INTERNATIONAL WORKSHOP ON

DIFFERENTIAL AND DIFFERENCE EQUATIONS:
Theory, Numerics and Applications

Hanoi and Halong, *29-31 October, 2009*

Main sponsors: Asia Reseach Center, VNU-Hanoi, and Hanoi University of Science

SCIENTIFIC PROGRAM & ABSTRACTS

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Final Announcement

Main sponsors: Asia Reseach Center, VNU-Hanoi, and Hanoi University of Science

Workshop venue: Hanoi University of Science Campus and Ha Long City

Topics:

- *Ordinary differential and differential-algebraic equations*
- *Difference equations*
- *Partial differential equations*
- *Stochastic differential equations*
- *Dynamical systems*
- *Numerical methods and simulations*
- *Modelling, scientific computation and applications, etc*

Scientific program committee: Nguyen Huu Du (Chair), Vu Hoang Linh, Pham Ky Anh, Nguyen Huu Cong, Hoang Quoc Toan, Nguyen Dinh Cong, Dinh Nho Hao

Local organizing committee: Vu Hoang Linh (Chair), Le Cong Loi, Nguyen Thi Hong Minh, Le Huy Chuan, Vu Cong Bang, Nguyen Trong Hieu, Vu Tien Dung

Invited speakers (confirmed): ***Keonhee Lee*** (Chungnam University, Korea), ***Manseob Lee*** (Mokwon University in Daejeon, Korea), ***Noboru Okazawa*** (Tokyo University of Science, Japan), ***Louis Chen*** (National University of Singapore, Singapore), ***Duong Minh Duc*** (Vietnam National University, Ho Chi Minh City), ***Nguyen Khoa Son*** (Institute of Mathematics, Hanoi), ***Mai Duc Thanh*** (Vietnam National University, Ho Chi Minh City), ***Nguyen Thieu Huy*** (Hanoi University of Technology), ***Dang Duc Trong*** (Vietnam National University, Ho Chi Minh City), ***Hoang Quoc Toan*** (Vietnam National University, Hanoi), ***Luu Hoang Duc*** (Institute of Mathematics, Hanoi), ***Nguyen Manh Hung*** (Hanoi University of Education, Hanoi)

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SCIENTIFIC PROGRAM

1st Day (Thu, 29.10), HUS Campus - Hanoi:

Meeting Room 418, Building T1, 334, Nguyen Trai, Thanh Xuan, Hanoi

08.00-08.30: **Registration**

08.30-08.45: **Opening Ceremony**

Chair: Nguyen Huu Du

08.45-09.15: **Keonhee Lee** (Chungnam University, Korea):
Global Dynamics Beyond Uniform Hyperbolicity

09.15-09.35: **Manseob Lee** (Mokwon University in Daejeon, Korea):
Diffeomorphisms with C^1-stably average shadowing

09.35-09.55: **Chuanjen Chyan** (Tamkang University, Taiwan):
On data-dependence of exponential stability and stability radii for linear time-varying differential-algebraic systems

09.55-10.15: **Vu Hoang Linh** (Vietnam National University, Hanoi):
Stability radii for linear time-varying differential-algebraic equations with respect to dynamic perturbations

10.15-10.25: **Coffee break**

Chair: Keonhee Lee

10.25-10.45: **Nguyen Huu Du** (Vietnam National University, Hanoi):
Stability radii of differential algebraic equations with structured perturbations

10.45-11.05: **Luu Hoang Duc** (Institute of Mathematics, Hanoi):
Hyperbolicity and invariant manifolds for planar nonautonomous systems on finite time intervals

10.05-11.25: **Khosro Tajbakhsh** (Chungnam University, Korea):
C^1-Generic Diffeomorphisms with Specification Property

11.25-11.45: **Le Huy Tien** (Chungnam University, Korea):
Hyperbolicity of Chain Components and Homoclinic Classes for C^1-Vector Fields

11.45-12.05: **Nguyen Quoc Tuan** (Le Quy Don Technical University):

Maximal stability bound for generalized singularly perturbed systems

12.05: **Travel by bus to Ha Long City (lunch will be organized during the trip)**

