

Demo of EEG REST

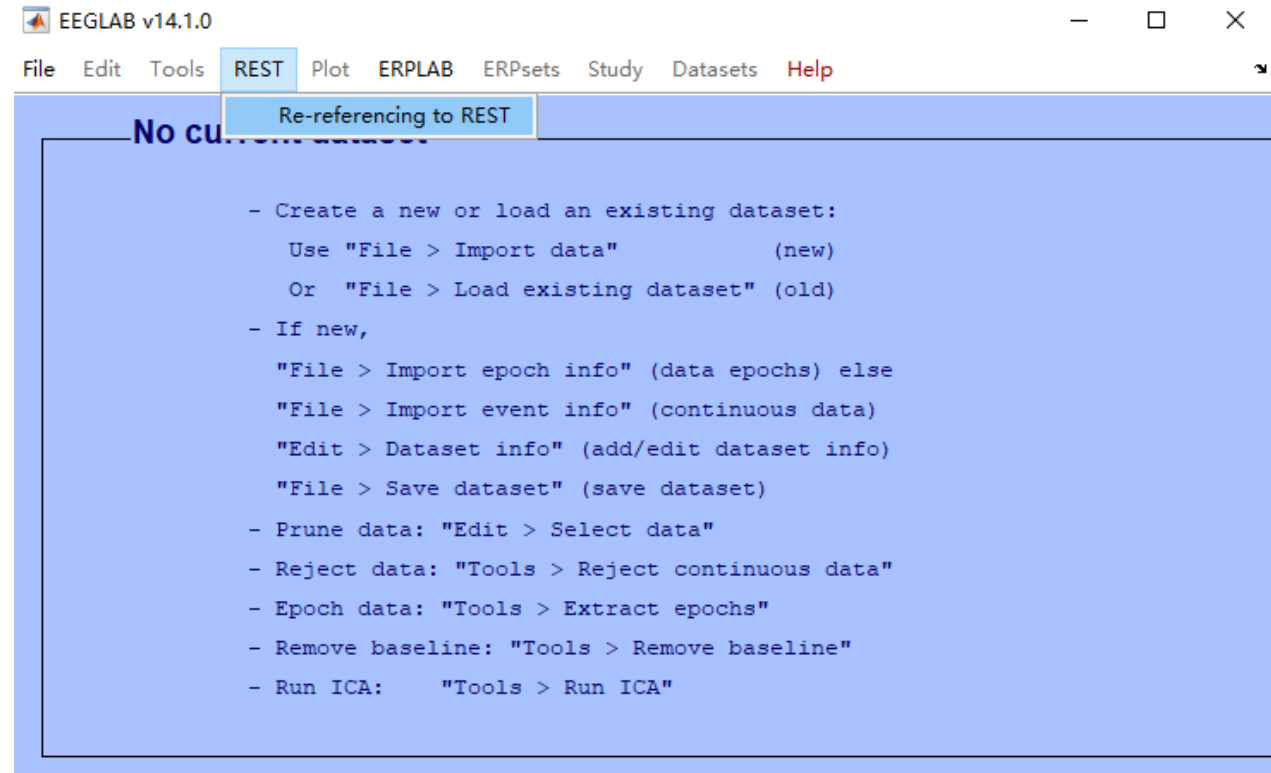
Install REST (EEGLAB Plugin version)

- To install REST, download the zip file (<http://www.neuro.uestc.edu.cn/rest/>)
- Unzip and place the folder in the 'plugins' folder of your existing EEGLAB installation (so something like `~/eeglab14_1_0b/plugins/REST_reference_v1.1_20190818/eegplugin_rest.m` exists).

Dong, L., et al. (2017). "MATLAB Toolboxes for Reference Electrode Standardization Technique (REST) of Scalp EEG." *Front Neurosci* 11.

