SFB 910 Symposium

"Complex Dynamics and Delay Effects in Coupled Systems"

Friday, 08th July 2022, 15:00 s.t.
H1035 / H1036 / via Zoom
For information on how to access the event, please contact:
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Technische Universität Berlin
Straße des 17. Juni 135, 10623 Berlin

15:00 – 15:50 **Chimera states, coexistence patterns and multifrequency clusters in systems of nonlinearly coupled amplitude oscillators**
Prof. Dr. Katharina Krischer *(TU München)*

15:50 – 16:10 Coffee Break

16:10 – 16:40 **Simulating dynamics of coupled complex systems with NetworkDynamics.jl**
Michael Lindner *(PIK Potsdam)*

16:40 – 17:10 **Bifurcations and Instabilities of Temporal Dissipative Solitons in DDE-systems with large delay**
Mina Stöhr *(WIAS Berlin)*

Guests are welcome!

Sabine Klapp Matthias Wolfrum Bernold Fiedler

http://www.itp.tu-berlin.de/sfb910/

Abstracts

Chimera states, coexistence patterns and multifrequency clusters in systems of nonlinearly coupled amplitude oscillators

Prof. Dr. Katharina Krischer *(TU München)*

Si electrodissolution in fluoride-containing electrolytes exhibits a multitude of self-organized spatio-temporal states, among them chimera states and other coexistence patterns as well as multi-frequency clusters. In this talk, I will discuss that most of these patterns emerge due to nonlinear coupling, which might be global or nonlocal depending on the parameter ranges.

Model caclulations with an ensemble of globally coupled Stuart-Landau oscillators with nonlinear coupling show that such an ensemble can express a range of coesxistence patterns more comprehensive than chimeras.[1] A hierarchy of coexisting states evolves from the fully synchronized solution in a series of cluster-splittings. At the far end of this hierarchy, the states further collide with their own mirror-images in phase space – rendering the motion chaotic, destroying some of the clusters and thereby producing even more intricate coexistence patterns. A sequence of such attractor collisions can ultimately lead to full incoherence of only single asynchronous oscillators. Chimera states, with one large synchronized cluster and else only single oscillators, are found to be just one step in this transition from low- to high-dimensional dynamics.

On the other hand, an analysis of the experimental conditions where multi-frequency clusters were observed, suggests that the spatial coupling in this parameter range is nonlinear and nonlocal, with the strength of the coupling adapting to the state of the oscillators, similar to what is known from the context of neural dynamics.[2] We will critically discuss the relationship between multifrequency clusters and chimeras.

Simulating dynamics of coupled complex systems with NetworkDynamics.jl

Michael Lindner *(PIK Potsdam)*

NetworkDynamics.jl is an easy-to-use and computationally efficient package for simulating heterogeneous dynamical systems on complex networks, written in Julia. By combining state of the art solver algorithms from DifferentialEquations.jl with efficient data structures, NetworkDynamics.jl achieves top performance while supporting advanced features like events, algebraic constraints, time-delays, noise terms and automatic differentiation. NetworkDynamics.jl is the computational backend of the PIK developed software PowerDynamics.jl which facilitates dynamical simulation and control of power grid models. BlockSystems.jl is a further combineable package maintained at PIK that allows to specify local dynamics via causal, symbolic equations.

Bifurcations and Instabilities of Temporal Dissipative Solitons in DDE-systems with large delay

Mina Stöhr *(WIAS Berlin)*

Temporal Dissipative Solitons are localized states that can be found in dynamical systems with time-delayed feedback, where the delay is large. With a broad field of applications, e.g. for the development of pulses in opto-electronic devices and neural systems, our research is focused on understanding the bifurcation scenarios and instabilities of this type of solutions. We will see how the concepts of classical homoclinic bifurcation theory can be used to understand the bifurcations of solitons in DDE-systems. We demonstrate our results with the examples of the FitzHugh-Nagumo system and Morris-Lecar model with time-delayed feedback.

[1]S.W. Haugland, A. Tosolini, and K. Krischer, Nature Communications (2021) 12, 5634.

[2]M. Patzauer and K. Krischer, Phys. Rev. Lett. (2021) 126, 194101.