# EEGLAB Tutorial - 22 channels

(20−10 electrode placement system)

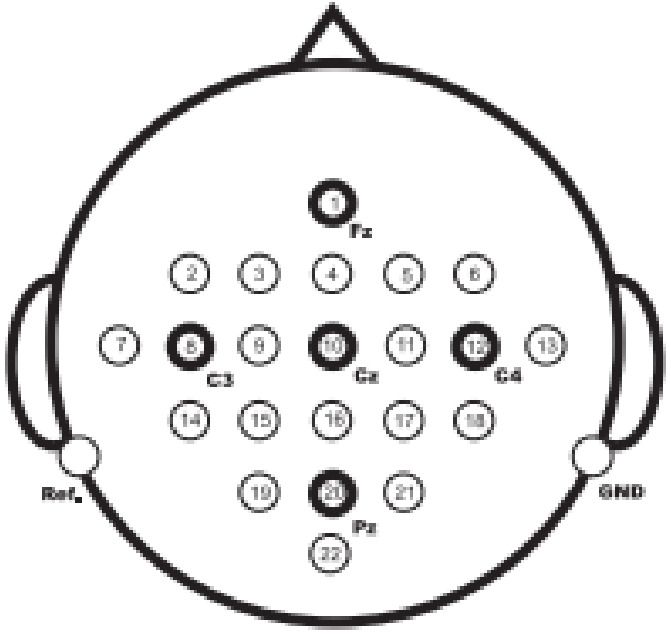
Jiazhen Hong
May 2021

# BCI Competition IV - IIa

Jiazhen Hong

Data Type: GDF
Analysis tool: EEGLAB
Package: Biosig

22 channel EEG




EOG

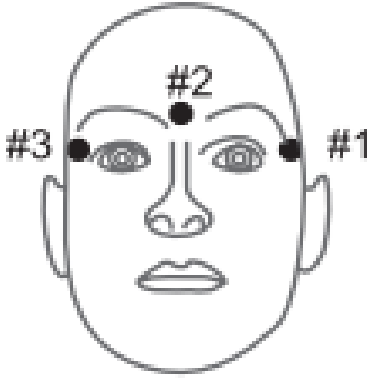
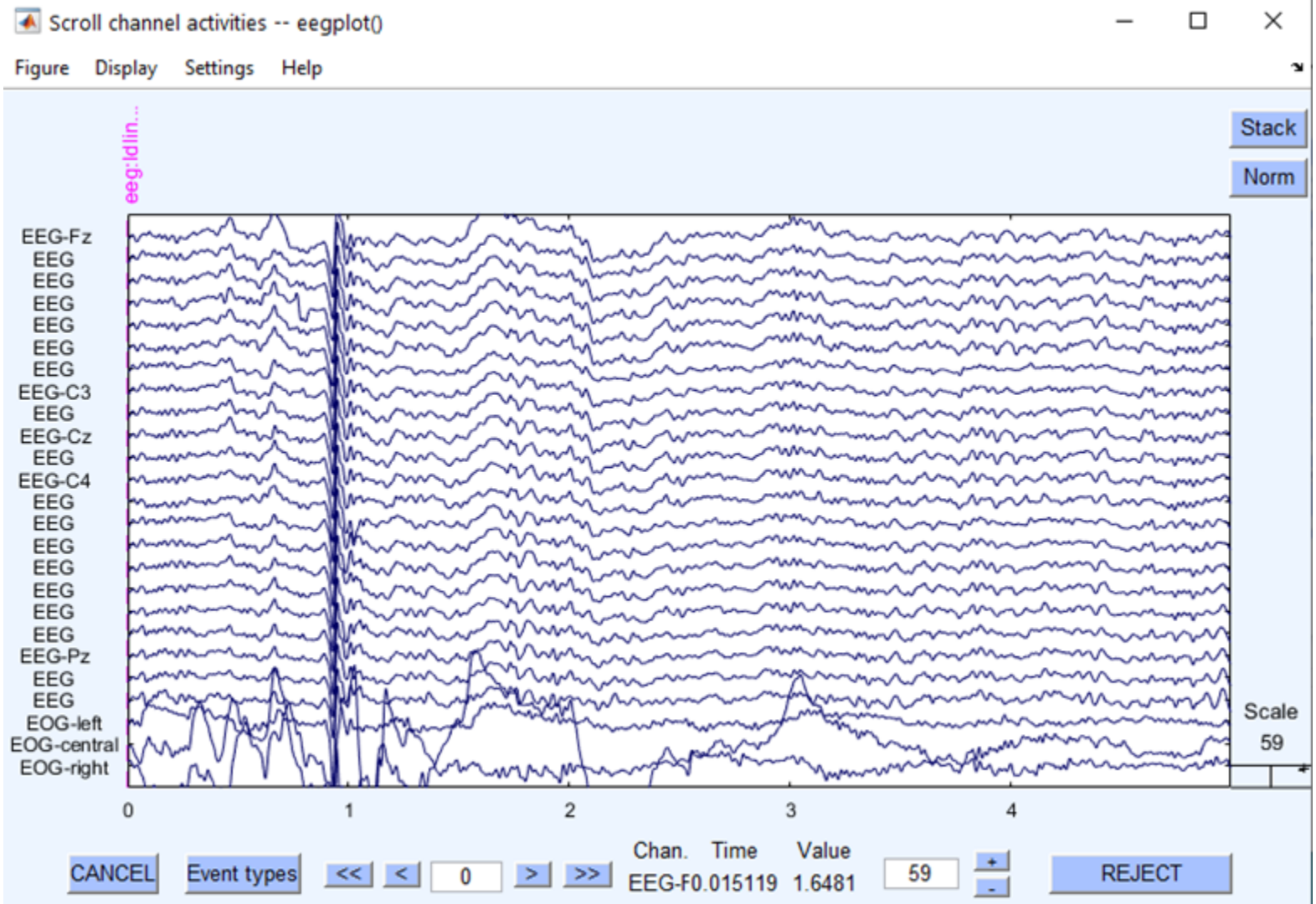



Figure 3: Left: Electrode montage corresponding to the international 10-20 system. Right: Electrode montage of the three monopolar EOG channels.


Scroll channel activities -- eegplot()
Figure
Display
Settings
Help
eeg:ldlin...
Stack
Norm
EEG-Fz
EEG
EEG
EEG
EEG
EEG
EEG
EEG-C3
EEG
EEG-Cz
EEG
EEG-C4
EEG
EEG
EEG
EEG
EEG
EEG
EEG
EEG-Pz
EEG
EEG
EOG-left
EOG-central
EOG-right
Scale
59
0
1
2
3
4
CANCEL
Event types
<<
<
0
>
>>
Chan.
Time
Value
EEG-F0.015119
1.6481
59
+
-
REJECT

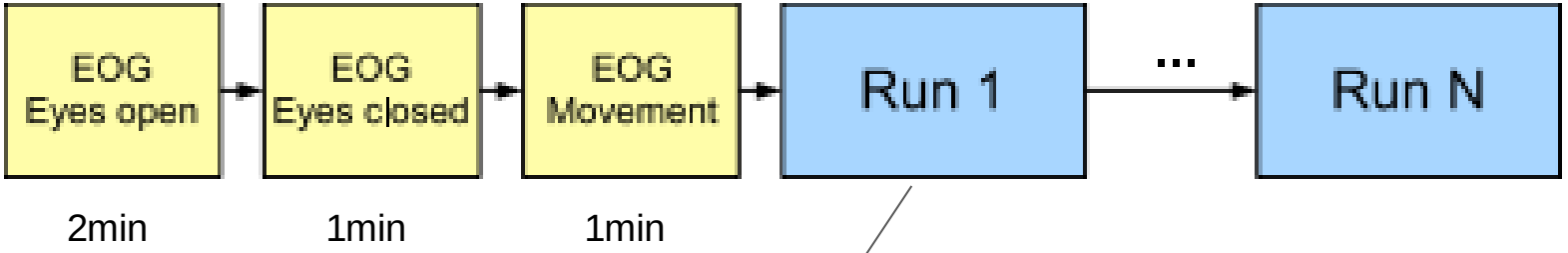



Figure 1: Timing scheme of one session.