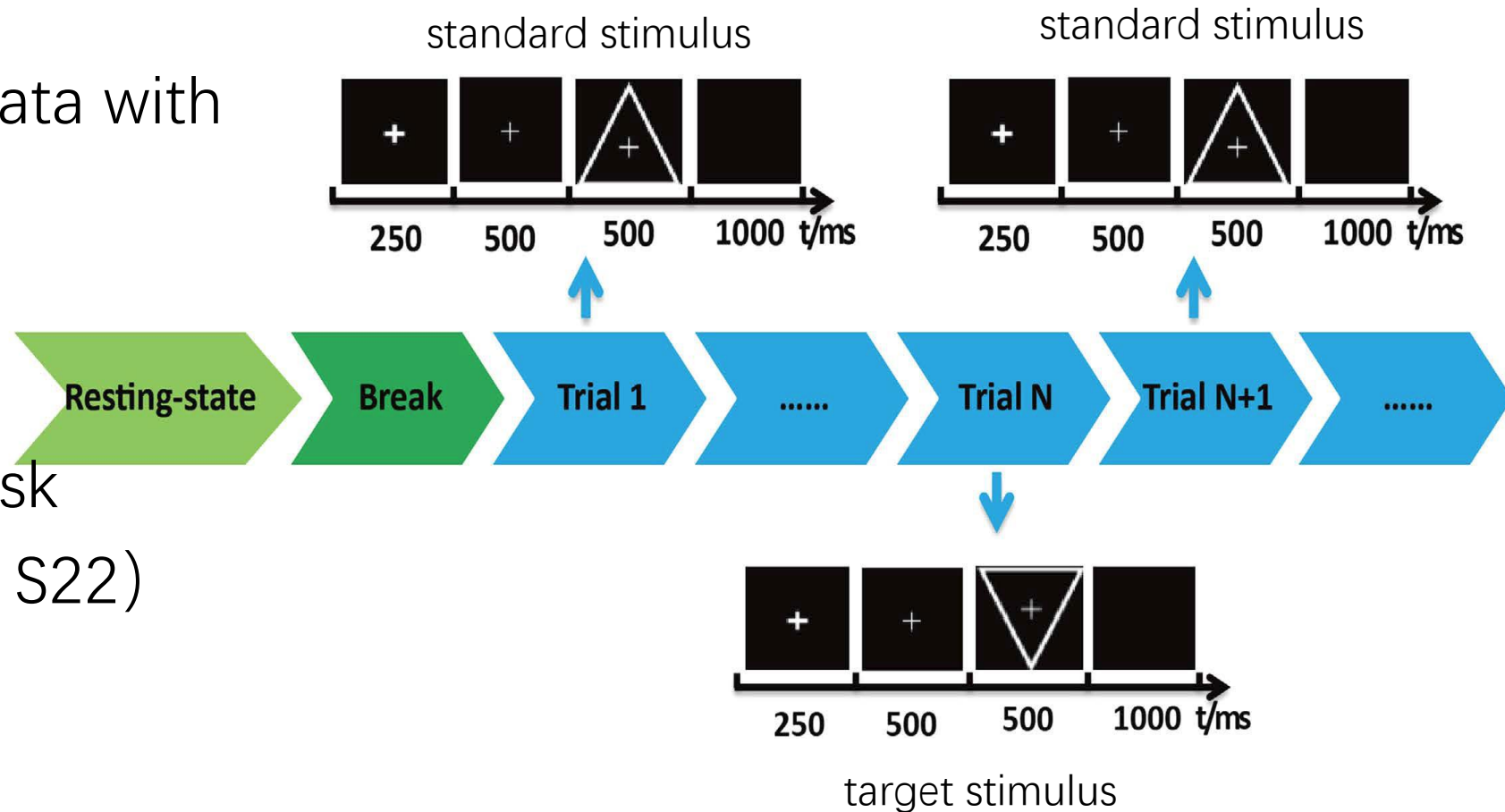
Run REST (EEGLAB Plugin version)

- To run REST, ensure that the correct EEGLAB folder is in your current Matlab path, and run 'eeglab' as a command from the Matlab Command Window.
- Then, load data using EEGLAB, click 'REST' --> 'Re-referencing to REST'



