

MYOCLONUS, FUNCTIONAL JERKS, AND BACK-AVERAGING

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Analysis Workshop Tools:

- ▶ [BacAv Online](#) (simple)
- ▶ [BacAv on GitHub](#) (advanced: requires [R base](#) and [RStudio](#))

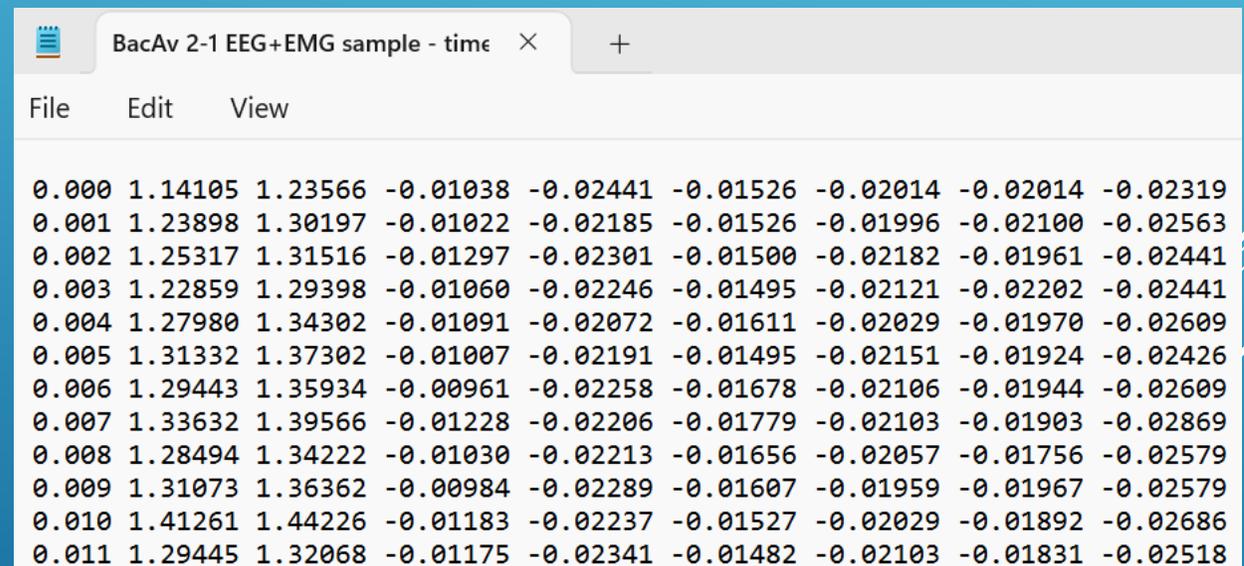
- ▶ [Tremoroton Online](#) (simple)
- ▶ [Tremoroton on GitHub](#) (advanced: also requires R)

- ▶ [Spike2 Demo](#)

ANALYSIS TOOLS

R-based open-source program for back-averaging using a threshold for event detection, created by Felipe Vial (PMID: 32095660)

- ▶ TXT file, with each channel as a column separated by a space (not a comma), with no headers
- ▶ Column 1: time
- ▶ Column(s) for EEG
- ▶ Column(s) for EMG



```
BacAv 2-1 EEG+EMG sample - time × +
File Edit View
0.000 1.14105 1.23566 -0.01038 -0.02441 -0.01526 -0.02014 -0.02014 -0.02319
0.001 1.23898 1.30197 -0.01022 -0.02185 -0.01526 -0.01996 -0.02100 -0.02563
0.002 1.25317 1.31516 -0.01297 -0.02301 -0.01500 -0.02182 -0.01961 -0.02441
0.003 1.22859 1.29398 -0.01060 -0.02246 -0.01495 -0.02121 -0.02202 -0.02441
0.004 1.27980 1.34302 -0.01091 -0.02072 -0.01611 -0.02029 -0.01970 -0.02609
0.005 1.31332 1.37302 -0.01007 -0.02191 -0.01495 -0.02151 -0.01924 -0.02426
0.006 1.29443 1.35934 -0.00961 -0.02258 -0.01678 -0.02106 -0.01944 -0.02609
0.007 1.33632 1.39566 -0.01228 -0.02206 -0.01779 -0.02103 -0.01903 -0.02869
0.008 1.28494 1.34222 -0.01030 -0.02213 -0.01656 -0.02057 -0.01756 -0.02579
0.009 1.31073 1.36362 -0.00984 -0.02289 -0.01607 -0.01959 -0.01967 -0.02579
0.010 1.41261 1.44226 -0.01183 -0.02237 -0.01527 -0.02029 -0.01892 -0.02686
0.011 1.29445 1.32068 -0.01175 -0.02341 -0.01482 -0.02103 -0.01831 -0.02518
```

