Effect of Signal-Dependent Noise on Phase Synchrony Pattern

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Background: Intermittent phase synchrony is a phenomenon that occurs at subthreshold levels of oscillator coupling, where two oscillators appear to be synchronized at some times and desynchronized at others. Here, periods of "synchrony" are defined by a certain amount of statistically significant correlation between the time series of the oscillators.[1] While general synchrony is observable in any number of settings (e.g. coupled pendula), intermittent synchrony has been detected in EEG readings from specific pairs of electrodes from patients with schizophrenia and Parkinson's Disease.[1] However, the extent to which EEG noise impacts synchrony pattern within the Rubchinsky et. al. model has not yet been studied.[1]

Methods: Using non-experimental data in MATLAB, we propose to run a series of trials to study the effect of signal-dependent multiplicative noise on the patterns of phase synchrony between oscillators. In the first condition, we simulate two completely synchronized signals, add signal-dependent noise to one, and observe the resulting changes to the synchronization pattern. In the second condition, we begin with two completely desynchronized signals.

Potential Impact: In studies of intermittent phase synchrony, it has been suggested that this pattern is the result of neuronal circuits which, as the EEG signals synchronize, fire more strongly and as a result become less responsive to outside input. This interpretation has the power to explain some of the symptoms experienced by patients. Thus, the specific pattern of synchronized and de-synchronized episodes is potentially highly significant. Our study is a necessary first step to understanding if the existing model and interpretations are accurate.

References:

1. Rubchinsky, L. L., Ahn, S., & Park, C. (2014). Dynamics of desynchronized episodes in intermittent synchronization. *Frontiers in Physics, 2*. doi:10.3389/fphy.2014.00038