TOM DONOGHUE's DEFENSE

Measuring and Investigating Periodic and Aperiodic Neural Activity

Understanding the functional organization of brain activity is a fundamental topic in neuroscience. Questions about how the brain coordinates information through space and time are often investigated with the use of neural field data – electrophysiological recordings of the aggregate electrical activity across groups of neurons. Such activity contains both periodic activity (neural oscillations), a common topic of investigation, and aperiodic activity, which has been less broadly studied, each of which have distinct interpretations. The overlap of these two components of activity is a source of difficulty for investigations which aim to measure and interpret the properties and dynamics of one or the other component, as methods that do not explicitly consider and measure both properties of the data are liable to conflate the two components. Despite this, many commonly employed analysis methods do not attempt to explicitly measure and separate both periodic aperiodic activity.

In this work, we develop a new method for separating and measuring periodic and aperiodic activity, using frequency domain representations of neural field data. First, we propose a novel algorithm for parameterizing neural power spectra, and validate this approach on simulated data, and demonstrate how it can be applied to real datasets. Second, we systematically explore how power spectrum parameterization compares to canonical approaches, using the example of frequency band ratio measures. Here we show that such measures that analyze pre-defined frequency ranges without considering and separating aperiodic activity are liable to reflect confounded measures of aperiodic activity. Finally, we apply the novel method across a series of datasets, systematically exploring the properties and variability of periodic and aperiodic activity across the human cortex. In sum, this work motivates that both periodic and aperiodic activity are dynamic components, necessitating dedicated methods to appropriately measure and interpret changes in the data. In doing so, methods that do consider both aperiodic and periodic activity allow for better quantifications of brain activity that can be investigated for their putative relationships to demographics, cognition and disease states.

TOM DONOGHUE TO DEFEND

THURSDAY SEPT 3, 2020 AT 10AM

VIA ZOOM

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