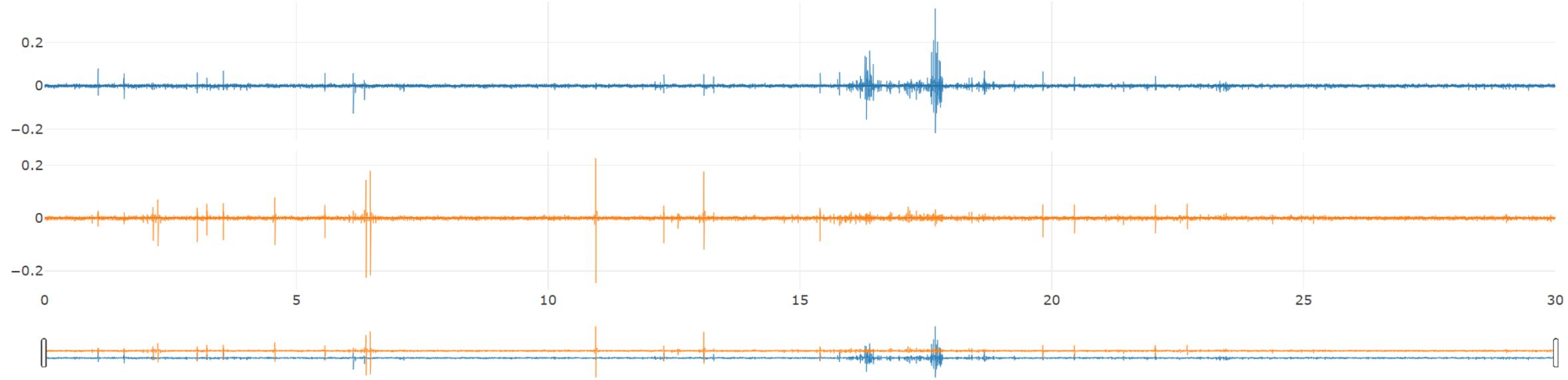
BACAV GENERAL FORMAT

BacAv 1-1, 1-2 ... files on course website Presenter view

- ▶ Column 1: time
- ▶ Column 2-3: EMG
- ▶ No EEG: these files are just intended to give you examples of cortical myoclonus in pairs of muscles
- ▶ Use EEG channel for column 2, EMG channel for column 3, leave sampling rate 1000
- ▶ Stay on General view tab

| | |
|--------------------------------|--|
| EEG channel | Sampling Rate |
| <input type="text" value="2"/> | <input type="text" value="1000"/> |
| EMG channel | Choose File |
| <input type="text" value="3"/> | <input type="button" value="Browse..."/> <input type="text" value="No file selected"/> |