Example data

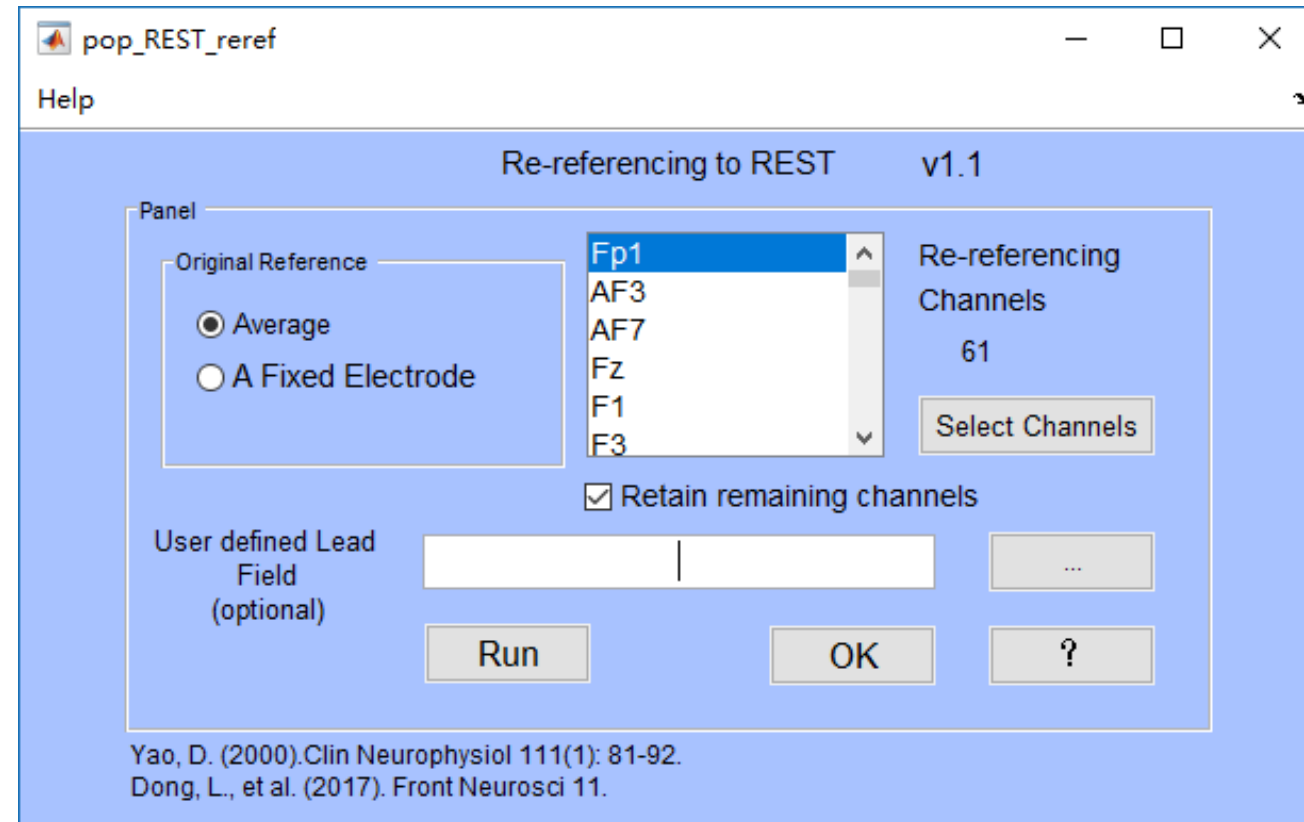
- A preprocessed EEG data with average reference
- 62 channels
- Sampling rate 500Hz
- Visual oddball P300 task
- 30 target trials (label S22)



Demo (step by step)

