Patterns in EEG that Correlate and Discriminate between Mental Behaviors

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Objective: Accurate and fast classification of EEG into classes corresponding to mental task.

Approach: Subjects perform one of several mental tasks: Mentally multiply two numbers. Imagine writing a letter. Imagine writing numbers sequentially. Mentally rotate 3-dimensional object. Resting baseline task.

Record from six electrodes for 10 seconds for each task. Search for signal representations of low-dimensionality and high discriminatory power. Search for classifiers that generalize accurately to untrained data.

Half-second windows of six channel EEG, represented as coefficients of autoregressive models, classified by feedforward neural networks. 54% of untrained windows correctly classified.

Averaging the classifier’s output over consecutive windows increases accuracy to 80%.

Interesting confusions are made by the classifier. Most obvious in the third column.

Recent Results

Simpler classifiers do well with new representation based on separating EEG into discriminating components. Can correctly discriminate between two tasks.

Committees of simple classifiers increase accuracy by voting for each mental task. Allows correct discrimination of up to five mental tasks.

Subject performs five mental tasks sequentially. EEG from six electrodes shown. Bottom graph shows which tasks receive the most votes. Second from bottom graph shows confidence.

Separating EEG into components also serves to remove artifacts from EEG.

Self-organizing maps (SOM neural networks) are being investigated as new way to separate EEG from different tasks.

Current Status:  http://www.cs.colostate.edu/eeg