eegR: an R package to analyze electrophysiological (EEG) signals

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eegR is the first and only *R* package which provides a comprehensive tool to analyze electrophysiological signals. In typical cognitive electrophysiological studies, scalp-recorded voltage fluctuations (electroencephalography, EEG) are measured with a sampling rate of 250-1000 Hz from 32-128 channels (electrodes) while participants are exposed so systematic sensory stimulation (events). The number of trials is generally at least 40 up to several hundred per experimental condition. The main focus is on the event-related changes of the ongoing EEG signals (event-related potentials, ERPs).

The most popular open source software applications like EEGLAB (Delorme & Makeig, 2004) and FieldTrip (Oostenveld et al., 2011) have been written in the *MATLAB* programming language (www.mathworks.com). Numerous other *MATLAB*-toolboxes have been developed for specific EEG and ERP analysis methods; several of them can be used as EEGLAB plug-ins. However, since *MATLAB* is a commercial software, those toolboxes are either not free or if used as free stand-alone applications (created via *MATLAB* Compiler), they lack most of the scripting possibilities provided by the *MATLAB* environment. Other disadvantages of these toolboxes are their suboptimal performance regarding CPU-time and memory management, and the relatively low user-friendliness compared to commercial EEG softwares.

eegR is an experimental attempt to develop a package in the *R* programming language which 1) is freely available with the same functionality for *Windows*, *Linux* and *OS X* operating systems, 2) covers all basic steps in the processing of EEG/ERPs (raw data import, filtering, artifact rejection, segmentation, frequency decomposition, statistical analyses of single-trial and averaged data, etc.) but its main strength lies in the extensively documented general methods, classes, and utility functions which additional packages can rely on, 3) can handle out-of-memory data and allows easy parallelization, 4) provides user-friendly workflows and GUIs for users with limited *R* knowledge but does not restrict power-users in developing custom scripts, 5) provides functions for interactive and/or animated plotting, 6) builds on existing *R* packages if possible. The basic structure and functionality of the package will be presented, along with illustrative examples of add-on analysis possibilities like threshold-free cluster enhancement and permutation statistics.

References

Delorme, A. & Makeig, S. (2004) EEGLAB: an open source toolbox for analysis of single-trial EEG dynamics. *Journal of Neuroscience Methods*, *134*, 9-21.

Oostenveld, R., Fries, P., Maris, E., Schoffelen, J-M. (2011) FieldTrip: Open source software for advanced analysis of MEG, EEG, and invasive electrophysiological data. *Computational Intelligence and Neuroscience*, Article ID 156869, 9 pages, doi:10.1155/2011/156869