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Brain Connectivity Alterations in Neurological Disorders

Connectivity studies using resting-state functional magnetic resonance imaging (rsfMRI), diffusion tensor imaging (DTI) and more recently, diffusion spectroscopic imaging (DSI) have enhanced our knowledge on the organization of large-scale structural and functional brain networks, which consist of spatially distributed, but functionally linked regions that continuously share information with each other. 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 BOLDbased 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). Some RSNs are functionally organized as dynamically competing systems both at rest and during tasks. The default mode network (DMN), the most important RSN, is even more active during rest and involved in realization of tasks like memory retrieval, emotional process and social cognition. Cortical connectivity at rest is reportedly altered in several neurological and psychiatric disorders. Most recently, human brain function has been imaged in fMRI and thereby accessing both sides of the mind-brain interface (subjective experience and objective observations) have simultaneously been performed. As such, functional neuroimaging moves onto new potential applications like reading the brain states, brain-computer interfaces, lie detection and so forth. The presentation aims to review and evaluate the most current approaches and findings on early detection and classification of brain dysfunctions, particularly among syndromes with relatively similar behavioral effects, on the basis of alterations in brain connectivity and patterns of activity at rest explored by fused rsfMRI and DSI.

Biography

Radu Mutihac is Chair of Medical Physics, University of Bucharest and works in Neuroscience, Signal Processing, Microelectronics and Artificial Intelligence. As postdoc/research associate/visiting professor/full professor he has conducted his research at the University of Bucharest, International Centre for Theoretical Physics (Italy), Ecole Polytechnique (France), Institut Henri Poincaré (France), KU Leuven (Belgium). Data mining and exploratory analysis of neuroimaging time series were addressed during two Fulbright Grants in Neuroscience (Yale University, CT and University of New Mexico, NM, USA). His research in fused biomedical imaging modalities was carried out at the Johns Hopkins University, National Institutes of Health and Walter Reed Army Institute of Research, MD, USA. Since 2008, he has been nominated PhD student supervisor in the field of Biophysics and Medical Physics at the University of Bucharest, Romania. He is member of the ISMRM, ESMRMB, OHBM, Romanian US Alumni Association and fellow of Signal Processing and Neural Networks Society IEEE. He published over 120 scientific papers in reputed peer-reviewed journals, 12 monographs and contributed with chapters in other 11 textbooks published by renowned scientific publishing houses.

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