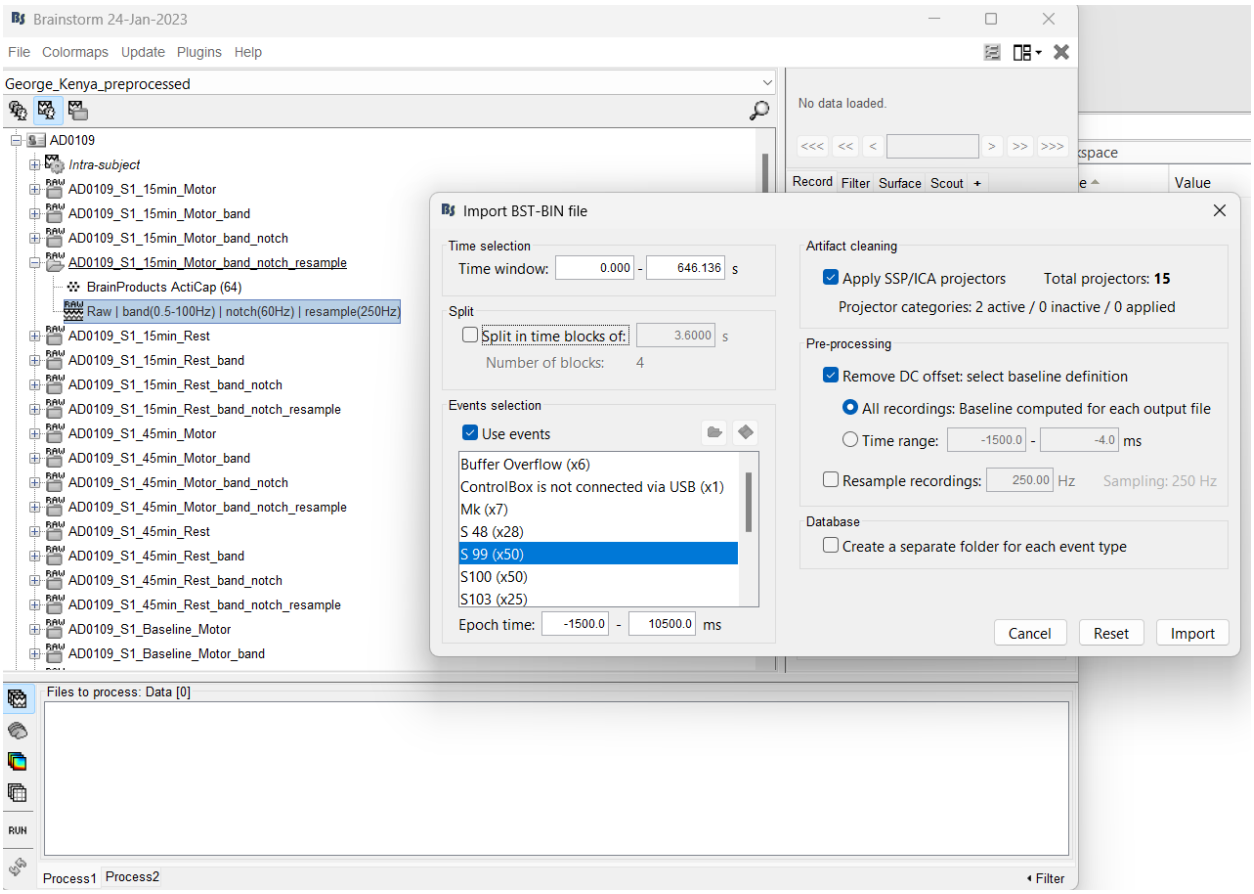
