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**EE 385V - Brain Computer Interaction**

**Homework 1 Report**

Step 1 – How does the dataset look like?

* What do these dimensions mean?

*The signal is the recorded EEG signal at a sampling frequency of 250-Hz, and the triggers represent recording interval.*

Step 2 – Triggers

* How is it in our case?

*In our case, they are starting points of the trials.*

* Can we deduce the number of trials? How?

*Yes, by computing the length of the array ‘trigger’.*

Step 3 – Raw signals

* Plot the raw signal.
* On top, plot when the triggers appear.

Step 4 - Filtering

* Why filtering data?

*We filter data to mitigate noise and remove artifacts.*

* Filter signal in alpha and beta bands ([9 11] Hz & [18 22] Hz, respectively).
* Plot the two filtered signals on top of the raw signal.

Step 5 – Power and moving average

* Compute the power of the signal.
* Plot the s2 on top of the previous signals.
* What is the moving average? Why apply it?

*It smoothens out outliers and suppresses high frequency noise.*

* Compute and plot it for alpha and beta band.
* What happens by changing the window size?

*By increasing the window size, you increase the number of samples that are being averaged. And the more samples are being averaged, the less the value of a given recording has an effect on the overall trend.*

Step 6 – Single trial plots

* Plot some trials of raw signal.
* Plot same trials filtered in alpha and beta bands.
  + trial\_id = [55 56 74 77];
  + trial\_timing = [-2 6];
* What can you infer from the different plots?
  + Are there (dis)similarities between different bands?

*Similarities:*

* + - *There is a synchronization before the trigger, then a desynchronization at the trigger, and then a rebound when the action is imagined.*

*Dissimilarities:*

* + - *They have different frequency content.*
    - *They have different energy for this task.*
  + Are there (dis)similarities between trials?

*Similarities:*

* + - *There is a synchronization before the trigger, then a desynchronization at the trigger, and then a rebound when the action is imagined.*

*Dissimilarities:*

* + - *The triggers are not evenly spaced out*

Step 7 – Grand average

* Plot averaged signals of alpha and beta power.
* What can we infer from these plots?

*SPECULATION: Averaged Alpha signal power is greater than Averaged Beta signal power.*

* What are the differences between single trial and grand average signals?

*PLOT GRAND AVERAGE OF SIGNALS. (ALL TRIGGERS OVERLAPING AND AVERAGED).*

* What is more useful for online real time BCI?

*They are both useful, but you can’t create a final grand average in real time. So it is best to rely on the single trial and to use a grand average as the fingerprint to check against that single trial.*

* What are the main difficulties when dealing with single trial analysis?
  + - *Noise*
    - *Artifacts*
    - *The subject’s focus and preparation*
    - *More challenging filtering approach*