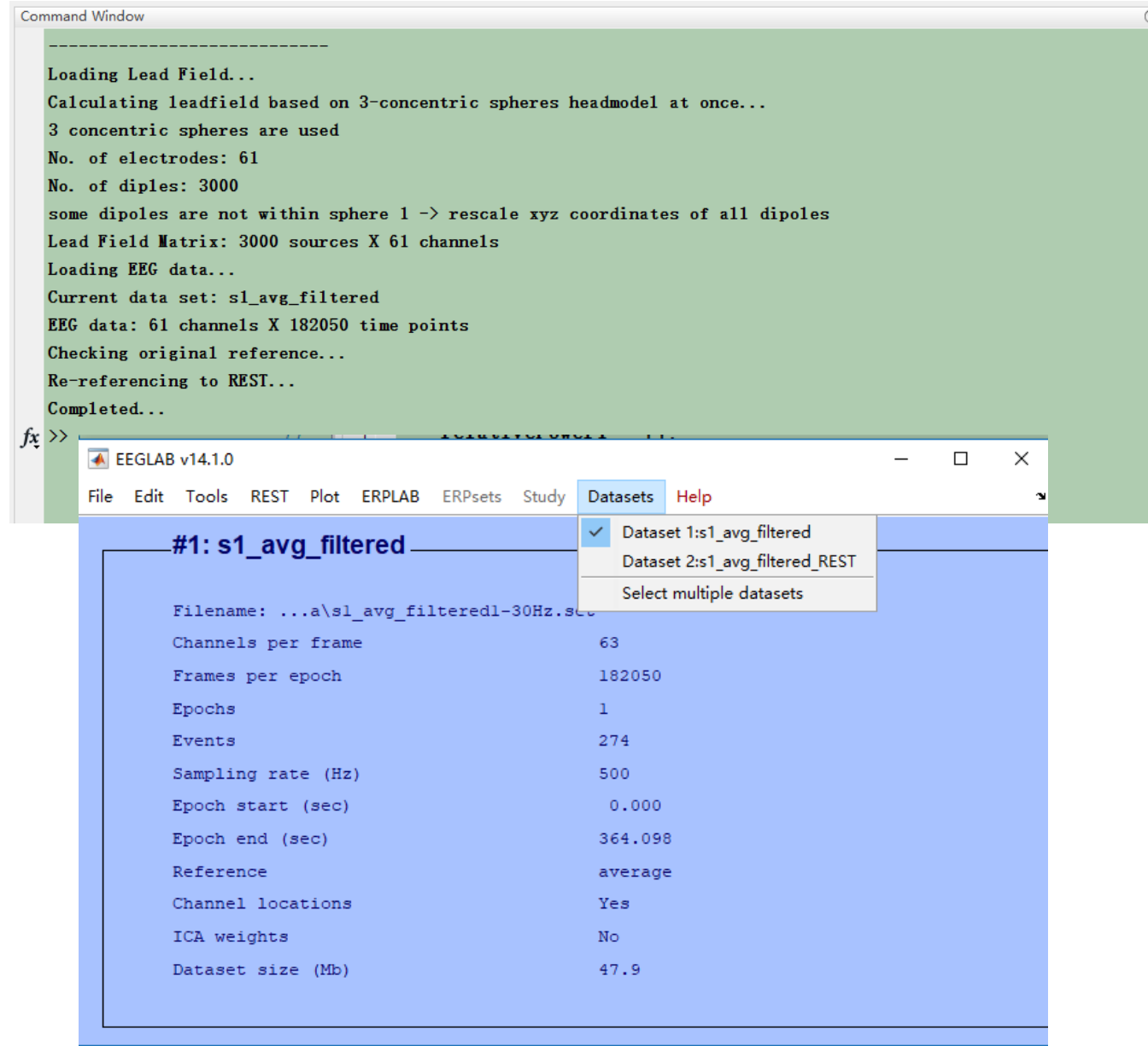
- [1] Select original reference of your EEG data (default is average).
- [2] Select Channels: Select **EEG channels** you want to re-reference (EEG channels 1-31, 33-62);
- Retain remaining channels?: if you want to keep un-selected channels in the data, check the box;

DO NOT select non-EEG channels!!!



