DY 32: Synchronization

Time: Friday 10:15–11:45 Location: H3

DY 32.1 Fri 10:15 H3

Quantum Stochastic Synchronization — •I. Goychuk[1], J. Casado-Pascual[2], M. Morillo[2], J. Lehmann[3], and P. Hanggi[1] — [1]Universität Augsburg, Germany — [2]Universidad de Sevilla, Spain — [3]Universität Basel, Switzerland

We study, within the spin-boson dynamics, the synchronization of a quantum tunneling system with an external, time-periodic driving signal [1]. As a main result we find that at a sufficiently large system-bath coupling strength (i.e. for a friction strength $\alpha > 1$) the thermal noise plays a constructive role in yielding forced synchronization. This noise-induced synchronization can occur when the driving frequency is larger than the zero-temperature tunneling rate. As an application evidencing the effect, we consider the charge transfer dynamics in molecular complexes.

[1] I. Goychuk, J. Casado-Pascual, M. Morillo, J. Lehmann, P. Hänggi, Phys. Rev. Lett. 97, 210601 (2006).

DY 32.2 Fri 10:30 H3

Sublattice synchronization of chaotic networks with delayed couplings — •Wolfgang Kinzel and Johannes Kestler — Theoretische Physik, Universität Würzburg

Chaotic systems, mutually coupled by their delayed variables, can synchronize to a common chaotic trajectory. This phenomenon may lead to interesting applications for secret communication with chaotic semiconductor lasers. We investigate networks of delay-coupled chaotic units which can be decomposed into two interconnected sublattices. For some values of the couplings we find sublattice synchronization: Each sublattice has a common chaotic trajectory, but the two sublattices are not synchronized. Although each sublattice is causing the synchronization of the other one, the sublattices are only correlated but not synchronized, not even in the meaning of generalized synchronization. Phase diagrams and spectra of Lyapunov exponents are calculated analytically for networks of iterated Bernoulli maps with delayed feedback and couplings.

DY 32.3 Fri 10:45 H3

Spatially localized desynchronization in weakly disordered lattices of phase oscillators — •Michael Zaks — Institut für Physik, Humboldt-Universität zu Berlin

If the coupling in a lattice of diffusively coupled non-identical phase oscillators is strong enough, a synchronized state appears in which all elements rotate with the same rate. I restrict myself to the case where the distribution of frequencies along the lattice is weakly disordered (the binary Thue-Morse lattice serves as an example). It turns out that the stable synchronized state is not necessarily a global attractor and may coexist with other nontrivial regimes. In such states, nearly the whole ensemble is synchronized whereas a few elements do not obey the common dynamics and rotate with different frequencies. Phase differences between such oscillators and the rest of the ensemble grow linearly in time. In spite of unbounded temporal growth, these phase defects do not propagate in space: they stay localized.

DY 32.4 Fri 11:00 H3

Synchronization of a hierarchical ensemble of coupled excitable oscillators — •Cornelia Petrovic and Rudolf Friedrich — Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster

In our work we investigate a model for an ensemble of globally coupled excitable oscillators. These oscillators are relaxation oscillators with hierarchically ordered frequencies and show several kinds of synchronization phenomena - from partial up to global synchronization - which can be detected in selfaffine features in the temporal evolution of the system. In our contribution we shall present some details of analytical and numerical analysis of the given system.

Our model was motivated by an experiment concerning the exothermic CO-oxidation on palladium supported catalyst (C.Ballandis, P.J.Plath, Journal of Non-Equilibrium Thermodynamics 25 3/4, 301 (2000)).

DY 32.5 Fri 11:15 H3

Synchronization in acoustical systems by the example of organ pipes — •Markus Abel[1], Karsten Ahnert[2], and Steffen Bergweiler[1] — [1]UP Transfer GmbH an der Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam — [2]Institut für Physik, Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam

From measurements on organ pipes, it is known since a long time, that phase-locking can lead to a mutual influence of organ pipes by each other. The same holds for external driving of pipes by acoustical sources of well-defined frequencies. We explain the theoretical background from nonlinear vibrational theory and apply it to measurements of the synchronization between an organ pipe and a loudspeaker. In the experiment we observe an Arnold tongue over a range of 60 dB, i.e. about 3 decades. With nonlinear, nonparametric embedding we are able to determine effective equations for the system in terms of a driven nonlinear oscillator.

DY 32.6 Fri 11:30 H3

Corticothalamic Projections control Synchronization in Ensembles of Bistable Thalamic Oscillators — •Jörg Mayer[1], Heinz Georg Schuster[1], Jens Christian Claussen[1], and Mathias Mölle[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts Universität, Olshausenstraße 40, 24098 Kiel — [2]Department of Neuroendocrinology, University of Lübeck, Ratzeburger Allee 160, 23538 Lübeck

Thalamic circuits are able to generate state dependent oscillations of different frequencies and degrees of synchronization. Experimental findings suggest, that the simultaneous occurrence of spindle oscillations over widespread territories of the thalamus is due to the corticothalamic projections. Synchrony is lost in the decorticated thalamus. Here we introduce a generic model of a thalamic oscillator and study the influence of corticothalamic projections on the degree of synchrony in a network of such coupled oscillators. For this purpose we feed our model with slow wave stimuli. We uncover the underlying control mechanism, an compare our results with experimental observations. This leads to a control method which is applicable to a wide range of stochastically driven excitable units.