Comparing the Performance of Beamformer Algorithms in Estimating Orientations of Neural Sources

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ABSTRACT

The efficacy of transcranial electric stimulation (tES) to effectively modulate neuronal activity depends critically on the spatial orientation of the targeted neuronal population. Therefore, precise estimation of target orientation is of utmost importance. Different beamforming algorithms provide orientation estimates; however, a systematic analysis of their performance is still lacking. For fixed brain locations, EEG and MEG data from sources with randomized orientations were simulated. The orientation was then estimated (1) with an EEG and (2) with a combined EEG-MEG approach. Three commonly used beamformer algorithms were evaluated with respect to their abilities to estimate the correct orientation: Unit-Gain (UG), Unit-Noise-Gain (UNG), Array-Gain (AG) beamformer. Performance depends on the signal-to-noise ratios for the modalities and on the chosen beamformer. Overall, the UNG beamformer appears as the most reliable. With increasing noise, the UG estimate converges towards a vector determined by the leadfield, thus leading to insufficient orientation estimates.