Contributed Session 5: Stability

On the stability of some stochastic differential equations

Khairia El-Said A. Abd El-Fattah El-Nadi
Alexandria University, Egypt
khairia_el_said@hotmail.com

Stochastic Volterra equations of the form:

$$dx(t) = f(x(t))dt + \int_0^t K(t-s)x(s)ds\,dt + g(x(t))dB(t),$$

are considered, where $\{B(t) : t \geq 0\}$ is standard one - dimensional Brownian motion and the kernel K decreases to zero non-exponentially. We study the convergence rate to zero of the stochastic solutions of the considered equation. It is proved under suitable conditions that :

$$\lim_{t\to\infty} \frac{|x(t)|}{K(t)} = \infty, \quad \text{almost surely.}$$

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Positive semigroups and asymptotic behaviour of structured population models

Jozsef Z. Farkas
The University of Memphis, USA
jzfarkas@gmail.com
Thomas Hagen

In the present talk we are going to discuss the asymptotic behaviour of age and size-structured population dynamical models. We present stability results and asynchronous exponential growth, as well. We would like to show the impact of positive operators but also point out what type of results can be obtained directly.

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A single localized vortex trapped in an harmonic trap in the two-dimensional approximation

Richard Kollar
University of Michigan, USA
kollar@umich.edu
Robert Pego

The existence of localized vortices in Bose-Einstein condensates was experimentally and analytically confirmed in the previous years. Although there is a large literature on their linear stability, the rigorous and complete approach to this problem is absent. We study a single localized vortex trapped in an harmonic trap in the two-dimensional approximation by the Evans function method which proved to be a robust and reliable technique for studying nonlinear eigenvalue problems. We confirm that singly-quantized vortices are linearly stable and that the linear stability of multi-quantized vortices depends on the diluteness of a condensate, with alternating intervals of stability and instability. Moreover, we propose a significant reduction of the numerical cost of the algorithm by replacing the traditional winding number calculation by using the information on the Krein signature of possible unstable eigenvalues. This allows us to extend the Evans function technique (an one-dimensional tool) to the three-dimensional case.

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A Computational model for the interaction between Tumors cell density and immune response

Sanjeev Kumar
Agra University, India
sanjeevibs@yahoo.co.in
Deepak Kumar

We consider a procedure for cancer therapy which consists of interaction between immune response (immune cells) and tumor cells without any specific drug. The cytotoxic T lymphocyte (CTL) and tumor necrosis factor (TNF) cause of the immune response. This process is modeled as a system of tumor cell density (TCD) and tumor necrosis factor (TNF). The purpose of this paper is to establish a rigorous mathematical analysis of the model and to explore the density/concentration of tumor cell and immune response (TNF). The result suggests that although TCD capable to growth of tumor but the immune response is block to direct tumor growth.

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A spectral gap mapping theorem and smooth invariant center manifolds for semilinear hyperbolic systems

Mark Lichtner
Humboldt University Berlin, Germany
lichtner@mathematik.hu-berlin.de

We prove a spectral gap mapping theorem, which characterizes exponential dichotomy in a Banach space of continuous functions for a general class of semilinear

hyperbolic systems of first order PDEs in one space dimension: A spectral gap of the generator of the linearized semigroup is mapped exponentially to a spectral gap of the linearized semigroup and vice versa. This resolves a key problem in applying invariant manifold theory to semilinear hyperbolic systems. A consequence is, that smooth center manifolds exist under simple and commonly verifiable spectral conditions on the linearized hyperbolic system. We give applications to semiconductor laser dynamics, Turing models with correlated random walk and neutral delay equations.

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Deterministic Dynamics in Questionnaires in Social Sciences

Charles lebon Mberi kimpolo
School of Computational and Applied Mathematics, University of the Witwatersrand , So Africa
mcharleslebon@yahoo.fr
David Sherwell

We translate a questionnaire into a sequence of "Yes/No" replies, or "$0/1$" digits. Such a sequence is a point in mathematical sequence space Σ. A longitudinal questionnaire is then a point that evolves in Σ. Distances can be defined in this space and the point jumps in Σ. We have developed a mathematical apparatus to analyse this abstract motion and to map the abstract space to the real line and other planes. If the motion is random then one can apply a diffusion equation. We will apply these ideas in demographic studies. To illustrate, migration is not well-modelled by a diffusion process because individuals do not random walk, geographically. Yet their social conditions as revealed by a questionnaire may random walk. Then the deterministic equation of applied mathematic might apply. As formulated above, we will extend formulation and apply to real demographic data.

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Global asymptotic stability of the Goodwin system with repression

Luis Sanchez
Universidad Politecnica de Cartagena, Spain
luis.sanchez@upct.es

The Goodwin system is a model for some processes of protein systhesis in cells. We provide a criterion for the global asymptotic stability of the system in the ODE case. The main tools are Poincar??-Bendixson properties of the flow and the monotocity of some associated linear systems.

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