LOCALIZATION OF THE NEURAL CURRENT SOURCE IN THE HUMAN BRAIN BASED ON A MAPPING FROM A SPHERE TO THE CORTICAL SURFACE

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In this talk, we propose a novel method for Magnetoencephalography (MEG) inverse problems in which the neural current source inside the human brain is identified from the measured magnetic field outside the head. The conventional approaches to this inverse problem are categorized into two groups: parametric methods and imaging approaches. The former assumes that the current source is expressed by a finite number of equivalent current dipoles, and reconstructs its number, positions, and moments via the non-linear least squares method. The latter assumes that the current source is fixed on grids on a cortical surface and solves for their moments. However, the problems are that the former method cannot identify the spatial extent of sources, whereas the latter obtains too smoothed solution by L2 regularization or too focal solution by L1 regularization.

To this problem, we propose a novel parametric approach to identify a source domain with spatial extent by using a mapping from a sphere to the cortical surface [1]. We express a source region on the cortical surface as a domain mapped from a circle on the sphere. As a result, a single source domain on the cortical surface can be represented by three parameters: the center (θ_0, ϕ_0) and radius r_0 of the circle on the sphere. Then, we minimize a squared error between the measured data and the theoretical magnetic field represented by those parameters. Since the parameters can be assumed in a Cartesian product set, we can apply an optimization algorithm based on the Lipschizian continuity that efficiently obtains a global minimum [2]. In this way, the neural current source domain with spatial extent can be parametrically identified. After verifying the proposed method with numerical simulations, real data analyses will be shown.

References

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This work is partially supported by JST PRESTO.