

Special Session 7: Nonautonomous Dynamical Systems and Applications

Roberta Fabbri, Universita' di Firenze, Italy
Carmen Nunez, Universidad de Valladolid, Spain

Generalized dynamical systems and ordinary differential equations

Zhivko Athanassov
Bulgarian Academy of Sciences, Bulgaria
zhivko@math.bas.bg

Abstract systems, called generalized dynamical systems (g.d.s.), which can be used to describe the topological properties of solutions of nonautonomous systems of ordinary differential equations are introduced. Basic properties of these systems are studied. Sufficient conditions for existence of recurrent and almost periodic orbits of g.d.s. are obtained. The proved results on g.d.s. are applied to the study of nonlinear nonautonomous ordinary differential equations.

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Schrödinger operators with potentials generated by the skew-shift

David Damanik
Rice University, USA
david.damanik@yahoo.com

We discuss the main conjectures for Schrödinger operators with potentials generated by the skew-shift and related recent results.

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Numerical techniques for exponential dichotomy

Cinzia Elia
University of Bari, Italy
elia@dm.uniba.it
Luca Dieci

We propose numerical techniques to establish exponential dichotomy on the whole line. To do so together with the exponential dichotomy on the positive and negative half line, we will also need to approximate stable and unstable subspace. An application to the orbital stability of travelling waves will be presented as well.

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Spectral theory and dynamical systems

Alex Haro
Universitat de Barcelona, Spain
alex@maia.ub.es
Rafael de la Llave

In this talk we study spectral properties of transfer operators defined from vector bundle maps, acting in vector fields of different regularities. This study has been motivated, among other problems, by the study of the regularity of invariant graphs of non-autonomous dynamical systems. We put special emphasis to vector bundle maps defined over irrational rotations, that arise in the study of invariant tori in quasi-periodically forced dynamical systems.

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Derivatives of the Evans function

Y. d. Latushkin
University of Missouri-Columbia, USA
latushkiny@mizzou.edu

We will discuss some new results regarding the derivatives of the Evans function. In particular, an infinite dimensional Evans function will be discussed.

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Uniform Szego cocycles over strictly Ergodic subshifts

Daniel Lenz
Technische Universität Chemnitz, Germany
dlenz@mathematik.tu-chemnitz.de
David Damanik

We consider ergodic families of Verblunsky coefficients generated by minimal aperiodic subshifts. These give rise to certain random CMV matrices. We show that the associated probability measures on the unit circle have essential support of zero Lebesgue measure if the underlying subshift satisfies Boshernitzan's condition. This is accomplished by relating the essential support to uniform convergence properties of the corresponding Szego cocycles

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Asymptotic behavior of periodic evolution equations

Nguyen Minh

University of West Georgia, USA
vnguyen@westga.edu

In this talk we present a new transform of functions on the line that leads to a new concept of spectrum of bounded functions. The main purpose of the talk is to show how this transform can be used to study the spectrum of bounded solutions of periodic evolution equations and their behavior such as almost periodicity. Extensions of previous results on the existence of almost periodic or bounded solutions are obtained.

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A dynamical theory for monotone neutral functional differential equations

Rafael Obaya

Universidad de Valladolid, Spain
rafoba@wmatem.eis.uva.es

Victor Muoz and Sylvia Novo

We study the monotone skew-product semiflow generated by a family of neutral functional differential equations with infinite delay and stable D-operator. The stability properties of D allows us to introduce a new order and to take the neutral family to a family of functional differential equations with infinite delay. We establish the 1-covering property of the omega limit sets under the componentwise separating property and the uniform stability of the trajectories.

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The structure of attractors in non-autonomous perturbations of gradient systems

James Robinson

University of Warwick, England
j.c.robinson@warwick.ac.uk

A Carvalho, J A Langa, A Suarez, A Vidal-Lopez

A gradient system has an attractor that is the union of the unstable manifolds of the equilibrium points. We show that this structure is preserved under small non-autonomous perturbations of the equation.

