Sparse MEG Source Localization on Parameterized Cortical Medial Surface

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The inverse mapping in MagnetoEncephaloGraphy involves localizing neuronal activity of the gray matter tissue from measured signals around the head. The search space of the inverse mapping is conventionally represented in 3-D Cartesian coordinates including the cortical volume, or alternatively, 2-D manifold describing the cortical tissue. 3-D Cartesian coordinates does not suit sparse regularization of the inverse mapping in multi-resolution source domains. On the other hand, boundary surface of the cortex, represented as triangulated mesh, is used as the search space in some other inverse mapping techniques. However, this surface does not represent depth of the cortex. Moreover, to represent neuronal activity in embedded signal dictionaries, convoluted manifold should be gridded. In this paper we propose to use medial surface as the best surface descriptor of the cortical tissue. Furthermore, manifold gridding is constructed by defining bijective mapping between a flattened parameterized domain and convoluted surface. Signal bases are defined conventionally in the parameterized domain and mapped to the cortical volume by means of the bijective mapping. Medial surface of the cortex tissue, represented as triangulated mesh, is extracted by gradient-based search algorithm. Source localization, for simulated neuronal activity, is performed in real head model extracted from magnetic resonance images. Sparse estimated source of the inverse mapping are compared on volume, boundary surface, and medial surface domains. Simulation results confirm advantages of surface over volume domain. Performnace measures of source localization proves the medial surface as the best surface describing the cortex volume.