The Manual for the ASAP_ICA_EEG_ArtifactRejection Toolbox

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1. To the users

Thanks for your support to use our toolbox. Actually, EEGLAB has provided a good manipulation to perform Independent Component analysis (ICA) on EEG data. However, in practice, we find it there are several disadvantages of the ICA module in EEGLAB, which disregard the stability of ICs. And it is hard to perform a semi-automatic ICA-based artifacts rejection. As a consequence, we complemented the above shortages by advanced ideas from two excellent toolboxes ICASSO (Himberg et al., 2004) and IClabel (Pion-Tonachini et al., 2019). This manual aims at helping researchers to master the toolbox as soon as possible. And if you would like to dig the complex formulations and methods, please refer to Himberg et al., (2004) and Pion-Tonachini et al., (2019).

2. Demo

The authors believe that a clear flowchart means more than three thousands words, because the whole ICA procedure can be accomplished by two functions 'Run_Icasso', and 'Remove_ICs_Artifact'. Good luck!

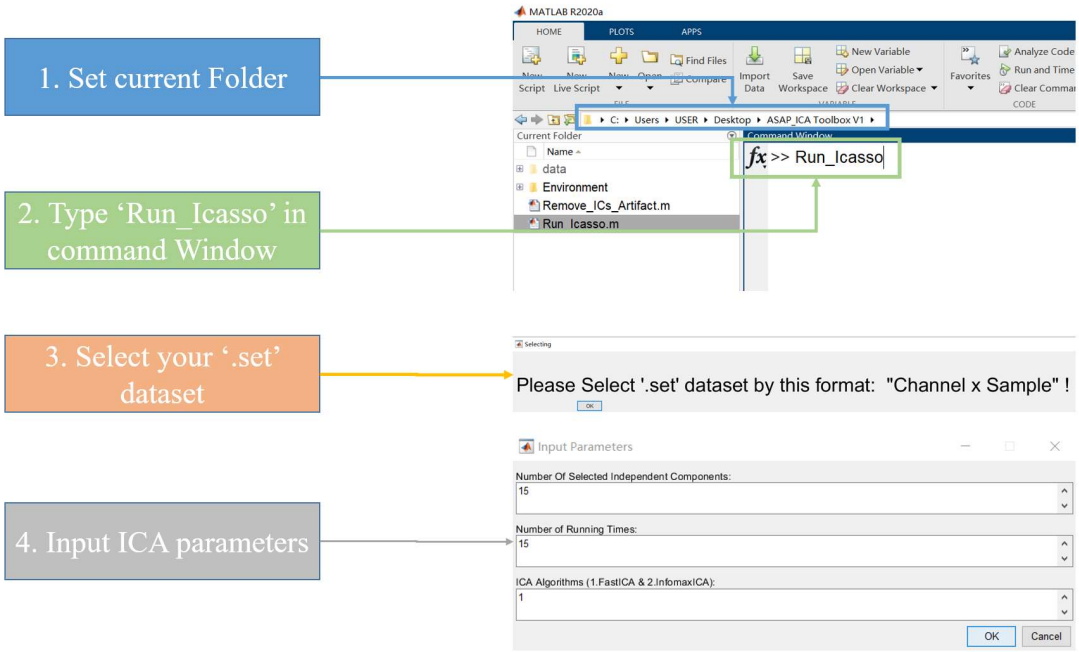

Figure 1: The flow chart of Run_Icasso function

2.1. Run_Icasso Outputs

The following figures are the evaluation indexes to assess the stability of ICs. See Himberg et al., (2004) for a detail description.

