Workshop on Causality and Dynamics in Brain Networks

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Organizing Committee

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Description

Causality has been considered to be one, if not the most fundamental pillars underpinning scientific explanation. Yet, the investigation of causal relations is challenging, particularly so in extremely complex and highly dynamic systems like the human brain. Brain networks are organized at several levels, inter-related through complex signal propagation pathways. Determining functional information flow in such a labyrinthine system is an extremely difficult task because functional interactions transcend the relatively well-understood patterns of structural connectivity. In vivo measurement techniques continue to improve with advances in engineering and technology, and the field is increasingly awash in data. Yet, the computational power and the concepts and models needed to analyse and model data follows the exponential increase, roughly analogous to Moore's Law. To be blunt, in the brain we still cannot answer the simple question: Does event A "cause" B , or vice versa, or does a non observed event C influence both of them?

To bring these questions into focus and to present approaches toward the study of causality and dynamics,

The workshop will cover (but will not be limited to) the following topics:

Analysis methods for brain dynamics
Brain networks and interactions
Causality analysis
Structure, function and dynamics in the brain networks
Information processing and dynamics of neural networks
Measurements of neural interactions

Motivation and audience

The workshop aims to bring together neurobiologists, experts of data analysis especially in the field of causality analysis and connectomic researchers with particular focus on dynamic interactions orchestrating the work of our brain. Neurobiologists are welcome to present not only their empirical results, but also to propose questions which may motivate new data analysis techniques.

Format and activities

The workshop will consist of the presentations of several invited speakers, a set of contributed presentations, and a panel discussion around the presented works and open questions.

Depending on the number of contributions, the workshop's duration would be from half a day to one day.

Preliminary list of invited speakers:
Diego Sona (Istituto Italiano di Tecnologia)
Michael Dayan (IIT Central Research Lab Geneva, Switzerland)
Umberto Olcese (University of Amsterdam)
Conrado Bosman (University of Amsterdam)

Short bio of the organizers

András Telcs scientific advisor at the Hungarian Academy of Sciences, head of Department of Computational Sciences , WIGNER Research Centre for Physics, Associate Professor at Department at Computer Science and Information Theory, Budapest University of Technology and Professor at Department of Quantitative Methods, Faculty of Economics, University of Pannonia Veszprém

By profession he is mathematician. He was head of a neuroscience research group supported by the grant at the Hungarian Brain Research Program I (2015-2017), and member of the same group of HBRP II (2018-2022) hosted by WIGNER RCP. His core research areas are probability theory, stochastic processes, random walks on graph and on fractal like structure, but not limited to that. He has publication in the field of scientometrics, econometry, statistics and data mining of financial data and social networks. He is head of a social science methodology research group, which has a a five years grant (2017-2022) from the Hungarian Academy of Sciences.

Zoltán Somogyvári is a Senior Researcher at Wigner RCP and leader of the Theoretical Neuroscience and Complex Systems Research Group. He holds MSc in physics and PhD in neuroscience. He introduced several new data analysis concepts and methods in the field of neuroscience and complex systems. He introduced the first inverse method for the reconstruction of the spatio-temporal distribution of current source density on single neurons, to reveal synaptic input of neurons.
In network science, He took part in the introduction of predicting framework for new technologies based on patent citation networks, derived analytical results on random Boolean network's dynamics as a general model for genetic networks, and introduced a hierarchical extension a game-theoretical model, the minority game.
Recently, he is working on a new causality analysis method, which is able to distinguish all possible causal relationship, based on parallel time series, including unidirectional (driver) connection, bidirectional (circular) coupling, and the existence of the hidden common cause.

Vaibhav Diwadkar is Professor and Co-Director of the Brain Imaging Research Division in the Department of Psychiatry & Behavioral Neurosciences at Wayne State University School of Medicine (Detroit, USA). Following undergraduate work in Computer Science and Psychology, he earned his PhD in Psychology from Vanderbilt University (USA). Following imaging and clinical post-doctoral research at Carnegie Mellon University and the University of Pittsburgh, he joined the faculty of the latter in 2003, and relocated to Wayne State University in 2006. The major focus of his work is in the analyses of fMRI data in the service of understanding brain network function and dysfunction. He has co-authored over 100 publications in in a wide range of topics, and is also Co-Editor of an invited volume from Nature Publishing on “Brain Network Dysfunction in Neuropsychiatric Illness.” His work has been supported by the NIMH and other funding organizations in the USA.

László Négyessy is a senior research fellow graduated as a biologist at the Eötvös Loránd University, Budapest and received PhD in experimental neuroscience at the University of Pécs, Pécs, Hungary. He is working recently in fields related both to theoretical and experimental brain research. The major field of interest of LN is structural and functional organization of the cerebral cortex, especially in primates. LN is also associated to the Semmelweis University, Budapest, where he has a group at the Department of Anatomy, Histology and Embryology. Here his work is focused on the exploration of neuronal connections in relation to functional representations of the primate somatosensory cortex.