Welcome to the *Applied Analysis* specialization of the Master Program Mathematical Sciences

Wednesday, February 12, 2014

Yuri Kuznetsov, coordinator ***AA***

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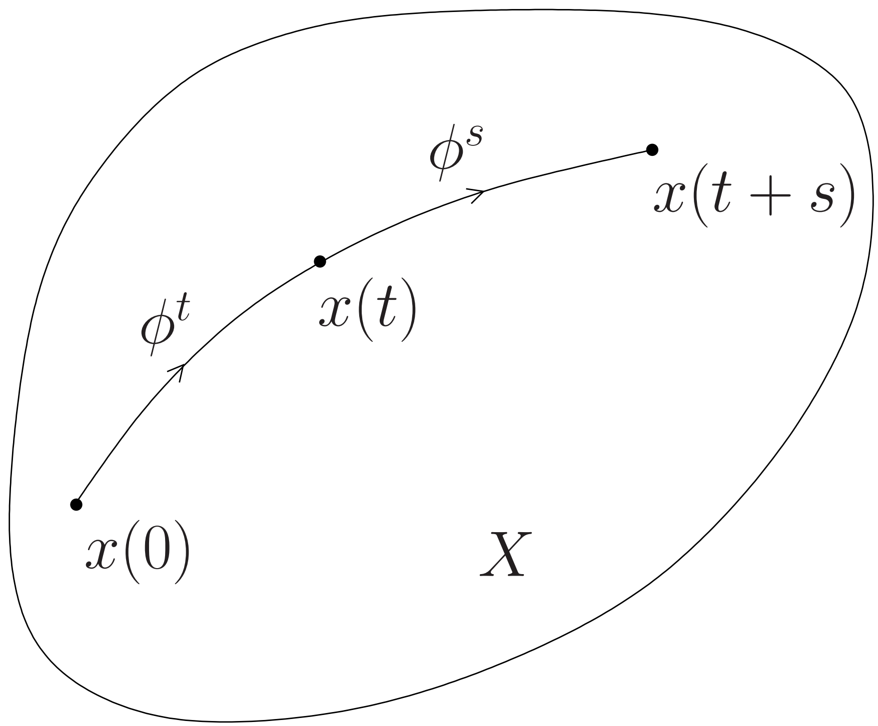
Dynamical Systems:
A bridge between pure and applied mathematics



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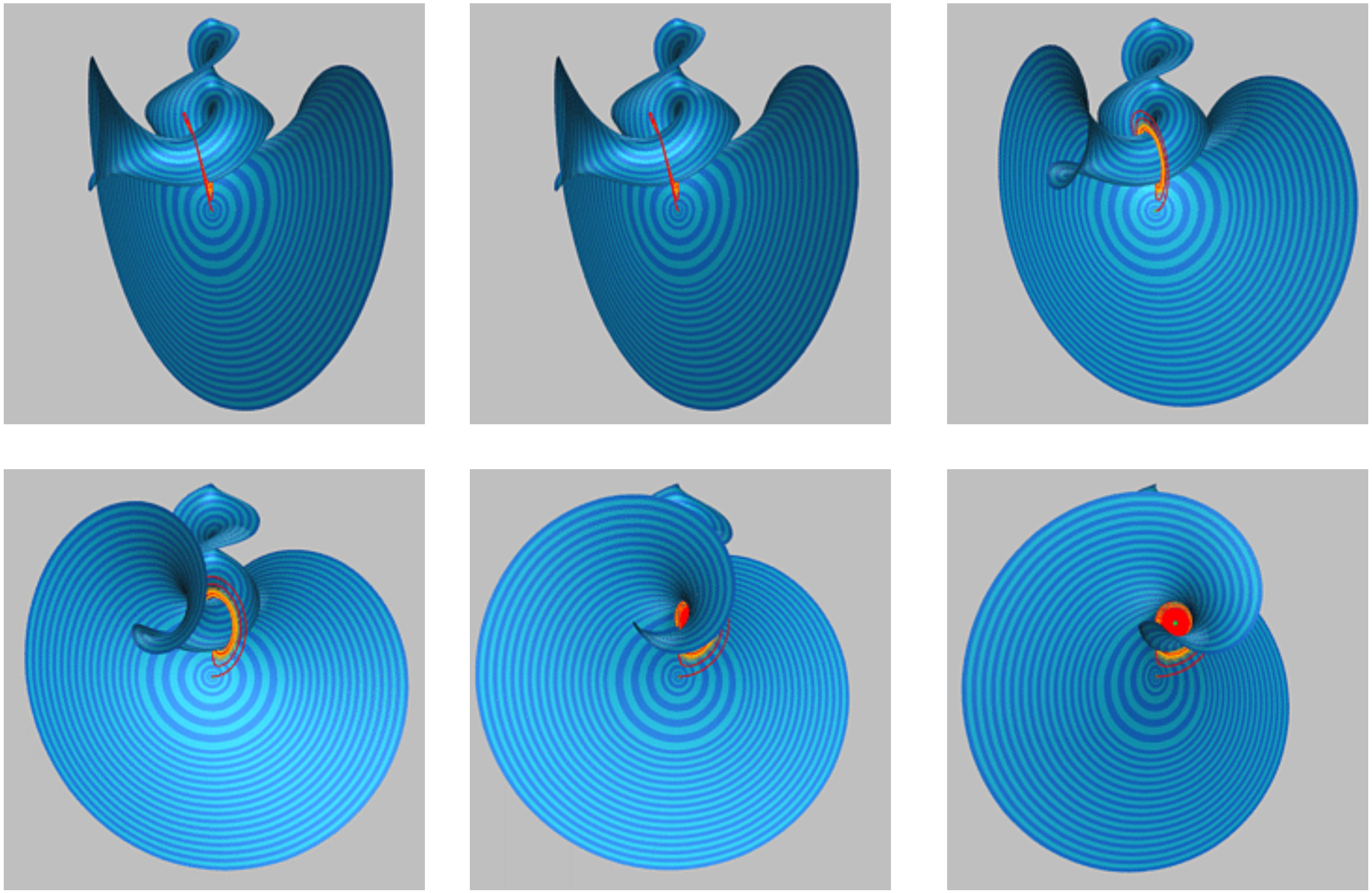
Unstable Invariant Manifold in Lorenz System



