Source Localization of Individual Forearm Extensor Muscles using High-Density Surface Electromyography

The limitations of conventional surface electromyography (sEMG) cause it to be unsuitable for use with the deep and compact muscles of the forearm. However, while source separation and localization techniques have been extensively explored to identify active sources in the brain using electroencephalography (EEG) signals, these techniques have not been adapted for identifying active sources in muscles using sEMG signals, despite being of a similar premise.

Our research explores the adaptability of conventional EEG source localization techniques (Figure 1) to identify active muscles within the forearm. Experiments consisted of controlled, isometric wrist and finger movements, with data obtained by high-density surface electromyography (Figures 2). The localization methodology consists of separating the raw sEMG signals using independent component analysis (ICA), estimating subject-specific a physics-based forward model through MRI tissue segmentation, and then correlating the obtained lead field matrix with the ICA mixing matrix. Localization was evaluated based on the accuracy of the estimated ECD source position with respect to the known active muscles.

Keywords: electromyography, source localization, source separation

Reference

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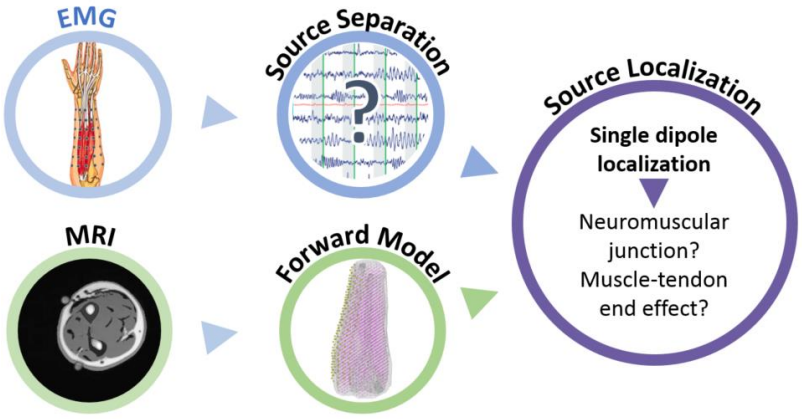

Figure 1. EEG-adapted source localization methodology.

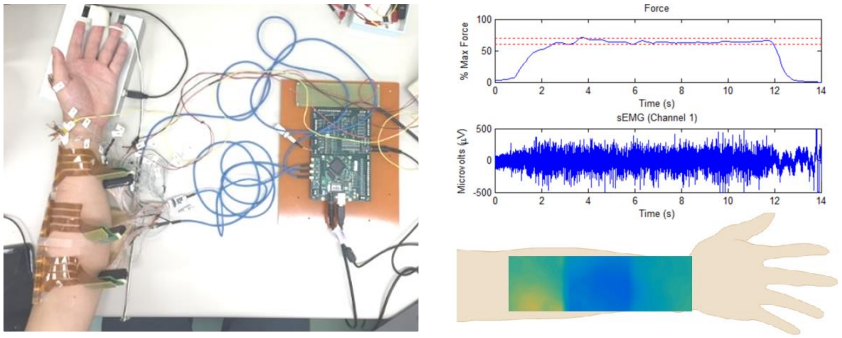

Figure 2. Experimental set-up (left), and example data obtained: force vs. time (top right), 1-channel sEMG vs time (middle right), and sEMG intensity color map (bottom right).