Modelling Grand Averaging in EEG Signals for Individuals with BCI control

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Background

Brain Computer Interface (BCI):

YES

EEG Signals:
- Electrical activity from the brain

Epoch:
- Time windows in EEG signals

Computer output
“YES”

Grand Averaging

Currently, no research is done to determine the impact on the EEG signals if processed through grand averaging

Objective

Compare ideal noise suppression and grand averaging in EEG signals collected through BCIs

Method

Input Noisy Signals (15 Simulated 14-channel EEG Signals)

Grand Averaging

Output Signals (Calculated)

Ideal Noise Suppression

Noise Suppressed Signal

Model Transformations by Estimating and Comparing Transfer Functions Between Inputs and Outputs

MATLAB → signal processing, simulate inputs and calculate outputs

SEREEGA /EEGLAB → simulate input EEG signals [1]

Transformation Methods Allow Brain Signals to be Read More Accurately to Improve Brain-Computer Communication

Comparison of Transformations

Step Response used to Investigate System Model

Noise Suppression → Grand Averaging

Between 5 to 300 epochs used for the grand averaged output does not change it’s transfer function significantly

* Rise time, peak, peak time, settling max/min/time

Grand Average Calculation vs Goodness of Fit

Reference:


Next Steps

1. Find signal transformation of grand averaging after noise suppression
2. Model transforms with more accuracy
3. Try on real participants

Relevance

BCI’s are commonly used for kids with complex communication needs, including:
- Locked-in syndrome (LIS)
- Amyotrophic lateral sclerosis (ALS)
- Cerebral palsy (CP)
- Spinal cord injury

This discovery helps further BCI technology

Enable communication and expression for those with complex communication needs
Promote and support people’s human rights, inclusion, and equality in participating in society

Holland Bloorview
Kids Rehabilitation Hospital

NSERC CRSNG

University of Toronto