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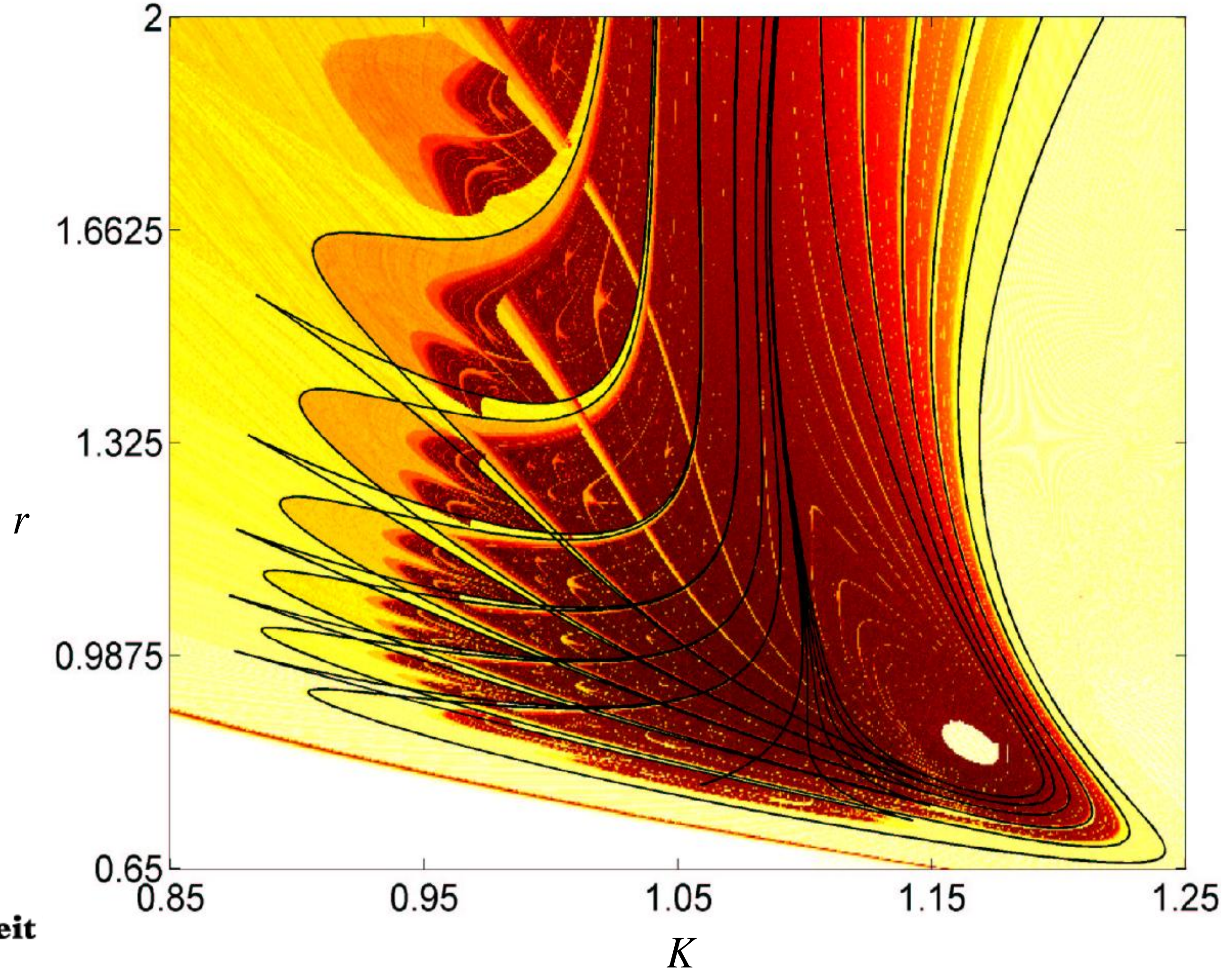
Bifurcation Diagram in Ecological Modeling



Specialization Applied Analysis

Goal:

Learn methods to study the qualitative as well as the quantitative behavior of finite- and infinite-dimensional dynamical systems.

