

Cross-Axis Projection Error in Optically Pumped Magnetometers and its Implication on Magnetoencephalography Systems

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Abstract

The sensitivity of optically pumped magnetometers (OPMs) can be greatly enhanced by operating it in a spin-exchange-relaxation-free (SERF) regime, where the alkali atoms' spin exchange rate is much faster than Larmor precession frequency. SERF regime accommodates a wide range of remnant static magnetic field. In the presented work, through simulation and experiment, we demonstrate that multi-axis magnetic signals in the presence of small remnant static magnetic fields, not violating the SERF criteria, can introduce significant error terms in OPM's output signal. For this deterministic noise, we have dubbed the term cross-axis projection error. Furthermore, we have analyzed the detrimental impact of the OPM's cross-axis projection error on the localization capability of OPM-based magnetoencephalography systems (OPM-MEG).

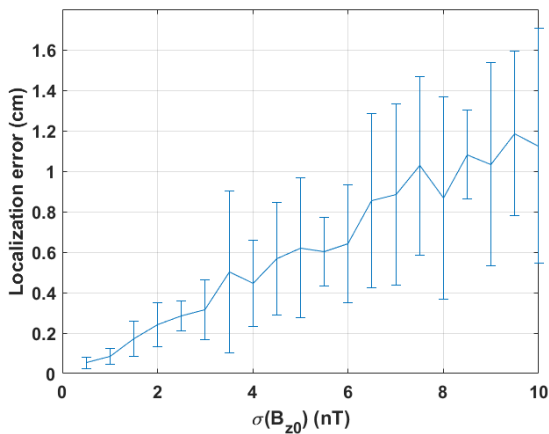


Fig. 1: The mean and standard deviation (bars) for source localization error

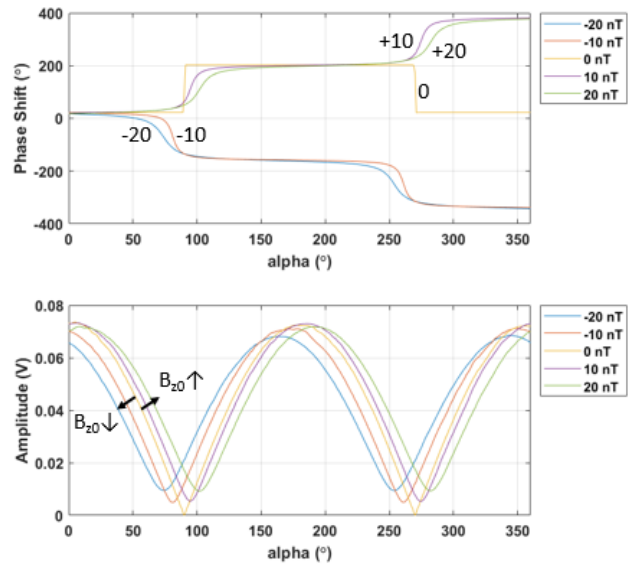


Fig. 2: Measured cross-axis projection error

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