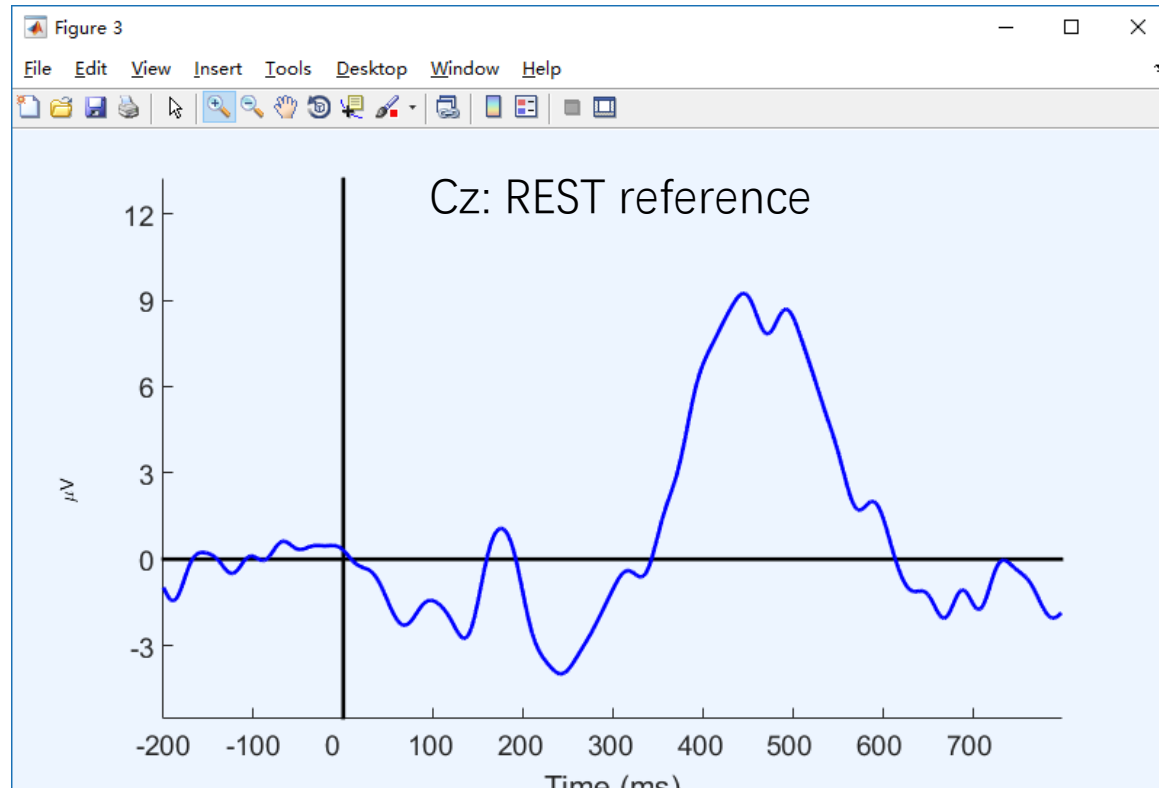
Demo (step by step)

- [3] If channel location has been imported in EEG.channlocs, press button "Run" directly; OR you can select a user defined lead field file, and then Press button "Run";
- [4] Press button "OK" to save the re-referencing data to workspace (ALLEEG). In EEGLAB, click 'Datasets' --> '*_REST';



Demo (step by step)

- Show results
- Tools->Extract epochs



Extract data epochs - pop_epoch()

Time-locking event type(s) ([] = all)