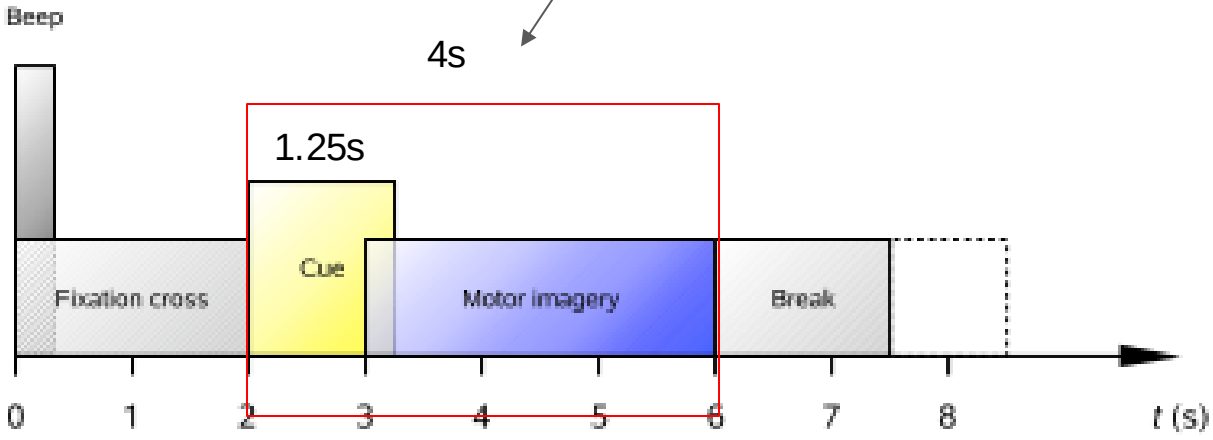
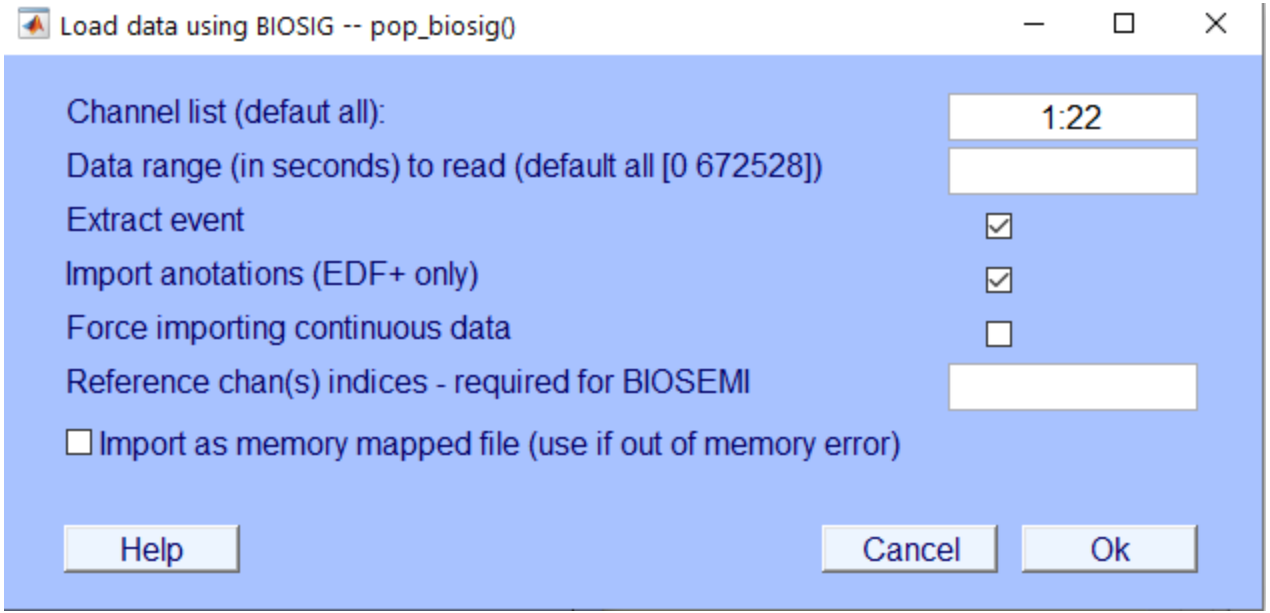
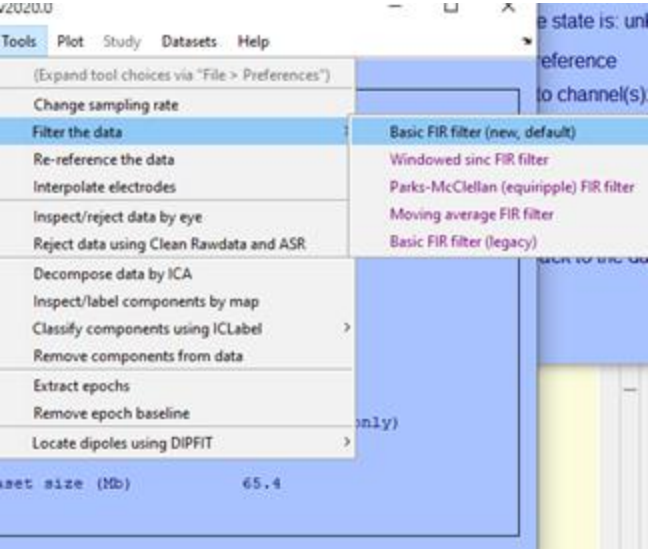


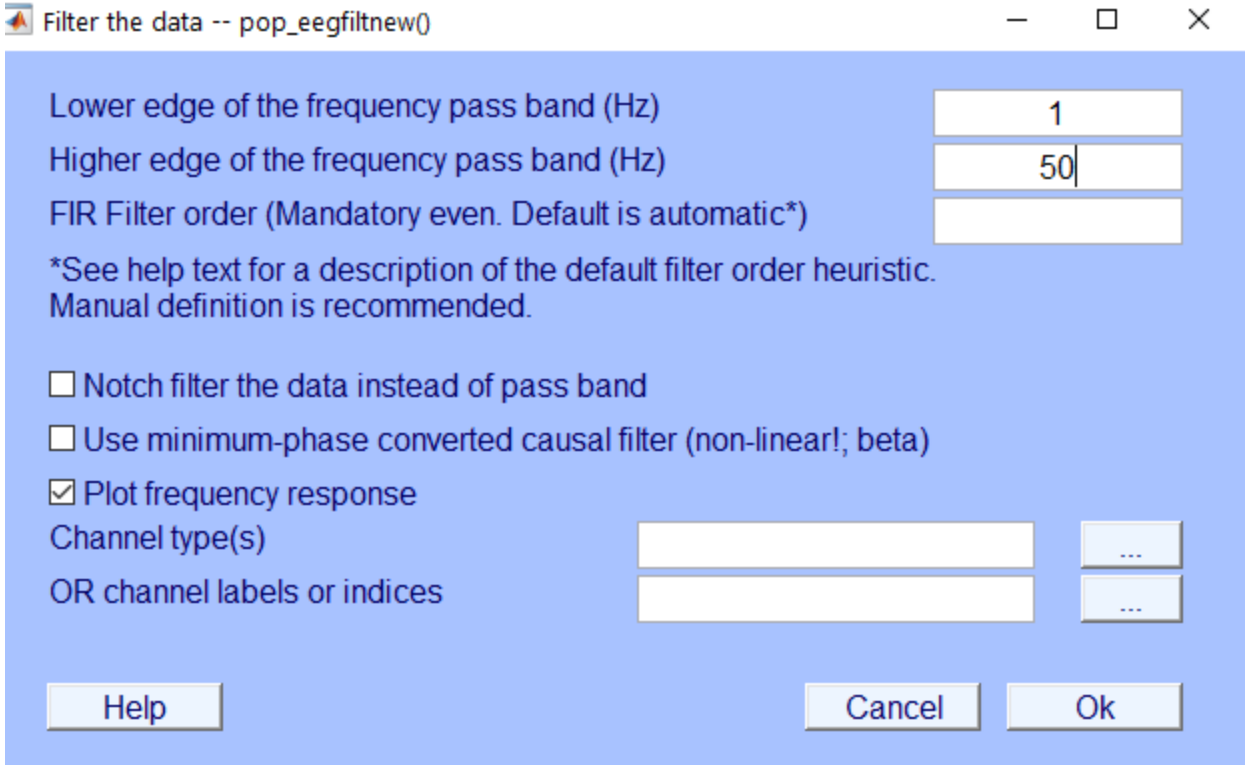

Figure 2: Timing scheme of the paradigm.

# Channel select

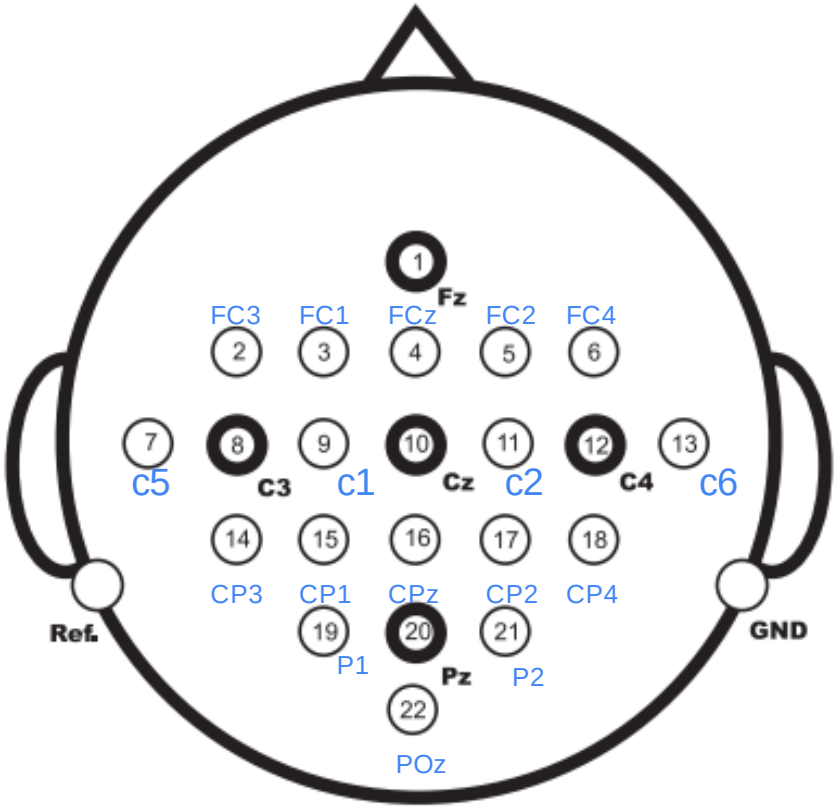


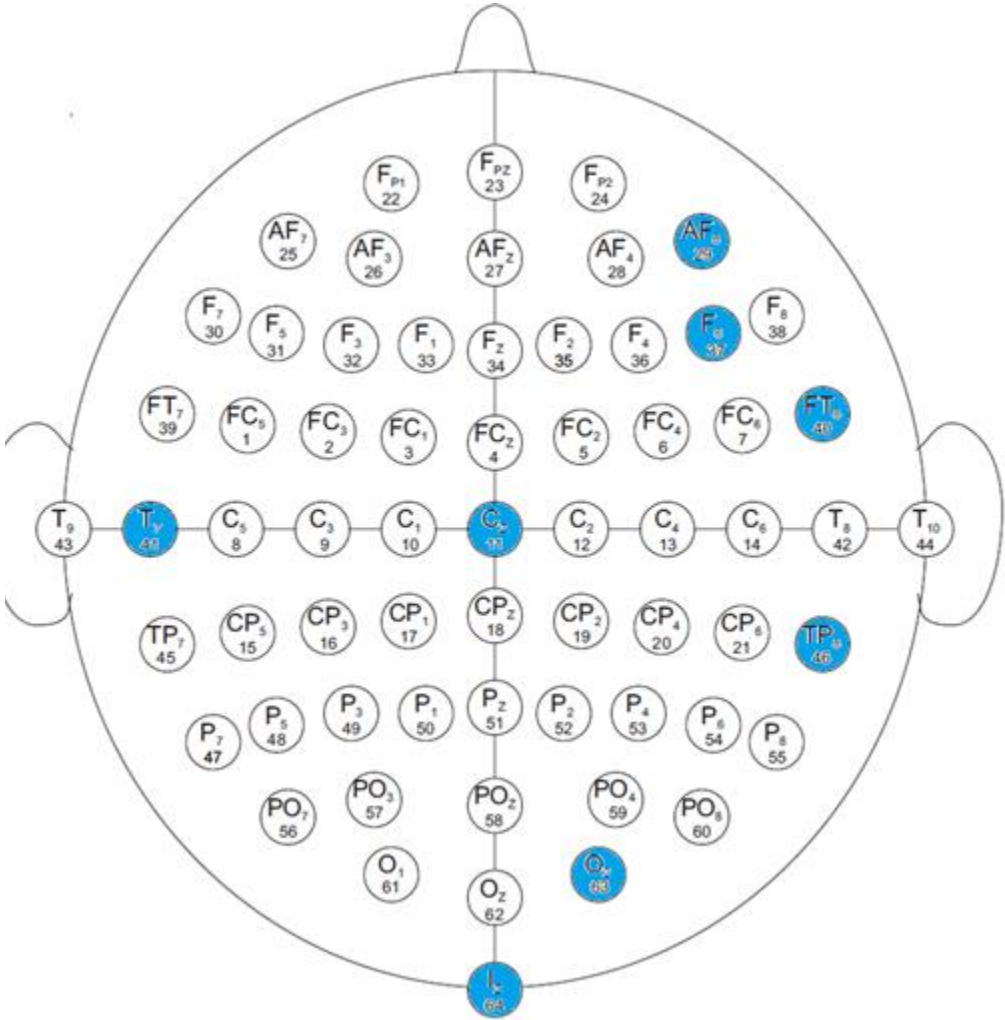
# 1 - Filter [1 50] hz



# 2-location


1
Fz
FC3
FC1
FCz
FC2
FC4
2
3
4
5
6
7
8
9
10
11
12
13
c5
C3
c1
Cz
c2
C4
c6
14
15
16
17
18
CP3
CP1
CPz
CP2
CP4
Ref.
19
20
21
GND
P1
Pz
P2
22
POz


