

Synchrony Analysis of Paroxysmal Gamma Waves in Meditation EEG

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Abstract— To investigate the physiological traits of Bhramari Pranayama meditation, a method named “Stochastic event synchrony” is applied in this work to access the synchrony measure between paroxysmal gamma wave sequences extracted from EEG of three subjects possessing different levels of expertise in Bhramari Pranayama.

Mediation is a fascinating topic that is still relatively poorly understood. To investigate its physiological traits, electroencephalograms (EEG) were recorded during meditation sessions. In a recent study, paroxysmal gamma waves (PGWs) have been discovered in EEG of meditators practicing Bhramari Pranayama (BhPr) [1]. In this work the synchrony between those PGWs is investigated, revealing functional connectivity patterns in the brain during BhPr. Specifically, the method of Stochastic Event Synchrony (SES) [2] is applied to pairs of PGW sequences in order to assess their synchrony. From those pair-wise synchrony measures, large-scale functional connectivity patterns are extracted.

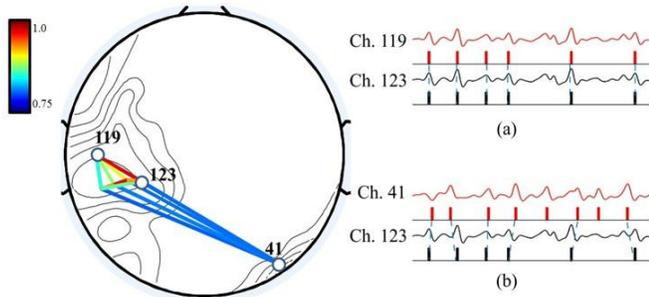


Figure 1. Connectivity map with connection strength in color (left), and EEG (right) in the 3rd exhalation period of subject B with extracted PGW sequences from a pair of (a) adjacent channels Ch. 119 and Ch. 123, and (b) distant channels Ch. 41 and Ch. 123.

Three subjects possessing different levels of expertise in BhPr are considered. Strong synchrony can be observed in the temporal lobes for all 3 subjects, in addition to long-range inter-hemispheric connections. Consistent connectivity patterns are present for exhalation periods, while those patterns are substantially less stationary for inhalation periods.

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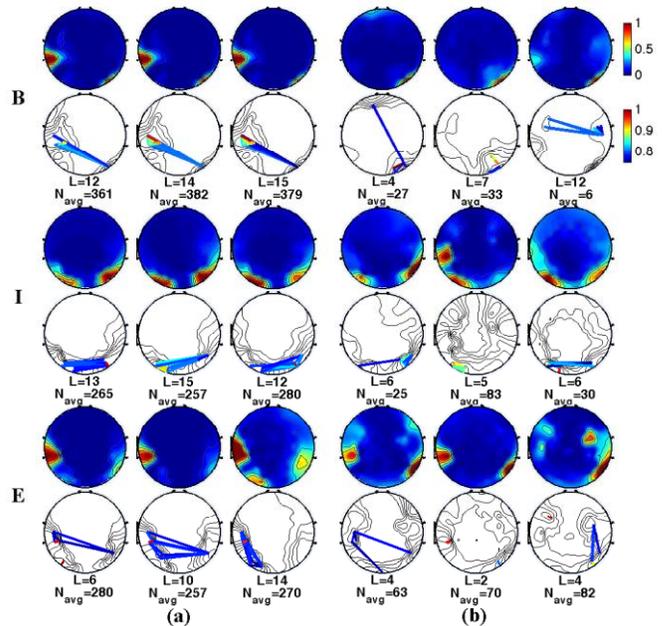


Figure 2. Power distribution and connectivity networks for three subjects (B, I, and E) with three successive periods of (a) exhalations, and (b) inhalations. L is the total number of connections, and N_{avg} is the average PGW count of each connection.

Interestingly, the synchrony seems to increase gradually during the meditation session. Moreover, the distribution of synchrony values seems to depend on the level of expertise in practicing BhPr: the higher the expertise, the more concentrated the intensity values.

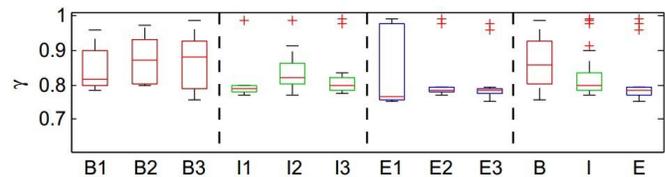


Figure 3. Synchrony measure for the three subjects. First three groups from left: Boxplot of connection strength for three successive exhalation periods for B, I and E. Right: Boxplot of connection strength for the three subjects (jointly for the three exhalation periods).

REFERENCES

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