Answers for the review of Prof. Jobbagy

PhD Thesis

Novel Methods for Removing EEG Artifacts and Calculating Dynamic Brain Connectivity

First of all, I would like to express my great thanks to Prof. Jobbagy for his careful reading and valuable comments which helped me to improve my dissertation. These are my answers for his questions:

Q1: To prove the optimality of the proposed metrics (Thesis III) requires clinical tests. The number of tested persons (patients as well as healthy control subjects) is relatively low. I agree with the author, *'further work on 'larger patient population is needed for statistically significant results'.*

A1: Thesis III was modified in terms of the number of tested subjects (patients and healthy control). Eleven healthy volunteers (males, aged 16-19) were used as a control group and eleven ischemic stroke patients were selected with different lesion location and stroke severity for analysis. The proposed metrics were calculated for each group and a statistical analysis was performed onto the result. Using delta, theta, alpha and beta frequency band connectivity graphs, the statistical comparison of connectivity measures showed significant differences between the group of healthy subjects and the stroke patient measurements immediately after stroke. This significant difference was either reduced or vanished between the healthy and three months after stroke group measurements. This normalization process indicates recovery and illustrates the role of brain plasticity during stroke recovery and demonstrates that the method can be used as a biomarker during stroke rehabilitation.

We are planning to continue this work and collaborate with the National Institute of Neurosurgery, Budapest.

Q2: In the flow-chart (Figure 4-1), following EOG peak detection either the component is rejected, or the peak is corrected. The decision is based on the condition 'num. peaks > threshold'. According to the explanation, this condition is: 'If the windows cover more than 60 percent of the given component. (Greater than 60 percent means the component worth to be rejected, this usually did not occur since EOG are just few peaks in the identified component).' The detailed explanation is missing, covering also why 60 percent is the optimal selection, and not 50, 55, 65 or 70 percent.

A2: I have tested many thresholds on more than one hundred datasets and the selected threshold showed the best results. The main idea behind the 60 percent selection that, when the EEG dataset contains more than 60 percent of EOG artifacts, the classification rate of the ICA algorithm for the component being a fully EOG artifacts is very high in terms of weight identity. Therefore, the larger the number of the EOG peaks, the larger the efficiency of the ICA algorithm for entirely isolating the candidate component as a clear independent EOG component, and the lower the chance of the EEG signal to be mixed with the EOG component. Thus, in this case, the EOG component will be rejected entirely instead of selective cleaning.

Q3: The ICA component weights for the Physionet dataset and for the records made by the author are similar while the weights for the Klados dataset are different from the other two. What is the difference between the Klados dataset and the other two datasets that caused the different ICA component weights?

A3: Physionet and our recorded dataset were measured with the same Biosemi cap ABC protocol, while Klados dataset was measured with 10-20 layout of different gains. The second reason that Klados dataset was generated by adding two bipolar signals, (Vertical EOG and Horizontal EOG) of high amplitudes to the EEG signal, and this explains why the ICA' weights are different.

The suggested method is illustrated in Figure 5-1. The details of the branch test 'ORS OK?' should have been inserted into the text.

This step was detailed at page 51 line16.

Q4: The thesis work is mostly carefully edited, however, there are misprints (a few examples: 'the ERP should only has brain activity data' (1.5.), 'a reference signal, has to supplied' (2.2.1), 'liner prediction method' (7.1.), 'with sampling frequency is 360Hz' (5.2.),) most text editors can reveal.

A4: The misprints were fixed on the text.

Q5: Sometimes the parameter values are given with decimal places not justifiable. (E.g. 4.3.2, the comparison of three methods based on the recordings of ten subjects. The improvements of the author's method for different parameters are given as 154.61 %, 136.88 % and 388.88 %. Maximum three (rather two) decimal places should have been given.)

A5: It will be fixed in the text.

Q6: ERP signal amplitude is usually much less than several mV, as given in Figure 4-23. In 5.1.1.1, 'MFR' should be in place of `MRF' (yk > MRF).

A6: figure 4-23 was fixed (vertical axis was adjusted) at page 44 and MFR as well at page 49.

Mohamed Fawzy Ibrahim Issa

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