Statistical and Non-linear Analysis of Electroencephalographic signals

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Electroencephalography (EEG) is a method to record the spontaneous electrical activity of the brain, which shows a broad range of complex signal behaviours. To understand cortical function, the EEG signal is typically divided into bands by frequency (delta, theta, alpha, beta, and gamma), isolating the rhythmic activity. These bands are related to different physiological functions and produced by different neuronal circuits. However, the bands show different characteristics for different cortical locations and states of mind, such as during the sleep-wake cycle states, which includes the states of wakefulness, rapid-eye movement, and non-rapid-eye movement sleep. Since considerable motivation exists for the development of an adequate statistical model for spontaneous EEG activity, we propose to study the main EEG bands recorded during the sleep-wake state using methods from Statistics and Chaos theory. Those taking on this project will be provided with an EEG dataset, that they will need to filter into frequency bands (pre-processing), obtain the main statistical descriptors for these bands (feature extraction), create surrogate signals for statistical hypothesis testing (statistical modelling), and analyse the phase portraits created by combining some bands (data exploration), which can lead to a state-dependent model for the EEG activity during the sleep-wake cycle and improvements to classification accuracy of machine and deep learning algorithms.

References:

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