BACAV EMG VIEWER



— EEG
— EMG

EEG channel

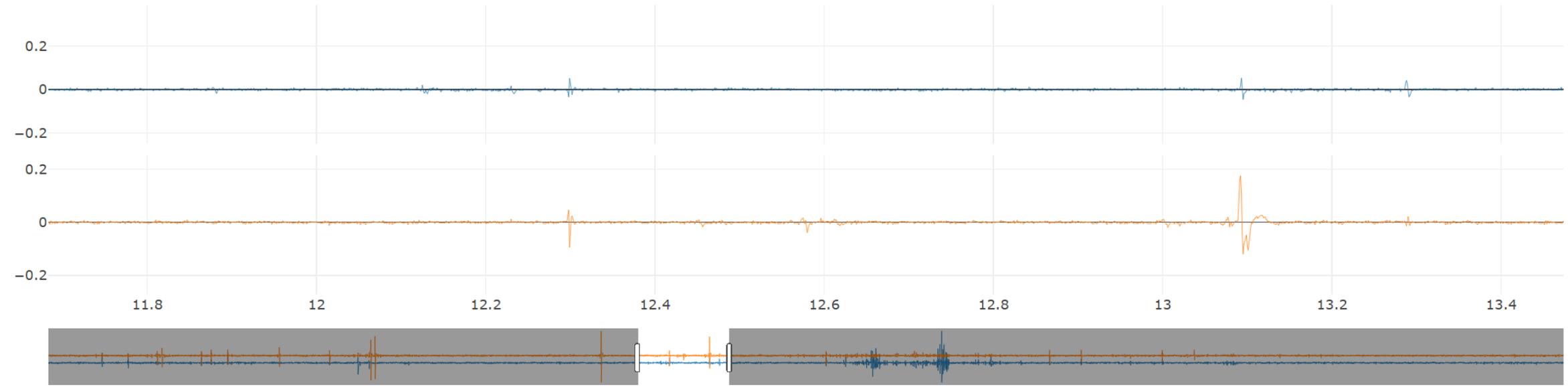
EMG channel

Sampling Rate

Choose File

Browse... BacAv 1-1 Cortical Myoclonus ;

Upload complete



— EEG
— EMG

EEG channel

EMG channel

Sampling Rate

Choose File

Browse... BacAv 1-1 Cortical Myoclonus :

Upload complete

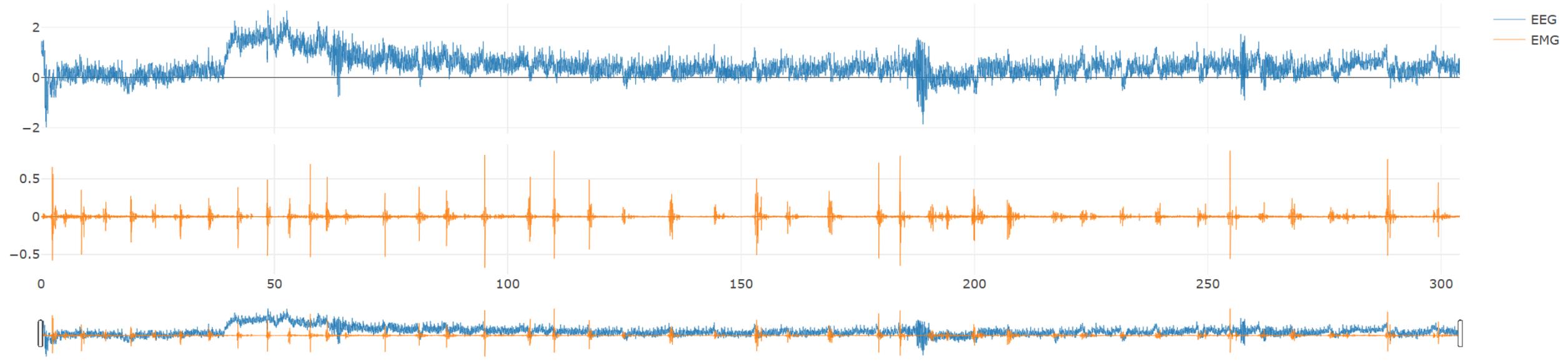
- ▶ Gather around the laptops and explore!

BACAV EMG VIEWER PRACTICE

BacAv 2-1 ... files on course website Presentations tab

- ▶ Time: column 1
- ▶ EEG: columns 2-3
- ▶ EMG: columns 4-9
- ▶ Sampling rate: 1000 Hz