FPZ 23
FP1 22
FP2 24
AF7 25
AF3 26
AFZ 27
AF4 28
AF8 29
F7 30
F5 31
F3 32
F1 33
FZ 34
F2 35
F4 36
F8 38
FT7 39
FC5 1
FC3 2
FC1 3
FCZ 4
FC2 5
FC4 6
FC6 7
FT8 40
T9 43
T7 41
C5 8
C3 9
C1 10
CZ 11
C2 12
C4 13
C6 14
T8 42
T10 44
TP7 45
CP5 15
CP3 16
CP1 17
CPZ 18
CP2 19
CP4 20
CP6 21
TP8 46
P7 47
P5 48
P3 49
P1 50
PZ 51
P2 52
P4 53
P6 54
P8 55
PO7 56
PO3 57
POZ 58
PO4 59
PO8 60
O1 61
OZ 62
O2 63
IZ 64

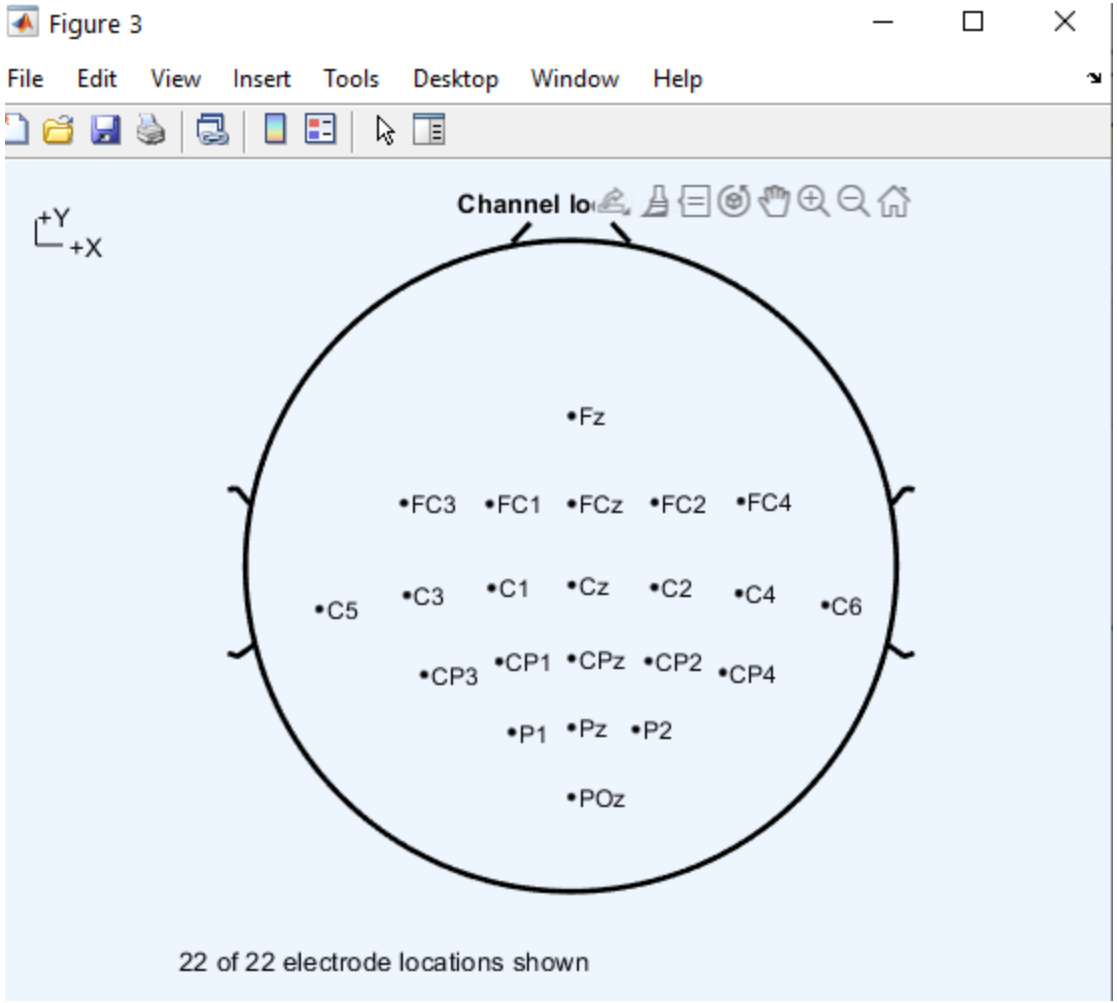
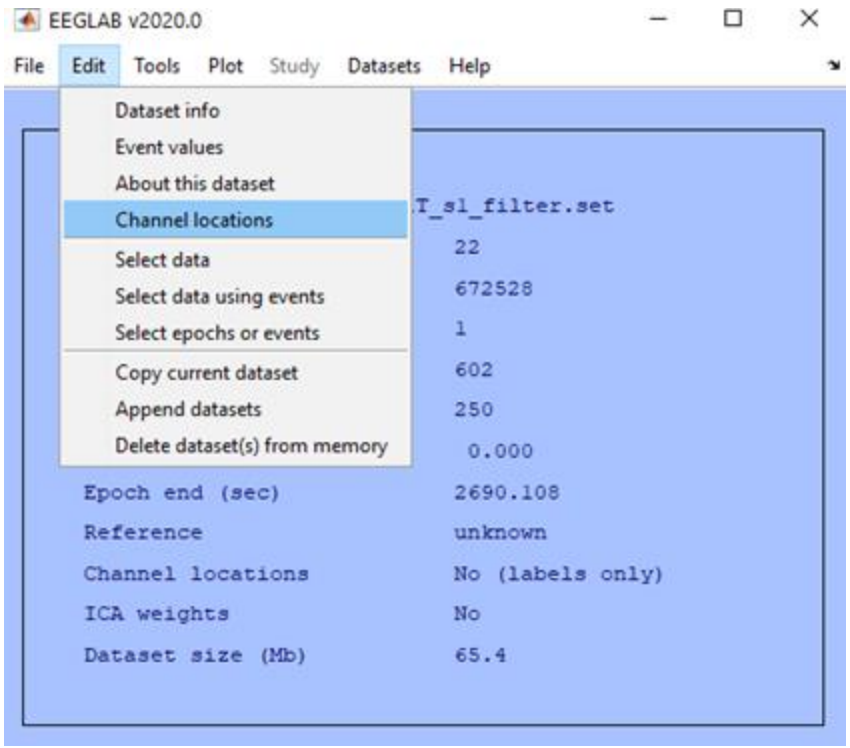
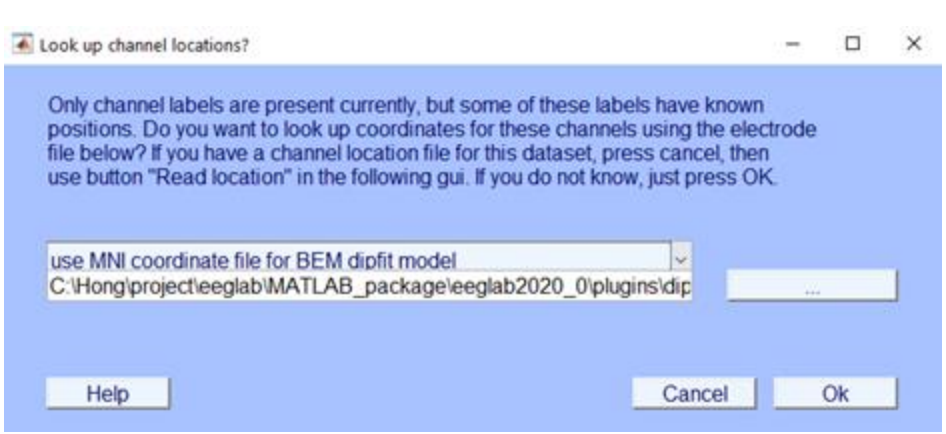


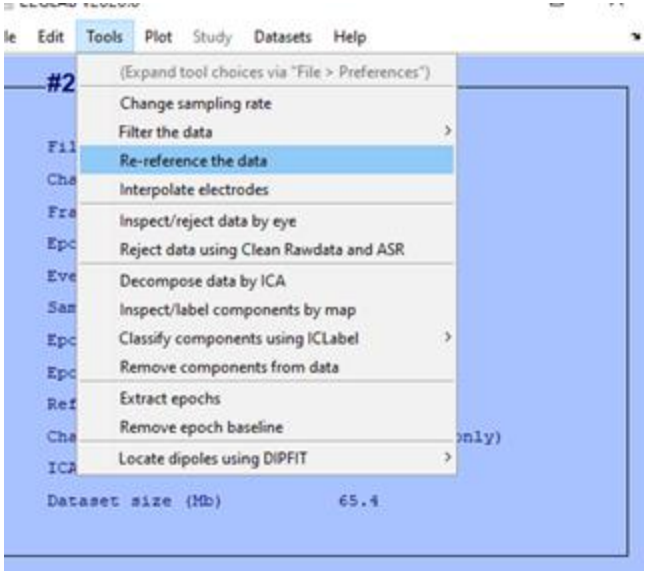
Figure 3
File Edit View Insert Tools Desktop Window Help
Channel lo
+Y
+X
Fz
FC3 FC1 FCz FC2 FC4
C5 C3 C1 Cz C2 C4 C6
CP3 CP1 CPz CP2 CP4
P1 Pz P2
POz
22 of 22 electrode locations shown

