BP 20: Dynamics of multilayer networks II (joint session SOE/DY/BP)

Time: Wednesday 15:00–16:45 Location: H17

Topical Talk BP 20.1 Wed 15:00 H17

Delay controls chimera relay synchronization in multiplex networks — •Eckehard Schöll, Jakub Sawicki, Iryna Omelchenko, and Anna Zakharova — Institut für Theoretische Physik, Technische Universität Berlin, Germany

We study remote (or relay) synchronization in multilayer networks between parts of one layer and their counterparts in a second layer, where these two layers are not directly connected. A simple realization of such a system is a triplex network where a relay layer in the middle, which is generally not synchronized, acts as a transmitter between two outer layers; an example is provided by the hippocampus connecting distant parts of the brain. We find various partial synchronization patterns, in particular chimera states, i.e., complex patterns of coexisting coherent and incoherent domains, and establish time delay in the interlayer coupling as a powerful tool of control [1]. We demonstrate that the three-layer structure of the network allows for synchronization of the coherent domains of chimera states in the first layer with their counterparts in the third layer, whereas the incoherent domains either remain desynchronized or synchronized. As model dynamics we use the paradigmatic FitzHugh-Nagumo system.

[1] J. Sawicki, I. Omelchenko, A. Zakharova, and E. Schöll, arXiv:1807.11223v2 (2018).

BP 20.2 Wed 15:30 H17

Spiral wave patterns and their synchronization in lattices of nonlocally coupled discrete-time systems — Andrei Bukh, Galina Strelkova, and •Vadim Anishchenko — Saratov State University, Saratov, Russia

We investigate numerically the spatio-temporal dynamics of a 2D lattice of coupled discrete-time systems with nonlocal interaction. The individual map is given by a universal discrete system (the Nekorkin map) proposed for modeling the neural activity. The network behavior is studied for periodic and open boundary conditions. It is shown that for certain values of the nonlinear coupling parameters, rotating spiral waves and spiral wave chimeras can be observed in the considered lattice. We analyze and compare statistical and dynamical characteristics of the local oscillators from coherence and incoherence clusters of a spiral wave chimera. We also explore the effects of partial and complete synchronization of spiral wave chimeras in two coupled lattices of discrete maps with varying the intercoupling between the networks.

BP 20.3 Wed 15:45 H17

Synchronization of spiral wave patterns in coupled 2D lattices of discrete maps — •Andrei Bukh[1], Eckehard Schöll[2], and Vadim Anishchenko[1] — [1]Saratov State University, Saratov, Russia — [2]Technical University, Berlin, Germany

We study numerically the dynamics of two symmetrically and unidirectionally coupled lattices of nonlocally coupled two-dimensional Nekorkin maps. The phenomena of external and mutual synchronization of spiral wave patterns including chimera states are explored. The partial and complete synchronization is analyzed by calculating the number of synchronous elements in the coupled lattices depending on the coupling strength between them. Synchronous regimes are quanitified by using mutual correlation coefficients between the relevant elements in the lattices.

BP 20.4 Wed 16:00 H17

Transmission and synchronization of chimeras in a multilayer network of nonlocally coupled chaotic maps — •Galina Strelkova and Tatiana Vadivasova — Saratov State University, Saratov, Russia

We explore numerically transmission and external synchronization of chimera states in a multilayer network of unidirectionally coupled rings of nonlocally coupled logistic maps. We consider two cases: when all M coupled layers are identical (homogeneous) and when (M-1) identical layers differ from the first driving layer in their nonlocal coupling parameters. It is shown that the master chimera state in the first layer can be retranslating along the network with small distortions which are defined by a parameter mismatch. The synchronization effect is evaluated by calculating the mean-square deviation of the structure in the layers when varying the nonlocal coupling parameters.

BP 20.5 Wed 16:15 H17

Synchronization of chimera states in multilayer heterogeneous network of nonlocally coupled maps — •Elena Rybalova[1], Galina Strelkova[1], Tatiana Vadivasova[1], and Anna Zakharova[2] — [1]Saratov State University, Saratov, Russia — [2]Technical University, Berlin, Germany

We present numerical results on the study of a complex network composed of many asymmetrically coupled heterogeneous layers of nonlocally coupled logistic maps. Transmission and synchronization of chimera states realized in the first (master) layer is considered for mutual and unidirectional inter-coupling between the layers. It is shown that there is a threshold of the forced synchronization, which is different for various chimeras (phase and amplitude) in the master layer. It is established that the presence of feedback (backward) inter-coupling is a significant obstacle for global synchronization across the network. We also analyze and compare the role of heterogeneity in control and coupling parameters on the degree of forced synchronization.

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