2^{nd} Day (Fri, 30.10), Halong: Conference Hall, Cong Doan Hotel

Chair: Pham Ky Anh

08.30-09.00: **Noboru Okazawa** (Tokyo University of Science, Japan):
Linear evolution equations of hyperbolic type in Hilbert space with applications to symmetric hyperbolic systems

09.00-09.20: **Nguyen Khoa Son** (Institute of Mathematics, Hanoi):
Stability radii of positive linear systems under affine parameter perturbations in infinite dimensional spaces

09.20-09.40: **Do Duc Thuan** (Hanoi University of Technology):
Controllability radius of linear systems under structured perturbations

09.40-10.00: **Nguyen Thieu Huy** (Hanoi University of Technology):
Exponentially dichotomous generators of evolution bisemigroups and perturbations

10.00-10.20: **Vu Tien Dung** (Vietnam National University, Hanoi):
Fully parallel methods for a class of linear partial differential-algebraic equations

10.20-10.30: **Coffee break**

Chair: Nguyen Van Mau

10.30-10.50: **Duong Minh Duc** (Vietnam National University,HCM):
Global eigenvalue-crossing and multiplicity of solutions to elliptic equations

10.50-11.10: **Mai Duc Thanh** (Vietnam National University,HCM):
Admissible shock waves and traveling waves of conservation laws with diffusion and dispersion coefficients

11.10-11.30: **Hoang Quoc Toan** (Vietnam National University, Hanoi):
Existence of solutions for a resonant problem under Landesman-Lazer conditions

11.30-11.50: **Nguyen Manh Hung** (National U. of Education):
Cauchy-Neumann problem for the hyperbolic systems in

cylinders with base containing conical points

11.50-12.10: **Le Cong Loi** (Vietnam National University, Hanoi):
On multipoint boundary value problems for higher index linear singular autonomous systems of difference equations

12.10: **Lunch break**

Chair: Nguyen Huu Cong

14.00-14.30: **Louis Chen** (National University of Singapore):
From Stein identities to moderate deviations

14.30-14.50: *Nguyen Duy Tien* (Vietnam National University, Hanoi):
Probability measures with big kernels

14.50-15.10: **Nguyen Trong Hieu** (Vietnam National University, Hanoi):
Evolution of predator-prey systems described by a Lotka-Volterra equation under random environment

15.10-15.30: **Nguyen Thanh Chung** (Vietnam National University, Hanoi):
On some semilinear elliptic problems with singular potentials involving symmetry

15.30-15.50: **Nguyen Van Mau** (Vietnam National University, Hanoi):
On a class of singular integral equations with the linear fractional Carleman shift and the degenerate kernel

15.50-16.00: **Coffee break**

Chair: Duong Minh Duc

16.00-16.20: **Vu Thai Luan** (Institute of Information Technology, Hanoi):
On Domain Decomposition Techniques for numerical solving of partial differential equations

16.20-16.40: **Cao Van Chung** (Vietnam National University, Hanoi):
Parallel iterative regularization methods for solving systems of ill-posed equations

16.40-17.00: **Phan Thanh Nam** (Quy Nhon University):
Robust stabilization of linear systems with delayed state and control

17.00-17.20: **Nguyen Hai Dang** (Vietnam National University, Hanoi):
On boundary value problems for dynamic systems on time scales

17.20-17.40: **Nguyen Thanh Dieu** (Vinh University):

Stability criteria for dynamic systems on time scales

19.30: **Workshop dinner**

3^{rd} Day (Sat, 31.10), Halong: Conference Hall, Cong Doan Hotel

Chair: Louis H. Y. Chen

08.30-09.00: **Pham Ky Anh** (Vietnam National University, Hanoi):
Stability of a class of singular difference equations

09.00-09.20: **Ha Thi Ngoc Yen** (Hanoi University of Technology):
Floquet theorem for linear implicit nonautonomous difference systems

09.20-09.40: **Shangwen Lin** (Tamkang University, Taiwan):
Positive Solutions of Three-Point Boundary Value Problems for Third-Order Differential Equations on Time Scales

09.40-10.00: **Le Dinh Dinh** (Vietnam National University, Hanoi):
Measure chains and time scales

10.00-10.20: **Nguyen Chi Liem** (Vietnam National University, Hanoi):
Dynamic inequalities on time scales

