EE-379K/385V

Neural Engineering - Spring 2021

ECE Department, The University of Texas at Austin

Term Project
Transcutaneous Electrical Stimulation

Out: Wednesday, March 7, 2021

Note-1: Please start exploring the data early!

1 Project Overview

In this option, you will be provided with data collected from two subjects who completed the following experiment over three sessions with multiple runs per session:

1.1 Session-1

Subjects did motor imagery (MI) of the hand flexion and hand extension tasks while EEG was recorded.

- **EEG**: recorded from 32 channels distributed over the scalp according to the 10/20 standard electrode positioning.

1.2 Session-2

Subjects rested while transcutaneous electrical spinal stimulation (TESS) was applied continuously for 20 minutes.

- **TESS**: stimulation was applied over the cervical vertebrae C5-C6 without evoking any muscular contractions.

1.3 Session-3

Same as Session-1: Subjects did motor imagery (MI) of the hand flexion and hand extension tasks while EEG was recorded.

- **EEG**: recorded from 32 channels distributed over the scalp according to the 10/20 standard electrode positioning.

2 Hypothesis (High Level)

Delivery of TESS will have an effect on EEG activity during motor imagery of fine hand movements: flexion/extension.

3 Objectives

- Elaborate on the high level hypothesis concerning the cortical effects of TESS and on the changes in MI correlates for each of the tasks following the stimulation session.
- Analyze the EEG activity during the three task periods (extension MI, flexion MI, and rest) before and after the TESS session
- Provide evidence based on your reviewed and proposed methods to probe your hypotheses and discuss possible physiological explanations for your results.
- Will you need to formulate a new hypothesis based on the results?

4 Data Description

Data is provided for the first and third sessions only. Each session includes the following:

- **Runs**: Two runs were completed with respectively 15 and 10 trials of each of the following tasks: hand extension, hand flexion, and rest.
- **Trials**: Each trial has a task period of 4 seconds, and it follows the structure shown in Fig 1.

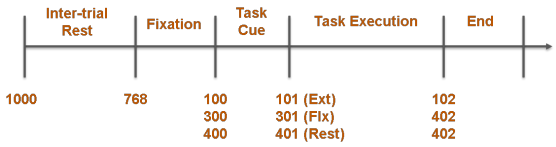

Figure 1: Trial organization with trigger labels.

4.1 Data Structure

The variable **subjectData** contains the following:

- **subjectData(s).pre(i).eeg**:(# samples x 32 channels) contains eeg data of the i^{th} run in the first session for subject s.
- **subjectData(s).pre(i).hdr**: header info of the i^{th} run in the first session for subject s.
  - .fs: sampling rate
  - .Label: labels of the 32 eeg channels
  - .EVENT.TYP: event triggers during the task
  - .EVENT.POS: position in samples of each trigger
- **subjectData(s).post(i).eeg**:(# samples x 32 channels) contains eeg data of the i^{th} run in the last session for subject s.
- **subjectData(s).post(i).hdr**: header info of the i^{th} run in the last session for subject s.
  - .fs: sampling rate
  - .Label: labels of the 32 eeg channels
  - .EVENT.TYP: event triggers during the task
  - .EVENT.POS: position in samples of each trigger
- **Note**: $s \in \{1, 2\}$ and $i \in \{1, 2\}$