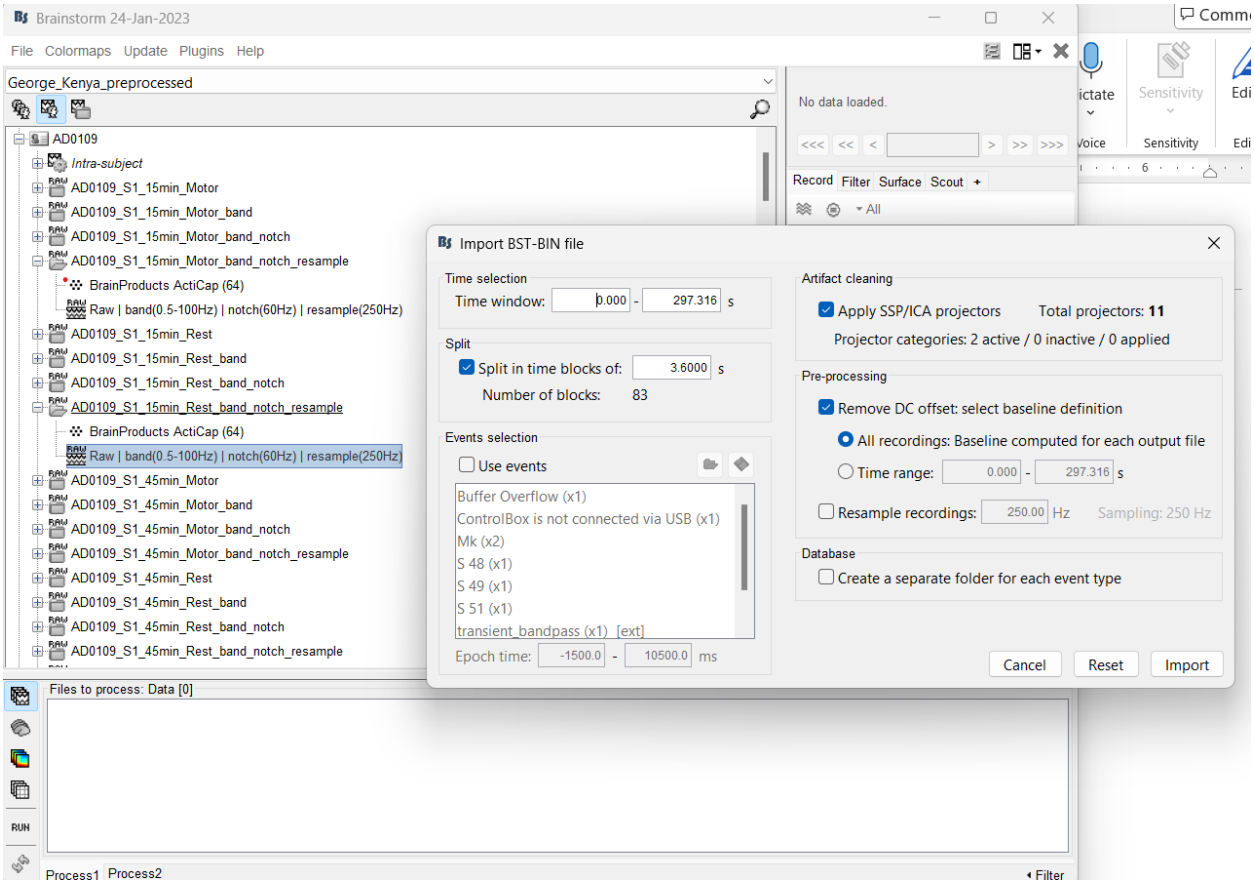
Analysis steps