10.20-10.30: **Coffee break**

Chair: Chuanjen Chyan

10.30-10.50: **Nguyen Huu Cong** (Vietnam National University, Hanoi):
Improved parallel-iterated pseudo two-step RK methods for nonstiff IVPs

10.50-11.10: **Nguyen Van Minh** (Thai Nguyen University):
Improved parallel-iterated pseudo two-step RKN methods for nonstiff problems

11.10-11.30: **Nguyen T. H. Minh** (Vietnam National University, Hanoi):
Parallel-iterated pseudo two-step Runge-Kutta-Nystrm methods for nonstiff second-order IVPs

11.30-11.40: **Nguyen Van Hung** (Hanoi Pedagogical University N02):
Regularized Seidel-Newton method and nonlinear problems at resonance

11.40-12.00: **Ta Duy Phuong** (Institute of Mathematics):
Unbounded components in the solution sets of strictly quasiconcave vector maximization problems

12.00-12.20: **Vu Cong Bang** (Vietnam National University, Hanoi):
Some remarks on stability in periodic multi-wavelet

decompositions

12.20: **Lunch break**

15.00: **Travel back to Hanoi by bus**

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ABSTRACTS

Stability of a class of singular difference equations

Pham Ky Anh
Department of Mathematics, Vietnam National University, Hanoi

Abstract. The aim of this talk is to apply Lyapunov functions to obtain some necessary and sufficient conditions for the stability of singular nonautonomous difference equations.

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Some remarks on stability in periodic multi-wavelet decompositions

Vu Cong Bang
Department of Mathematics, Vietnam National University, Hanoi

Abstract. "L^p-stability" of a set of functions $\{f_i\}$ means that $\|\sum c_i f_i\|_p$ is comparable to $(\sum |c_i|^p)^{1/p}$. Let ϕ_k^j $(1 \le j \le n,\ k \in \mathbb{Z})$ be functions on $\mathbb{T} = \mathbb{R}/2\pi\mathbb{Z}$ and let $\phi_{k,s}^j(x) = \phi_k^j(x - 2\pi s/2^k)$ for $0 \le s < 2^k$. The authors give necessary and sufficient conditions for $\{\phi_{k,s}^j\}$ to be L^p-stable provided that it is an orthogonal set. In case $\phi_k^j(x) = \sum_m \psi^j(2^k(x-2\pi m))$ where ψ^j is compactly supported on $\mathbb{R}$, the authors also relate the L^p-stability of $\{\phi_{k,s}^j\}$ to the L^p-stability of $\{\psi_s^j \colon 1 \le j \le n,\ s \in \mathbb{Z}\}$ where $\psi_s^j(x) = \psi^j(x - 2\pi s)$.

From Stein identities to moderate deviations

Louis H. Y. Chen
National University of Singapore

Abstract. Unlike the classical method for probability approximations, Steins method does not rely on Fourier analysis but on the solution of a functional equation which may be a differential equation, a difference equation or an integral equation. Central to Steins method is the construction of Stein identities. In this talk I will begin with a discussion on Steins method and ways of constructing Stein identities, with illustrations from a number of examples including the zero-biased coupling, the binary expansion of a random integer, the anti-voter model, and the Curie-Weiss model. I will then present a Cramer-type moderate deviation result based on a fairly general Stein identity and apply the result to the four examples mentioned above. This talk is based on a joint work with Xiao Fang and Qi-Man Shao.

Parallel iterative regularization methods for solving systems of ill-posed equations

Cao Van Chung
Department of Mathematics, Vietnam National University, Hanoi

Abstract. In this note two parallel iterative regularization methods for finding a minimal-norm solution to a system of ill-posed equations involving the so-called strongly-inverse monotone operators have been investigated. Some applications of the proposed methods are considered and numerical experiments are discussed.

