CAS 741: Problem Statement
EEG Source Localizer

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Table 1: Revision History

Date	Developer(s)	Change
26/09/2020	Leila Mousapour	First version of the problem statement was written
5/10/2020	Leila Mousapour	Second version of the problem statement was written

Inputs:

- EEG signals
  (Dim: Channel No. x time samples(recording time/sampling frequency)) (μvolt)
- Electrode locations
  (Dim: Channel No. x 3 coordinations
- Individual's MRI (Magnetic resonance imaging)
- The method (inverse solution technique)

Output: Activity of all sources inside the brain
The activity of each voxel of the brain mesh grid in time (source time-course)
(Dim: Number of sources x time samples (recording time/sampling frequency)) (μvolt)

Electroencephalography (EEG), which is a method to record electrical activity of the brain, has a plethora of applications such as decoding mental imageries used in brain-computer interfaces. One of the big open problems in EEG signal processing is finding a good feature space after which we can apply machine learning and classification methods to the data. The standard in the field is to start with the electrode space and then extract features such as amplitude or latencies (time domain features), frequency power spectra (frequency features), common spatial patterns (spatial features) etc. A novel approach that we would like to investigate is to first map EEG signals from electrode space into spatial coordinates of the brain to achieve more useful features.

These techniques are known as “source localization “ algorithms which can be applied to the signals recorded from the scalp and locate the underlying active sources generating the activity sensed on the electrodes expected to increase the signal to noise ratio. Additionally, mapping the activity from an n-channel space to fewer sources reduces data dimensionality immensely, helps avoid overfitting and redundancy, leads to better human interpretations and less computational cost with the simplification of models. Therefore, this scientific software will implement several techniques to map EEG signals from electrode space to source space.