M/EEG Forward Model Computation Via Source-Adaptive Meshless Solving

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Abstract

Electroencephalography (EEG) and magnetoencephalography (MEG) allow for a non-invasive investigation of the brain activity with high time resolutions. The neural sources are reconstructed by solving a typical inverse problem. Therefore, building an accurate forward model for the head is a key step in the process of estimating the neural sources [1].

Given a model for the brain activity and a model for the head, the M/EEG forward problem can be formulated as a set of boundary value problems for the Laplace operator, coupled by interface conditions.

The state-of-the-art Boundary Element Method (BEM) [2] involves both time-consuming meshing algorithms in the pre-processing step and costly numerical integration routines. Because of the high computational cost of these tasks, BEM solvers make use of one discretization of the domain, regardless the position of the neural source.

We propose the application of a meshless boundary-type solver which is is based on the Method of Fundamental Solutions (MFS) [3]. Remarkable savings in computational time allow for an adaptive computation of the forward head model which takes into account the position of the neural source.

Numerical experiments, both for spherical and realistic head geometries, show the validity and the attractiveness of the proposed approach.

References

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