Towards active magnetic field cancellation on a moving array of OPMs

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Head mounted OPMs have enabled the development of wearable magnetoencephalography (MEG), allowing participants to move whilst being scanned. However, large movements through non-zero magnetic fields induce artefacts which send OPMs outside of their narrow dynamic range. Active magnetic shielding using electromagnetic coils is used to cancel the remnant magnetic field inside a magnetically shielded room within a fixed volume. Crucial to the operation of such systems is knowledge of the magnetic field generated at each sensor per unit of applied current in each coil, with feedback loops then used to keep the sensors in range. As this coil calibration changes depending on sensor positions when the participant moves, a means to rapidly update the calibration and position of the nulled volume is needed to ensure the feedback loop remains stable.

Here we present steps towards continuous coil calibration and field cancellation on a moving array of OPMs using an active shielding system comprising six square coils mounted on the inner faces of a small cubic shield. Each coil is driven with a sinusoidal current at a different, known frequency (Fig. 1a) and a triaxial fluxgate magnetometer measures the field per unit current generated by each coil to inform calibration of a feedback loop. Figure 1b shows how the field per unit current from a single coil in the x-y plane changes as the sensor is rotated about 180°.

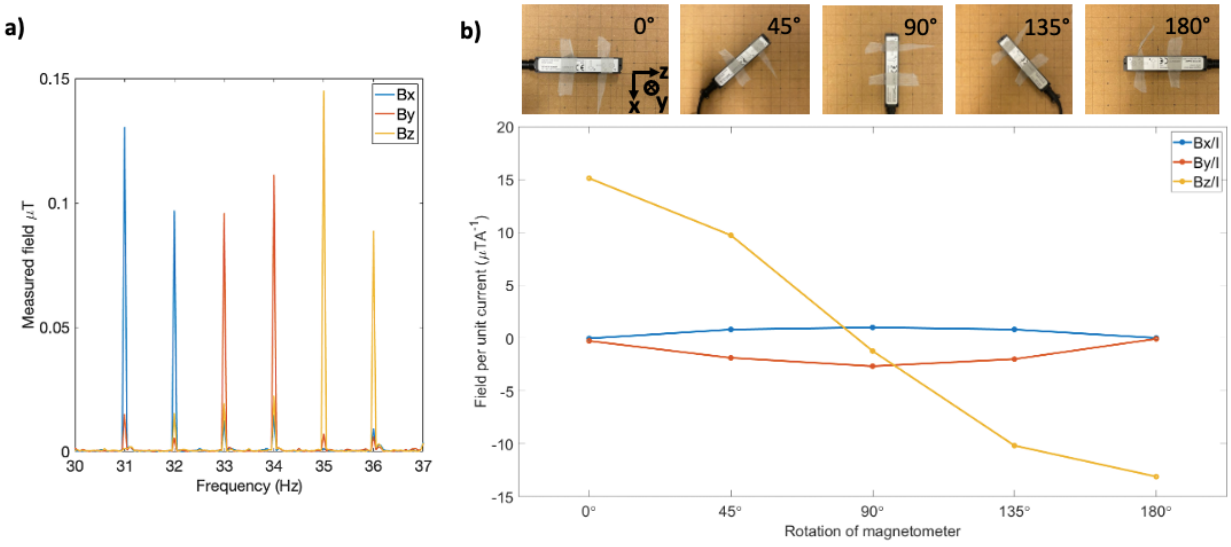

Figure 1: *(a) Fourier transform of the B_x, B_y and B_z field components measured by the fluxgate magnetometer, when the six coils are driven at frequencies of 31, 32, 33, 34, 35 and 36 Hz. (b) The B_x, B_y and B_z components of the magnetic field (shown in blue, red and yellow respectively), generated by a square coil, positioned on the inside x-y face of a 50x50x50cm^3 mu-metal box, were measured using a triaxial fluxgate magnetometer. The field per unit current at the position of the sensor was calculated after each rotation, between 0 and 180°.*