BE 521: Homework 0

Introduction

Spring 2021

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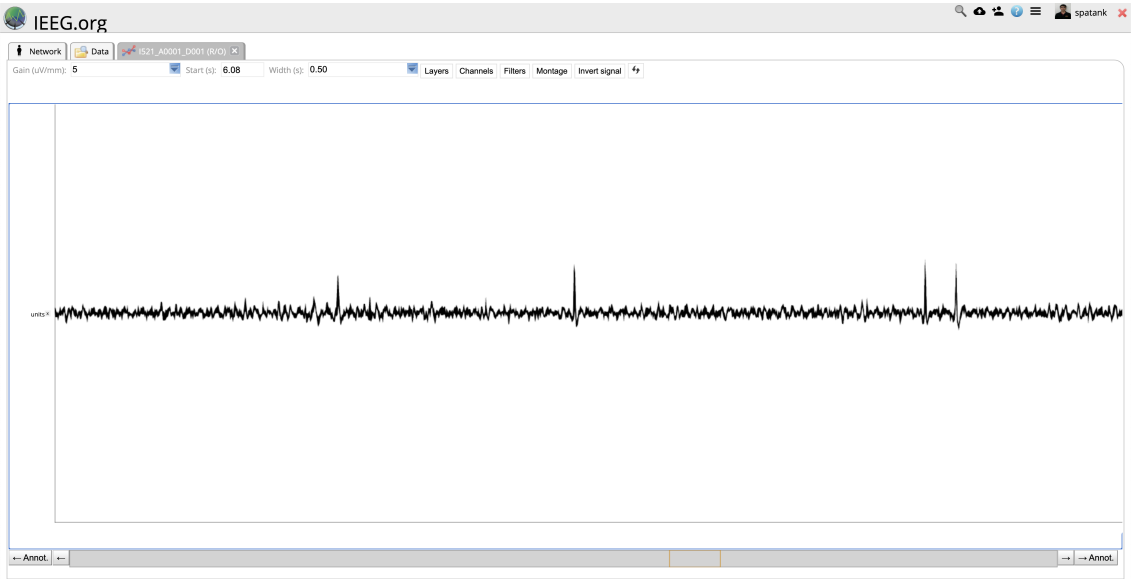
Due: Thursday 1/28/2021 11:59 PM

Objective: Working with the IEEG Portal, basic MATLAB commands, publishing LaTeX

1 Unit Activity (15 pts)

The dataset `I521_A0001_D001` contains an example of multiunit human iEEG data recorded by Itzhak Fried and colleagues at UCLA using 40 micron platinum-iridium electrodes. Whenever you get new and potentially unfamiliar data, you should always play around with it: plot it, zoom in and out, look at the shape of individual items of interest (here, the spikes). The spikes here will be events appx. 5 ms in duration with amplitudes significantly greater than surrounding background signal.

1. Using the time-series visualization functionality of the IEEG Portal find a single time-window containing 4 spikes (use a window width of 500 ms). The signal gain should be adjusted so that the spikes can be seen in entirety. Give a screenshot of the IEEG Portal containing the requested plot. Remember to reference the LaTeX tutorial if you need help with how to do this in LaTeX. (2 pts)



2. Instantiate a new IEEGSession in MATLAB with the `I521_A0001_D001` dataset into a reference variable called *session* (Hint: refer to the IEEGToolbox manual, class tutorial, or the built-in *methods*

commands in the *IEEGSession* object - i.e., *session.methods*). Print the output of *session* here. (1 pt)

```
cd('/Users/sppatankar/Developer/BE-521')
addpath(genpath('ieeg-matlab-1.14.49'))
addpath(genpath('Homework_0'))

% password_file = IEEGSession.createPwdFile('spatank', '***');

session = IEEGSession('I521_A0001_D001', 'spatank', 'spa_ieeglogin.bin')
```

```
IEEGSETUP: Found log4j on Java classpath.
URL: https://www.ieeg.org/services
Client user: spatank
Client password: ****

session =

  <a href="matlab:help('IEEGSession')">IEEGSession</a>:

      server: 'ieeg.org'
    userName: 'spatank'
        data: [1x1 IEEGDataset]

  <a href="matlab:methods(IEEGSession)">Methods</a>, <a href="matlab:IEEGObject.openPortalSite()">main.ieeg.
```

3. What is the sampling rate of the recording? You can find this information by exploring the fields in the *session* data structure you generated above. Give your answer in Hz. (2 pts)

```
sampling_rate = session.data.sampleRate
```

```
sampling_rate =

       32051
```

