BrainTrees 2014 program

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Venue: De Waver, VU University Medical Center

Martijn van den Heuvel

Assistant professor, Psychiatry, Brain Center Rudolf Magnus

Exploring the human connectome

Brain function depends on effective communication processes within a network of neural interactions, the substrate of which is connectivity. The 'connectome ' describes a comprehensive map of the connections of a neural system, and growing evidence suggests that the connectome wiring of a species neural system -ranging from simple Nematode species all the way to higher order mammalian and primate species- shows several features of an efficient communication architecture. Similar to other networks, like the internet or social networks, brain systems display a strong local organization and community structure together with a central rich club core of neural hubs that plays an important role in effective routing and global integration of neural information; a network architecture that is crucial for healthy brain functioning. In my talk I will introduce the 'connectome' and discuss a general framework to examine connectome organisation. I will highlight founding moments of the field together with recent discoveries, and underscore the general importance of mapping and examining the wiring diagrams of connectome systems to obtain a better understanding of the workings of the healthy and diseased brain.

Linda Douw

Assistant professor, Anatomy and Neurosciences, VU University Medical Center
Postdoctoral research fellow, Radiology, Athinoula A. Martinos Center for Biomedical Imaging

From molecules to networks

Although network analysis has been applied on multiple spatial scales, for instance microscopically and using whole-brain neuro-imaging, the interrelations between these scales have rarely been investigated. However, determining the molecular basis of anatomical and functional brain networks will help us understand the brain in health and disease. Gliomas are primary brain tumors that originate from the supporting glial tissue. They not only interfere with the surrounding brain areas, but change the entire functional brain network. Furthermore, frequently occurring symptoms, such as global cognitive deficits and epileptic seizures, are related to these brain-wide alterations. The glioma population therefore provides a unique window of opportunity to investigate how growing lesions affect molecular processes, multi-scale network topology, and behavior at the same time. Results elucidate the workings of the brain on a basic neuroscientific level, while also providing new directions for neuro-oncological clinical research.

Arjan Hillebrand

Medical Physicist, Clinical Neurophysiology / MEG Center, VU University Medical Center

Network analysis in source space

I will describe an analysis framework that has been used in many of the MEG studies in our lab, which captures frequency-dependent interactions within, and characterises the topology of, functional brain networks. It is based around three main ideas: (i) functional connectivity is computed for a set of atlas-based ROIs that covers the entire cortex, allowing for a direct anatomical interpretation of the MEG data, and for a direct comparison with data from other modalities; (ii) effects of volume conduction and similar biases are removed by using the Phase Lag Index; iii) biases in network analyses are avoided through computation of the minimum spanning tree (MST), a uniquely defined sub-network of the whole network.

Jil Meier

PhD Student, Mathematics, Delft University

MST - a network science perspective

Extracting the important links of a network is a challenging problem in network science. Setting arbitrary thresholds for the link weights can lead to different results in terms of graph metrics. Constructing the minimum spanning tree (MST) as a connected minimal network representation has led to interesting findings concerning differences between patients and controls. In this talk, I present the MST method with its advantages and disadvantages from a network science perspective and explain the applicable graph metrics. Furthermore, I will place the MST in a broader framework by relating it to all shortest paths in the network.

Edwin van Dellen

Postdoctoral research fellow, Psychiatry, Brain Center Rudolf Magnus

Disturbed network organization in brain tumours

Patients with focal brain lesions such as brain tumours frequently suffer from epilepsy and global cognitive deficits. Surgical resection is part of the treatment of brain tumours, but seizure freedom after resective surgery is not obtained in a substantial number of patients. Similarly, elective surgery for patients with medically intractable epilepsy does may not lead to seizure freedom. In this talk, I will argue that functional neural network analysis is a promising technique for more accurate identification of the target areas for epilepsy surgery, and present results of a longitudinal MEG study in epilepsy- and tumour surgery patients with an emphasis on minimum spanning tree analysis.

Prejaas Tewarie

PhD Student, Neurology, VU University Medical Center

The clinical radiological gap in MS: is the solution in the tree?

Cognitive dysfunction in Multiple Sclerosis (MS) is closely related to altered functional brain network topology. In this talk, I will discuss the use of minimum spanning tree analysis of MEG source space recordings in MS patients to study the relation between cognitive dysfunction and functional brain networks.

Eric van Diessen

PhD Student, Neurology and Neurosurgery, Brain Center Rudolf Magnus

Added value of MST networks in children with newly diagnosed epilepsy

Chronic epilepsy is increasingly associated with brain network alterations. These alterations seem less clear in patients newly diagnosed with epilepsy. In this presentation I will discuss the added value of MST metrics, in comparison with traditional network metrics, to characterize brain networks in epilepsy. The first part of my presentation will focus on how MST networks can improve early diagnosis in epilepsy. Secondly, I will present how MST networks can provide insights into the mechanism behind the added clinical value of sleep deprivation in patients suspected of having epilepsy.

Betty Tijms

Post-doctoral research fellow, Alzheimer Center, VU University Medical Center

Dementia: structural networks

Coordinated patterns of cortical morphology can be described as a graph, where nodes represent anatomical areas that are connected by edges when they show covariation of grey matter volume or thickness across subjects or structural similarity within a subject. The organization of such graphs is different from that of a random graph, indicating that grey matter structure is not uniquely determined in each individual subjects. In brain diseases these patterns are disturbed, suggesting that they convey neuropathologically relevant information. This talk will demonstrate grey matter graphs alterations in Alzheimer's disease.

Ilse van Straaten

Clinical Neurophysiologist, Clinical Neurophysiology / MEG Center, VU University Medical Center

Exploring the Dementia Dynome

Dementia syndromes affect brain function with cognitive impairment as one of the clinically visible results. The changes in brain function are approximated by the assessment of functional connectivity and network analysis and this approach has revealed patterns of change in several types of dementia. Alzheimer's disease (AD) is the most prevalent form of dementia and the increasing belief that neuronal synapses are involved in AD coincided with the appreciation of a decreased functional connectivity and specific network changes in this condition. The findings of network and dynamic systems analysis in AD as well as in several other dementia types are discussed.