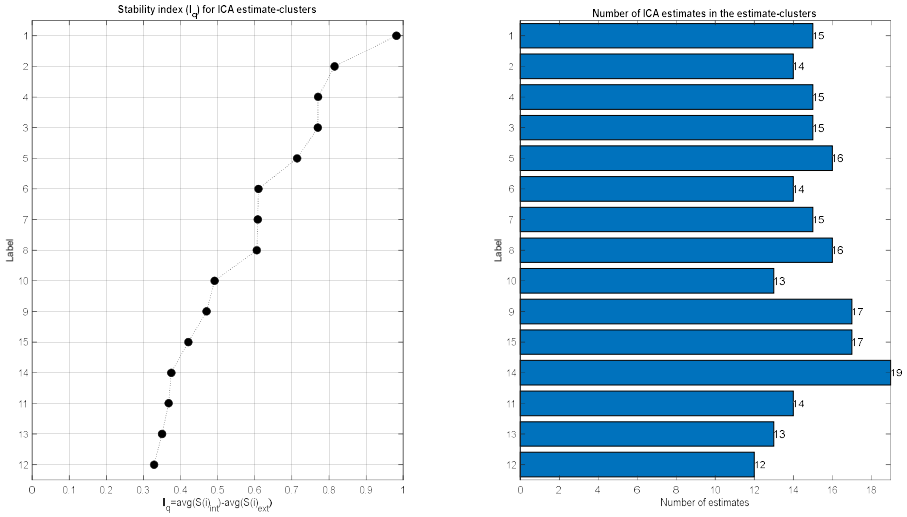

Figure 2: Stability (reliability) indices of the selected L estimate-clusters

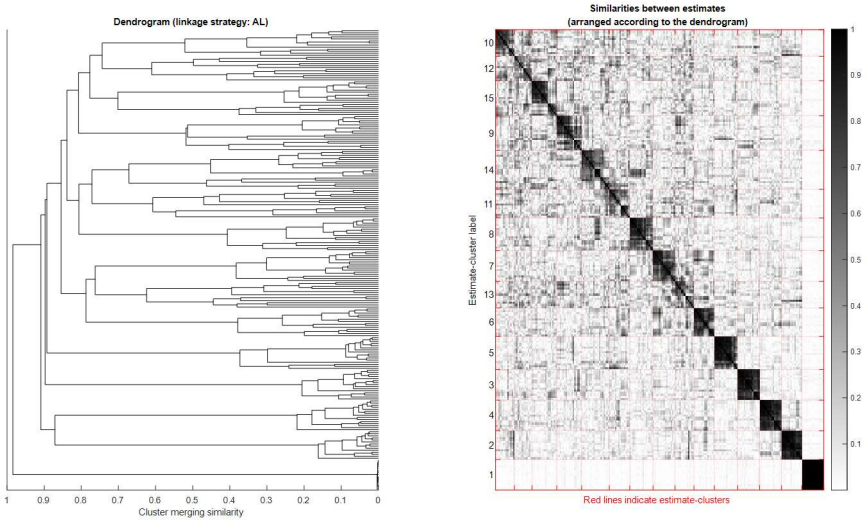

Figure 3: Correlation structure as a matrix and a dendrogram representation for L clusters.

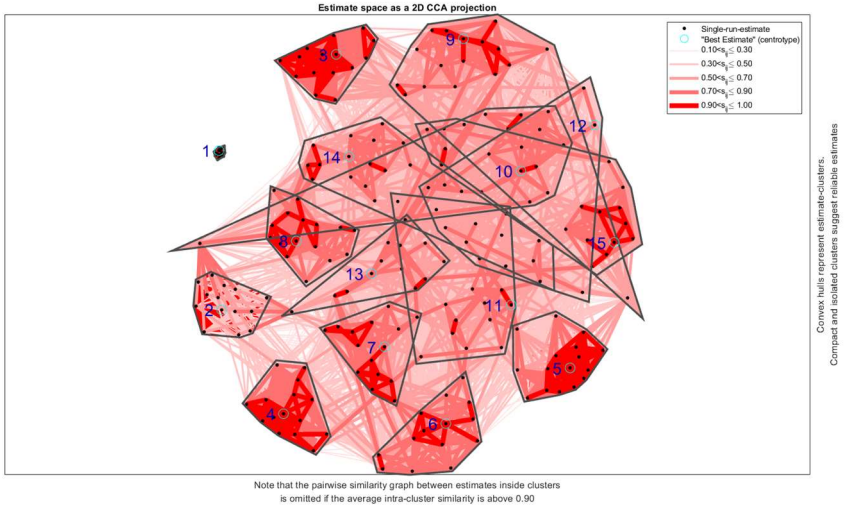

Figure 4: Graph of the correlations between all the estimates and estimate-clusters as convex hulls for L clusters

