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Stimulated abductor digiti minimi muscle measured by SQUID, OPM, and sEMG in magnetically shielded environment

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We report measurements of the bioelectricity of the electrically stimulated abductor digiti minimi (ADM) muscle of the right hand using three types of measurement modalities:
(1) by recording magnetic flux density with a state of the art zero field optically pumped magnetometer (OPM),
(2) by recording magnetic flux density with a superconducting quantum interference device (SQUID), and
(3) by recording the electric potential at the skin with a high-density grid of surface electromyography (sEMG) electrodes.
For the magnetic measurements we recorded the radial field component with OPM and SQUID. Both sensors have a similar size of the sensing element and a distance to the outer shell of about 6 mm, enabling an effective sensor-to-skin distance of about 10 mm in both cases. Despite the limited characteristics in terms of bandwidth and transfer function of the chosen OPM, we observed only slightly distorted, similar signal shapes compared to the stimulated ADM recordings performed with the SQUID. We found that the spectral profile and frequency content differed only slightly in all three measurement modalities. This work provides an initial validation of whether magnetomyography (MMG) using flexible and easy-to-use OPMs can be a useful alternative to surface electromyography (sEMG) in terms of sensor capabilities.

Author: HARTWIG, Stefan (Physikalisch-Technische Bundesanstalt)

Co-authors: KELES, A. D. (University of Stuttgart); MARQUETAND, Justus (University of Tübingen and University of Stuttgart); BAIER, Lukas (University of Tübingen and University of Stuttgart); SIEGEL, Markus (University of Tübingen); KRUSE, Marlen (Physikalisch-Technische Bundesanstalt); NOURY, Nima (University of Tübingen); RÖHRLE, Oliver (University of Stuttgart); NORDENSTRÖM, Simon (Physikalisch-Technische Bundesanstalt); KLOTZ, Thomas (University of Stuttgart); MIDDELMANN, Thomas (Physikalisch-Technische Bundesanstalt)

Presenter: HARTWIG, Stefan (Physikalisch-Technische Bundesanstalt)

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