BACAV EEG+EMG SAMPLE



EEG channel

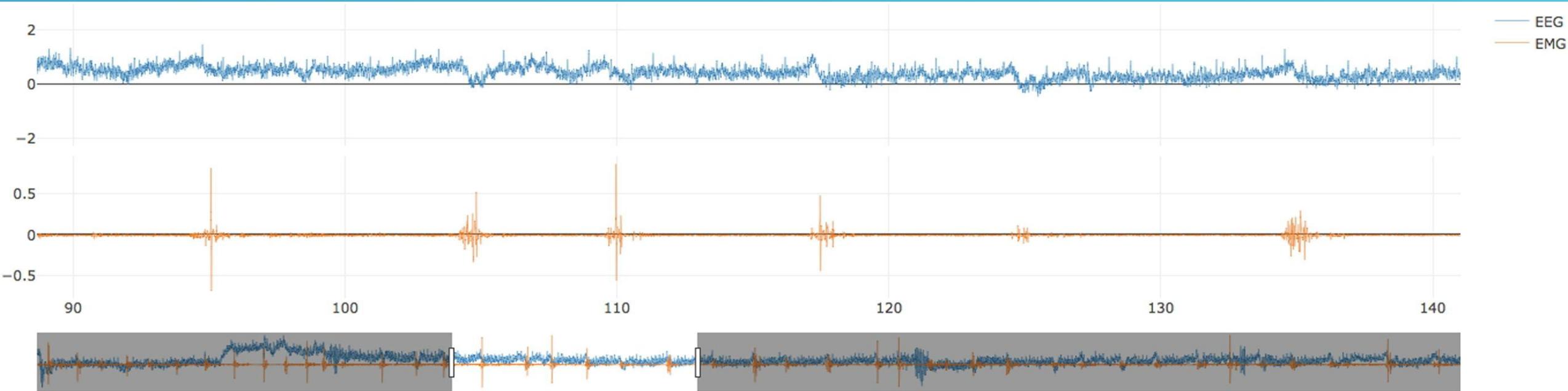
EMG channel

Sampling Rate

Choose File

Browse... BacAv sample.txt

Upload complete



BACAV EEG, EMG VIEWER

Parameters for EMG markers

Threshold

Time After (in sec)

Time Before (in sec)

Amplitud After > than

Amplitud Before < than

Burst duration (in sec)

Window (in sec)

Onset (in sec)

RUN

BACAV TIME DOMAIN PARAMETERS

1) Find a candidate EMG burst:

- ▶ **Threshold:** A value between 0 and 1 which the normalized EMG amplitude must rise above in order to be considered a candidate burst.
 - ▶ If some low-amplitude bursts are being missed, consider decreasing the Threshold.

2) Check the preceding baseline:

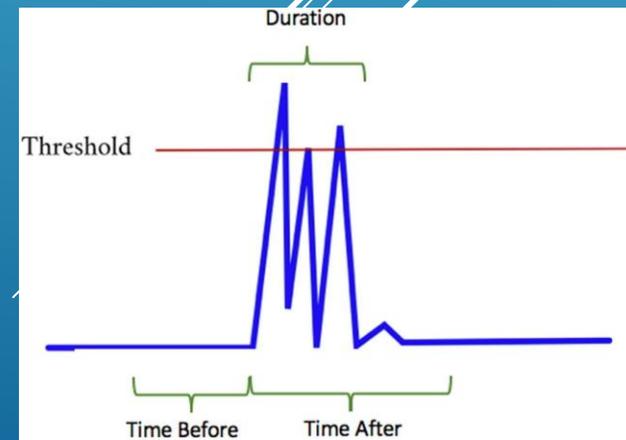
- ▶ **Time before:** A window of time (in seconds) before a candidate burst peak. This is used to check the baseline EMG activity preceding the burst
- ▶ **Amplitude before:** The mean amplitude in the “Time before” window must be lower than the value specified in this parameter. The goal is to ensure a quiet baseline.
 - ▶ If 2 peaks in 1 burst are being marked, consider decreasing the Amplitude Before.
 - ▶ If peaks during sustained muscle activity are being marked, consider decreasing the Amplitude Before

3) Check the EMG burst amplitude:

- ▶ **Time after:** A window of time (in seconds) after a candidate burst peak. This is used to check the average EMG amplitude of the burst
- ▶ **Amplitude after:** The mean amplitude in the “Time after” window has to be higher than the value specified in this parameter. This ensures the burst is substantial, and less likely to be noise/artifact
 - ▶ If nonspecific muscle activity or artifacts are being marked, consider increasing the Amplitude After