Methods:

- asymptotic analysis (perturbation theory and averaging);
- bifurcation analysis (topological equivalence, normal forms, invariant manifolds);
- functional analysis (semi-groups of operators, dual spaces, fixed point theorems);
- numerical analysis (continuation techniques and computation of normal forms).

Expected Bachelor Program in Years 2 and 3

- Functions and Series (WISB211)
- Differential Equations (WISB231)
- Numerical Analysis (WISB251)
- Introduction to Topology (WISB243)
- Multidimensional Real Analysis (WISB212)

- Complex Analysis (WISB311)
- Functional Analysis (WISB315)
- Introduction to nonlinear dynamical systems (WISB333)
- Hamiltonian dynamical systems (WISB331)
- Measure and integration (WISB312)
- Stochastic processes (WISB362)

MasterMath Courses in Applied Analysis

- Dynamical Systems

- Functional Analysis
- Fourier Analysis and Distribution Theory
- Asymptotic Methods for Differential Equations
- Partial Differential Equations
- Infinite Dimensional Systems
- Numerical Bifurcation Analysis of ODEs and Maps
- Numerical Bifurcation Analysis of Large-Scale Systems
- Hamilton Mechanics
- Mathematical Biology
- Advanced Modelling in Science

People of Applied Analysis

Prof. **Sjoerd Verduyn Lunel** (delay equations)
Prof. **Yuri Kuznetsov [UU/UT]** (numerical bifurcation theory)
Prof. **Stephan van Gils [UT/UU]** (neuroscience)

Dr. **Martin Bootsma [UU/UMC]** (epidemiology)
Dr. **Daan Crommelin [CWI/UU]** (atmospheric research)
Dr. **Heinz Hanssmann** (Hamiltonian systems)
Dr. **Thijs Ruijgrok** (game theory, nonlinear mechanics)
Dr. **Paul Zegeling** (partial differential equations)

Prof. **Odo Diekmann** (delay equations, mathematical biology)
Prof. **Ferdinand Verhulst** (nonlinear mechanics, singular perturbations)

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Recent Master Thesis

- S. Janssens. *On a normalization technique for codimension two bifurcations of equilibria of delay differential equations* (UU 2010)
- G. Moutsinas. *Unfolding of a nilpotent equilibrium in a Hamiltonian system with 2 degrees of freedom* (UU 2011)
- P. Sarridis. *Numerical approximation of the replicator equations for the Nash bargaining game* (UU 2011)
- D. van Kekem. *Homoclinic orbits of planar maps: asymptotics and Mel'nikov functions* (UU 2013)
- R.J. Wesselink. *Synchronization of oscillators* (UU 2013)
- L. van Schaijk. *Mathematical modeling of the transmission dynamics of hepatitis B using phylogenetics* (UU 2013)

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Sample Master Thesis by H.G.E. Meijer

On the codimension two bifurcation of a fold-flip type

Hil Meijer

May 27, 2002

Supervisor : Yu. A. Kuznetsov

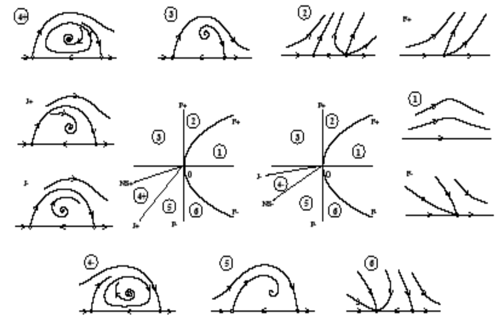

Figure 13: Vector field : Case 1. $a > 0, b > 0$

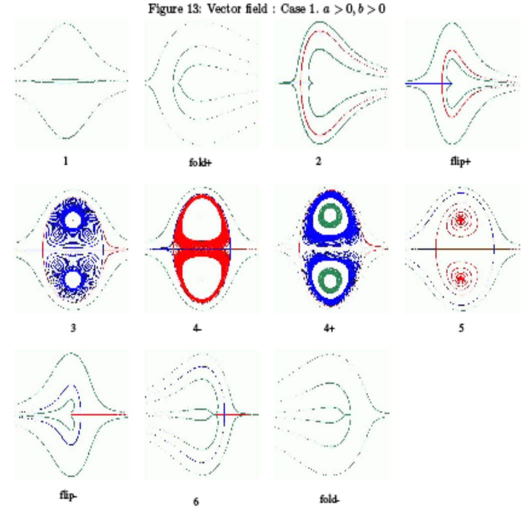

Figure 14: Map : Case 1. $a > 0, b > 0$

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Questions ?

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