Theta, alpha or beta - classification of major depressive disorder using support vector machines

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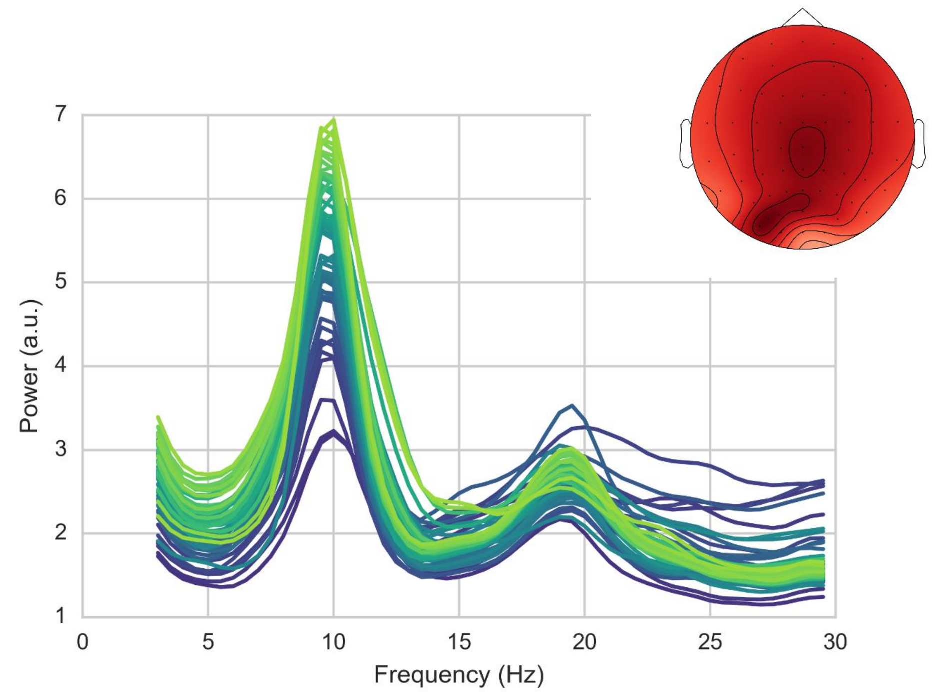
Introduction

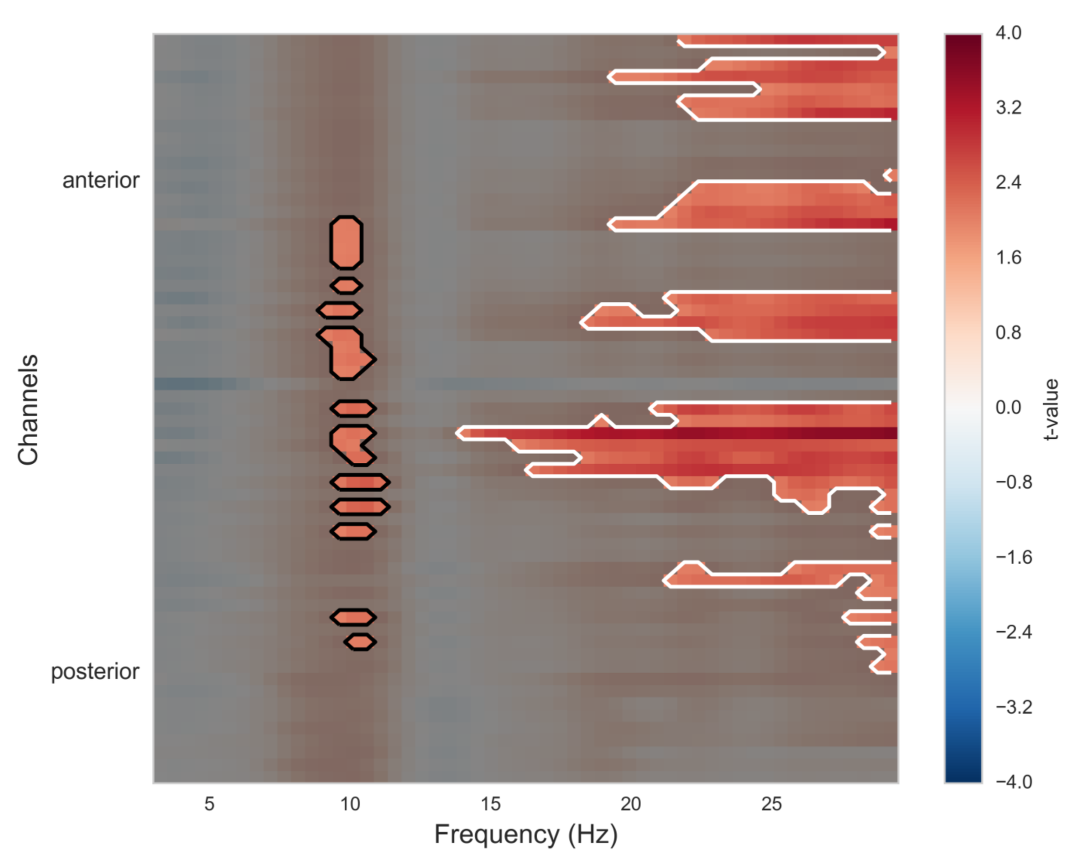
Major Depressive Disorder (MDD) is one of the most prevalent psychiatric disorders. Previous EEG studies focused mostly on asymmetry in the alpha band recorded from frontal channels as a potential biomarker of MDD [1,2]. Most such studies measured frontal alpha asymmetry (FAA) at rest and only for a selected subset of channels. However, it is still not clear whether FAA constitutes a reliable biomarker of MDD. Moreover, FFA is a univariate measure, while MDD may be potentially better characterized by the overall pattern of scalp oscillations in the relevant band (multivariate measure). In fact, alpha asymmetry can be considered more broadly as a subset of many potential multivariate patterns. Below we present initial results of classifying MDD using scalp topographies of spectral power in different bands.

