

IC_MARC Quick Start Guide

classification of Independent Components of EEG into Multiple Artifact Classes
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IC_MARC classifies independent components of EEG data into one neural and five artifactual classes. The artifactual classes are blinks, heartbeat artifacts, lateral eye movements, muscular artifacts, and mixed ICs. Mixed ICs do not fit into any of the other categories and may represent activity from several of the five other categories, random noise, loose electrodes, or other artifacts not covered by the first five classes. The development of the method is described in [1] (available at <http://onlinelibrary.wiley.com/doi/10.1111/psyp.12290/abstract>).

1 Installation

Download *IC_MARC.zip*, e.g. from http://www2.imm.dtu.dk/~lffr/publications/IC_MARC.zip. Then unzip the this folder and save the unzipped folder in the *plugins* subdirectory of the EEGLab folder.

EEGLab will then automatically locate the function *eegplugin_icmarc.m* which will add menu items to the Tools and Plot menus as described below.

2 IC_MARC Menu Items

IC_MARC adds a submenu to the Tools and the Plot menus in the main EEGLab window. In each submenu, one action is offered. These actions are grayed out if no ICA weights or no channel locations are associated with the EEGLab data structure currently in EEGLab memory.

The data set *eeglab_data.set*, also used in the EEGLab tutorial (http://sccn.ucsd.edu/wiki/Chapter_01:_Loading_Data_in_EEGLAB) was used to produce the screen shots. It was pre-processed with the following code:

```
addpath(path_to_eeglab_folder)
eeglab
EEG = pop_loadset('filename','eeglab_data.set','filepath',path_to_eeglabdataset);
EEG = eeg_checkset( EEG );
EEG=pop_chanedit(EEG, 'load',{[path_to_eeglab_folder...
    '/sample_data/eeglab_chan32.locs'] 'filetype' 'autodetect'});
EEG = eeg_checkset( EEG );
EEG = pop_eegfiltnew(EEG, [], 1, 424, true, [], 0);
EEG = eeg_checkset( EEG );
EEG = pop_selectevent( EEG, 'position',2,'deleteevents','on');
EEG.setname='Square, Position 2';
```

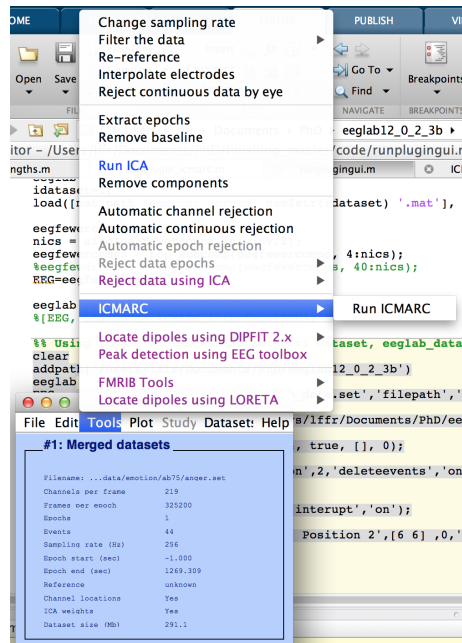


Figure 1: The submenu that starts the classification of ICs using IC_MARC.

```

EEG = eeg_checkset( EEG );
EEG = pop_runica(EEG, 'extended',1,'interrupt','on');
pop_selectcomps(EEG, [1:32] );
EEG = pop_epoch( EEG, { 'square' }, [-1 2], 'newname',...
    'Square, Position 2 epochs', 'epochinfo', 'yes');
EEG = pop_rmbase( EEG, [-1000 0]);
eeglab redraw

```

2.1 Run IC_MARC (Tools menu)

Upon clicking “Run ICMARC” in the “ICMARC” submenu of the Tools menu (see Figure 1), the window shown in Figure 2 pops up to gather input to start IC_MARC through the function *pop_ICMARC_interface*.

The first input to *pop_ICMARC_interface* is which feature set to use. There are three possibilities: “established_spatial_features”, “spatial2”, and “established_features”. These are the three feature sets for which classifiers have been trained. The feature set “established_spatial_features” consists solely of spatial features and seems to perform the best over most datasets (based on undocumented experience). This is also the default which will be used if the user does not change the feature set value in the window. The feature set “spatial2” also consists of only spatial features, but has no features derived from the dipole fit, which may take a long time to obtain. It was optimised manually to obtain a compromise between speed of feature calculation and classification performance. The final feature set, “established_features”, was optimised automatically within one study as described in [1]. This contains both spatial, temporal, and spectral features.

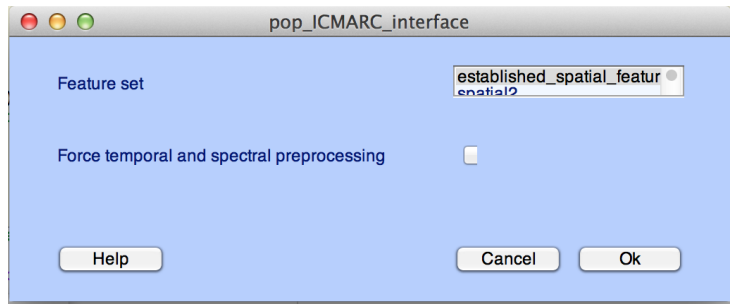


Figure 2: The pop up window for starting IC_MARC.