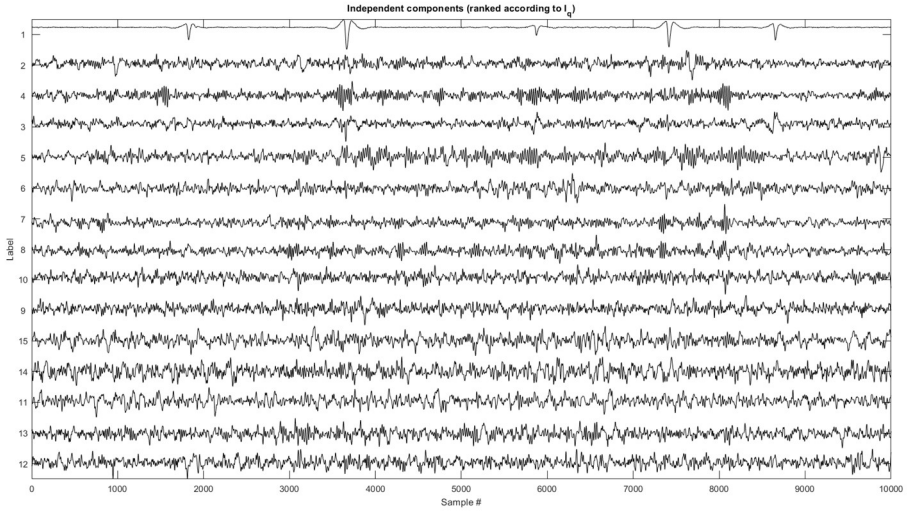

Figure 5: IC estimates, rows of W, or columns of A that correspond to the centroid of the selected estimate-clusters.

Notably, Figure 6 is another supplement for semi-automatic artifacts rejection, which was adopted from IClabel Toolbox. Consequently, users can have a good reference of determining the ICs of artifacts.

