Radu Mutihac, Madridge J Intern Emerg Med. 2019
http://dx.doi.org/10.18689/2638-1621.a2.013

Functional Neuroimaging for Prognostics and Diagnostics at Rest

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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 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 dementia, particularly among syndromes with relatively similar behavioral effects, as well as stages in a given syndrome, based on modifications of the brain connectivity at rest explored by rsfMRI, DTI and DSI.

Biography:

Professor Emeritus Radu Mutihac is Chair of Medical Physics, University of Bucharest and works in Neuroscience, Neural Networks, Signal Processing, Microelectronics and Artificial Intelligence. As postdoc/research associate/visiting professor/full professor he has conducted research at the University of Bucharest, International Centre for Theoretical Physics (Italy), Ecole Polytechnique (France), Institute 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, Professor Radu Mutihac has been nominated PhD student supervisor in the field of Biophysics and Medical Physics at the University of Bucharest, Romania.