Michaelmas Term 2007

CABDyN SEMINAR SERIES
Saïd Business School, University of Oxford

Convenors:
Felix Reed-Tsochas, *James Martin Institute*, *Saïd Business School*
Jukka-Pekka Onnela, *Physics Department & Saïd Business School*

Our meetings intend to provide a forum for rigorous research (in a broad range of disciplines) focusing on complex adaptive systems, using methods and techniques such as agent-based modelling and complex network analysis. Since potential areas of application for such approaches can be located across the social, natural and engineering sciences, our aim is to involve participants from a wide range of departments in Oxford. We welcome talks which focus on particular areas of application and associated technical issues, but also encourage contributions which address more fundamental conceptual or mathematical problems. The CABDyN Seminar Series is one of the activities of the CABDyN Research Cluster (http://sbs-xnet.sbs.ox.ac.uk/complexity/).

Tuesday 9th October, 12.30 – 2.00 pm
(Buffet lunch from 12.00)

Seminar Room B

Dr Marcus Kaiser
School of Computing Science / Institute of Neuroscience
Newcastle University

Spatial and modular organisation of brain networks prevents large-scale activation

ABSTRACT

The brain, as many other natural networks, shows multiple clusters [1] and properties of small-world as well as scale-free [2] networks. Are there general principles that shape the network organization of neural systems?

For the last decade, it was thought that saving resources should be the most important constraint for the brain. Therefore, long-distance connections should be avoided wherever possible. In contrast, recent studies show that there are more long-distance connections than would be expected if saving resources was the only constraint [3]. These long-distance connections help to reduce path lengths in neural system and thus the number of intermediate processing steps. However, if activity can propagate through few steps, how is large-scale activation of the whole brain, as during *epileptic seizures*, prevented?

The brain network shows a modular *topological* organization at different hierarchical levels – from the level of individual neurons to the level of brain areas. Connections between modules form bottlenecks for activity spreading. Such an organisation limits complete spreading and provides a balanced activity without the need for inhibitory nodes, thus it provides a mechanism of topological inhibition [4]. Finally, I will present developmental mechanisms that yield such modular networks.

References:
[1] Sporns, Chialvo, Kaiser, Hilgetag (2004) *Trends in Cognitive Sciences* 8: 418-425
[2] Kaiser, Martin, Andras, Young (2007) *European Journal of Neuroscience* 25:3185
[3] Kaiser, Hilgetag (2006) *PLoS Computational Biology* 7:e95
[4] Kaiser, Goerner, Hilgetag (2007) *New Journal of Physics* 9:110

Sandwiches and drinks will be provided

For further information contact felix.reed-tsochas@sbs.ox.ac.uk
Seminar webpage: http://sbs-xnet.sbs.ox.ac.uk/complexity/complexity_seminars.asp