An MEG Based BCI for Classification of Multi Direction Wrist Movements Using Empirical Mode Decomposition

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Introduction

- A novel filtering method based on the empirical mode decomposition (EMD) for classification of multi direction wrist movements based Magnetoencephalogram (MEG) signals for enhancing brain-computer interface (BCI).
- The EMD [1] method breaks MEG signals into a set of intrinsic mode functions (IMFs). These IMFs can be considered narrow-band, amplitude and frequency modulated (AM-FM) signals.
- The maximum frequency measure of these IMFs has been used to combine these IMFs in order to obtain enhanced MEG signals which have major contributions from low frequency band (<8 Hz).
- We have used BCI competition IV, dataset 3, containing MEG signals for four classes, namely, right, forward, left and backward. The signals from 10 channels above the motor areas have been used for the study. There are two subjects S01 and S02 with one training set and one test set respectively [2].
- Training set contains 40 trial of each class giving a total of 160 trials for S01 and S02 subjects.
- In test set, there are 74 trials in S01 and 73 trials in S02 to be classified in four different classes.
- Significant improved performance for dataset 3, which demonstrates the effectiveness of the proposed method.

EMD flow chart

The MEG signals from channel LC21 for wrist movement to right, forward, left and backward directions and first five IMFs generated.

Conclusion

- We have explored an application of the empirical mode decomposition (EMD) based filtering method for enhancing performance of wrist movements in brain-computer interface (BCI).
- The proposed method identifies a combination of IMFs whose maximum frequency falls in the low frequency band (<8 Hz).
- It has provided improvement in the accuracy with sample entropy feature to classify multi direction wrist movement signals as compared to BCI competition winners.

References

