DTU Compute
Department of Applied Mathematics and Computer Science

New course: 01622 Advanced Dynamical Systems – Applications and Methods in Science and Engineering

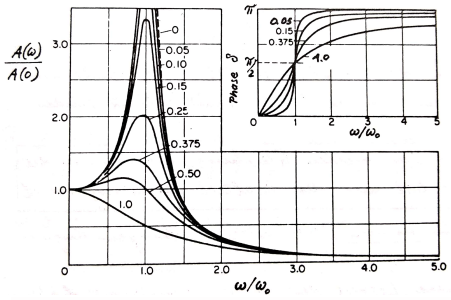
This course covers both theory and practical techniques to analyze simple and complex networked systems and nonlinear oscillations with engineering applications. Whereas the focus in the introductory level dynamical systems course (01617) lies on the mathematical theory of local dynamics, we focus in this course on mastering advanced mathematical analysis, with applications to practical problems occurring in mathematics, physics, engineering, and life sciences.

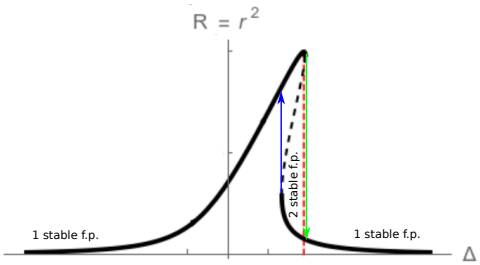
In parallel to analyzing systems with both simple and complex structure, you will learn to master the analysis of dynamics characterized by periodic to aperiodic nonlinear oscillations, chaotic dynamics, and stochastic fluctuations.

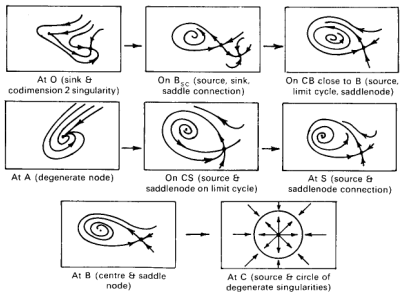
Contents of the course include theory of nonlinear oscillations, perturbation methods, averaging theory, multi-scale methods, Hamiltonian and Lagrangian theory, dynamics on and of networks, introduction to graph/network theory, applications of bifurcation theory, introduction to chaos theory and to stochastic dynamical systems.

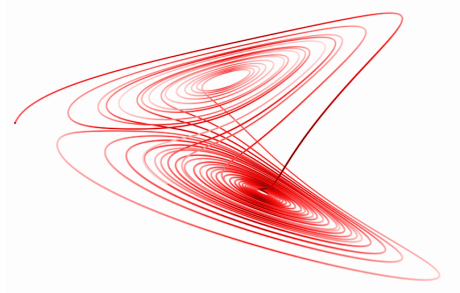
What will you learn?

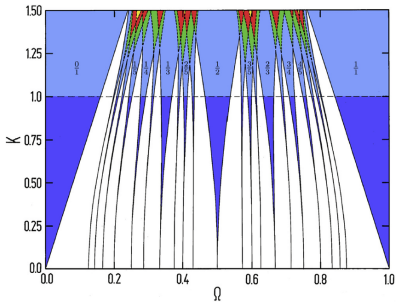
- Analysis of nonlinear oscillations
- Perturbation methods, incl. multi-scale analysis
- Reduction of complex to simple systems: averaging theory and mean field theory
- Bifurcation analysis via numerical continuation in ODE systems
- Lagrangian and Hamiltonian theory
- Variational analysis
- Algorithms for symplectic integration
- Numerically compute Lyapunov spectra
- Dynamics *on* and *of* networks
- Synchronization theory
- Stochastic differential equations

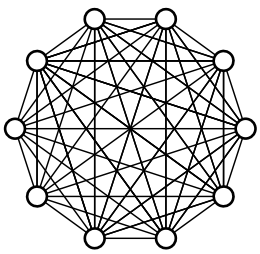












Practical information on course 01622

- Taught during spring semester, starts spring 2020
- Friday 13.00-17.00: Lectures and group exercises
- 5 ECTS
- Course responsibles: E. A. Martens, P. G. Hjorth, M. P. Sørensen, U. H. Thygesen