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On some semilinear elliptic problems with singular potentials involving symmetry

Nguyen Thanh Chung
Department of Mathematics, Vietnam National University, Hanoi

Abstract. Using varational techniques, we deal with the existence and multiplicity of solutions for semilinear elliptic problems of the form

$$\begin{cases} -\Delta u &= \dfrac{\mu}{|x|^2} + f(x,u) \quad \text{in } \Omega, \\ u &= 0 \quad \text{on } \partial\Omega, \end{cases}$$

where $\Omega = \Omega_1 \times \Omega_2 \subset \mathbb{R}^N (N \geq 5)$ is a bounded domain having cylindrical symmetry, $\Omega_1 \subset \mathbb{R}^m$ is a bounded regular domain and Ω_2 is a k dimensional ball of radius R, centered in the origin and $m + k = N$, and $m \geq 2$, $k \geq 3$, $0 \leq \mu < \mu^* = \Big(\dfrac{N-2}{2}\Big)^2$.

On data-dependence of exponential stability and stability radii for linear time-varying differential-algebraic systems

Chuanjen Chyan
Department of Mathematics, Tamkang University, Taiwan

Abstract. This report addresses some questions concerning exponential stability and its robustness measure for linear time-varying differential-algebraic systems of index 1. First, the Bohl exponent theory, which is well known for ordinary differential equations, is extended to differential-algebraic equations. Then, we investigate how the Bohl exponent and the stability radii with respect to dynamic perturbations for a differential-algebraic system depend on the system data.

Improved parallel-iterated pseudo two-step RK methods for nonstiff IVPs

Nguyen Huu Cong
Graduated School, Vietnam National University, Hanoi

Abstract. In this talk several parallel predictor-corrector methods are considered. They are pseudo two-step fourth-, fifth- and sixth-order explicit Runge-Kutta methods for solving first-order nonstiff initial value problems. However, in a similar way many other schemes can be derived with high order.

We also study the consistency of the methods, zero and absolute stability in a general way and later for the particular case of the methods proposed.

Finally, they compare these methods with other well-known sequential (DOPRI5 and DOP853) and parallel (PIRK) methods with good results in three numerical examples.

As the authors say, the methods use constant step-length and they will pursue the study of variable stepsize control in future works.

On boundary value problems for dynamic systems on time scales

Nguyen Hai Dang
Department of Mathematics, Vietnam National University, Hanoi

Abstract. This talk, we shall discuss existence and uniqueness of solutions of two point boundary value problems. The properties of the Greeen's matrix shall be also studied. First, we shall establish the existence and uniqueness solutions to two-point boundary value problems on an in-homogeneous time scale of a system of the linear dynamic process by utilizing the variation of parameters formula. The solution is obtained as an integral representation of Green's matrix and the properties of the Green's matrix are also studied.

Stability criteria for dynamic systems on time scales

Nguyen Thanh Dieu
Department of Mathematics, Vinh University

Abstract. As is well known, we can develop qualitative behavior of solution of differential systems as well as difference equations by employing Lyapunov like functions and the theory of corresponding inequalities. In this report, we shall investigate stability criteria by utilizing Lyapunov's method suitably in the framework of the comparison principle. We shall prove necessary comparison results in terms of Lyapunov like functions using the calculus of functions on time scales appropriatelly. Next, stablity criteria which include representative theorems analogous to Lyapunov's theorems as well as general results exploiting comparison principle have been studied.

Stability radii of differential algebraic equations with structured perturbations

Nguyen Huu Du
Department of Mathematics, Vietnam National University, Hanoi

Abstract. This report deals with the behavior of the differential algebraic equation

$$A\,X'(t) - B\,X(t) = 0 \tag{1}$$

($X(t) \in \mathbb{R}^m$, $A, B \in \mathbb{K}^{m\times m}$, $\mathbb{K} = \mathbb{R}$ or $\mathbb{C}$) under structured perturbations of the form

$$A\,X'(t) - (B + E\,\Delta\,F)\,X(t) \;=\; 0, \tag{2}$$

where the matrices $E \in \mathbb{K}^{m\times p}$ and $F \in \mathbb{K}^{q\times m}$ are fixed, and $\Delta \in \mathbb{K}^{p\times q}$ is arbitrary. Assuming that (1) is asymptotically stable, the author studies the stability radius $d_{\mathbb{K}} = \inf\{\|\Delta\| : \Delta \in \mathbb{K}^{p\times q}\}$ and (2) is irregular or unstable$\}$. In particular, he obtains that

$$d_{\mathbb{C}} = \left[\sup_{s\in i\mathbb{R}} \left\|F\,(s\,A - B)^{-1}E\right\|\right]^{-1},$$

and that there is an optimal Δ such that $\|\Delta\| = d_{\mathbb{C}}$ if and only if the norm $\|F\,(s\,A - B)^{-1}E\|$ reaches its maximum value on $i\mathbb{R}$. He also gives a characterization of the above stability radius formula for the differential algebraic equation, and provides sufficient conditions under which the complex stability radius and the real stability radius are equal.