Beta bursts

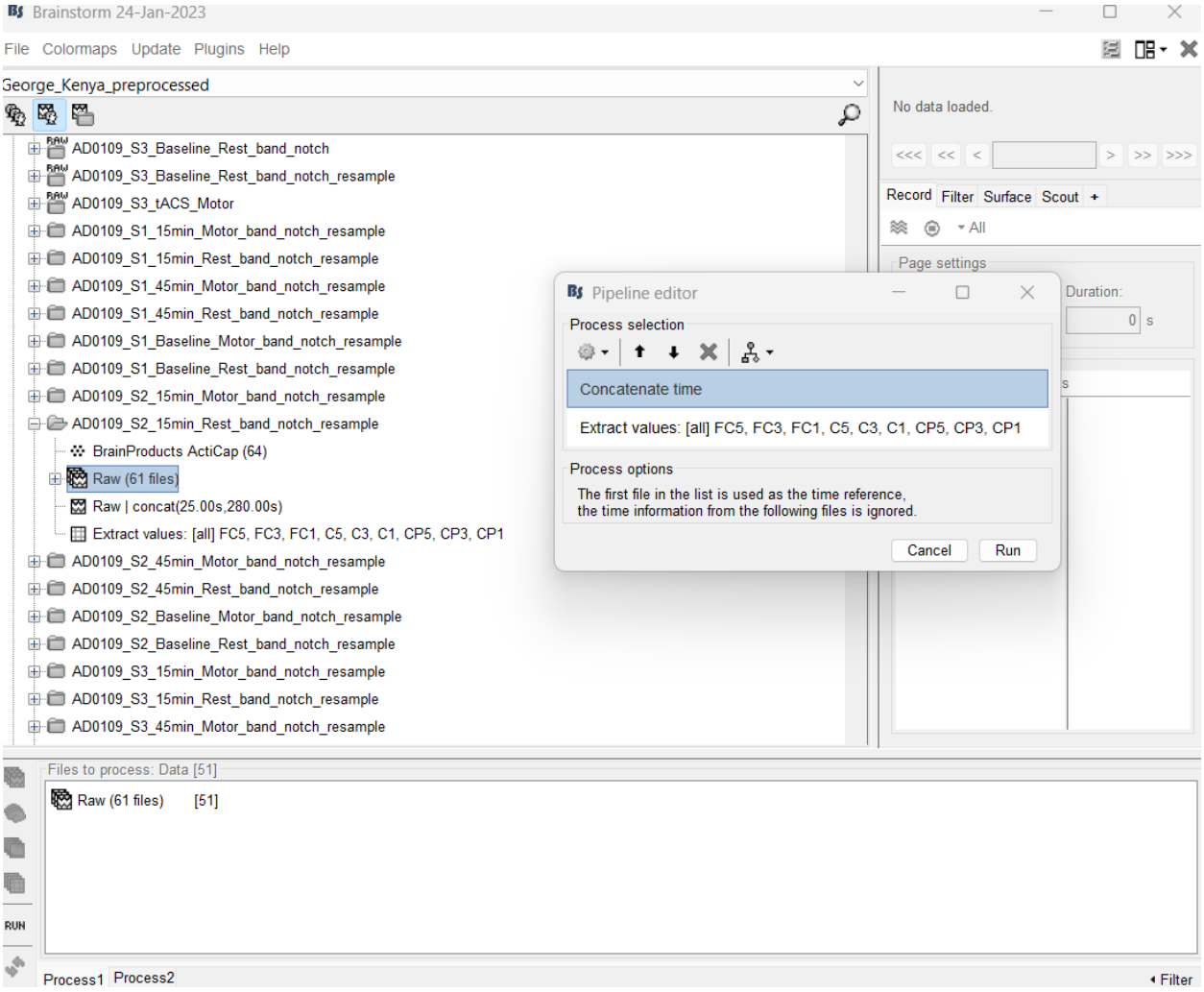
1. Preprocess data
    a. Reject bad electrodes
    b. Bandpass filter (0.5-100Hz)
    c. Notch filter (60 Hz)
    d. Resample to 250Hz
    e. Re-reference to an average reference
    f. Remove bad segments through visual inspection
    g. ICA for eye blinks and muscle artifacts
2. Import preprocessed raw file in database
    a. Motor data – epoch time (-1.5s,10.5s)

