Aalto University

Enhancing the spatial accuracy and design of brain-imaging experiments by magnetic-field modeling

Title of the dissertation	Applications of magnetic-field modeling for hybrid MEG and MRI
Contents of the dissertation	The brain has been studied via magnetic phenomena for decades. Information about the structure of the brain can be obtained by magnetic resonance imaging (MRI). To infer how the brain works, the magnetic field generated by its electrical activity can be recorded by the means of magnetoencephalography (MEG). At Aalto University, these two conventionally incompatible brain imaging methods have been merged in a single hybrid MEG–MRI device. The hybrid imaging enables new ways of studying brain disorders and facilitates the execution of functional brain imaging experiments.
	To achieve higher spatial accuracies in the imaging, the spatial characteristics of the magnetic fields must be known and modeled correctly. In this Thesis, computational methods were developed to model and utilize the magnetic fields present in the imaging. For instance, accurate field modeling was used to develop a method to spatially calibrate MEG and MRI so that they can automatically be handled in the same coordinate system. Furthermore, an open-source software for magnetic-field modeling was created with the aim of facilitating the design and analysis of the fields used in the imaging. Besides the hybrid imaging, the methods developed in this Thesis can be used in other application areas that deal with low-frequency magnetic fields.
Field of the dissertation	Physics, Biomedical engineering
Doctoral candidate	Antti Mäkinen, Master of Science (tech)
Time of the defence	18.11.2020 15 pm (UTC+2)
Place of the defence	remote connection: https://aalto.zoom.us/j/62702105698
Opponent	Professor Matthew Rosen, Harvard Medical School; MGH/Martinos Center for Biomedical Imaging, Boston, Massachusetts, United States
Custos	Professor Risto Ilmoniemi., Aalto University School of Science, Department of Neuroscience and Biomedical Engineering
Electronic dissertation	http://urn.fi/URN:ISBN:978-952-64-0110-2
Doctoral candidate's contact information	Antti Mäkinen, Department of Neuroscience and Biomedical Engineering, tel. +358-445713188, antti.makinen@aalto.fi