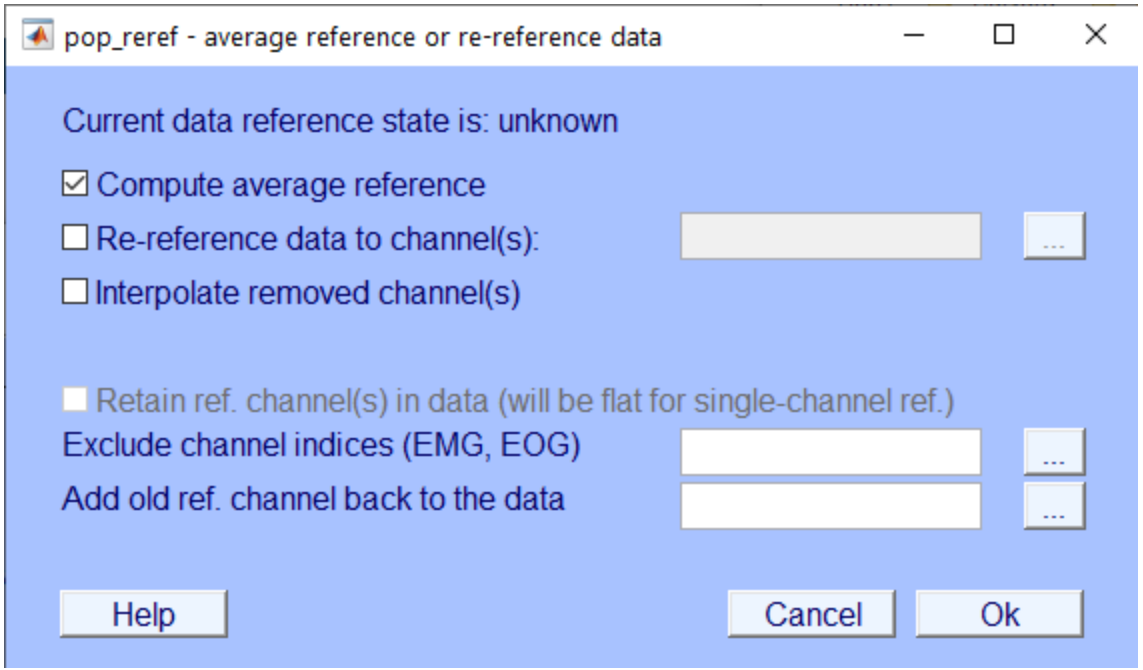
# 2 - location


EEGLAB v2020.0
File
Edit
Tools
Plot
Study
Datasets
Help
Dataset info
Event values
About this dataset
Channel locations
Select data
Select data using events
Select epochs or events
Copy current dataset
Append datasets
Delete dataset(s) from memory
T_sl_filter.set
22
672528
1
602
250
0.000
Epoch end (sec) 2690.108
Reference unknown
Channel locations No (labels only)
ICA weights No
Dataset size (Mb) 65.4

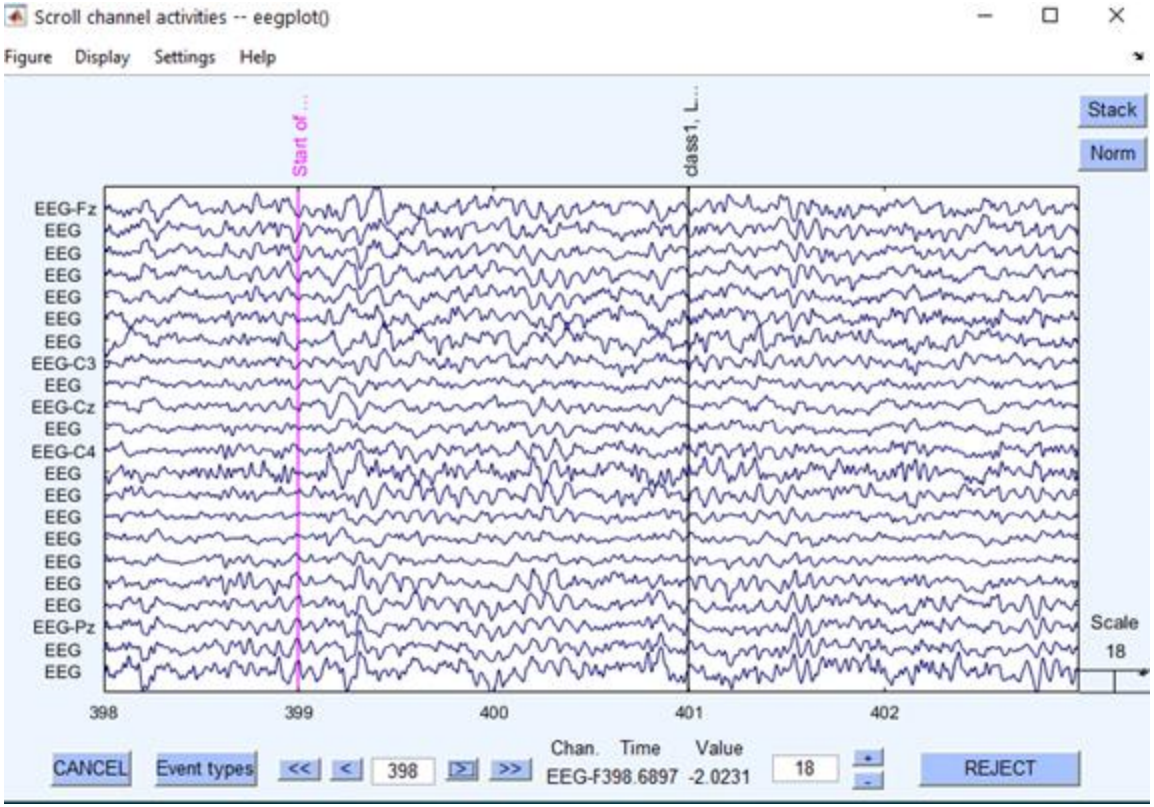

Look up channel locations?
Only channel labels are present currently, but some of these labels have known positions. Do you want to look up coordinates for these channels using the electrode file below? If you have a channel location file for this dataset, press cancel, then use button "Read location" in the following gui. If you do not know, just press OK.
use MNI coordinate file for BEM dipfit model
C:\Hong\project\eeglab\MATLAB_package\eeglab2020_0\plugins\dip
...
Help
Cancel
Ok

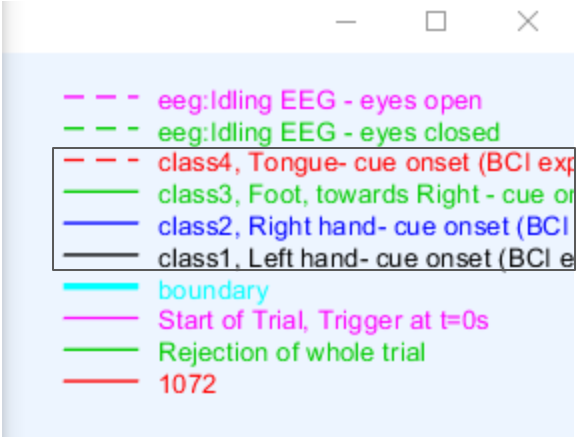
# 3 - ref: average



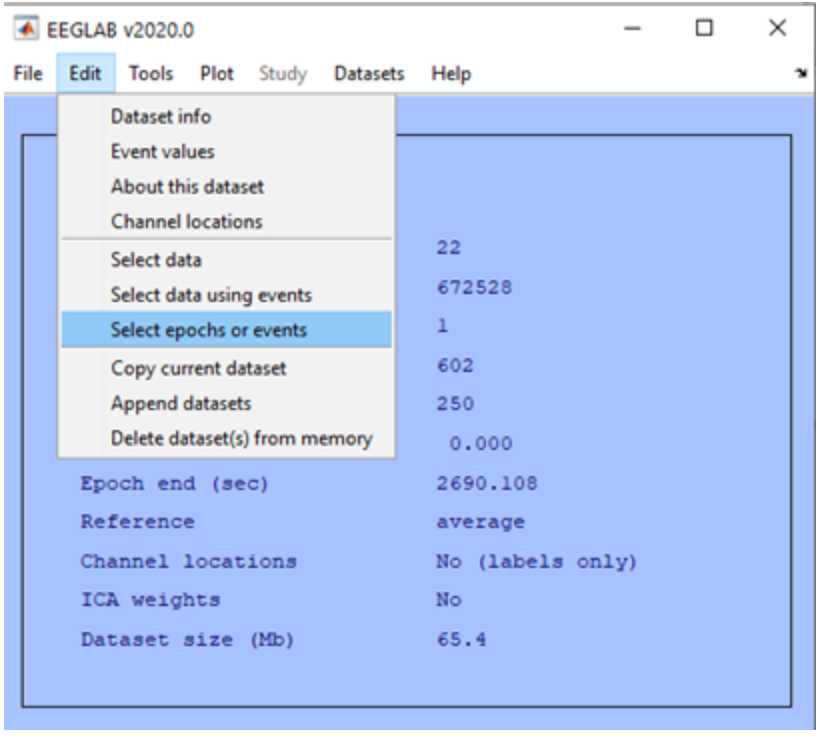



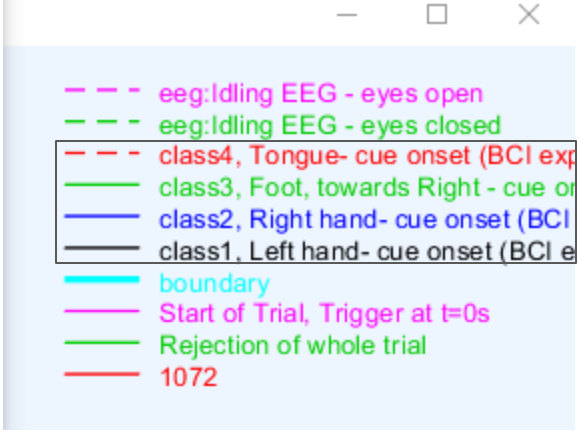
# 4 - flag event select (1)