Global eigenvalue-crossing and multiplicity of solutions to elliptic equations

Duong Minh Duc
Department of Mathematics and Computer Science,
University of Science , Hochiminh City

Abstract. We introduce the concept of global eigenvalue-crossing and use it to study the problem on multiple solutions of asymptotically linear elliptic equations

$$\Delta u + f(x,u) = 0$$

involving $(S)_+$ operators. Our method can be applied to the case that $\dfrac{f(x,u)}{u}$ globally but not pointwise crosses any λ_i for any x in a part of Ω when u varies from $-\infty$ to ∞, that is, $\dfrac{f(x,u)}{u}$ may not cross any λ_i for every x in this part and $\lim\limits_{u\to\infty}\dfrac{f(x,u)}{u}$ may be equal to some λ_j for every x in another part of Ω.

Hyperbolicity and invariant manifolds for planar nonautonomous systems on finite time intervals

Luu Hoang Duc
Ha Noi Institute of Mathematics, 18 Hoang Quoc Viet street, Ha Noi
Stefan Siegmund
Institute of Analysis, Department of Mathematics, TU Dresden, 01062 Dresden, Germany

Abstract. The method of invariant manifolds was originally developed for hyperbolic rest points of autonomous equations. It was then extended from fixed points to arbitrary solutions and from autonomous equations to nonautonomous dynamical systems by either the LyapunovPerron approach or Hadamard's graph transformation.

We go one step further and study meaningful notions of hyperbolicity and stable and unstable manifolds for equations which are defined or known only for a finite time, together with matching notions of attraction and repulsion. As a consequence, hyperbolicity and invariant manifolds will describe the dynamics on the finite time interval.

We prove an analog of the Theorem of Linearized Asymptotic Stability on finite time intervals, generalize the OkuboWeiss criterion from fluid dynamics and prove a theorem on the location of periodic orbits. Several examples are treated, including a double gyre flow and symmetric vortex merger.

Fully parallel methods for a class of linear partial differential-algebraic equations

Vu Tien Dung
Department of Mathematics, Vietnam National University, Hanoi

Abstract. This note deals with two fully parallel methods for solving linear partial differential-algebraic equations (PDAEs) of the form:

$$Au_t + B\Delta u = f(x,t)$$

where A is a singular, symmetric and nonnegative matrix, while B is a symmetric positive define matrix. The stability and convergence of proposed methods are discussed. Some numerical experiments on high-performance computers are also reported.

Keywords: Differential-algebraic equation (DAE), partial differential-algebraic equation (PDAE), nonnegative pencil of matrices, parallel method

Measure chains and time scales

Le Dinh Dinh
Department of Mathematics, Vietnam National University, Hanoi

Abstract. In recent times, theory of difference equations has assumed a greater importance. Although there is a striking duality between the theories of differential equations and difference equations, the theory of difference equations is a lot richer than the corresponding theory of differential equations, and often demands additional assumptions to overcome the topological deficiency of lacking connectedness. None the less, it is natural to seek a framwork which permits us to handle both dynamic systems simultaneously in order to get better insight and understanding of the subtle differences of the two systems. Recently developed theory of dynamic systems on time scales provides the desired unified approach. In this report, we shall develop systematically the calculus on time scales to investigate the fundamental theory of dynamic systems on time scales as well as some qualitative properties of soultions.

Evolution of predator-prey systems described by a Lotka-Volterra equation under random environment

Nguyen Trong Hieu
Department of Mathematics, Vietnam National University, Hanoi

Abstract. In this report, we consider the evolution of a system composed of two predator-prey deterministic systems described by Lotka-Volterra equations in random environment. It is proved that under the influence of telegraph noise, all positive trajectories of such a system always go out from any compact set of $\operatorname{int}\mathbb{R}^2_+$ with probability one if two rest points of the two systems do not coincide. In the case where they have the rest point in common, the trajectory either leaves from any compact set of $\operatorname{int}\mathbb{R}^2_+$ or converges to the rest point. The escape of the trajectories from any compact set means that the system is neither permanent nor dissipative.