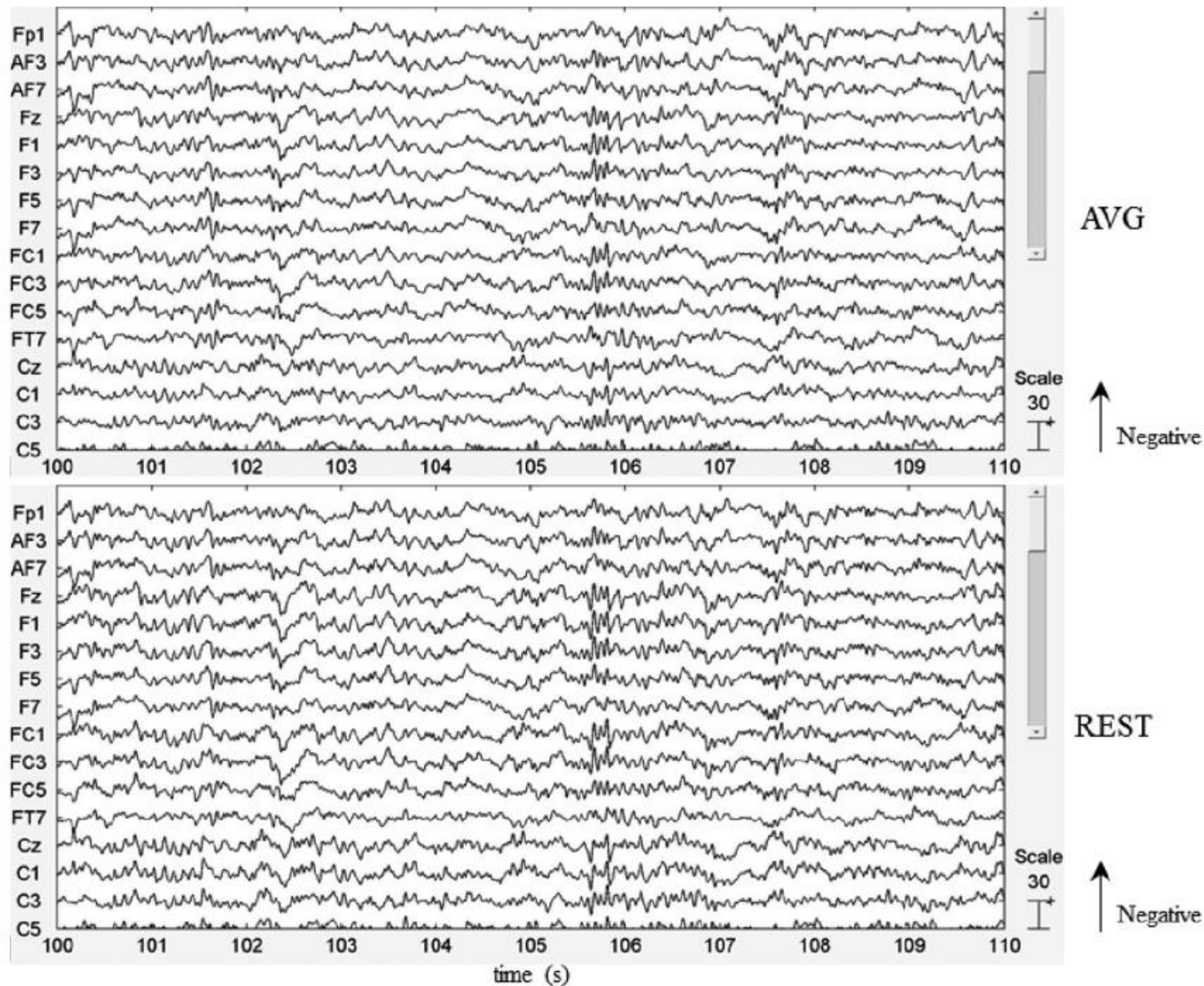
Epoch limits [start, end] in seconds

Name for the new dataset

Out-of-bounds EEG limits if any [min max]

