Automated EEG Repair Tool

Kristjan-Julius Laak*
Institute of Computer Science, University of Tartu, *julius.laak@gmail.com

Abstract

The **Automated EEG Repair Tool** detects and repairs electroencephalography (EEG) data that is noisy or contains artifacts. To detect the contaminated channels, the tool uses probability density estimation accompanied with heuristics. Once identified, channels that have more than one clean neighbour are interpolated using nearest-neighbour approach. User can choose whether to include additional semi-automatic visual rejection. Illustrations of the EEG data before and after the tool is used are shown in the figures below (Fig. 1 and 2).

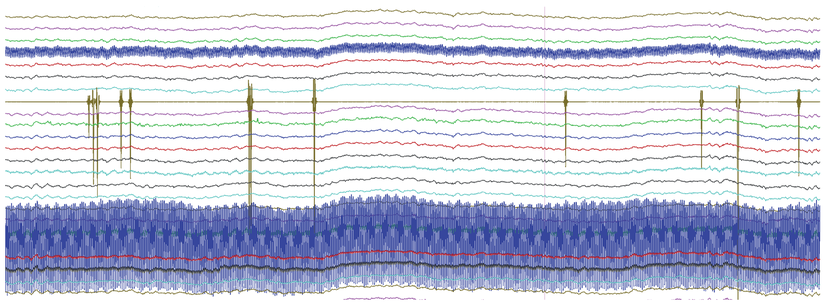

Figure 1. Illustration of the initial EEG data that contains artifacts.

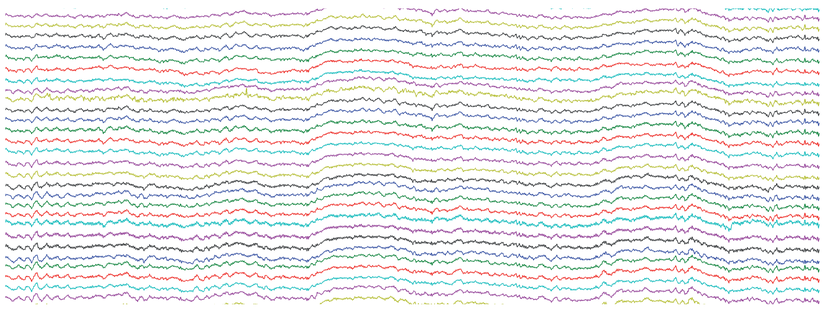

Figure 2. Illustration of the same data as shown in Figure 1 after being cleaned by the Automated EEG Repair Tool.

Background

A tedious phase of working with EEG data involves cleaning the recording from non-brain-related activity (i.e. measurement artifacts). Yet, there are no automated tools that would repair the data and assure a desirable mix of false positives and false negatives.

Identification algorithm

1. Channels with absolute **amplitudes over 250 µV** are marked as contaminated.
2. Each channel is standardized to a unit variance and the Euclidean **distance from the median** of all the channels is calculated.
3. For each trial, a probability **density estimate** of the channels is computed.
4. Channels farther than the **double distance from the beginning to the maximum of the curve** are marked as contaminated (See Fig. 3).

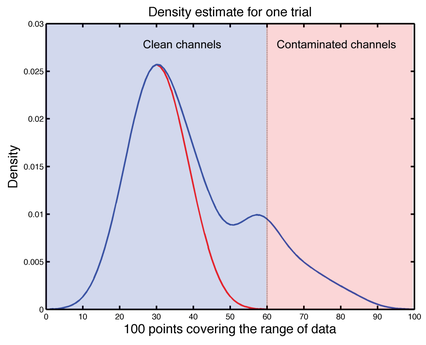

Figure 3. Contaminated EEG channels identification illustration. Blue curve is density estimation for channels' distance from the median of the channels. Red curve represents reflection from the left side. Channels that's distance cross the dotted line (red vs white background) are identified as contaminated.

Interpolation

The tool uses nearest-neighbour approach to repair bad channels in EEG data. This means replacing these channels with the average of their neighbours weighted by distance. A channel is repaired only when it has at least two clean neighbours.

Visual rejection

User can choose whether to include a semi-automatic visual rejection protocol after the interpolation. Thus, the user can reject trials, channels, or both that did not pass the interpolation (See Fig. 4).

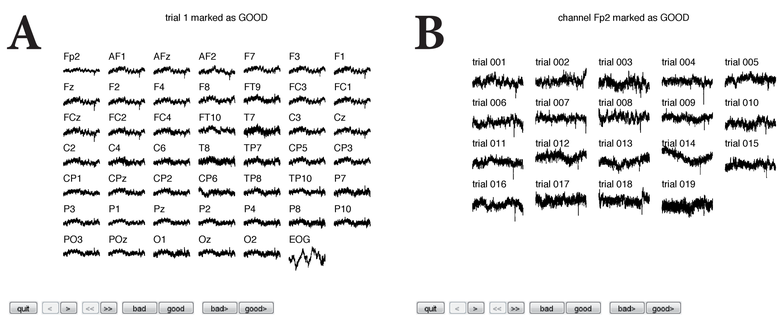

Figure 4. User guided visual rejection of trials (A) and/or channels (B).

Notes

- Built for MATLAB® and requires Statistics Toolbox and Fieldtrip (See **http://fieldtrip.fcdonders.nl/**).
- Published at MATLAB Central File Exchange, download from **http://www.mathworks.se/matlabcentral/fileexchange/46952-automated-eeg-repair-tool**