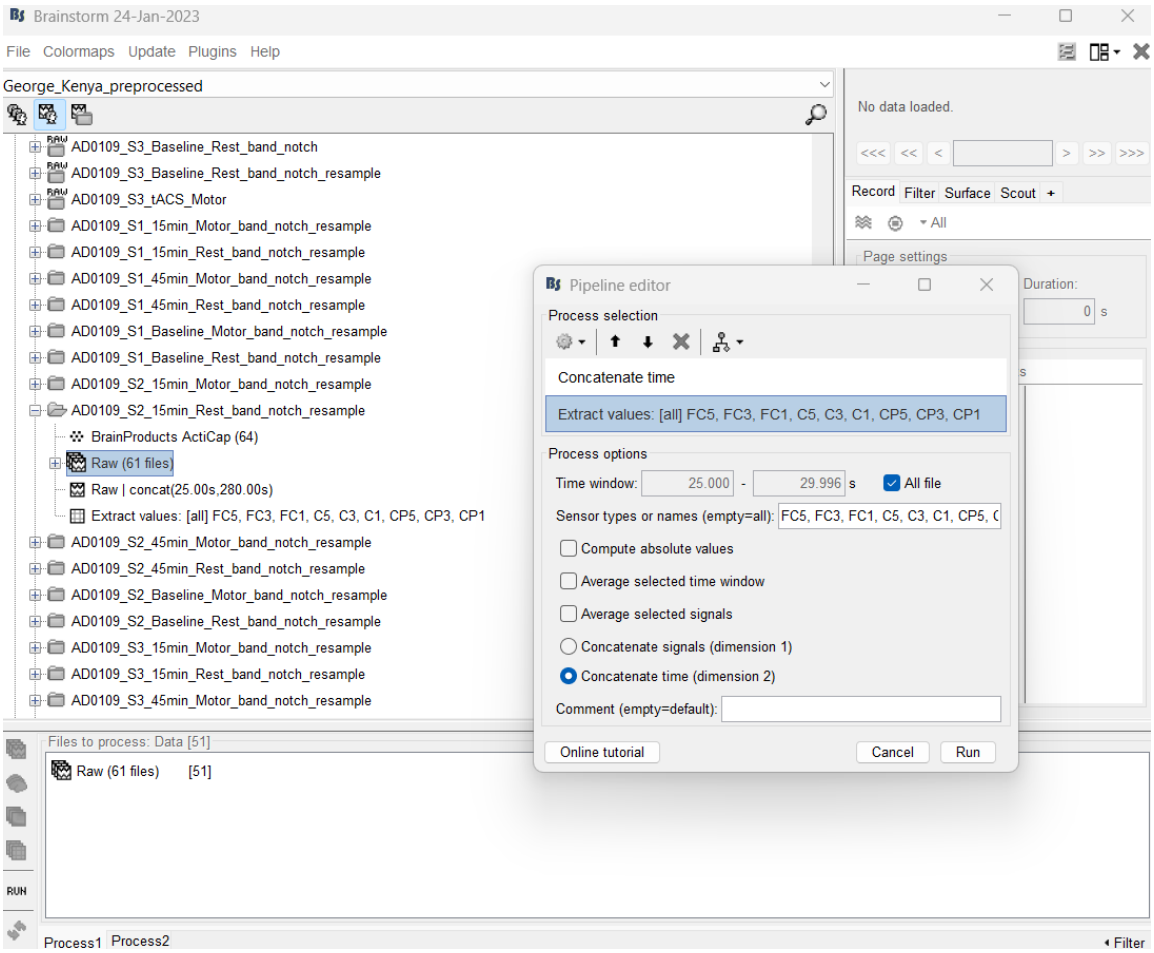


b. Rest data – Split in blocks of 3.6s



3. Reject first 5 trials from rest and motor epochs
4. Concatenate time of raw files and extract channels of interest

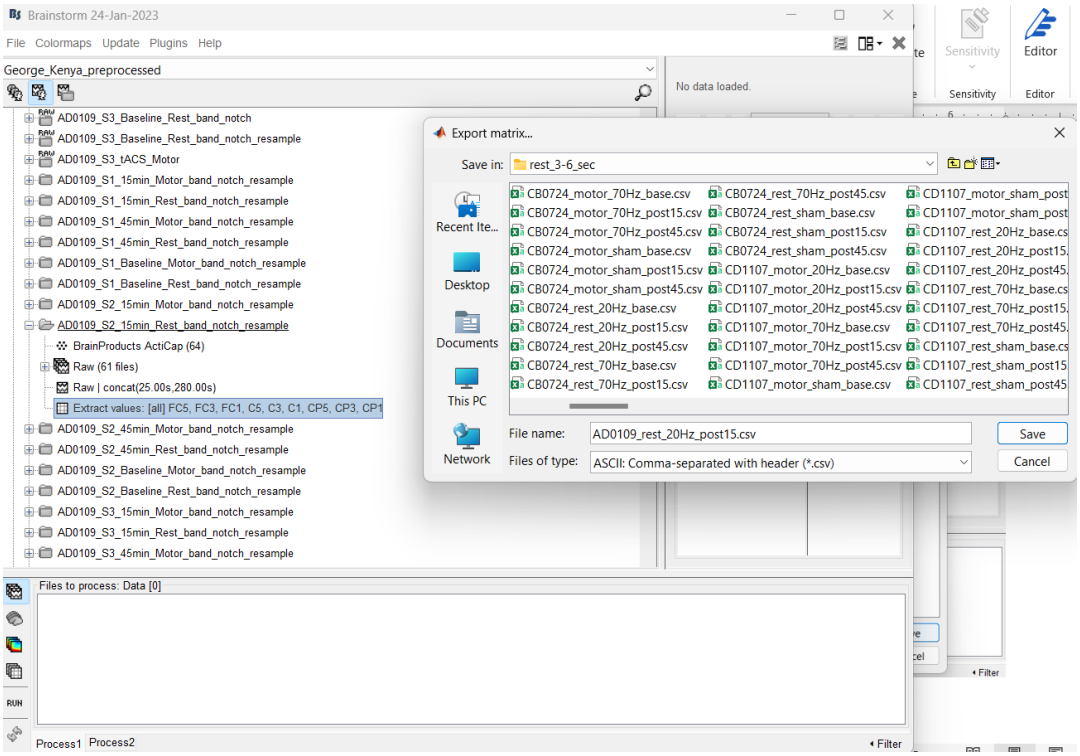


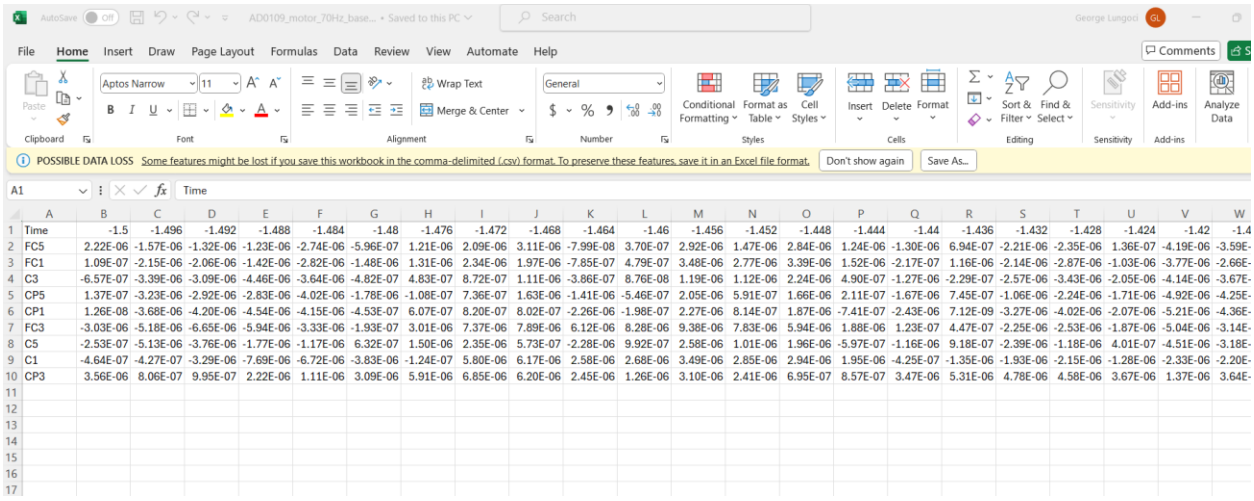

Brainstorm 24-Jan-2023
File Colormaps Update Plugins Help
George_Kenya_preprocessed
AD0109_S3_Baseline_Rest_band_notch
AD0109_S3_Baseline_Rest_band_notch_resample
AD0109_S3_tACS_Motor
AD0109_S1_15min_Motor_band_notch_resample
AD0109_S1_15min_Rest_band_notch_resample
AD0109_S1_45min_Motor_band_notch_resample
AD0109_S1_45min_Rest_band_notch_resample
AD0109_S1_Baseline_Motor_band_notch_resample
AD0109_S1_Baseline_Rest_band_notch_resample
AD0109_S2_15min_Motor_band_notch_resample
AD0109_S2_15min_Rest_band_notch_resample
BrainProducts ActiCap (64)
Raw (61 files)
Raw | concat(25.00s,280.00s)
Extract values: [all] FC5, FC3, FC1, C5, C3, C1, CP5, CP3, CP1
AD0109_S2_45min_Motor_band_notch_resample
AD0109_S2_45min_Rest_band_notch_resample
AD0109_S2_Baseline_Motor_band_notch_resample