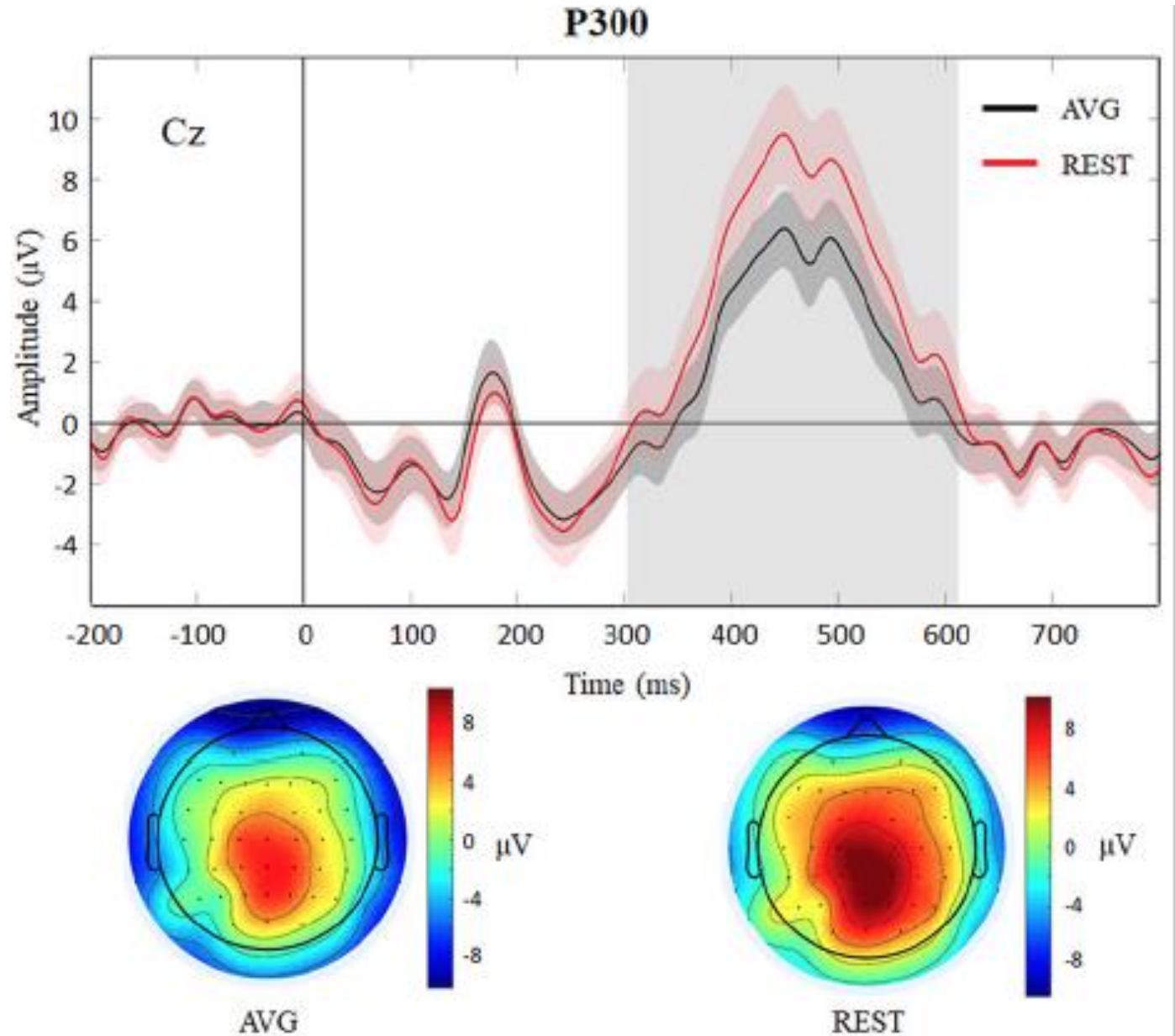
REST vs AVG

Figure shows that by visually inspecting the EEG figures of AVG and REST references, the similar EEG waves were observed, roughly.



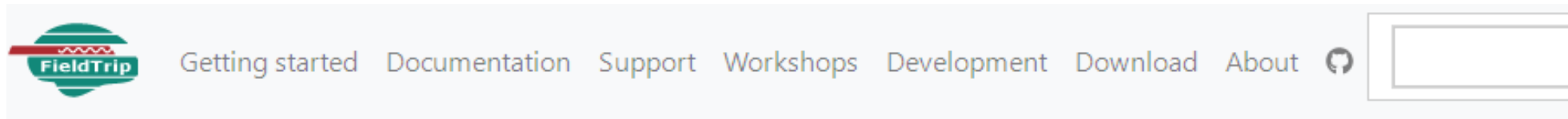
REST vs AVG

- P300 waves (with standard error) of AVG and REST references for Cz are showed and topographies of AVG (peaking at 450ms) and REST (peaking at 448ms) references are displayed.
- The gray region represents significantly (paired t-test, $P < 0.05$) larger signal intensity of P300 for REST than AVG.



REST in FieldTrip

- REST was integrated in the FieldTrip



Welcome to the FieldTrip website

FieldTrip is the MATLAB software toolbox for MEG, EEG, iEEG and NIRS analysis. It offers preprocessing and advanced analysis methods, such as time-frequency analysis, source reconstruction using dipoles, distributed sources and beamformers and non-parametric statistical testing. It supports the **data formats** of all major MEG systems and of the most popular EEG, iEEG and NIRS systems. New data formats can be **added easily**. FieldTrip contains high-level functions that you can use to construct your own analysis protocols as a MATLAB script.

The FieldTrip software is released free of charge as **open source software** under the GNU **general public** ..

<http://www.fieldtriptoolbox.org/>

REST in FieldTrip

- Usage

See test_ft_preprocessing_REST_574

```
ft_defaults;

load test_pr574.mat % load data and leadfield calculated by FieldTrip
% -----
% rest re-referencing
cfg = [];
cfg.reref      = 'yes';
cfg.refmethod   = 'rest'; % if select 'rest', 'leadfield' is required.
cfg.leadfield = lf;
%           The leadfield can be a matrix (channels X sources)
%           which is calculated by using the forward theory, based on
%           the electrode montage, head model and equivalent source
%           model. It can also be the output of ft_prepare_leadfield.m
%           (e.g. lf.leadfield) based on real head model using FieldTrip.

% cfg.refchannel = data.label([1:3,5:60],1); % use first 60 channels
cfg.refchannel = {'all'}; % vector with indices of the selected channels
%           (re-referenced channels), or 'all'.
data_eeg_rest = ft_preprocessing(cfg,data);
% -----
```