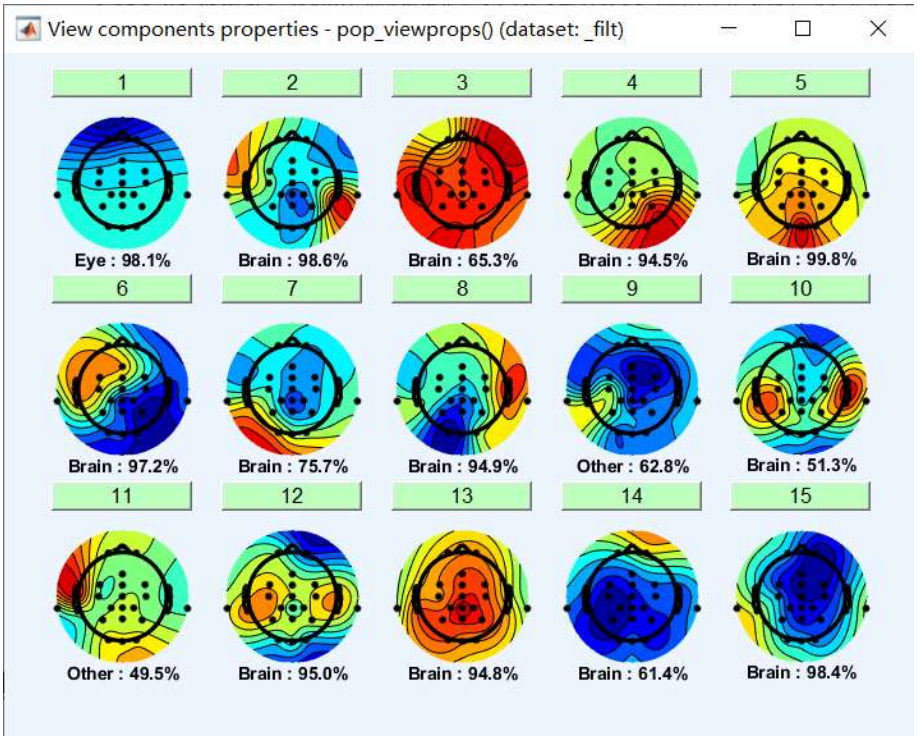

Figure 6: Artifacts evaluation by IClabel.

2.2. Remove_ICs_Artifact Procedure

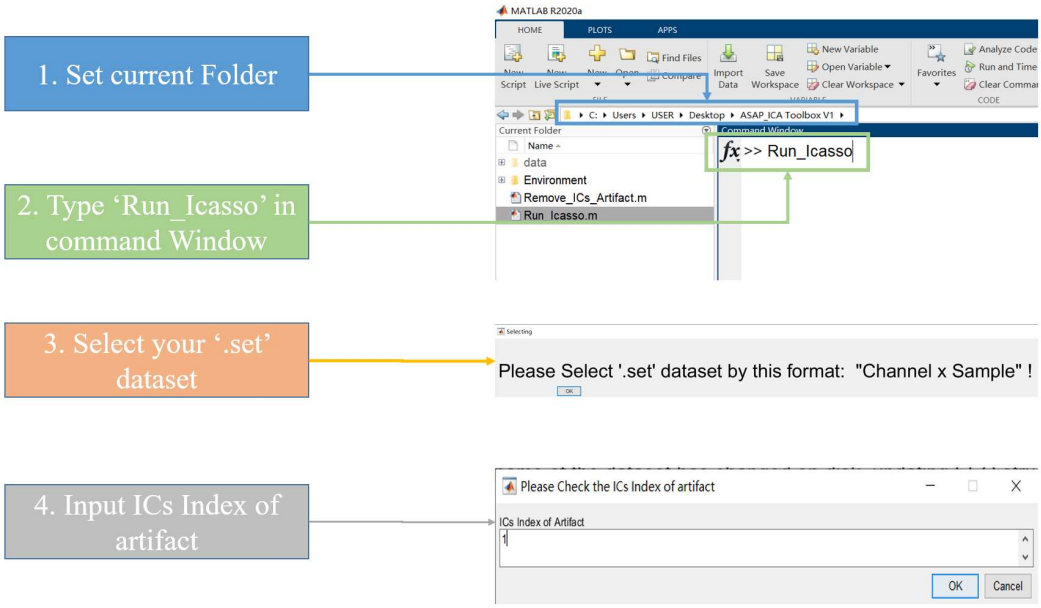

Figure 7: The flow chart of Remove_ICs_Artifact function

2.3. Remove_ICs_Artifact Outputs

After running the '**Remove_ICs_Artifact**' function, you will get temporal waveforms comparison between pre-filtered and post-filtered EEG data by ICA (Figure 8). Meanwhile, the spatial filtered EEG dataset will be saved as 'Spatial_filtered_ICA.set' in the dataset folder, which can be easily processed in EEGLAB.

