

On the Stability of Complex Networks and Their Application to Control Power Grids

Schedule: Mo-am1, 9:00- 10:00hrs

Auditorium: "Rafael Nieto" Rectory Building UASLP



Speaker: Professor Jurgen Kurths

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Abstract:

The human brain, power grids, arrays of coupled lasers and the Amazon rainforest are all characterized by multistability. The likelihood that these systems will remain in the most desirable of their many stable states depends on their stability against significant perturbations, particularly in a state space populated by undesirable states. Here we claim that the traditional linearization-based approach to stability is too local to adequately assess how stable a state is. Instead, we quantify it in terms of basin stability, a new measure related to the volume of the basin of attraction. Basin stability is non-local, nonlinear and easily applicable, even to highdimensional systems. It provides a long-sought-after explanation for the surprisingly regular topologies of neural networks and power grids, which have eluded theoretical description based solely on linear stability. We anticipate that basin stability will provide a powerful tool for complex systems studies, including the assessment of multistable climatic tipping elements. As a first example, new principles for the design of stable power grids under the restriction of smart grids will be given.

References:

- P. Menck, J. Heitzig, N. Marwan, and J. Kurths, Nature Physics 9, 89 (2013)
Runge, J. , J. Heitzig, V. Petoukhov, and J. Kurths, Phys. Rev. Lett. 108, 258701 (2012).
Donges, J., R. Donner, M. Trauth, N. Marwan, H.J. Schellnhuber, and J. Kurths, PNAS 108, 20422-20427 (2011).
Arenas, A., Diaz-Guilera, A., Kurths, J., Moreno, Y., and Zhou, C., Physics Reports 469, 93-153 (2008).

Short CV:

Jürgen Kurths studied mathematics at the University of Rostock and got his PhD in 1983 at the GDR Academy of Sciences and his Dr. habil. in 1990. He was full Professor at the University of Potsdam from 1994-2008 and has been Professor of Nonlinear Dynamics at the Humboldt University, Berlin and chair of the research domain Transdisciplinary Concepts of the Potsdam Institute for Climate Impact Research since 2008 and a 6th century chair at the Institute for Complex Systems and Mathematical Biology at Kings College of the Aberdeen University (UK) since 2009.

He is a fellow of the American Physical Society and of the Fraunhofer Society (Germany). He has become a member of the Academia Europaea in 2010. He got an Alexander von Humboldt research award from CSIR (India) in 2005 and a Honory Doctorate in 2008 from the Lobachevsky University Nizhny Novgorod., a Honorary Professor of Potsdam University in 2011, a Honorary Doctorate in 2012 from the State University Saratov and has become a Guest Professor at the Southeast University in Nanjing. He was awarded the L.F. Richardson Medal of the European Geosciences Union in 2013.

His main research interests are complex synchronization phenomena, complex networks, time series analysis and their applications in climatology, sustainability research, physiology, systems biology and engineering.

He has supervised more than 60 PhD students from about 20 countries; more than 30 of them have now tenured positions in various countries.

He has published more than 500 papers in peer-reviewed journals and two monographs which are cited more than 19.000 times (H-factor: 58).

He is in the editorial board of more than 10 journals, among them CHAOS, Philosophical Trans. Royal Soc. A, PLoS ONE, European J. Physics ST and Nonlinear Processes in Geophysics and of the Springer Series Complexity.

He coordinated several large projects in EU and DFG and is now speaker of an International Research Training Group on complex networks (DFG and Brazil).