

A Demo pipeline package for using DDWiener and SOUND

1. Introduction

The purpose of this package is to show through a practical MATLAB example on how DDWiener and SOUND can be used to clean partially noisy EEG data. The MATLAB programs also show how a simple three-layer spherical head model, needed for SOUND, can be computed with the theoretical locations of the electrodes.

2. Terms of use

1. The provided Matlab demo package and/or the results can be used for a *non-commercial* or *academic* purpose only.
2. When the demo package is used to obtain new scientific results, the original article has to be cited.
3. When the user distributes a method, which depends on the demo package, the original article has to be cited with mentioning of this Demo Package.
4. The Authors provide no support for using the demo package.
5. The ~~Library~~ comes with no warranty: THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE. (The CAPITALIZED text is from the MIT License.)

3. System requirements

The programs in this package are meant to be used on a standard desktop. The package has been tested with **Windows 7** and Mac OS X 10.10.5. The programs in this package are written in MATLAB code and, therefore, require the MATLAB software to work. Prior to publishing, the package has been tested with MATLAB Releases

R2015b and R2016b. The authors cannot guarantee that the programs will work with other MATLAB releases.

Within the package, you can find a program <MAIN_SCRIPT.m> that demonstrates how DDWiener and SOUND can be used alongside the open-source MATLAB toolbox EEGLAB (Delorme and Makeig, 2004) to clean a sample EEG dataset. The sample EEG dataset used in the demo package can be downloaded from the HeadIT Data Repository (available online <http://headit.ucsd.edu/>) maintained by the Swartz Center for Computational Neuroscience at the University of California at San Diego. The used dataset corresponds to the study of Auditory Two-Choice Response Task with an Ignored Feature Difference, session 7, recording 1 (available online http://headit.ucsd.edu/recording_sessions/99bc255c-a238-11e2-b5e7-0050563f2612). Note that you also need to download the .elp file containing the EEG-channel locations. In order to use the HeadIT Data Repository, the user must agree to the HeadIT Data Repository Terms of use and Data use agreement. For more details on the dataset, see the HeadIT Data Repository site.

Since the used sample EEG dataset is in Biosemi data format (.bdf), the BioSig toolbox (Schlögl and Brunner, 2008; available online <http://biosig.sourceforge.net/download.html>) is also needed. The EEGLAB-compatible program has been tested with EEGLAB toolbox Version 14.0.0b and BioSig toolbox Version 3.1.0. The authors cannot guarantee that the provided program will work as intended with other EEGLAB and BioSig versions.

The sample dataset has been measured with a 254-channel EEG system. Due to the large number of EEG electrodes, it is only likely that the data contain a few corrupted channels. Running the program <MAIN_SCRIPT.m> demonstrates how the corrupted channels can be cleaned in a straightforward manner with minimal user interference. Because of the high dimensionality of the sample dataset, running the program can take several minutes. For more details on DDWiener and SOUND, see the original article by Mutanen et al. (in press).

4. Running the program

1. Download and install the EEGLAB toolbox (Version 14.0.0b has been tested; available online <https://scn.ucsd.edu/eeglab/downloadtoolbox.php>).
2. Download and install the BioSig toolbox (Version 3.1.0 has been tested; available online <http://biosig.sourceforge.net/download.html>) in the EEGLAB “plugins” subfolder.
3. Download the sample EEG dataset (eeg_recording_1.bdf) and the file containing the channel locations (channel_locations.elp) from the HeadIT Data Repository (available online http://headit.ucsd.edu/recording_sessions/99bc255c-a238-11e2-b5e7-0050563f2612).
4. Download and install the SOUND pipeline package.

5. Make sure that all the needed folders and files (listed above) are located in your MATLAB path.
6. Open the program <main_script_eeglab.m> in MATLAB. You can either run the whole script at once or run the different sections step by step. The sections have been numbered and are intended to be ran in the specified order. The programs in the package are meant to be self-explanatory after reading the original article by Mutanen et al. (in press).

References

Delorme, A., Makeig, S. 2004. EEGLAB: an open source toolbox for analysis of single-trial EEG dynamics including independent component analysis. J Neurosci Methods 134, 9–21, <http://dx.doi.org/10.1016/j.jneumeth.2003.10.009>.

Mutanen, T.P., Metsomaa, J., Liljander, S., Ilmoniemi R.J. In press. Automatic and robust rejection of sensor noise in EEG: the SOUND algorithm.

Schlögl, A., Brunner, C. 2008. BioSig: a free and open source software library for BCI research. Computer 41, 44–50, <http://dx.doi.org/10.1109/MC.2008.407>.