The Parallel Factor Analysis and the Tucker Model: A Simulation Study

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The electroencephalogram (EEG) provides a useful tool for the description of the neural activity of a brain. Analysis of multichannel, spatially distributed, EEG information is preferred over a separate analysis of EEG signal from each electrode. However, because of the multiway character of the EEG data, the hidden sources of neural activity cannot be reliably extracted by standard statistical methods like the principal component analysis (PCA) or factor analysis.

The parallel factor analysis (PARAFAC) [1, 2] represents a generalisation of PCA in higher dimensions and can be used for detection of hidden factors of multichannel EEG in time, space and frequency domain [3]. However, when the measurement with a lower number of EEG electrodes is analyzed, the resemblance of the observed spatial distribution of several, in frequency not overlapped oscillatory sources, may indicate that the usage of a more flexible Tucker3 model can be preferred.

In this study, we validate and compare the PARAFAC and Tucker3 model on two types of simulated EEG data; i) with a different spatial location of neural activity of the target frequencies and ii) with a different number of electrodes distributed over the whole scalp. The aim of this analysis is to better understand situations where the Tucker3 model leads to a more parsimonious representation of EEG data, but with a comparable explanation of neural activity variability as the PARAFAC model.

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