetometer measures magnetic fields generated by electrically conductive and magnetically permeable plates. We show that different components of the secondary magnetic fields create the object response depending on the properties of the material, with the polarisation of the rf field varying across the object's surface. We argue that the ability of the sensor to simultaneously detect different field components enables us to optimise the experimental setup depending on the object's composition.

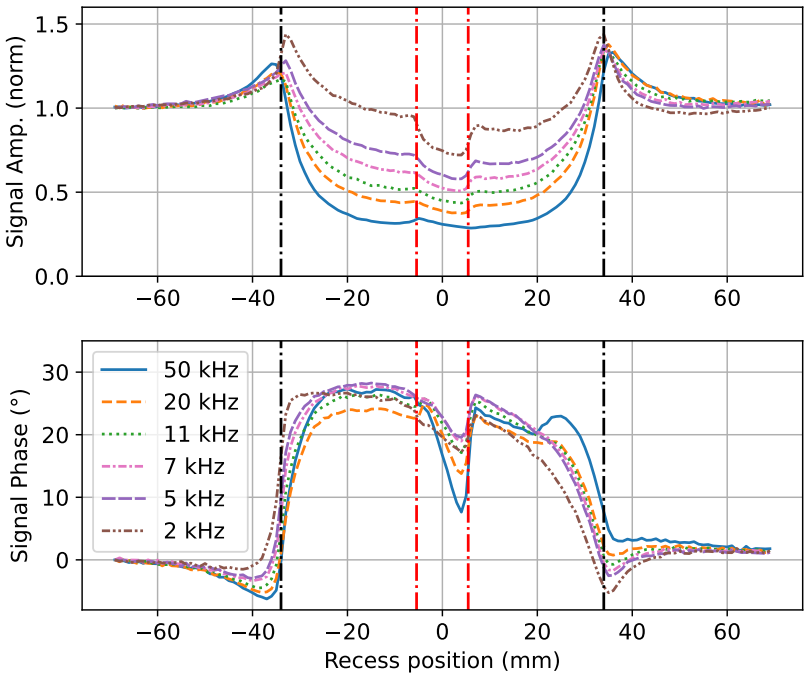

Figure 1. Amplitude and phase of MIT line scans recorded at different frequencies over a square carbon steel plate with a recess in the middle. The plate edges are notated by black dash-dot lines and the recess edges are notated by red dash-dot lines.

[1] V. Gerginov, *Phys. Rev. Appl.* **11**, 024008, (2019).
[2] L. M. Rushton, L. M. Ellis, J. D. Zipfel, P. Bevington and W. Chalupczak, *Phys. Rev. Appl.* **22**, 014002 (2024).