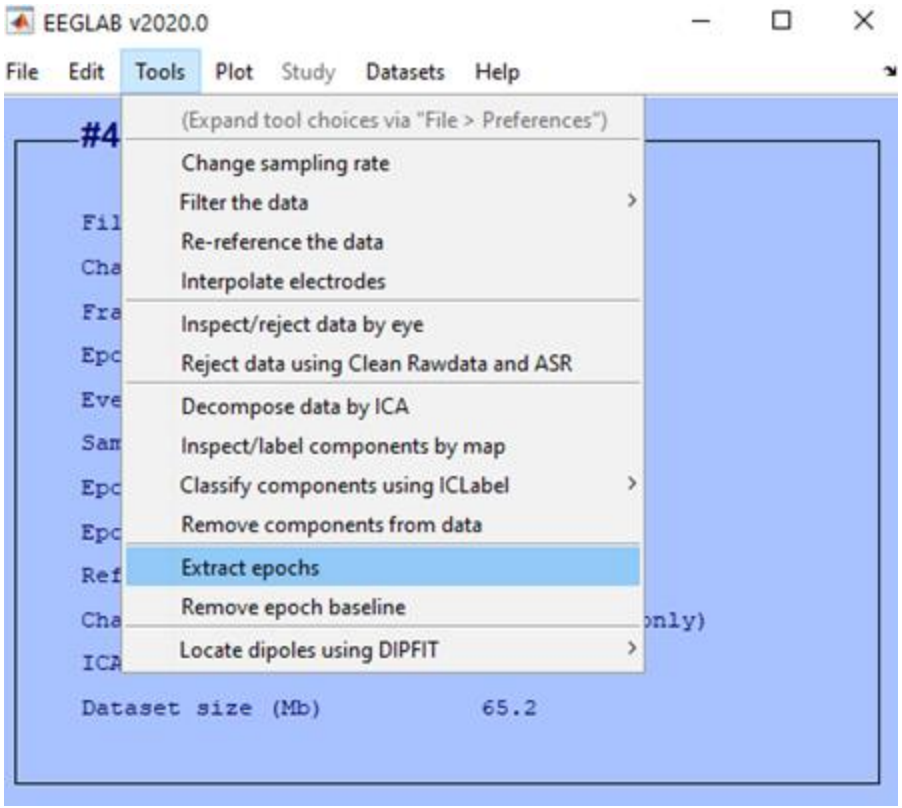



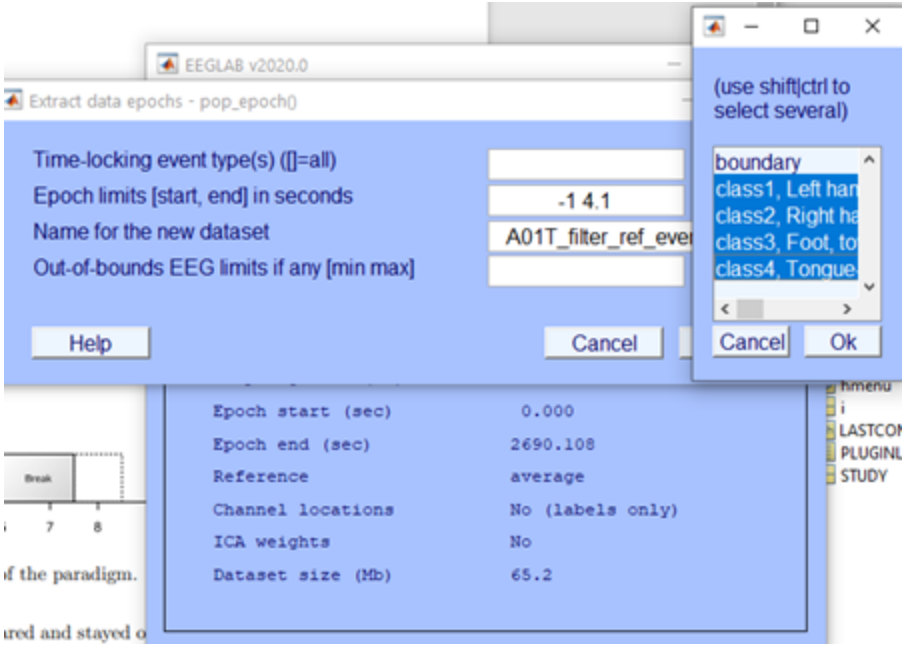
# 4 - flag event select (2)



