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Dynamics on Complex Networks with Time Varying Topology

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Abstract—Recent research has revealed a rich and complicated network topology in various model systems as well as in several fields of applications. It will be discussed whether this approach can lead to useful new insights into rather large complex systems or whether it is fashionable only to interpret various phenomena from this viewpoint and publish papers on that. On one side, among such studies it has become very popular to look for a scale-free behaviour by showing log-log plots. This reminds the hunting for low dimensional chaos in the 80ies of the last millennium. On the other side, many promising approaches have already lead to useful applications, e.g. immunization problems (spreading of diseases), functioning of biological/physiological processes as protein networks, brain dynamics, colonies of thermites, or functioning of social networks as network of vehicle traffic in a region or air traffic. 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. Therefore, we next study a network of networks with time varying topology for modelling epidemic spreading. We find qualitatively different behaviour there in dependence on the changes of the topology.

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