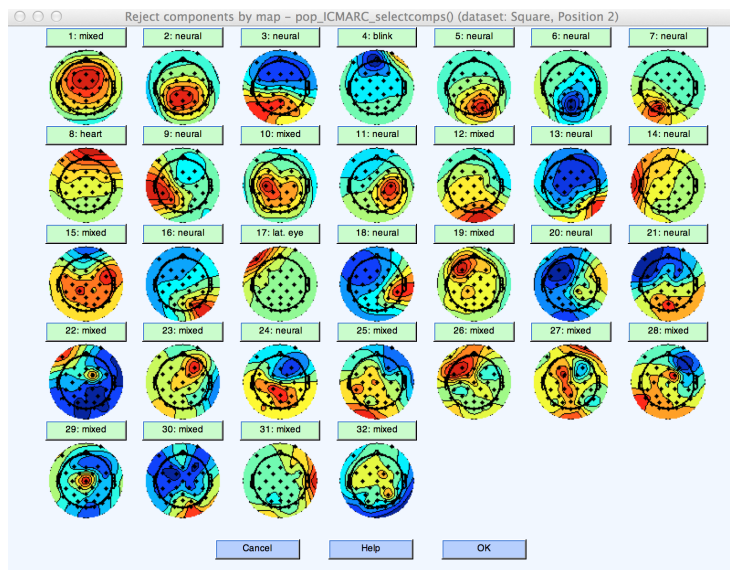


Figure 3: Plot of scalpmaps and their predicted classes.

The second input to *pop_ICMARC_interface* determines whether or not to perform pre-processing steps for temporal and spectral features if no spectral or temporal features are included in the requested feature set. This is a checkbox that, if set, forces the pre-processing steps to be performed. If unchecked (the default), pre-processing steps for temporal and spectral features are skipped if no such features are included in the requested feature set to save time.

2.2 Plot classified ICs (Plot menu)

Upon clicking “Plot scalpmaps with classes” in the “ICMARC” submenu of the Plot menu, the scalpmaps of all ICs in the EEG data structure are plotted below buttons labeled with their respective classes as shown in Figure 3.

The buttons labeled with the IC classes can be clicked to inspect the power spectrum and, if epochs are present in the EEG data set, an ERP image for each IC in a window such as that shown in Figure 4. This window also allows the user to change the class of the IC. The ERP image will be empty if epochs

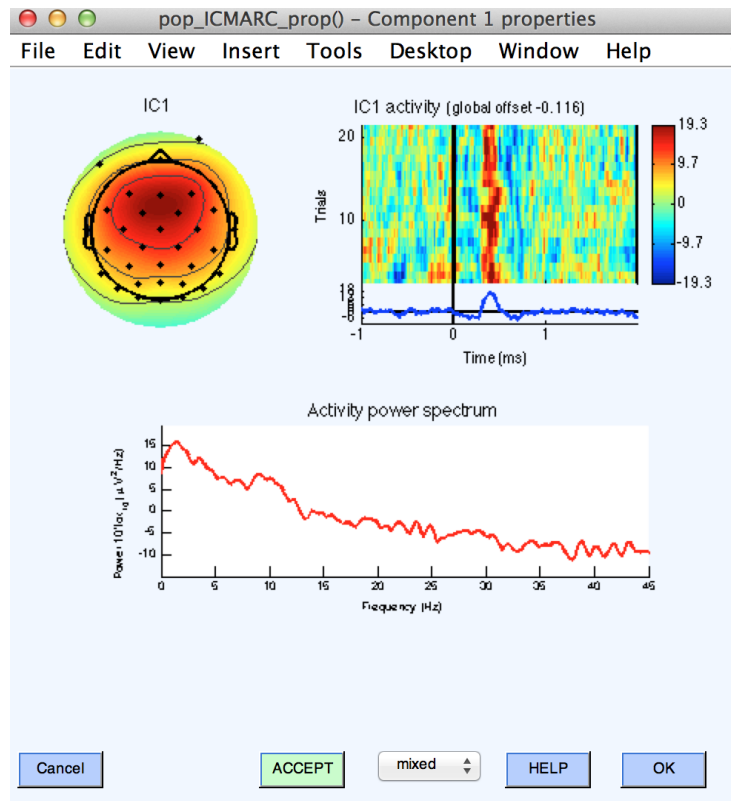


Figure 4: Inspect power spectrum, ERP image and change class of IC.

are not present.

In the case of many ICs in the EEG data set, several windows containing ICs and their labels will pop up. If the cancel button of such a window is clicked, only the changes made in that window will be canceled while the changes made to the ICs contained in the other windows will be retained if the OK buttons of those windows are clicked.

If the field `EEG.reject.classtype` is empty or not present, the classes of all ICs are initialized as type “mixed” and a window pops up to warn of this as shown in Figure 5. This allows the user to manually classify ICs while making sure that the manual classifications are stored in the field `EEG.reject.classtype`. The dropdown menu for manual classifications also contains a “loose electrode” class.

3 Bugs and request

If you run into problems using this plug-in, please send an e-mail to laura.frolich@gmail.com and I will do my best to help. Also, if you would like to assist in improving the classifier I would be very grateful for access to EEG data sets containing manually labeled ICs to use as training data to explore further improvements.

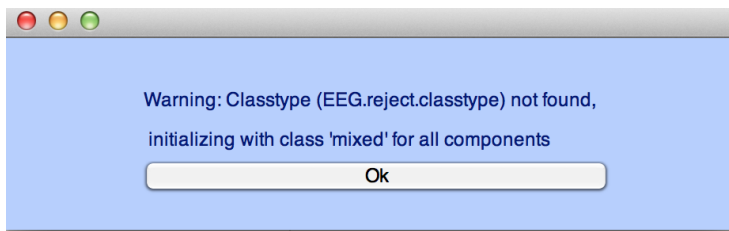


Figure 5: The warning that pops up if the field `EEG.reject.classtype` is empty or not present when “Plot scalpmaps with classes” in the Plot menu is clicked.

References

- [1] Laura Frølich, T. S. Andersen, and Morten Mørup. Classification of independent components of eeg into multiple artifact classes. *Psychophysiology*, 2014.