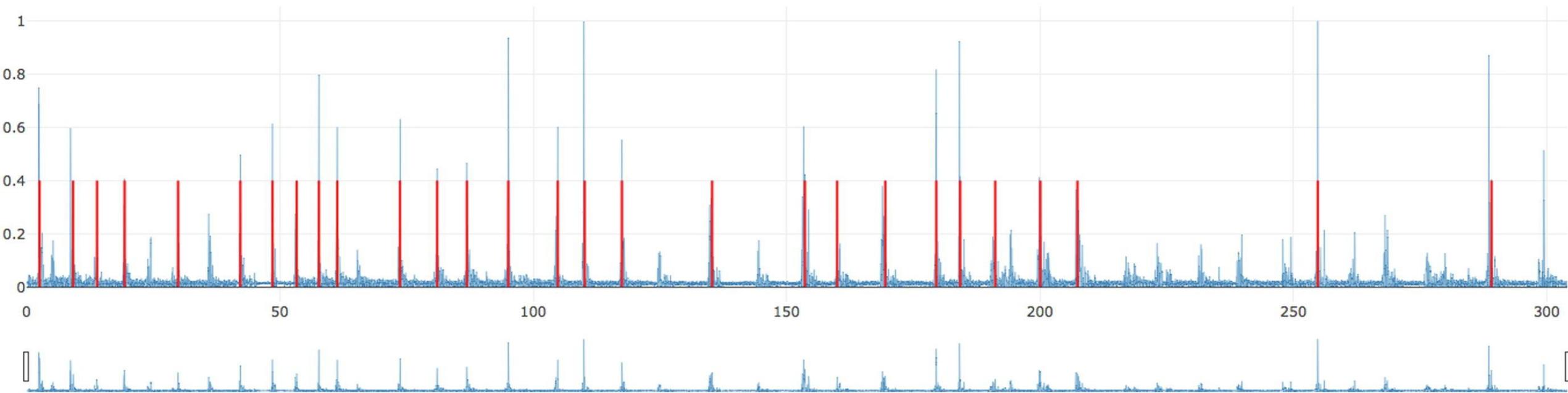
4) Prevent double-marking of a single burst:

- ▶ **Burst duration:** Window of time (in seconds) after a candidate burst during which no new muscle burst can be marked, to avoid marking a single peak twice
 - ▶ If bursts are being double-marked, consider increasing the Burst Duration