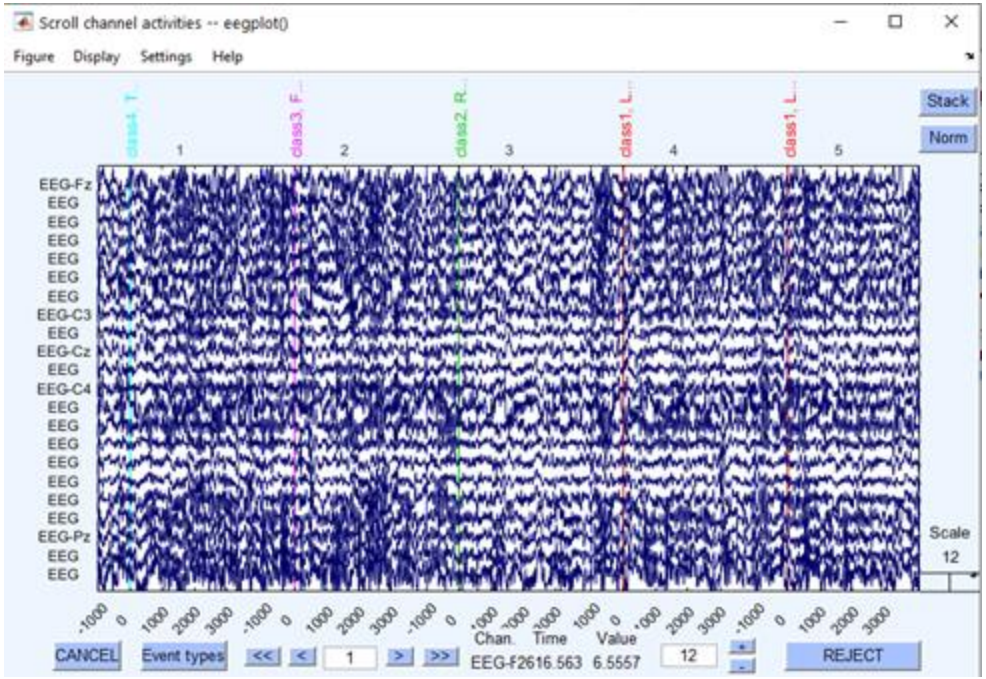


# 5 - extract epochs [-1 4.1]  (cue: 0-1.25s, mi: 1-4s)



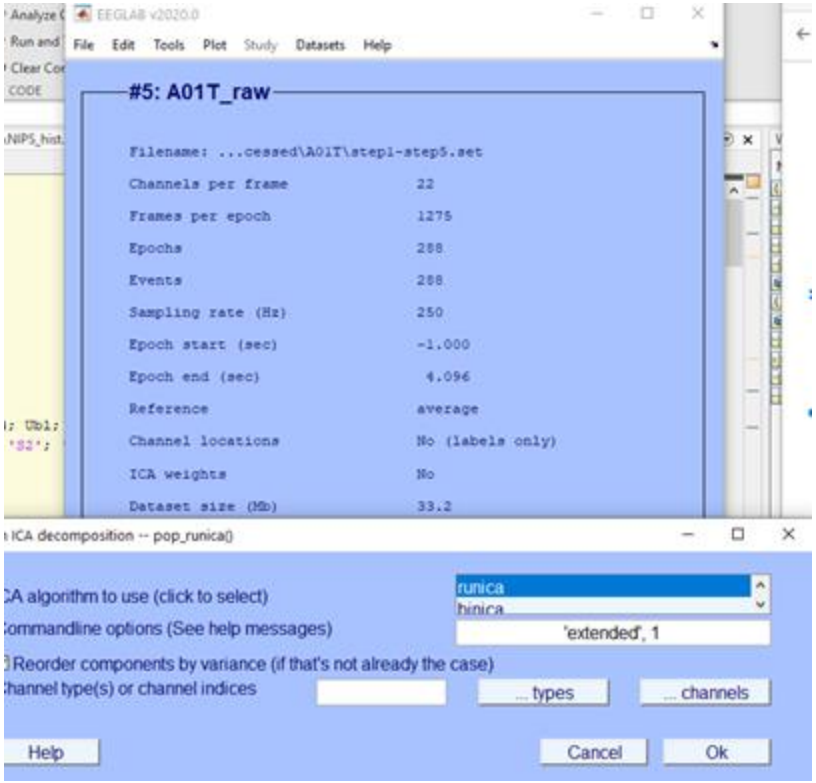



# Demo after step5. And we name is **raw

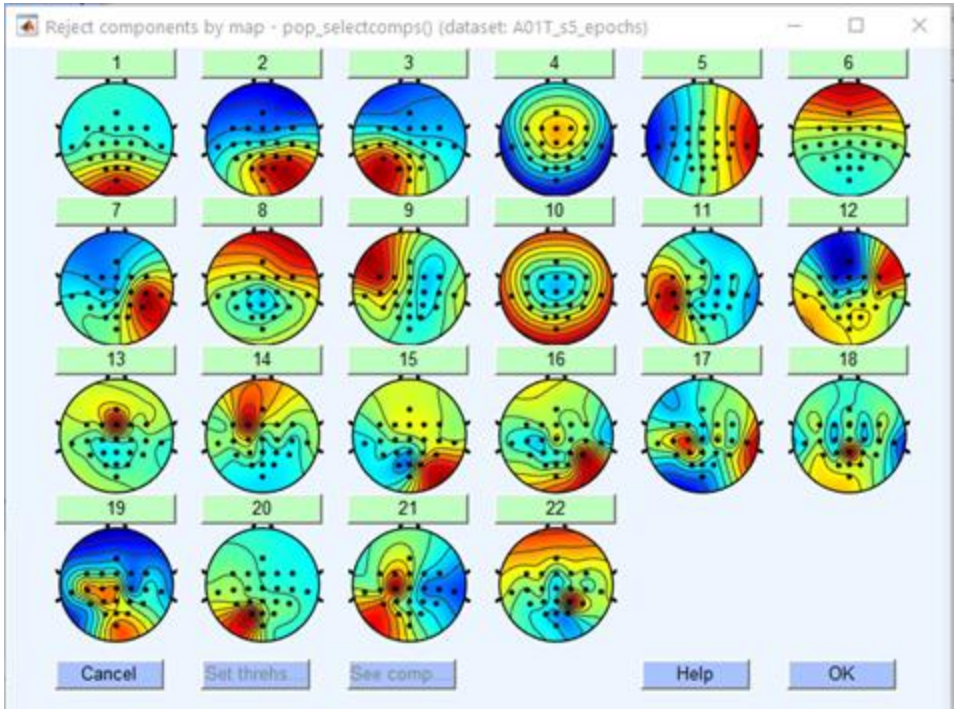


4*72 = 288

# 6 - ICA

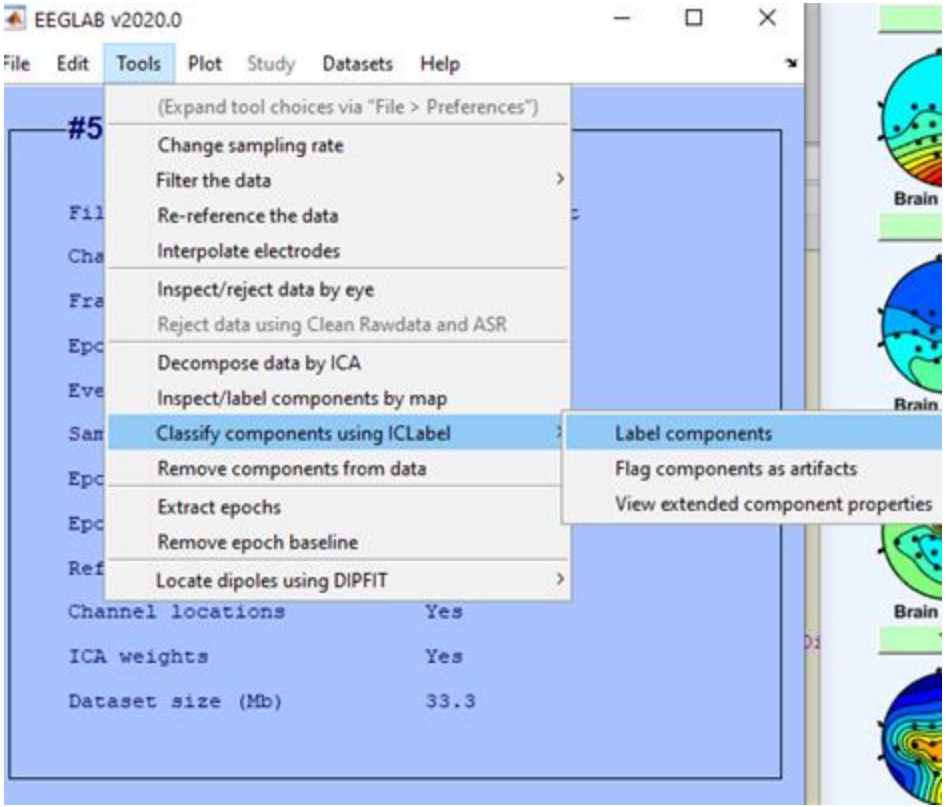


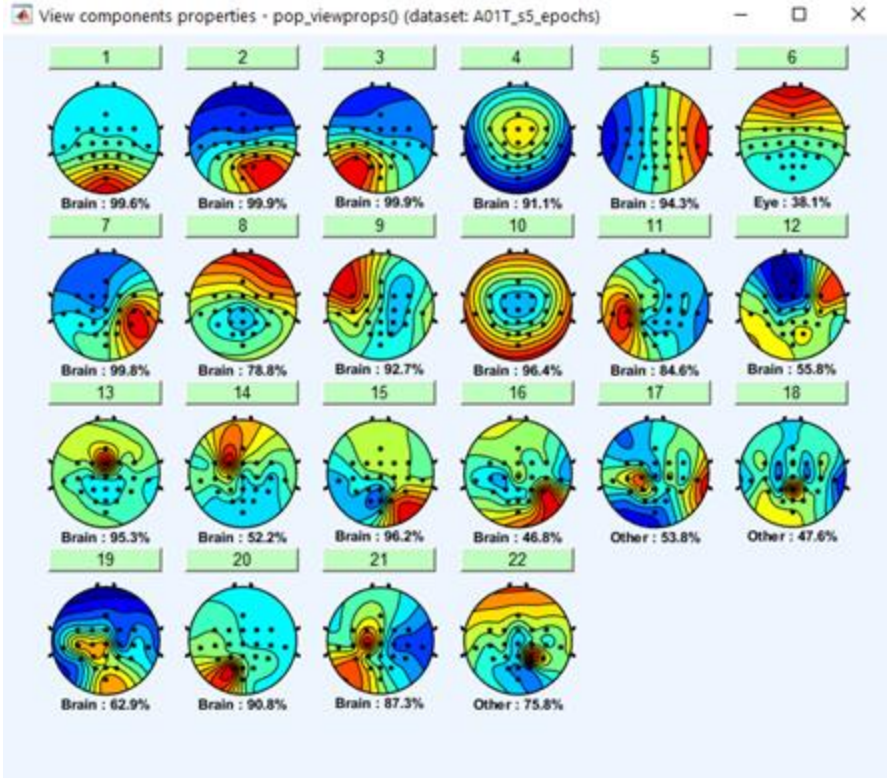

Observation by hand



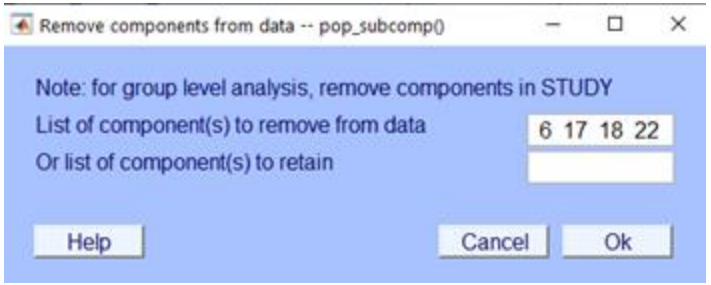
Mark 6 17 18 22

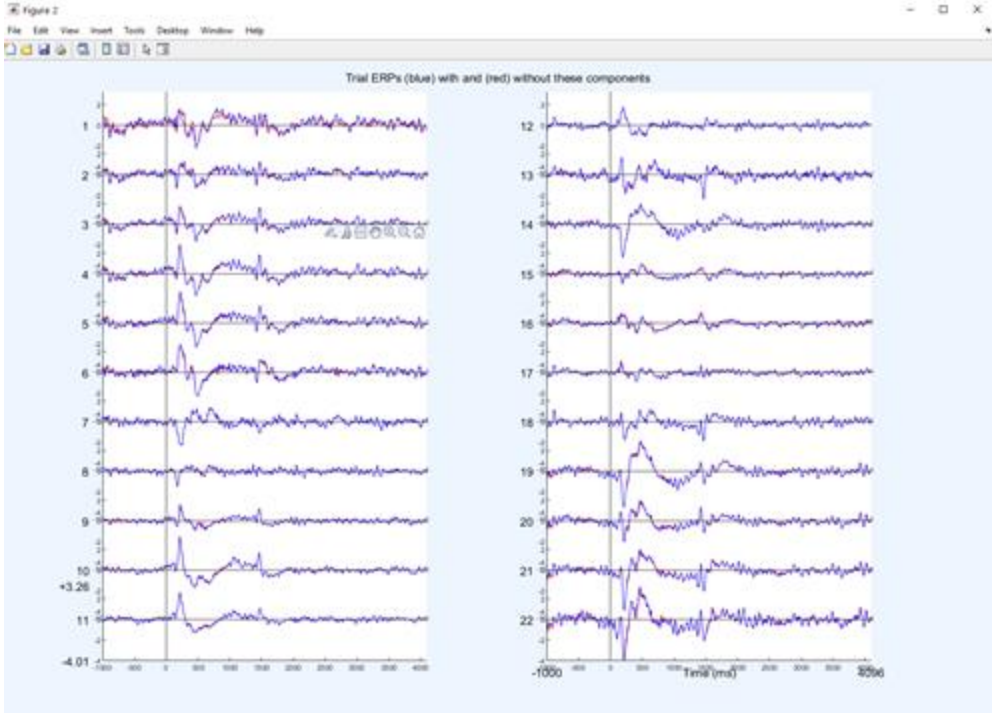
Observation auto



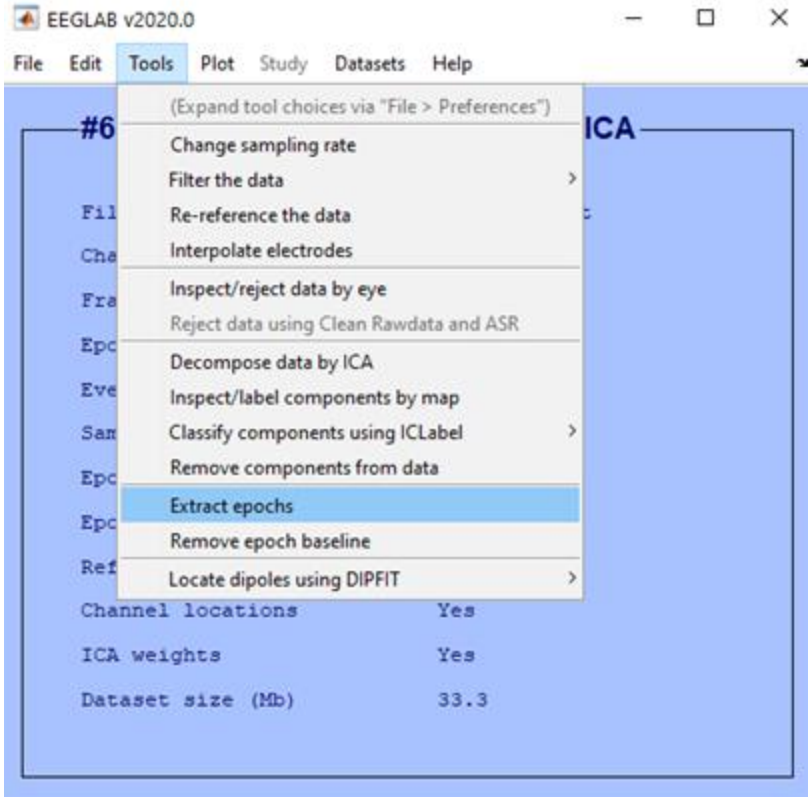



# 7 - Remove components

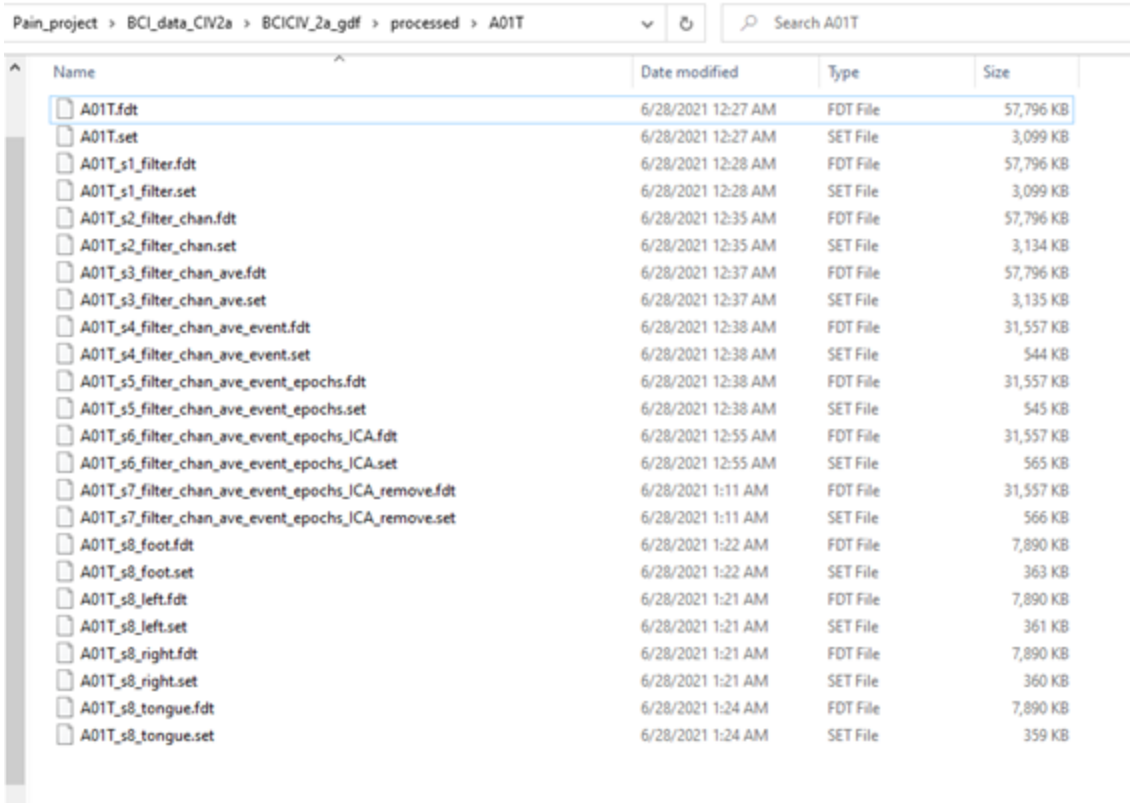


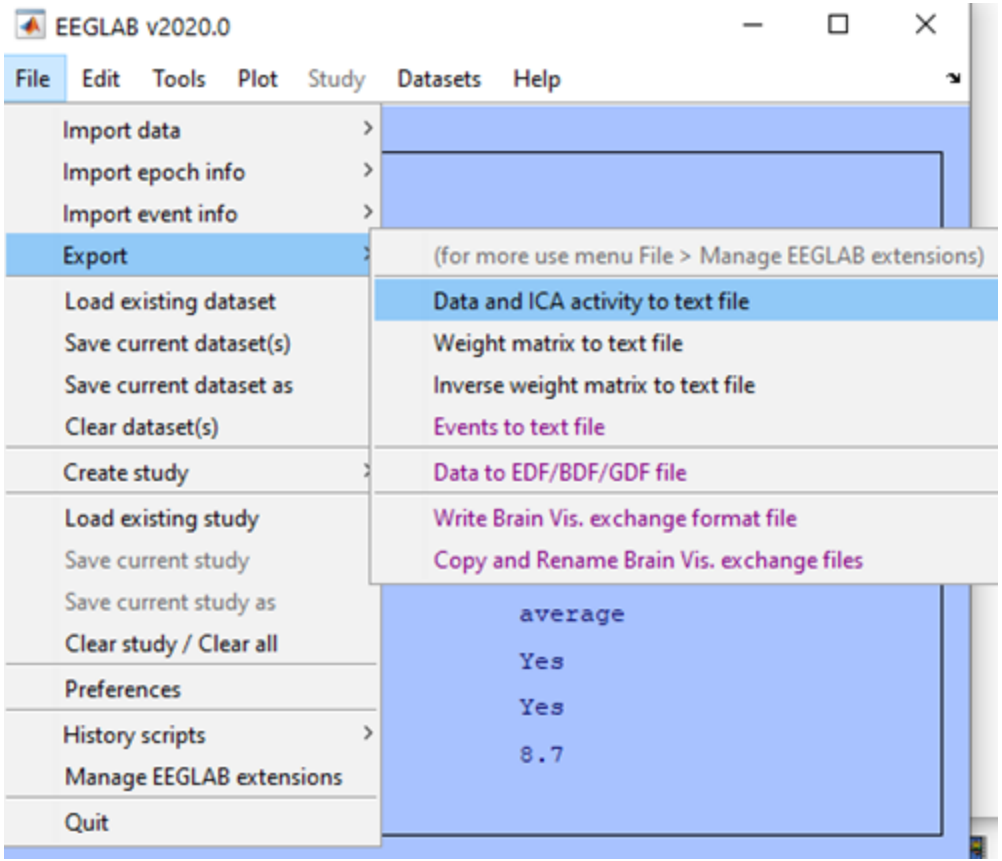
# 8 - divided data



# Overview


Pain_project › BCI_data_CIV2a › BCICIV_2a_gdf › processed › A01T
Search A01T
Name
Date modified
Type
Size
A01T.fdt 6/28/2021 12:27 AM FDT File 57,796 KB
A01T.set 6/28/2021 12:27 AM SET File 3,099 KB
A01T_s1_filter.fdt 6/28/2021 12:28 AM FDT File 57,796 KB
A01T_s1_filter.set 6/28/2021 12:28 AM SET File 3,099 KB
A01T_s2_filter_chan.fdt 6/28/2021 12:35 AM FDT File 57,796 KB
A01T_s2_filter_chan.set 6/28/2021 12:35 AM SET File 3,134 KB
A01T_s3_filter_chan_ave.fdt 6/28/2021 12:37 AM FDT File 57,796 KB
