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Keynote: Synchronization in Oscillatory Networks

The formation of collective behaviour in large ensembles or networks of coupled oscillatory elements is one of the most fundamental aspects of dynamical systems theory. Applications range from physics and chemistry via neuroscience to engineering and social sciences. Here some basic properties, potentials but also open problems will be discussed.

Recent research has revealed a rich and complicated network topology in the cortical connectivity of mammalian brains. A challenging task is to understand the implications of such network structures on the functional organization of the brain activities. This is studied here basing on dynamical complex networks. We investigate synchronization dynamics on the cortico-cortical network of the cat by modelling each node (cortical area) of the network with a sub-network of interacting excitable neurons. We find that the network displays clustered synchronization behaviour and the dynamical clusters coincide with the topological community structures observed in the anatomical network. Our results provide insights into the relationship between the global organization and the functional specialization of the brain cortex.

This approach of a network of networks seems to be of general importance, especially for spreading of diseases or opinion formation in human societies or socio-economic dynamics.

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