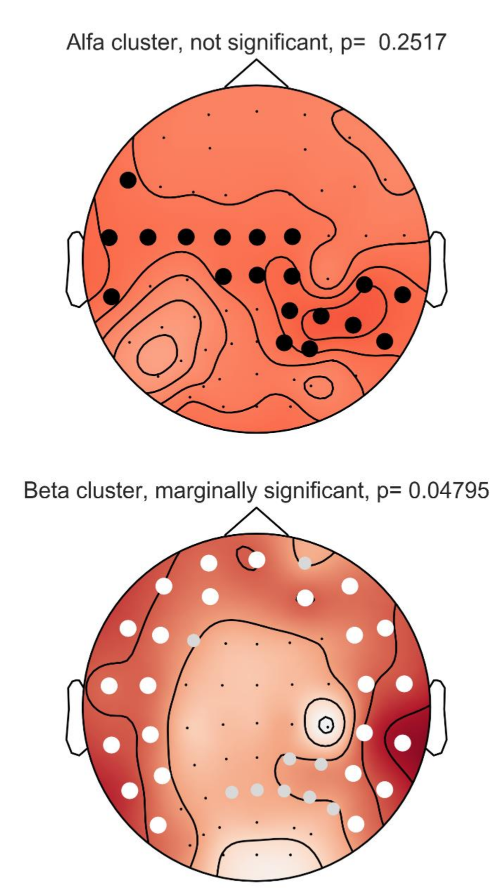


Example of the frequency spectrum for all 64 channels.
Inset shows topography of alpha power.

Univariate statistics

Conducting classical univariate statistics with cluster – based permutation test yields two clusters: one not significant in alpha band (9 – 11 Hz) and one marginally significant in beta band (20 – 30 Hz).