AD0109_S2_Baseline_Rest_band_notch_resample
AD0109_S3_15min_Motor_band_notch_resample
AD0109_S3_15min_Rest_band_notch_resample
AD0109_S3_45min_Motor_band_notch_resample
No data loaded.
Record Filter Surface Scout +
All
Page settings
Duration:
0 s
Pipeline editor
Process selection
Concatenate time
Extract values: [all] FC5, FC3, FC1, C5, C3, C1, CP5, CP3, CP1
Process options
Time window: 25.000 - 29.996 s
All file
Sensor types or names (empty=all): FC5, FC3, FC1, C5, C3, C1, CP5, C
Compute absolute values
Average selected time window
Average selected signals
Concatenate signals (dimension 1)
Concatenate time (dimension 2)
Comment (empty=default):
Online tutorial
Cancel
Run
Files to process: Data [51]
Raw (61 files) [51]
RUN
Process1 Process2
Filter

5. Export the concatenated file to **.csv with header** following the proper naming convention:

```
# filename = participant_task_session_block.csv
# e.g. AD0109_motor_20Hz_post15.csv
# e.g. AD0109_rest_sham_base.csv

participant (e.g.AD0109), task (rest vs motor), session (20Hz vs 70Hz vs
sham), block (base, post15, post45)
```





