Magnetic imaging with microfabricated optically-pumped magnetometer arrays

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We present our ongoing effort in developing imaging systems with microfabricated optically-pumped magnetometers (μOPMs). Through the use of microfabrication technologies and simplification of optical setups, we aim to develop manufacturable sensors of small size and weight, and low power. Our zero-field μOPMs require a shielded environment but reach high sensitivities of less than 10 $fT/Hz^{1/2}$. Target applications lie in the field of non-magnetic brain imaging, specifically magnetoencephalography (MEG). The attraction of using these sensors for non-invasive brain imaging stems from the possibility to place them directly on the scalp of the patient, as close as possible to the brain sources. The MEG test system we present consists of 48 μOPMs. They are integrated into pairs on small flying lead sensor heads, such that they form 24 first-order gradiometers with a baseline of 2 cm. The gradiometer and magnetometer data can be read out simultaneously. All μOPMs operate under negative feedback at the zero-field point [1]. The sensors are assembled on a conformal 3D printed helmet with spokes that can be adjusted in the radial direction. The helmet is attached to a wooden bed, which can be inserted into a set of shield cans, big enough to hold an adult subject, and is open on one side. The residual field inside the shield is around 5 nT. Shimming coils are installed to reduce the fields and gradients further. The magnetic field in the direction radial to the head is recorded with the magnetometers and radial gradiometers. We present MEG recordings of resting-state measurements and evoked responses used to characterize the system.

References

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