"MIN$_e$D Graphs" :
graphs mined from time-resolved functional brain connectomics

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Abstract

The concept of functional connectivity is central for understanding the synergistic behavior of brain regions which form distributed networks. With the fast advancement of neuroimaging techniques and the subsequent development of sophisticated signal-analytic methodologies, connectivity can nowadays be assessed in various ways. Often, the descriptive power of graphs is exploited by turning connectivity measurements into graph topologies.

Studies of cognition aim at elucidating the inherent mechanisms for information processing and rely on observation of signals emitted from distinct brain areas. Cognition is thought to emerge through integrated activities of neuronal populations throughout the brain, following the principles of segregation and integration. Distinctive patterns of brain activation were extensively sought as neural correlates of cognitive (sub) processes, by associating them with stimuli and behavioral responses. However, it is only recently that the ongoing reconfiguration of brain networks has been brought under examination.

Tracking brain's self-organization on a millisecond-by-millisecond basis is feasible using signals from fast modalities like EEG/MEG and ECoG. It requires efficient signal-processing algorithms for producing quasi-instantaneous functional/effective connectivity estimates and entails the additional challenge of producing an enormous number of graphs the study of which calls for delicate, customized, signal processing techniques for streaming graph-data. Single connectivity graphs (CGs) can be thought of as connectivity snapshots describing short-lived brain states. It is the spatiotemporal evolution of the underlying network dynamics that must be systematically organized so as to mine the semantics of cognition. Understanding how MIND ‘‘emerges’’ in the brain converges to relate the occurrence of connectivity snapshots with brain states and responses. In turn, novel dynamic signatures can be derived from the time-indexed CGs offering potential alternatives to current mind-reading technology and to the diagnosis of cognitive impairments.

Here, we review our signal-analytic framework for handling graph timeseries, introduce its recent adaptation towards the analysis of multiplex networks and demonstrate its use with ECoG data from **Neurotycho Project** (http://neurotycho.org/).

for more details : **http://neuroinformatics.gr/research/publications**