	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Time	-1.5	-1.496	-1.492	-1.488	-1.484	-1.48	-1.476	-1.472	-1.468	-1.464	-1.46	-1.456	-1.452	-1.448	-1.444	-1.44	-1.436	-1.432	-1.428	-1.424	-1.42	-1.4
2	FC5	2.22E-06	-1.57E-06	-1.32E-06	-1.23E-06	-2.74E-06	-5.96E-07	1.21E-06	2.09E-06	3.11E-06	-7.99E-08	3.70E-07	2.92E-06	1.47E-06	2.84E-06	1.24E-06	-1.30E-06	6.94E-07	-2.21E-06	-2.35E-06	1.36E-07	-4.19E-06	-3.59E-
3	FC1	1.09E-07	-2.15E-06	-2.06E-06	-1.42E-06	-2.82E-06	-1.48E-06	1.31E-06	2.34E-06	1.97E-06	-7.85E-07	4.79E-07	3.48E-06	2.77E-06	3.39E-06	1.52E-06	-2.17E-07	1.16E-06	-2.14E-06	-2.87E-06	-1.03E-06	-3.77E-06	-2.66E-
4	C3	-6.57E-07	-3.39E-06	-3.09E-06	-4.46E-06	-3.64E-06	-4.82E-07	4.83E-07	8.72E-07	1.11E-06	-3.86E-07	8.76E-08	1.19E-06	1.12E-06	2.24E-06	4.90E-07	-1.27E-06	-2.29E-07	-2.57E-06	-3.43E-06	-2.05E-06	-4.14E-06	-3.67E-
5	CP5	1.37E-07	-3.23E-06	-2.92E-06	-2.83E-06	-4.02E-06	-1.78E-06	-1.08E-07	7.36E-07	1.63E-06	-1.41E-06	-5.46E-07	2.05E-06	5.91E-07	1.66E-06	2.11E-07	-1.67E-06	7.45E-07	-1.06E-06	-2.24E-06	-1.71E-06	-4.92E-06	-4.25E-
6	CP1	1.26E-08	-3.68E-06	-4.20E-06	-4.54E-06	-4.15E-06	-4.53E-07	6.07E-07	8.20E-07	8.02E-07	-2.26E-06	-1.98E-07	2.27E-06	8.14E-07	1.87E-06	-7.41E-07	-2.43E-06	7.12E-09	-3.27E-06	-4.02E-06	-2.07E-06	-5.21E-06	-4.36E-
