Magnetomyography with Optically Pumped Magnetometers

S. Hartwig[1], J. Marquetand[3,4], P. J. Broser[2], T. Willms[1], V. Lebedev[1], T. Sander-Thömmes[1], C. Braun[3,4,5] and T. Middelmann[1]

[1]Physikalisch-Technische Bundesanstalt, Berlin, Germany
[2]Children's Hospital of Eastern Switzerland, Sankt Gallen, Switzerland
[3]MEG Center, University of Tübingen, Germany
[4]Hertie-Institute for Clinical Brain Research, Tübingen, Germany
[5]CIMeC, Center for Mind/Brain Sciences, Tübingen, Germany

Magnetomyography (MMG) is a promising method in neurophysiology, as it may possibly be able to replace the invasive and painful needle-electromyography (needle-EMG). The latter, being the daily applied gold standard in neurophysiology to diagnose the functional operation of skeletal muscles. In contrast to MMG performed with superconducting quantum interference device (SQUID)-systems, sets of OPMs may not have a fixed spatial arrangement. Instead they can be flexibly put close to the muscle or directly fixed onto the skin. This flexibility together with the option to use small compact magnetic shields might be game-changing. We will present and compare MMG measurements of stimulated muscle responses performed with SQUIDs and OPMs in different modalities under the especially quiet magnetic field conditions as they are provided inside PTB's Berlin Magnetically Shielded Room (BMSR-2.1). While the 304 sensors in PTB's SQUID-system have fixed positions inside the cryogenic dewar, which comes along with an increased sensor-to-body distance, the 8 QuSpin QZFM-gen-2.0 OPMs were employed twofold. Once in a row above the body like the SQUID-system (lab-fix), and second directly placed onto the skin (body-fix) and thus with minimal possible sensor-to-body distance. We compare the measurements with respect to the achieved signal-to-noise ratio as well as the temporal structure of the signals and discuss benefits and limitations of current commercial OPMs in MMG, also in contrast to surface and needle-EMG.