Towards unshielded magnetorelaxometry imaging of magnetic nanoparticles using pulsed OPM

A. Jaufenthaler[1], P. Schier[1], and D. Baumgarten[1]

[1]Private University for Health Sciences, Medical Informatics and Technology (UMIT-Tirol), Hall in Tirol, Austria

Exciting biomedical applications of magnetic nanoparticles (MNP), e.g. magnetic hyperthermia require quantitative imaging of MNP distributions. MNP can be quantified by magnetorelaxometry (MRX), where the MNP's relaxation after previous magnetization is measured. Spatial information can be obtained by repeating the MRX procedure with different inhomogeneous magnetization fields and solving an inverse problem. We have previously demonstrated MRX imaging with OPM (QZFM from QuSpin) [1] and unshielded MNP quantification by exploiting pulsed OPM (OMG from Twinleaf) [2].

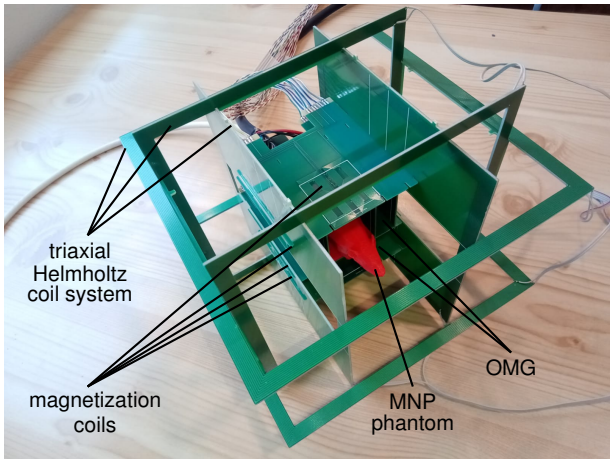

Figure 1: Portable OPM-MRX imaging setup, composed of two OMG, a triaxial Helmholtz coil system and 64 magnetization coils. The rat phantom (red) contains an MNP distribution.

We now aim for achieving OPM-MRX imaging in unshielded environments (Figure 1). Besides challenging noise perturbations, several issues arise due to the Earth's field, which introduces significant (and hardly modellable) relaxation effects depending on the field's relative orientation to the magnetization field [3]. To solve these problems, we form synthetic gradiometers, partially compensate the Earth's field and apply $\approx 5\,\mu T$ fields to perform pseudo-vectorization of the magnetometer. Imaging parameters of the setup are currently investigated.

References

[1] A. Jaufenthaler, Sensors **20(3)**, 753 (2020).
[2] A. Jaufenthaler, Sensors **21(4)**, 1212 (2021).
[3] A. Jaufenthaler, EPJ Quantum Technology **7(1)**, 1-14 (2020).