7	FC3	-3.03E-06	-5.18E-06	-6.65E-06	-5.94E-06	-3.33E-06	-1.93E-07	3.01E-06	7.37E-06	7.89E-06	6.12E-06	8.28E-06	9.38E-06	7.83E-06	5.94E-06	1.88E-06	1.23E-07	4.47E-07	-2.25E-06	-2.53E-06	-1.87E-06	-5.04E-06	-3.14E-
8	C5	-2.53E-07	-5.13E-06	-3.76E-06	-1.77E-06	-1.17E-06	6.32E-07	1.50E-06	2.35E-06	5.73E-07	-2.28E-06	9.92E-07	2.58E-06	1.01E-06	1.96E-06	-5.97E-07	-1.16E-06	9.18E-07	-2.39E-06	-1.18E-06	4.01E-07	-4.51E-06	-3.18E-
9	C1	-4.64E-07	-4.27E-07	-3.29E-06	-7.69E-06	-6.72E-06	-3.83E-06	-1.24E-07	5.80E-06	6.17E-06	2.58E-06	2.68E-06	3.49E-06	2.85E-06	2.94E-06	1.95E-06	-4.25E-07	-1.35E-06	-1.93E-06	-2.15E-06	-1.28E-06	-2.33E-06	-2.20E-
10	CP3	3.56E-06	8.06E-07	9.95E-07	2.22E-06	1.11E-06	3.09E-06	5.91E-06	6.85E-06	6.20E-06	2.45E-06	1.26E-06	3.10E-06	2.41E-06	6.95E-07	8.57E-07	3.47E-06	5.31E-06	4.78E-06	4.58E-06	3.67E-06	1.37E-06	3.64E-
11																							
12																							
13																							
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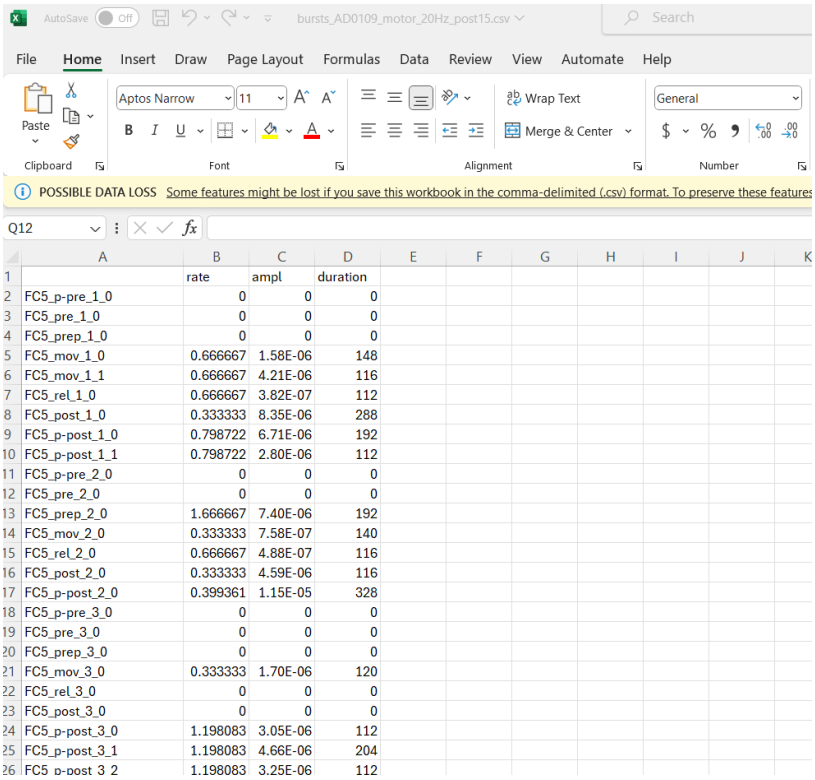
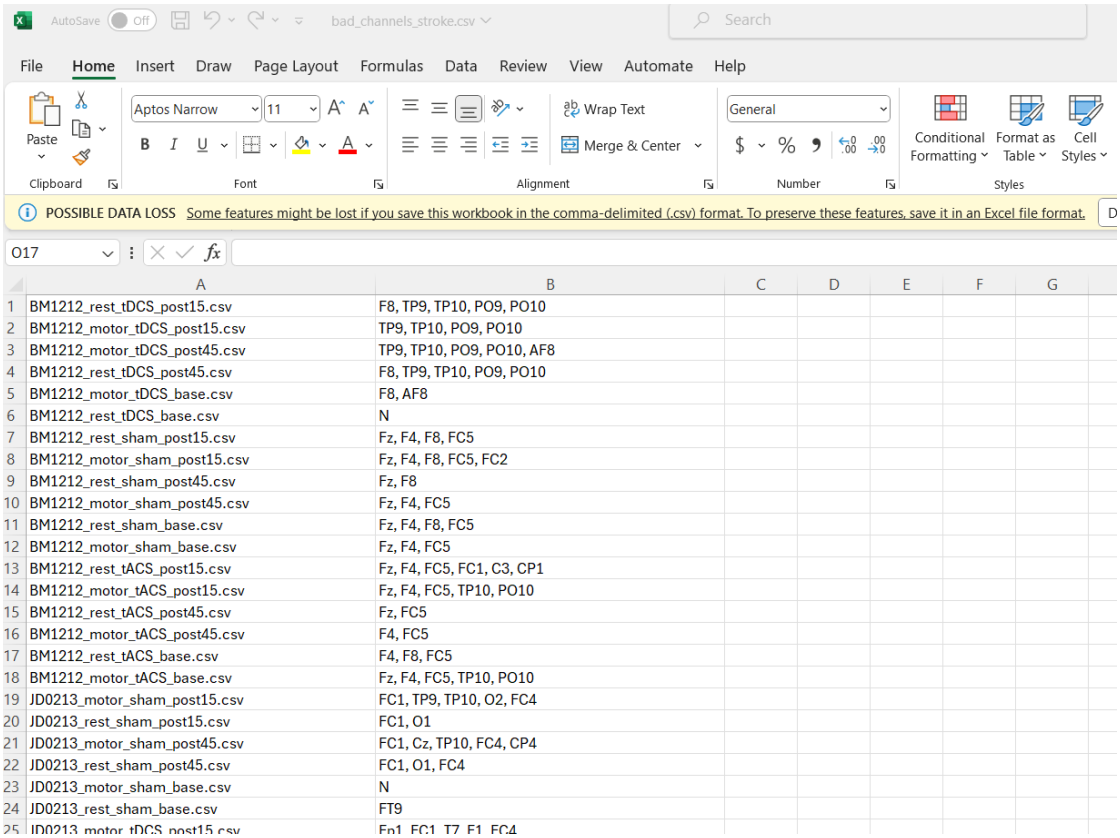
16																							
17																							

