PhD Dissertation Defense Announcement
Mechanical and Aerospace Engineering Department
University of Texas at Arlington

Multiple Dipole Source Position and Orientation Estimation Using Non-Invasive EEG-like Signals

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Abstract

The human brain comprises of neurons that connect with each other via electrical signals. One can record and measure these activities using an electroencephalogram (EEG). An essential use of the EEG is in locating the generating source of these signals, usually approximated by dipoles. This is important because, in some particular circumstances, neurons may not function optimally and could make the equivalent dipole generate abnormal signals. This could be a result of seizures or other brain disorders. In order to isolate such disorders, the challenge is to find a non-invasive way to locate the anomalous source. This research introduces an algorithm that can precisely detect the source location of an EEG-like signal and also estimate other characteristic signal features, such as orientation and magnitude. We develop a constrained nonlinear least squares based algorithm to localize multiple sources and compare the results with widely used research software such as EEGLAB. The research also incorporates a least squares based spectrum matching algorithm to detect frequencies of the signals during the localization process. The algorithms are ported to a microcomputer such as the Raspberry Pi 4, running a Python based optimization module, to illustrate the transition to a more real-time application. The complete suite of algorithms is tested on synthetic data, and publicly available clinical datasets.