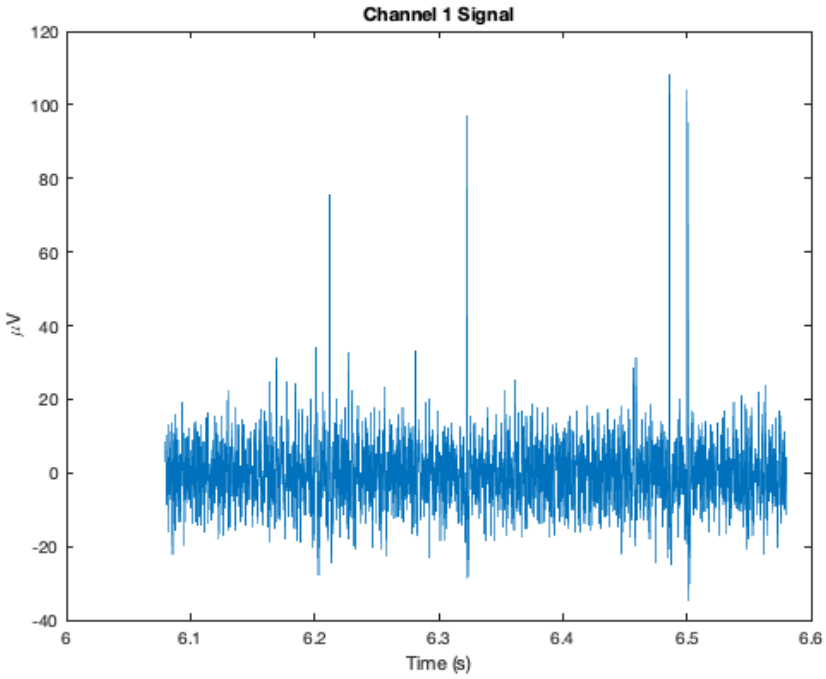
4. How long (in seconds) is this recording? (1 pt)

```
durationInUSec = session.data(1).rawChannels(1).get_tsdetails.getDuration;
durationInSec = durationInUSec/1e6
```

```
durationInSec =

    10
```

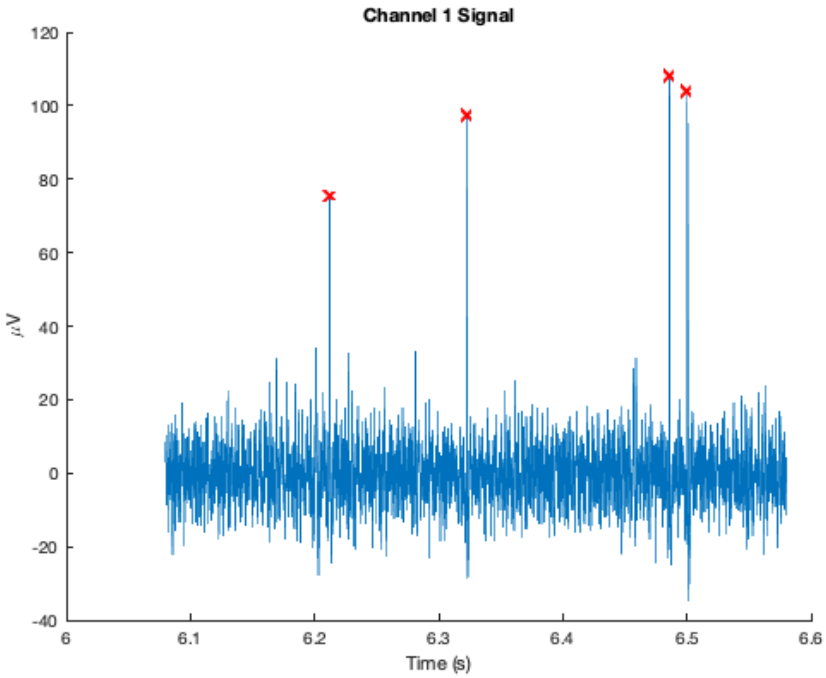
5. (a) Using the *session.data.getvalues* method retrieve the data from the time-window you plotted in Q1.1 and re-plot this data using MATLAB's plotting functionality. Note that the amplitude of the EEG signals from the portal is measured in units of μV (microvolts), so label your y-axis accordingly. (NOTE: Always make sure to include the correct units and labels in your plots. This goes for the rest of this and all subsequent homeworks.). (3 pts)

```
start_time = 6.08;
window_size = 0.5;
channel_id = 1;
data_window = session.data.getvalues(start_time * 1e6, window_size * 1e6, channel_id);

figure;
plot(start_time:1/sampling_rate:start_time+window_size, data_window);
xlabel('Time (s)');
ylabel('\muV');
title('Channel 1 Signal');
```



(b) Write a short bit of code to detect the times of each spike peak (i.e., the time of the maximum spike amplitude) within your time-window. Plot an 'x' above each spike peak that you detected superimposed on the plot from Q1.5a. (Hint: find where the slope of the signal changes from positive to negative and the signal is also above threshold.) (4 pts)

```
threshold = 50;
inds_df_2 = diff(diff(data_window) < 0);
inds_thresh = data_window(2:end-1) > threshold;
inds = find(inds_df_2 .* inds_thresh);

figure;
hold on
plot(start_time:1/sampling_rate:(start_time+window_size), data_window);
plot(start_time + (inds/sampling_rate), data_window(inds + 1), 'rx')
hold off
xlabel('Time (s)');
ylabel('\muV');
title('Channel 1 Signal');
```



(c) How many spikes do you detect in the entire data sample? (1 pt)

```
data = session.data.getvalues(1, 10 * 1e6, channel_id);
inds_df_2 = diff(diff(data) < 0);
inds_thresh = data(2:end-1) > threshold;
inds = find(inds_df_2 .* inds_thresh);
num_spikes = length(inds)
```

```
num_spikes =

    32
```

6. Content Question - In the assigned reading, you learned about different methods to obtain and localize neural signals for BCIs. Describe the naming convention for the International 10-20 system for EEG recording. In your own words, what do the letters refer to and what can you infer from the parity (even vs. odd) of the number at a given site? (1 pt)

   The first letter of an electrode's name denotes the region of the brain from which it records signals. Fp stands for pre-frontal, F for frontal, C for central, P for parietal, O for occipital, and T for temporal. These are appended to with numbers that denote which side of the head the electrode is placed at. Odd numbered electrodes are placed on the left-hand side of the skull, and even numbered electrodes on the right-hand side. Electrodes placed along the nasion-inion axis do not take a number, instead taking the letter z.