BACAV TIME DOMAIN MARKERS

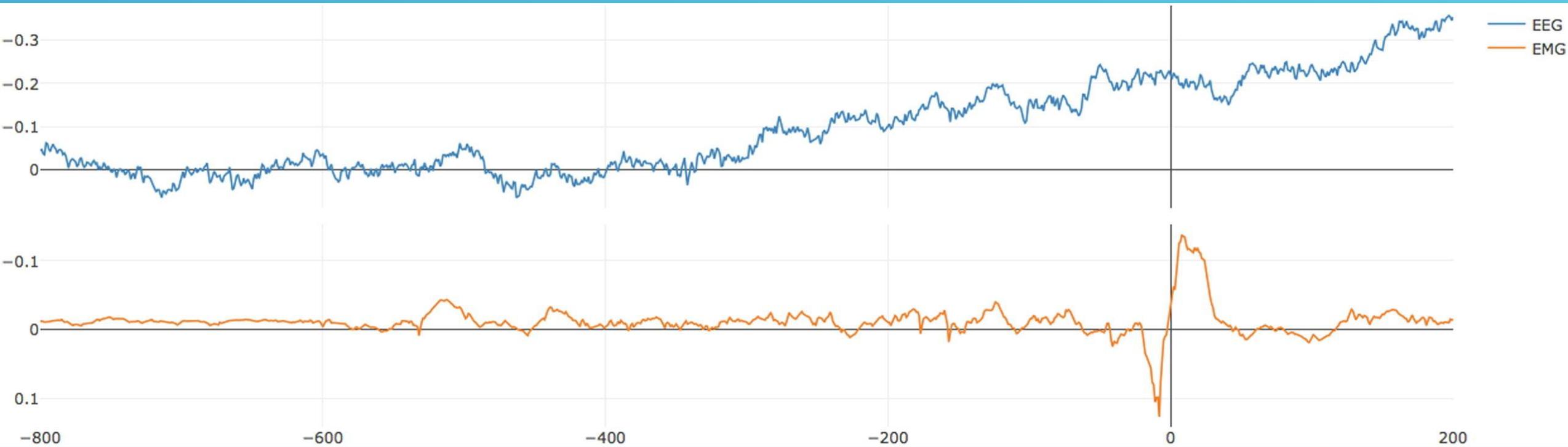
EMG plus markers



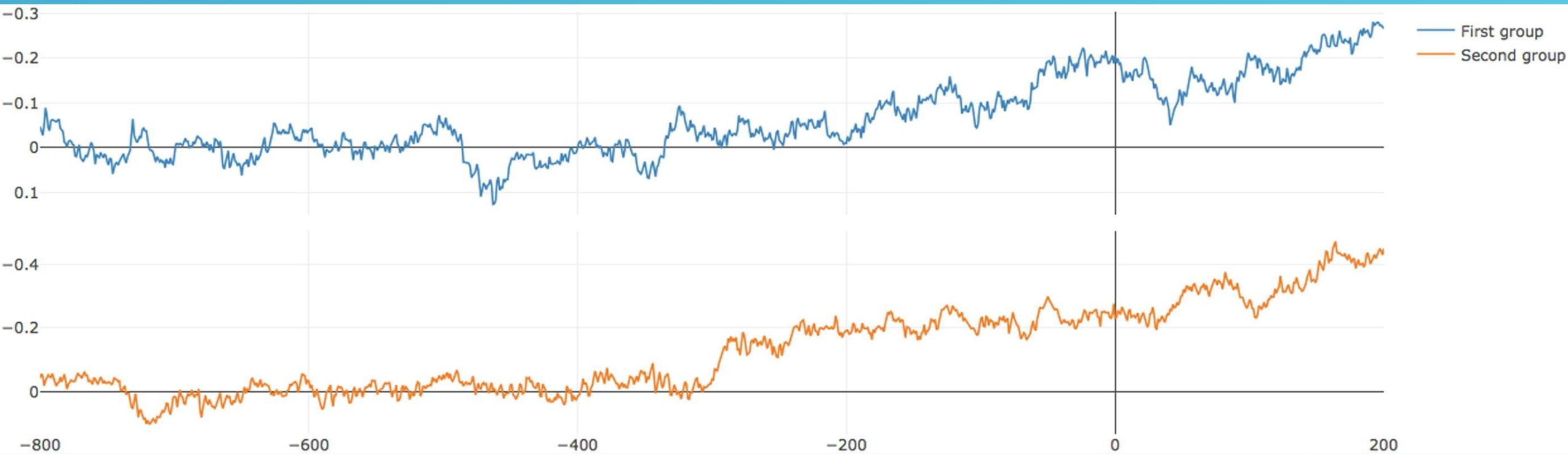
BACAV MARKERS

- ▶ **Window:** the length (in seconds) of the epoch surrounding each marker that will be collected, averaged, and visualized
- ▶ **Onset:** the time (in seconds) within the epoch where the marker will be set
 - ▶ For example: if the Window is 1.2 seconds (1200 msec) and the Onset is 1 second (1000 msec), the epoch will go from 1 second before the marker to 200 msec after the marker
 - ▶ If you want to see a longer epoch preceding the marker, increase the Window and the Onset, e.g. Window = 2.2 seconds and Onset = 2 seconds to see more of the early BP
 - ▶ If you want to focus on a shorter epoch preceding the marker, decrease the Window and the Onset, e.g. Window = 0.4 seconds and Onset = 0.2 seconds
 - ▶ If you want to see a longer epoch after the marker, increase the Window and keep the Onset the same, e.g. Window = 2 seconds and Onset = 1 second

BACAV TIME DOMAIN EPOCHS



BACAV EEG, EMG AVERAGE



BACAV RANDOM GROUP EEG AVERAGES

- ▶ Gather around the laptops and explore!

BACAV EEG+EMG PRACTICE

Commercial software from Cambridge Electronic Design (CED), can be used with data acquired using CED hardware, or can import a wide variety of file types recorded with other hardware and exported

- ▶ Spike2 1-1 and Spike2 resource file on course website
- ▶ Requires downloading demo version of Spike2
- ▶ File -> Open: Spike2 1-1 file
- ▶ File -> Resources Files -> Apply Resource File: Spike2 Resource File

SPIKE2 DEMO

31 Keyboard



- ▶ Gather around the laptops and explore!

SPIKE2 PRACTICE

