Node coherence contribution in electroencephalographic recordings from epilepsy patients

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Epilepsy is a common neurological disorder that can be characterized as a network reorganization process. For patients who suffer from pharmacoresistant focal-onset epilepsy, electroencephalographic (EEG) recordings are essential for the localization of the brain area where seizures start. This study proposes a method to determine how a specific node m, or EEG channel, affects the entire network coherence, which can help to localize the focus. We introduce the phase-locking contribution measure δ_m combined with the concept of surrogates and apply it to multichannel intracranial EEG recordings before, during, and after seizure occurrence. We have two channel categories: seizure-onset zone (SOZ) channels where the first seizure EEG signal changes could be detected and nonSOZ channels that are located in other brain areas. We analyze if the dynamics underlying signals measured from SOZ and nonSOZ channels are consistent with the null hypothesis represented by surrogates. The null hypothesis is that the dynamics are a multivariate stationary linear stochastic cross-correlated Gaussian process. Since the phase is better defined in narrow-frequency bands, we study the outcomes of the surrogate test in low (<30Hz) and high (>80Hz) frequencies. Results show that the contribution to the network coherence is significant with regard to the null hypothesis. We find, in general, that the combination of the test outcomes in low and high frequencies gives the highest contrast between signals from SOZ and nonSOZ channels. In particular, signals measured from SOZ channels contribute positively and significantly to the network coherence as compared with other brain regions.