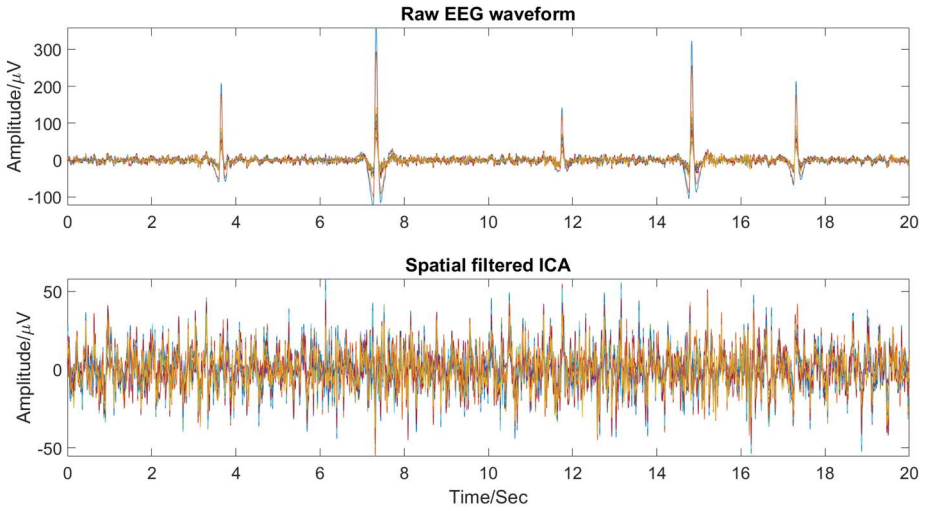

Figure 8: Temporal waveforms comparison between pre-filtered and post-filtered data by ICA.

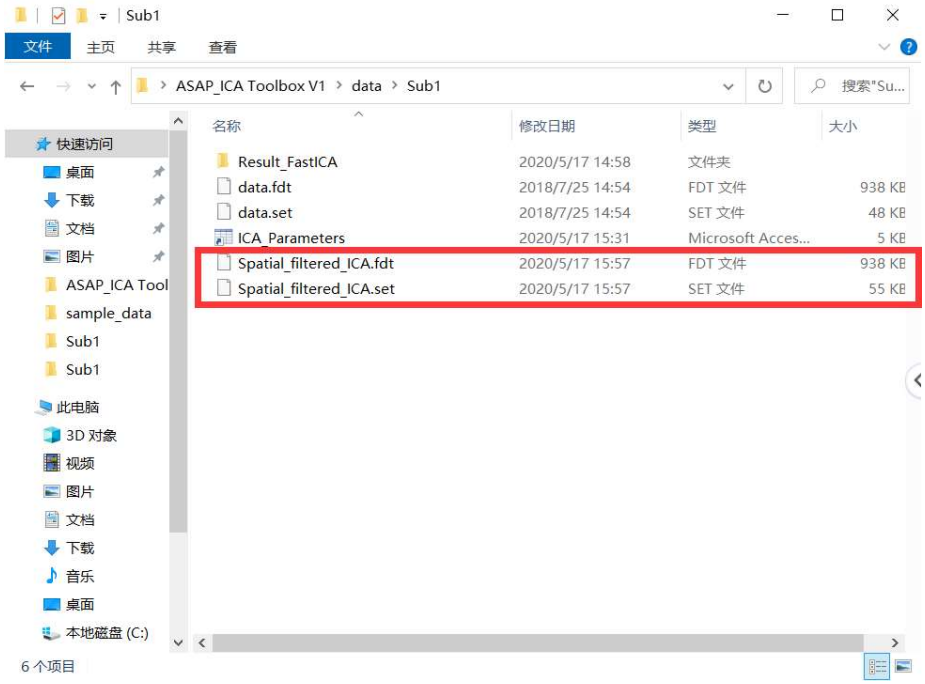

Figure 9: Spatial filtered EEG dataset by ICA.

Reference：

Himberg, J., Hyvärinen, A., and Esposito, F. (2004). Validating the independent components of neuroimaging time series via clustering and visualization. *Neuroimage* 22**,** 1214-1222.

Pion-Tonachini, L., Kreutz-Delgado, K., and Makeig, S. (2019). ICLabel: An automated electroencephalographic independent component classifier, dataset, and website. *NeuroImage* 198**,** 181-197.