Center for Network Science | CENTRAL EUROPEAN UNIVERSITY

COMPLEX BRAIN NETWORKS: APPLICATIONS AND ISSUES

A TALK BY

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ABSTRACT | The brain can be regarded as a network: a complex connected system where nodes, or units, represent different specialized regions and links, or connections, represent communication pathways. From a functional perspective, communication is coded by temporal dependence (i.e. functional connectivity) between the activities of different brain areas. In the last decade, the abstract representation of the brain as a graph has allowed to visualize functional brain networks and describe their complex topological properties in a compact and objective way. As with other real-world connected systems and relational data, studying the topology of interactions in the brain has profound implications in the comprehension of complex phenomena, such as the emergence of coherent behavior and cognition or the capability to functionally reorganize after brain lesions (i.e. brain plasticity). One of the main views inspiring this talk is that while the emerging area of complex networks has led to a paradigm shift in the neuroscience community, many methodological and conceptual issues still remain unaddressed. Thus, despite the promising advances in the graph modeling and analysis of functional connectivity, our understanding of the brain organization at the network level is still in its infancy. This talk will cover some recent theoretical aspects of network science (multiplex networks, controllability, etc) and the application to real data recorded from different neuroimaging techniques (e.g. EEG, MEG, fMRI). A special effort will be paid to highlight the existing shortcoming and the possible solutions to better understand the functional organization in the healthy brain and improve the extraction of predictive network-based diagnostics of brain diseases. The nature of this talk is inherently cross-disciplinary, calling upon expertise from different fields including applied mathematics, statistical physics and neuroscience.

BIO | Mario Chavez has a background in complex systems applied to neurosciences (M.S. and Ph.D. degrees in France). After holding different postdoctoral positions (France & Italy) in the field of nonlinear physics and biomedical signal processing, he became a researcher at Centre National de la Recherche Scientifique (CNRS). His research activities concern new methodologies for characterising functional connectivity of electrophysiological signals recorded at multiple scales (LFP/MEG/EEG/SEEG/fMRI). He has developed a complex network-based framework to quantify the functional interactions between different neural structures involved in generation and propagation of epileptic activities.