6. Run extract_bursts_filtering_entire_trial.py to extract bursts
    a. This code will extract the burst characteristics (rate, amplitude, duration) for each of the above file and will be saved as bursts_FILENAME.csv
    b. Before running, make sure to change the parameters as needed, in particular:
        i. import_folder (where the files from step 5. were saved)
        ii. export_folder (where the beta burst files will be saved)
        iii. mov_epoch_intervals (depends on the motor task and how epochs were separated in Brainstorm)
            1. [-1.1s, -0.1s] Pre-movement
            2. [0.5s, 3.5s] Movement
            3. [5s, 8s] Post-movement
        iv. mov_epoch_name_intervals
        v. rest_intervals (depends on the resting state epochs were separated in Brainstorm)
        vi. rest_name_intervals
    c. The bursts_FILENAME.csv has each line representing one burst within the file. The first column is the burst identifier: channel_interval_epoch_index
        i. Channel = channel from which the burst was extracted
        ii. Interval = Movement or Resting state interval as defined in mov_epoch_name_intervals and rest_name_intervals
        iii. Epoch = In which motor or rest epoch the burst is identified
        iv. Index = The index number of the burst in the current channel, interval and epoch



	A	B	C	D
1		rate	ampl	duration
2	FC5_p-pre_1_0	0	0	0
3	FC5_pre_1_0	0	0	0
4	FC5_prep_1_0	0	0	0
5	FC5_mov_1_0	0.666667	1.58E-06	148
6	FC5_mov_1_1	0.666667	4.21E-06	116
7	FC5_rel_1_0	0.666667	3.82E-07	112
8	FC5_post_1_0	0.333333	8.35E-06	288
9	FC5_p-post_1_0	0.798722	6.71E-06	192
10	FC5_p-post_1_1	0.798722	2.80E-06	112
11	FC5_p-pre_2_0	0	0	0
12	FC5_pre_2_0	0	0	0
13	FC5_prep_2_0	1.666667	7.40E-06	192
14	FC5_mov_2_0	0.333333	7.58E-07	140
15	FC5_rel_2_0	0.666667	4.88E-07	116
16	FC5_post_2_0	0.333333	4.59E-06	116
17	FC5_p-post_2_0	0.399361	1.15E-05	328
18	FC5_p-pre_3_0	0	0	0
19	FC5_pre_3_0	0	0	0
20	FC5_prep_3_0	0	0	0
21	FC5_mov_3_0	0.333333	1.70E-06	120
22	FC5_rel_3_0	0	0	0
23	FC5_post_3_0	0	0	0
24	FC5_p-post_3_0	1.198083	3.05E-06	112
25	FC5_p-post_3_1	1.198083	4.66E-06	204
26	FC5_p-post_3_2	1.198083	3.25E-06	112

7. Create the bad_channels.csv file
    a. Run bad_channels.py and set the “path” variable as the export folder used above.
    b. Open the created file in Excel and manually enter on the second column all the bad channels.
        i. Bad channels can be obtained in Brainstorm by right clicking on an epoch from each file > View all the bad channels
        ii. If no bad channels are within a file, write “N”



	A	B	C	D	E	F	G
1	BM1212_rest_tDCS_post15.csv	F8, TP9, TP10, PO9, PO10					
2	BM1212_motor_tDCS_post15.csv	TP9, TP10, PO9, PO10					
3	BM1212_motor_tDCS_post45.csv	TP9, TP10, PO9, PO10, AF8					
4	BM1212_rest_tDCS_post45.csv	F8, TP9, TP10, PO9, PO10					
5	BM1212_motor_tDCS_base.csv	F8, AF8					
6	BM1212_rest_tDCS_base.csv	N					
7	BM1212_rest_sham_post15.csv	Fz, F4, F8, FC5					
8	BM1212_motor_sham_post15.csv	Fz, F4, F8, FC5, FC2					
9	BM1212_rest_sham_post45.csv	Fz, F8					
10	BM1212_motor_sham_post45.csv	Fz, F4, FC5					
11	BM1212_rest_sham_base.csv	Fz, F4, F8, FC5					
12	BM1212_motor_sham_base.csv	Fz, F4, FC5					
13	BM1212_rest_tACS_post15.csv	Fz, F4, FC5, FC1, C3, CP1					
14	BM1212_motor_tACS_post15.csv	Fz, F4, FC5, TP10, PO10					
15	BM1212_rest_tACS_post45.csv	Fz, FC5					
16	BM1212_motor_tACS_post45.csv	F4, FC5					
17	BM1212_rest_tACS_base.csv	F4, F8, FC5					
18	BM1212_motor_tACS_base.csv	Fz, F4, FC5, TP10, PO10					
19	JD0213_motor_sham_post15.csv	FC1, TP9, TP10, O2, FC4					
20	JD0213_rest_sham_post15.csv	FC1, O1					
21	JD0213_motor_sham_post45.csv	FC1, Cz, TP10, FC4, CP4					
22	JD0213_rest_sham_post45.csv	FC1, O1, FC4					
23	JD0213_motor_sham_base.csv	N					
24	JD0213_rest_sham_base.csv	FT9					
25	JD0213_motor_tDCS_post15.csv	Fp1, FC1, T7, F1, FC4					

8. Run graph_bursts.py to plot the bursts
    a. Note: graph_bursts.py needs to be changed based on what you need to plot
    b. Requires:
        i. A bad_channels.csv file
        ii. functions.py file to be in the same folder
    c. Change parameters at the top of the file:
        i. channels
        ii. motor_intervals_of_interest
        iii. rest_intervals_of_interest
    d. Comment/Uncomment the line_error() function calls to plot the data you are interested in