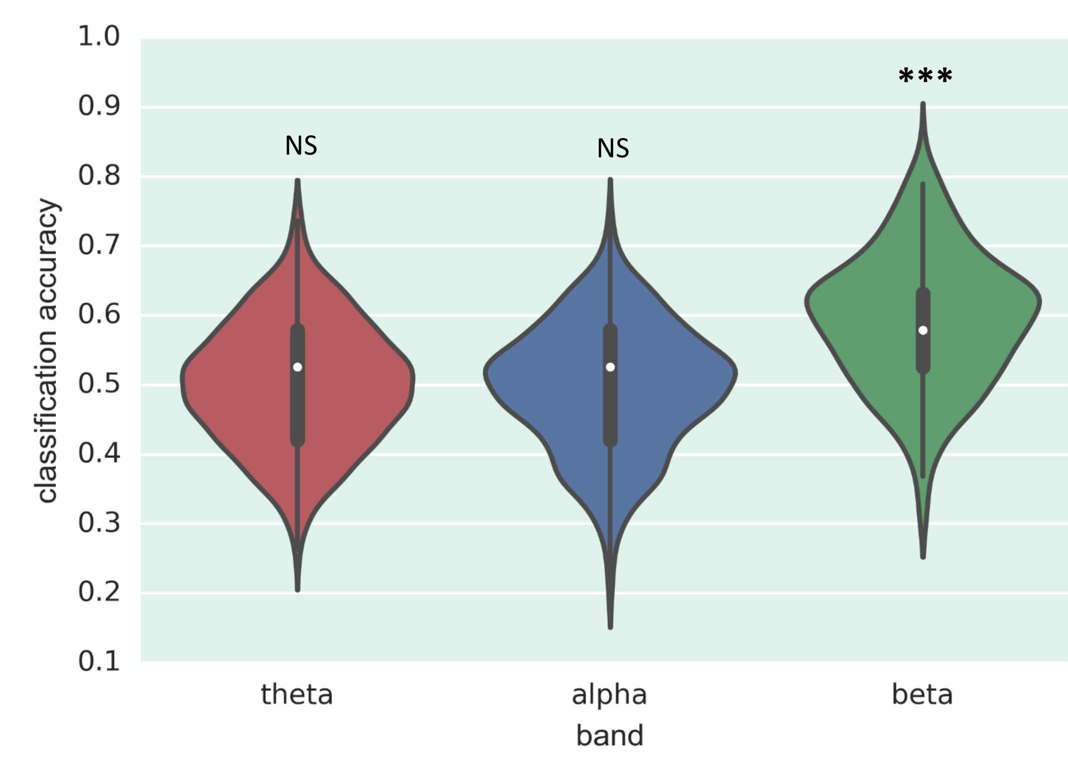
Method

We used support vector machines (SVM) with linear kernel to test whether the pattern of theta (4 – 8 Hz), alpha (8 – 12 Hz) or beta (15 – 30 Hz) oscillations allows to classify participants as MDD patients (N=23) or controls (N=22).

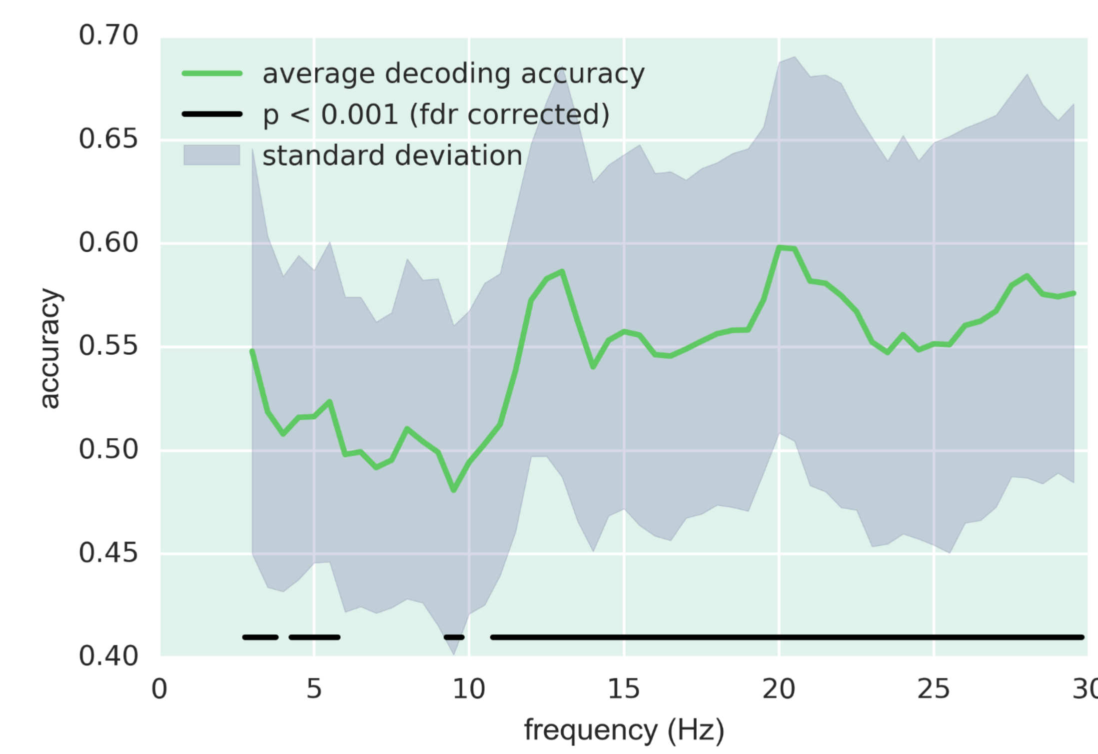
To avoid using extensive feature engineering we use scalp topographies of average power for each oscillatory band.

Standard procedures were used to select SVM hyperparameters and fit the classifier– 70% of the data was used as the training set and the remaining 30% was used for testing; 5-fold cross-validation was used to select SVM hyperparameters.

Because classification on small samples (N=55) can highly depend on the particular partitioning of the data into training and test sets we used the same partition for each frequency band and repeated the classification 250 times – each time using a random partition.



Distribution of classification accuracy for averaged frequency bands



Classification accuracy for each frequency bin.

Surprisingly, we see that beta band was significantly better in classification than alpha or theta band. More specifically - only the pattern of beta band oscillations allowed to classify participants better than chance.

References

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WANT MORE INFO?

Download the poster from GitHub repository:

https://github.com/mmagnuski/SfN2016-poster

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Founding: Ministry of Science and Higher Education Republic of Poland; National Science Centre Poland