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# Hierarchical organisation of dynamical clusters in complex brain networks

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How do diverse dynamical patterns arise from the topology of complex networks? The complex networks of cortico-cortical connectivity in mammalian brain represent a good example of clustered and hierarchically organized topology [1, 2]. Here we study synchronization dynamics of the cat cortical network representing each node (cortical area) by a sub-network of interacting exitable neurons. For single unit, generic FitzHugh-Nagumo model in excitatory regime is used with addition of independent white noise simulating natural perturbations. Variation of coupling strength separates dynamics into two major regimes allowing the observation of different clustering mechanisms. For weak couplings (biologically realistic regime), we detect existence of dynamical clusters which coincide with topological communities in anatomical structure. This observation is confirmed by hierarchical clustering analysis and optimal modularity values [3] of obtained functional networks. The functional connectivity also reveals hierarchical organisation of this complex network. Increasing of the coupling strength leads to merging of main functional communities and the formation of a hyper-cluster in the system. Our results provide better understanding of the relationship between global topological organization and functional specialization of the brain cortex.

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[3] M.E.J. Newman and M. Girvan, *Phys. Rev. E.* **69**, 026113 (2004).