Georg Gottwald, University of Sydney
Statistical properties of deterministic dynamical systems

The talk is concerned with recent results on statistical properties of deterministic dynamical systems. We will discuss the problem of finding diffusive limits in multi-scale systems. Homogenization has been widely used in stochastic model reduction of slow-fast systems, including geophysical and climate systems for several decades now. The theory relies on an infinite time scale separation. In this talk we present results for the realistic case of infinite time scale separation. In particular, we employ Edgeworth expansions as infinite size corrections to the central limit theorem and show improved performance of the reduced stochastic models in numerical simulations. In a second part we address the issue of linear response in deterministic dynamical systems. Since the works of Baladi and collaborators it is well known that simple systems such as the logistic map do not obey linear response. It is, however, widely believed that linear response theory is valid in high-dimensional systems. We present here a proof of concept based on statistical limit laws that in high-dimensional systems in which each uncoupled degree of freedom evolves according to dynamics which violates linear response, linear response theory remains valid for macroscopic observables. This is joint work with Jeroen Wouters and Caroline Wormell.

Thomas Rot, VU Amsterdam
The classification of homotopy classes of proper non-linear Fredholm mappings into a Hilbert space.

Non-linear existence problems can often be solved with topological methods. The non-vanishing of a suitable topological invariant shows the existence of solutions. One such invariant is framed cobordism: In the fifties Pontryagin showed that homotopy classes of maps from compact manifolds into spheres are in one to one correspondence with framed cobordism classes of the domain. The non-vanishing of the associated framed cobordism class shows the existence of solutions to non-linear problems and in favourable situations multiplicity questions can be attacked. In this talk I will discuss joint work with Alberto Abbondandolo where we generalize the theory to an infinite dimensional setting.

Paul Carter, University of Leiden
Reaction-Diffusion-Advection Models of Vegetation Stripes on Sloped Terrain.

Odo Diekmann, University of Utrecht
Renewal Equations and Twin Semigroups

A renewal equation is a delay equation, i.e., a rule for extending a function of time towards the future on the basis of the (assumed to be) known past. By translation along the extended function (i.e., by updating the history), one defines a dynamical system.
If for renewal equations one chooses as state-space L1, translation is continuous, but the value in one point is not defined and as a consequence changes in the rule for extension correspond to unbounded perturbations.
In ongoing joint work with Sjoerd Verduyn Lunel, we choose as state space the space of measures (represented by NBV-functions) and thus sacrifice strong continuity in order to gain a simple description of the rule for extension.
The aim of the lecture is to introduce the framework of twin semigroups of bounded linear operators on a norming dual pair of spaces, to show how renewal equations _t in this framework and to sketch how neutral equations can be covered. The growth of an age-structured population serves as a pedagogical example.

Kathrin Smetana, University of Twente
Randomized model order reduction

During the last decades (numerical) simulations based on partial differential equations have considerably gained importance in engineering applications, life sciences, environmental issues, and finance. However, especially when multiple simulation requests or a real-time simulation response are desired, standard methods such as finite elements are prohibitive. Model order reduction approaches have been developed to tackle such situations. Here, the key concept is to prepare a problem-adapted low-dimensional subspace of the high-dimensional discretization space in a possibly expensive offline stage to realize a fast simulation response by Galerkin projection on that low-dimensional space in the subsequent online stage.
In this talk we show how randomization as used say in randomized linear algebra or compressed sensing can be exploited both for constructing reduced order models and deriving bounds for the approximation error. We also demonstrate those techniques for the generation of local reduced approximation spaces that can be used within domain decomposition or multiscale methods.

Jim Portugies, TU Eindhoven
Stability of nonlinear eigenvalues for spaces with curvature bounded below

Just as on Finsler manifolds, the Laplace operator is in general nonlinear on metric measure spaces with a generalized Ricci curvature lower bound (that is, on general $CD(K,\infty)$ spaces). Because of this non-linearity, one needs to rethink the definition of eigenfunctions and eigenvalues of the Laplace operator, and the standard min-max formula will not find them anymore. For the purpose of the talk, eigenfunctions and eigenvalues are solutions to the eigenvalue equation. We show that a sequence of min-max problems with topological constraints *does* produce solutions to the eigenvalue equation. In addition, we show that the sequence of eigenvalues found in this way is stable with respect to measured Gromov-Hausdorff convergence.
This is joint work with Luigi Ambrosio and Shouhei Honda.

Janne Kool
Quantifying pollinator behaviour with Deep Learning

Automatic monitoring the number of pollinators visiting a flower is difficult because 1) flowers can mover a lot in the wind, 2) pollinators are small and vary a lot in their appearance and 3) the light changes all the time. In this talk I will give an overview of how to do this anyway, using deep learning methods.

Mark Veraar, TU Delft
Partial differential equations with noise at the boundary

In this talk I will consider the heat equation with multiplicative noise at the boundary. In the first part of the talk I will explain some new phenomena for the heat equation itself. In the second part I will connect this to a stochastic framework to study the problem with noise at the boundary.

Yuri Kuznetsov, University of Utrecht
Homoclinic saddle to saddle-focus transition with 3D leading eigenspace

Jan Bouwe van den berg, VU Amsterdam
Computer-assisted theorems in dynamics

In nonlinear analysis we often simulate dynamics on a computer, or calculate a numerical solution to a partial differential equation. This gives very detailed, stimulating information. However, it would be even better if we can be sure that what we see on the screen genuinely represents a solution of the problem. In particular, rigorous validation of the computations would allow such objects to be used as ingredients of theorems. In this talk we explore an approach based on a Newton-Kantorovich type argument in a suitable neighborhood of a numerically computed candidate. This method has been applied successfully for various problems in ordinary differential equations, delay differential equations and partial differential equations. We will illustrate the general setup using an example stemming from the Navier-Stokes equations in two dimensions. The latter is joint work in progress with Maxime Breden, Jean-Philippe Lessard and Lennaert van Veen.

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