Connectomics for Diagnostics of Some Brain Disorders

RADU MUTIHAC, UNIVERSITY OF BUCHAREST, ROMANIA

The human brain is a large-scale complex network whose function relies on the interaction between its various regions. Recent studies of the human brain connectivity using resting-state/sleep functional magnetic resonance imaging (rsfMRI), diffusion tensor imaging (DTI), and, more recently, diffusion tensor spectroscopic imaging (DSI) data, as well as "classical" modalities like positron emission tomography (PET) and magnetoencephalography (MEG) have provided deeper insight on the organization of structural and functional brain networks that continuously share information. Brain's energy is largely consumed at rest during spontaneous neuronal activity (~20%), while task-related increases in metabolism energy are minor (<5%). Spontaneous ultralow-frequency fluctuations in BOLD-based rsfMRI signals (<0.01Hz) at the level of large-scale neural systems are not noise, but orderly and organized in a series of functional networks that permanently maintain a high level of temporal coherence among brain areas that are structurally segregated and functionally linked in resting state networks (RSNs). There is evidence suggesting that such signals permit to extract information about the connectivity and functionality of specific networks. It is also documented that functional connectivity reflects the underlying structural connectivity, which, at rest undergoes specific alterations in several neurological and psychiatric disorders. Human brain function imaged by rsfMRI allows accessing both sides of human mind-brain interface (subjective experience and objective observations). As such, functional neuroimaging moves onto new potential applications like reading the brain states, discriminate neurological dysfunctions (if any), artificial intelligence (AI), brain-computer interfaces (BCI), lie detection, and alike. The presentation aims to review and evaluate the most current approaches for early detection and classification of various forms of brain dysfunction and cognitive impairment, particularly among syndromes with relatively similar behavioral effects, as well as stages in a given syndrome, based on the alteration of brain connectivity at rest explored by rsfMRI, DTI, DSI, PET, and MEG.