Dynamical Systems
Systèmes dynamiques
(Org: **Arno Berger** and/et **Hao Wang** (Alberta))

ARNO BERGER, University of Alberta
Digits and dynamics - an update

This talk will present some recent results concerning the distribution of significant digits and significands, with an emphasis on data generated by dynamical processes (deterministic or random, discrete or continuous). The results are put in perspective by comparison with classical facts. Several intriguing open problems will be mentioned as they pertain to analysis, probability and number theory.

CHRISTOPHER BOSE, University of Victoria
Rigorous uniform approximation of invariant densities for interval maps

Various techniques have been developed for rigorous L^1- approximation of the invariant probability density associated to a nonsingular map T acting on a compact interval of the real line. Different discretization schemes may be used, including piecewise constant (Ulam), linear, quadratic etc. For uniform approximation, only piecewise linear or higher order schemes are applicable. We show how to establish rigorous approximations in this context. Our work is motivated by some escape rate formulae due to Keller and Liverani that are based on pointwise data for the invariant density of the associated closed system. We will explain this background.

This is joint work with Wael Bahsoun, School of Mathematics, Loughborough University.

YONGFENG LI, Universities Space Research Association
Nonlinear Oscillation and Multiscale Dynamics in a Closed Chemical Reaction

In this talk, we present the damped nonlinear oscillation and multi-scale dynamics in a closed isothermal chemical reaction system described by the reversible Lotka–Volterra model. This is a three-dimensional, dissipative, singular perturbation to the conservative Lotka–Volterra model, with the free energy serving as a global Lyapunov function. We will show that there is a natural distinction between oscillatory and non-oscillatory regions in the phase space, that is, while orbits ultimately reach the equilibrium in a non-oscillatory fashion, they exhibit damped, oscillatory behaviors as interesting transient dynamics. This is the joint work with Hong Qian and Yingfei Yi.

WILLIAM MANCE, The Ohio State University
Normal numbers with respect to the Cantor series expansions

We will discuss extending the concept of normality to the Q-Cantor series expansions by defining two notions that are equivalent for b-ary expansions: Q-normality and Q-distribution normality. Much of the theory of Q-normal numbers and Q-distribution normal numbers is similar to the classical theory of normal numbers. For example, almost every real number is Q-distribution normal and many sets of non-Q-normal or non-Q-distribution normal numbers are residual sets with full Hausdorff dimension. Surprisingly, Q-normality and Q-distribution normality are no longer equivalent. We will provide recent constructions that demonstrate this fact.

JAMES MULDOWNEY, University of Alberta
Lyapunov functions and exponential dichotomies for differential equations

This talk will discuss sufficient conditions, as well as necessary conditions, for a system of linear differential equations to have an exponential dichotomy. The criteria are expressed in terms of pairs of associated scalar functions. The approach seems to be amenable to the discussion of the behaviour of non-linear non-autonomous equations near an equilibrium. A question, recently raised by Arno Berger, about an equation whose linearization about an equilibrium has an exponential dichotomy on a compact time interval will be considered.

CECILIA GONZALEZ TOKMAN, University of Victoria
Semi-invertible Oseledets theorem for compositions

Semi-invertible multiplicative ergodic theorems provide the existence of an Oseledets splitting for cocycles of non-invertible linear operators over invertible base. We present a constructive approach to semi-invertible multiplicative ergodic theorems, and give an application to random composition of maps. This is joint work with Anthony Quas.

HAO WANG, University of Alberta
Global analysis of a stoichiometric producer-grazer model with Holling-type functional responses

Cells, the basic units of organisms, consist of multiple essential elements such as carbon, nitrogen, and phosphorus. The scarcity of any of these elements can strongly restrict cellular and organismal growth. During recent years, ecological models incorporating multiple elements have been rapidly developed in many studies, which form a new research field of mathematical and theoretical biology. Among these models, the one proposed by Loladze et al. (Bull Math Biol 62:1137-1162, 2000) is prominent and has been highly cited. However, the global analysis of this nonsmooth model has never been done. In this talk, I will provide the complete global analysis for the model with Holling type I functional response and a bifurcation analysis for the model with Holling type II functional response.