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Optimization of electrode channels in a visual discrimination task

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Background

Independent component analysis (ICA) is a well accepted blind source separation technique in electroencephalography (EEG) analysis to separate the independent sources of the electrical brain activity. Usually, the number of electrode channels in EEG analysis is selected arbitrarily in the cortical region of interest without any systematic study.

Methods

The number and location of scalp electrodes in a visual discrimination task were optimized by using ICA on a publicly available EEG database [1], a collection of 31-channel raw data from 14 human subjects who performed a go-nogo categorization task and a go-nogo recognition task on natural photographs. The data were artifacts removed, average referenced, baseline removed, bandwidth (0.5 – 35 Hz) filtered, and epoched with 100 ms before and 1000 ms after the presentation of the cue. Three different sets of data consisting of 31, 16, and 8 channels with respect to the 10–20 international electrode placement criterion were generated for each of the categorization and recognition tasks. ICA was performed and event related potentials (ERPs) and 2-D maps of the independent components were compared for each of the data sets in the two tasks.

Results

Separate comparisons of ERPs and 2-D maps of the independent components in the target and non-target categorization task show that most of the components do not have a significant difference with increasing the number of channels from 8 to 31. However, for a number of the components, there exists some performance difference using 8 and 16 channels; but no significant difference between 16 and 31 channels. Similar results were observed in the recognition task and in different participant groups.

Conclusion

This study suggests that it was not helpful to include more than 16 channels in the visual discrimination task. Therefore, it is possible to reduce time, physical and computation efforts, and subject discomfort by using smaller number of electrodes when a systematic optimization is performed.

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References

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