Exponentially dichotomous generators of evolution bisemigroups and perturbations

Nguyen Thieu Huy
Faculty of Applied Mathematics and Informatics,
Hanoi University of Technology

Abstract. We will talk about the relation of dichotomies of evolutions families and that of related operators. Concretely, to an evolution family $\mathcal{U} = \big(U(t,s)\big)\ t \geq s \geq 0$ of bounded operators on a Banach space X and through the integral equation

$$u(t) = U(t,s)u(s) + \int_s^t U(t,\xi)f(\xi)d\xi,$$

we associate an operator G_Z acting on Banach spaces of X-valued functions corresponding to admissible Banach function spaces. These spaces contain the Lp spaces ($1 \leq p < \infty$), the Lorentz spaces $L_{p,q}$ and many other function spaces occurring in interpolation theory. We will show that the exponential dichotomy of U is equivalent to the exponential dichotomy of the operator G_Z generating a bisemigroup $\big(T(t)\big)_{t\in\mathbb{R}}$. We also prove that the exponential dichotomy of G_Z is robust under small perturbations by bounded operators. This leads to applications to vector-valued Wiener-Hopf and to Riccati equations. This is a joint work with Professor Nagel from university of Tuebingen.

Cauchy-Neumann problem for the hyperbolic systems in cylinders with base containing conical points

Nguyen Manh Hung
Department of Mathematics, HaNoi National University of Education

Abstract. The goal of this paper is to establish the existence, uniqueness and regularity of solutions of Cauchy-Neumann problem for the hyperbolic systems in cylinders with base containing conical points.

Regularized Seidel-Newton method and nonlinear problems at resonance

Nguyen Van Hung
Department of Mathematics, Hanoi Pedagogical University $N^0 2$, Hanoi

Abstract. The talk is devoted to a modification of the Seidel-Newton (SN) method for the solution of the nonlinear equation $Ax + F(x) = 0$, when $QF'(x)$ is a singular operator. Here A is a linear and F is a nonlinear operator acting on the pair of Hilbert spaces X, Y. Using the idea of iterative regularization the authors construct the regularized variant of the SN method (RSN)

$$u_{n+1} = -\hat{A}^{-1}P(x_n),\ \overline{x}_n = u_{n+1} + v_n,$$

$$v_{n+1} = v_n - [QF'(\overline{x}_n)]^*[QF'(\overline{x}_n)] + \alpha_n I^{-1} \times [QF'(\overline{x}_n)]^*[QF(\overline{x}_n)] + \alpha_n(v_n - v^o),$$

$x_{n+1} = v_{n+1} + v_{n+1}$, where $P(Q)$ is the projection in $Y_1 = \operatorname{Im} A (Y_2 = Y \ominus Y_1)$, $\hat{A}$ is the restriction of A to $X_1 = X \ominus \operatorname{Ker} A$. The local convergence theorem for the RSN is proved and an application to a boundary-value.

Global Dynamics Beyond Uniform Hyperbolicity

Keonhee Lee
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Abstract. Uniformly hyperbolic systems are nowadays fairly well understood, both from the topological and the ergodic point of view. Outside the hyperbolic domain, two main phenomena occur: homoclinic tangencies and cycles involving saddles with different indices. Homoclinic classes and chain compoments are the natural candidates to replace hyperbolic basic sets in non-hyperbolic theory. Several recent papers explore their hyperbolic-like properties, many of which hold only for generic dynamical systems. In this talk, we study how a C^1-robust dynamic property (i.e. a property that holds for a system and all C^1 nearby ones) on the underlying manifold would influence the behavior of the tangent map on the tangent bundle.

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Diffeomorphisms with C^1-stably average shadowing

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Abstract. Recently C. Bonatti, N. Gourmelon and T. Vivier [2] proved that a periodic orbit of large period of a diffeomorphism on a compact smooth manifold either admits a l-dominated splitting or can be turned into a sink or a source by a C1-small perturbation along the orbit. In this paper we show that if f has the C1-stably average shadowing property on a closed f-invariant transitive set , then admit a l-dominated splitting.

