DY 38: Partial Synchronization in Networks (Focus Session joint with DY and BP) (joint session SOE/DY)

Time: Wednesday 9:00–10:00 Location: SOEa

DY 38.1 Wed 9:00 SOEa

Partial synchronization as a model for uni-hemispheric sleep — •Jakub Sawicki[1], Lukas Ramlow[1,2], and Eckehard Schöll[1,3] — [1]Institute of Theoretical Physics, Technische Universität Berlin, Germany — [2]Humboldt University of Berlin, Berlin, Germany — [3]Potsdam Institute for Climate Impact Research, Potsdam, Germany

Uni-hemispheric slow-wave sleep is a dynamical state of the brain where one hemisphere is asleep while the other remains awake. This state can also be characterized by simultaneous but spatially separated occurrence of high and low degree of synchronization in the sleeping and the awake hemisphere, respectively. Therefore, this real world phenomenon can be described in terms of partial synchronization characterizing patterns of coexistence of synchronized and desynchronized parts of a network. Here we investigate the occurrence of partial synchronization patterns in empirical structural connectivities of the human brain. The connectivities consist of ninety regions of interest using the Automated Anatomical Labeling (AAL) Atlas, and were derived by magnetic resonance imaging (MRI) based probabilistic diffusion tractography. The local dynamics is modeled by FitzHugh-Nagumo oscillators. We demonstrate under which conditions partial synchronization patterns with respect to the brain hemispheres can be found.

DY 38.2 Wed 9:20 SOEa

Effect of Topology upon Relay Synchronization in Triplex Neuronal Networks — •Fenja Drauschke, Iryna Omelchenko, Rico Berner, Jakub Sawicki, and Eckehard Schöll — Institute of Theoretical Physics, Technische Universität Berlin

Complex networks consisting of several interacting layers allow for remote synchronization of distant layers via an intermediate relay layer. We investigate relay synchronization in a three-layer neuronal network and study the effect of the topology of the layers upon the synchronization scenarios. Introducing random topologies either in the outer layers or in the middle (relay) layer leads to an increase of the range of inter-layer coupling strength for which the relay-synchronized state is preserved, compared with regular nonlocal coupling topologies.

DY 38.3 Wed 9:40 SOEa

Complexified Kuramoto model – synchrony in the weak coupling regime — •Moritz Thümler, Sheshagobal Srinivas, Malte Schroeder, and Marc Timme — TU Dresden, Dresden, Germany

Networks of Kuramoto oscillators constitute paradigmatic models for the emergence of temporal patterns – foremost synchrony – across oscillatory systems. Here we extend the Kuramoto model to complex dynamical variables. We uncover a transition from traditional synchrony emerging for sufficiently large coupling strengths to a second type of synchrony that exists in the weak coupling regime, i.e. below the coupling required for the real-variable model to synchronize. The new type of synchrony state is known from systems that are not dissipative but conservative, compare [1,2] for relations of the two system types. We introduce a novel, two dimensional order parameter for networks of N oscillators that enables us to consistently quantify synchrony.

[1] D. Witthaut and M Timme, Phys. Rev. E 90:032917 (2014)
[2] D. Witthaut et al., Nature Comm. 8:14829 (2017)