A01T_s3_filter_chan_ave.set 6/28/2021 12:37 AM SET File 3,135 KB
A01T_s4_filter_chan_ave_event.fdt 6/28/2021 12:38 AM FDT File 31,557 KB
A01T_s4_filter_chan_ave_event.set 6/28/2021 12:38 AM SET File 544 KB
A01T_s5_filter_chan_ave_event_epochs.fdt 6/28/2021 12:38 AM FDT File 31,557 KB
A01T_s5_filter_chan_ave_event_epochs.set 6/28/2021 12:38 AM SET File 545 KB
A01T_s6_filter_chan_ave_event_epochs_ICA.fdt 6/28/2021 12:55 AM FDT File 31,557 KB
A01T_s6_filter_chan_ave_event_epochs_ICA.set 6/28/2021 12:55 AM SET File 565 KB
A01T_s7_filter_chan_ave_event_epochs_ICA_remove.fdt 6/28/2021 1:11 AM FDT File 31,557 KB
A01T_s7_filter_chan_ave_event_epochs_ICA_remove.set 6/28/2021 1:11 AM SET File 566 KB
A01T_s8_foot.fdt 6/28/2021 1:22 AM FDT File 7,890 KB
A01T_s8_foot.set 6/28/2021 1:22 AM SET File 363 KB
A01T_s8_left.fdt 6/28/2021 1:21 AM FDT File 7,890 KB
A01T_s8_left.set 6/28/2021 1:21 AM SET File 361 KB
A01T_s8_right.fdt 6/28/2021 1:21 AM FDT File 7,890 KB
A01T_s8_right.set 6/28/2021 1:21 AM SET File 360 KB
A01T_s8_tongue.fdt 6/28/2021 1:24 AM FDT File 7,890 KB
A01T_s8_tongue.set 6/28/2021 1:24 AM SET File 359 KB