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Omega-limit sets in non-autonomous infinite delay FDEs

Ana Sanz

Universidad de Valladolid, Spain
anasan@wmatem.eis.uva.es

Sylvia Novo and Rafael Obaya

The study of the structure of omega-limit sets is an important issue in dynamical systems. In the field of monotone dynamical systems the major result says that, if the dynamical system is strongly monotone, then there is generic convergence of precompact orbits to the set of equilibria. When considering non-autonomous dynamical systems, equilibria are translated into the so-called copies or one-coverings of the base flow. Nevertheless, the corresponding result of generic convergence of precompact orbits to one of these sets fails to hold in general. During the last 20 years additional conditions have been imposed in order to guarantee that every precompact orbit does converge to a copy of the base. In this talk we present the one-covering property for omega-limit sets in monotone infinite delay FDEs under a componentwise separating property and uniform stability of semiorbits. In this way we extend a recent result for finite delay FDEs by Jiang and Zhao (2005) to the infinite delay case.

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Some remarks on a class of strangeness free differential-algebraic equations

Marco Spadini

University of Florence, Italy
marco.spadini@math.unifi.it

It is well known that strangeness free differential algebraic equations (DAEs) are equivalent to ODEs on differentiable manifolds. We consider strangeness free DAEs in semi-explicit form and, in the autonomous (C^1) case, we obtain a formula for the computation of the fixed point index of the flow induced on the underlying manifold. We apply this result to the study of the set of harmonic solutions to periodic perturbations of such an equation, proving the existence of a co-bifurcating branch of harmonic solutions.

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The error in QR integration and some applications

Erik Van vleck

University of Kansas, USA

erikvv@ku.edu

We consider the error in approximating continuous QR factorizations of fundamental matrix solutions of linear ODEs. An error analysis is presented where the global error in the orthogonal change of variables Q is determined chiefly by the local error in approximating Q , the non-normality in the upper triangular factor R , and integral separation. Applications will be presented on the approximation of Lyapunov exponents and Sacker-Sell spectrum for ODEs and on inertial manifolds, dichotomies for some linear Schrodinger operators, and the embedding of dissipative lattice differential equation in inhomogeneous reaction-diffusion PDEs. This talk respresents joint work with Luca Dieci, Mike Jolly, Weishi Liu, Ricardo Rosa, and Arnd Scheel.

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Asymptotic symmetry in monotone skew-product semiflows with applications

Yi Wang

University of Science & Technology of China, China
Georgia Institute of Technology, China
wangyi@ustc.edu.cn; ywang@math.gatech.edu

This talk is mainly concerned with the asymptotic symmetry of the monotone skew-product semiflows under a group action. It is shown that any stable minimal set is residually symmetric and any uniformly stable bounded trajectory is asymptotically symmetric. These results are then applied to study the spatio-temporal asymptotics of stable solutions of reaction-diffusion equations on a symmetric domain in time recurrent structures including almost periodicity and almost automorphy. In particular, the 1-covering property of omega limit sets is established for uniformly stable bounded solutions of R-D equations on a ball.

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On K-dV and Camassa-Holm hierarchies

Luca Zampogni

Università di Perugia, Italy
zampogni@math.unifi.it

By using a zero-curvature method one can find hierarchies of commuting equations containing the well-known K-dV and Camassa-Holm (CH) equations. We find solutions for all the equations in the hierarchies when the initial condition belongs to a class of reflectionless potentials of Sturm-Liouville type, i.e. when they determine an equation of the form $-(p\varphi)' + q\varphi = \lambda y\varphi$ for which the associated Green's function $G(\lambda)$ has positive real part almost everywhere in the spectrum Σ .

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Compact kernel sections of non-autonomous lattice systems

Shengfan Zhou

Shanghai Normal University, China
sfzhou@shnu.edu.cn

We first present a set of sufficient and necessary conditions for the existence of globally attractive kernel sections for processes defined on a general Banach space and a weighted space ℓ_p^p of infinite sequences ($p \geq 1$), respectively. Then we establish a criteria for finite fractal dimensionality of a family of compact subsets of a Hilbert space, and apply it to obtain an upper bound of fractal dimension of compact kernel sections to first order non-autonomous lattice reaction-diffusion systems. Finally we consider the upper semi-continuity of kernel sections of general first order non-autonomous lattice systems.

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