# Export data



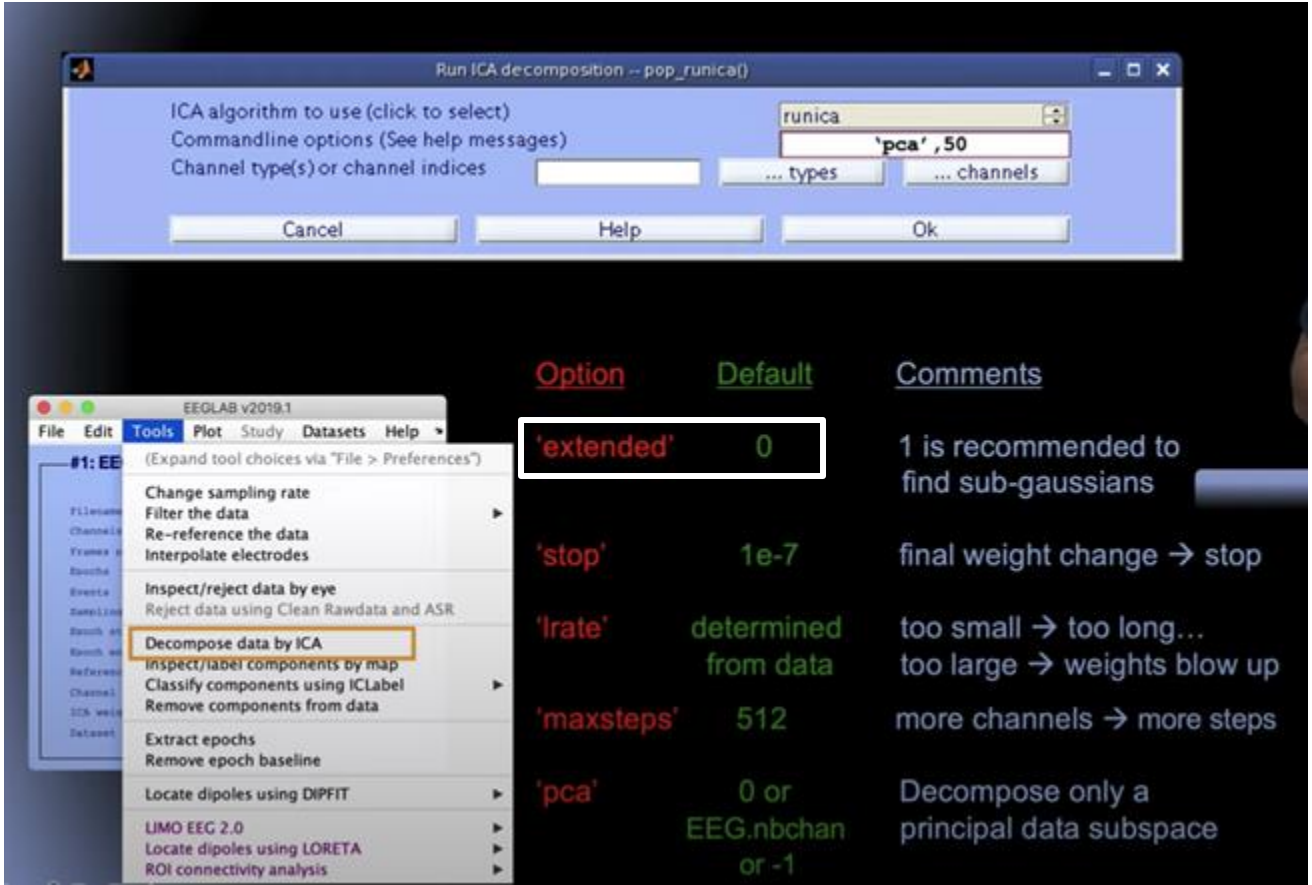

A01T_left.txt - Notepad

File Edit Format View Help

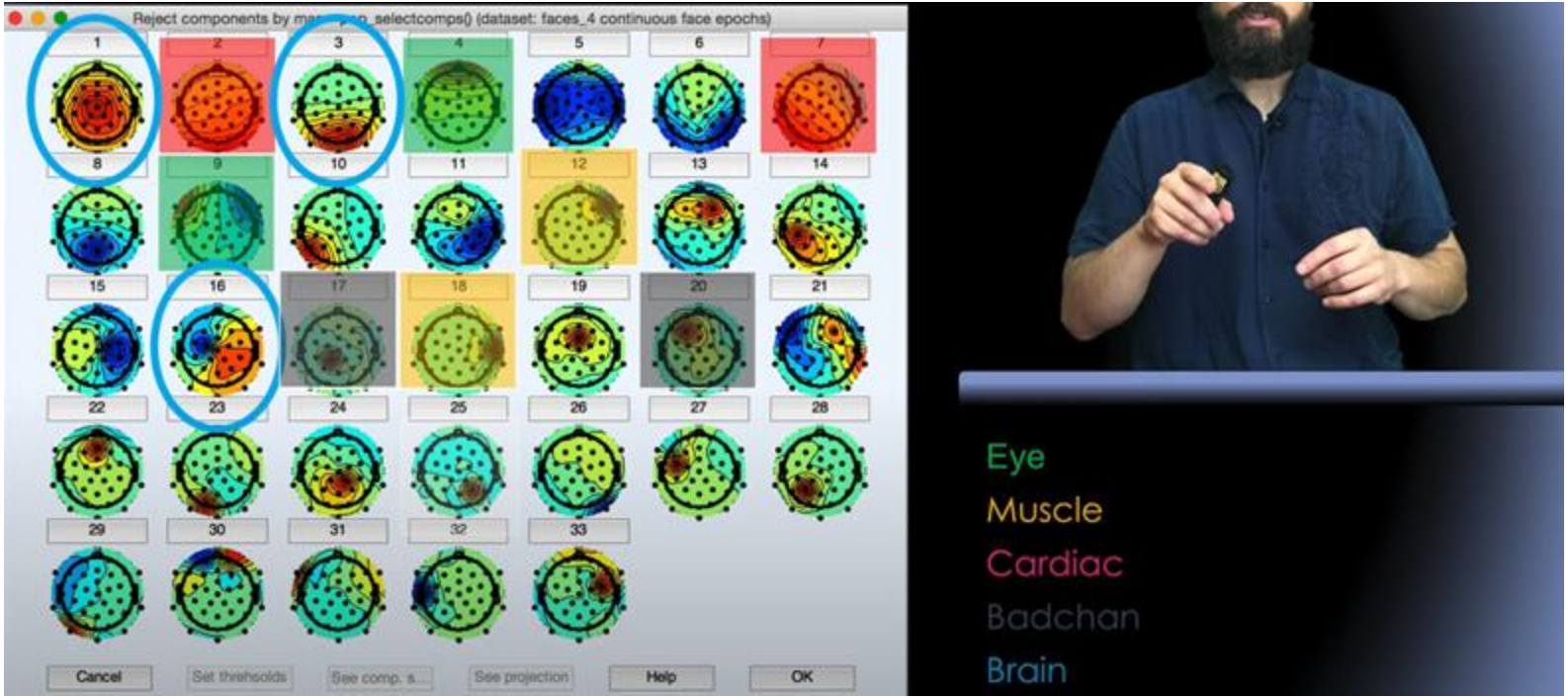
| Time | Fz | FC3 | FC1 | FCz | FC2 | FC4 | C5 | C3 | C1 | Cz |
|---|---|---|---|---|---|---|---|---|---|---|
| -1000.0000 | | 1.9998 | 1.7988 | 2.1546 | 2.7429 | 1.2542 | 0.5386 | -1.0457 | 0.7410 | -0 |
| -996.0000 | | 3.7145 | 1.4797 | 2.1576 | 3.8153 | 3.5744 | 4.1535 | -2.9361 | -1.1146 | -0 |
| -992.0000 | | 5.1984 | 1.5834 | 2.4611 | 6.0133 | 6.6001 | 7.9480 | -6.6112 | -2.7314 | -0 |
| -988.0000 | | 5.3635 | 1.9527 | 3.0054 | 8.1035 | 8.2234 | 9.5071 | -10.0202 | | -3 |
| -984.0000 | | 2.2381 | 1.3837 | 2.3961 | 6.8250 | 5.9751 | 6.5174 | -9.6162 | -2.6117 | 1. |
| -980.0000 | | 1.9473 | 2.0108 | 3.6605 | 6.1362 | 3.8542 | 2.4313 | -8.7697 | -0.7954 | 3. |
| -976.0000 | | -1.6283 | 1.5715 | 3.7106 | 3.1165 | 0.7444 | -3.3190 | -5.1727 | 2.2023 | 5. |
| -972.0000 | | -1.3621 | 2.4542 | 4.0643 | 1.2874 | -0.6524 | -5.6986 | -0.9163 | 4.6251 | 5. |
| -968.0000 | | -0.5693 | 3.1324 | 3.7824 | 0.2908 | -0.7322 | -4.8867 | 3.0244 | 5.6502 | 4. |
| -964.0000 | | 0.1006 | 2.9448 | 2.7341 | -0.4301 | -0.0850 | -1.9306 | 6.1176 | 5.0963 | 1. |
| -960.0000 | | 1.4835 | 2.2099 | 1.4718 | -0.9141 | 1.0417 | 1.6145 | 7.3931 | 3.6087 | -1 |
| -956.0000 | | 1.2790 | 1.0911 | -0.1122 | -2.0267 | 1.5295 | 3.4150 | 7.3851 | 2.6471 | -2 |
| -952.0000 | | -0.0621 | 0.5006 | -1.8525 | -3.4250 | 0.5499 | 3.1652 | 6.9885 | 2.7105 | -3 |
| -948.0000 | | -2.3462 | 0.8448 | -2.8951 | -4.4396 | -1.6526 | 1.4116 | 6.7333 | 3.7694 | -3 |
| -944.0000 | | -5.0931 | 1.5329 | -2.7257 | -4.4673 | -3.6980 | -0.5666 | 6.1033 | 5.1140 | -1 |
| -940.0000 | | -5.4089 | 2.1925 | -2.0046 | -4.2165 | -4.8082 | -1.2409 | 5.6363 | 5.7626 | -0 |
| -936.0000 | | -5.2454 | 1.6297 | -1.6431 | -4.1400 | -4.6255 | -1.0691 | 4.4175 | 5.4405 | -0 |
| -932.0000 | | -4.4117 | 0.2279 | -1.9280 | -3.7631 | -3.5017 | -0.1821 | 2.1753 | 3.9683 | -0 |
| -928.0000 | | -2.8954 | -1.0633 | -2.1451 | -2.5177 | -1.9503 | 0.8162 | -0.3457 | 1.7798 | -1 |
| -924.0000 | | -0.9782 | -1.6736 | -1.7192 | -0.7017 | -0.2372 | 1.4421 | -2.1263 | -0.3489 | -1 |
| -920.0000 | | 0.9526 | -1.5486 | -0.7852 | 0.6481 | 1.5059 | 1.6789 | -2.3847 | -1.6218 | -0 |
| -916.0000 | | 2.3057 | -1.1965 | -0.4316 | 0.7220 | 2.7934 | 2.1014 | -1.3928 | -1.8896 | -0 |
| -912.0000 | | 1.3478 | -1.6233 | -1.4840 | -0.1956 | 3.0724 | 2.9102 | -0.6544 | -1.6421 | -1 |

# Appendix

# ICA method


Run ICA decomposition -- pop_runica()
ICA algorithm to use (click to select)
runica
Commandline options (See help messages)
'pca',50
Channel type(s) or channel indices
... types
... channels
Cancel
Help
Ok
EEGLAB v2019.1
File Edit Tools Plot Study Datasets Help
(Expand tool choices via "File > Preferences")
Change sampling rate
Filter the data
Re-reference the data
Interpolate electrodes
Inspect/reject data by eye
Reject data using Clean Rawdata and ASR
Decompose data by ICA
Inspect/label components by map
Classify components using ICLabel
Remove components from data
Extract epochs
Remove epoch baseline
Locate dipoles using DIPFIT
LIMO EEG 2.0
Locate dipoles using LORETA
ROI connectivity analysis
Option
Default
Comments
'extended'
0
1 is recommended to find sub-gaussians
'stop'
1e-7
final weight change → stop
'lrate'
determined from data
too small → too long…
too large → weights blow up
'maxsteps'
512
more channels → more steps
'pca'
0 or EEG.nbchan or -1
Decompose only a principal data subspace

# Component remove



# Result 2a Kappa value is required

## Data sets 2a [Graz]

The performance measure is kappa value. The first column shows the average across all subjects, columns 2 to 10 show the results for the individual subjects.
**-> Note: The expected kappa value, if classification is made by chance, is 0. <-**

| #. | contributor | kappa | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | research lab | co-contributors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Kai Keng Ang | **0.57** | 0.68 | 0.42 | 0.75 | 0.48 | 0.40 | 0.27 | 0.77 | 0.75 | 0.61 | Institute for Infocomm Research, Agency for Science, Technology and Research Singapore | Zheng Yang Chin, Chuanchu Wang, Cuntai Guan, Haihong Zhang, Kok Soon Phua, Brahim Hamadicharef, Keng Peng Tee |
| 2. | Liu Guangquan | **0.52** | 0.69 | 0.34 | 0.71 | 0.44 | 0.16 | 0.21 | 0.66 | 0.73 | 0.69 | School of Mechanical Engineeing, Shanghai Jiao Tong University, China | Huang Gan, Zhu Xiangyang |
| 3. | Wei Song | **0.31** | 0.38 | 0.18 | 0.48 | 0.33 | 0.07 | 0.14 | 0.29 | 0.49 | 0.44 | College of Information Science and Technology, Beijing Normal University, China and National Key Laboratory for Cognitive Neuroscience and Learning, Beijing Normal University, China | Jin Wu, Jiacai Zhang |
| 4. | Damien Coyle | **0.30** | 0.46 | 0.25 | 0.65 | 0.31 | 0.12 | 0.07 | 0.00 | 0.46 | 0.42 | Intelligent Systems Research Centre, School of Computing and Intelligent Systems, Faculty of Computing and Engineering, Magee Campus, University of Ulster, UK | Abdul Satti, Martin McGinnity |
| 5. | Jin Wu | **0.29** | 0.41 | 0.17 | 0.39 | 0.25 | 0.06 | 0.16 | 0.34 | 0.45 | 0.37 | National Key Laboratory for Cognitive Neuroscience and Learning, Beijing Normal University, China and College of Information Science and Technology, Beijing Normal University, China | Guangming Chen, Wei Song, Jiacai Zhang |