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Dynamic inequalities on time scales

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Abstract. This talk introduces dynamic systems on time scales and proves the basic properties of solutions of such systems so that the theory developed includes the corresponding theories of differential equations and difference equations at the same time. The approach brings out clearly the extra assumptions needed when we deal with difference equations directly. As we shall see the induction principle is employed very crucially in most of the proofs. In particular, we shall consider dynamic inequalities for systems, which are then utilized to prove existence of extremal solutions.

Positive Solutions of Three-Point Boundary Value Problems for Third-Order Differential Equations on Time Scales

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Abstract. In this report we consider the three-point boundary value problems for third-order differential equations on time scales

$$\Big[q(t)\Phi_p\big(x^{\Delta\Delta}(t)\big)\Big]^{\Delta} + kx^{\Delta\sigma}(t) + g\big(t, x^{\sigma}(t), x^{\Delta\sigma}(t)\big) = p(t), \quad t \in (0,1)_T,$$

$$x^{\Delta}(0) = x^{\Delta}(1) = x(\eta) = 0.$$

Sufficient conditions for the existence of at least one solution are established.

Stability radii for linear time-varying differential-algebraic equations with respect to dynamic perturbations

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Abstract. This talk provides an extension of a result concerning robust stability for time-varying ordinary differential equations. A formula for the structured stability radius is obtained for time-varying systems of linear differential-algebraic equations under the effect of uncertain dynamic perturbations.

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On multipoint boundary value problems for higher index linear singular autonomous systems of difference equations

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Abstract. In this report, on the background of a careful analysis of higher index linear singular difference equations with constant coefficients case, multipoint boundary value problems for these equations are considered. We establish necessary and sufficient conditions for the solvability of multipoint boundary value problems. Further, a general solution formula is explicitly constructed.

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On Domain Decomposition Techniques for numerical solving of partial differential equations

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Abstract. We introduce some parallel domain decomposition preconditioners for iterative solution of sparse linear systems like those arising from the approximation of partial differential equations by finite elements or finite volumes. We first give an overview of algebraic domain decomposition techniques. We then introduce a preconditioner based on a multilevel approximate Schur complement system. Then we present a Schwarz-based preconditioner augmented by an algebraic coarse correction operator. Being the definition of a coarse grid a difficult task on unstructured meshes, we propose a general framework to build a coarse operator by using an agglomeration procedure that operates directly on the matrix entries. Numerical results are presented aimed at assessing and comparing the effectiveness of the two methodologies. The main application will concern computational fluid dynamics (CFD), and in particular the simulation of compressible flow around aeronautical configurations.

On a class of singular integral equations with the linear fractional Carleman shift and the degenerate kernel

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Abstract. This report deals with the solvability and the explicit solutions of a class of singular integral equations with a linear-fractional Carleman shift and with the degenerate kernel on the unit circle. Solutions are found by means of the Riemann boundary value problem and by means of a system of linear algebraic equations. All cases concerning the index of the coefficients in the equations are considered in detail.

Parallel-iterated pseudo two-step Runge-Kutta-Nystrm methods for nonstiff second-order IVPs

Nguyen Thi Hong Minh
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Abstract. In this talk the authors develop a pseudo two-step Runge-Kutta-Nystrm method for solving a special kind of second-order differential equation $y''(t) = f(y(t))$ on parallel computers. The method is implicit and uses the parallel PC iteration for solving the nonlinear system of equations. It is shown that the optimal number of processors is equal to $w \leq p^*/2$, where w and p^* are the number of implicit stages and the order of the method, respectively. Numerical examples show the superiority of the method over existing sequential and parallel methods.

Improved parallel-iterated pseudo two-step RKN methods for nonstiff problems

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Abstract. The aim of this talk is to consider parallel PC iteration schemes for a general class of pseudo-two-step Runge-Kutta-Nystrm (PTRKN) methods of arbitrary high order and arbitrary low number of implicit stages for solving nonstiff second-order IVPs $\mathbf{y}''(t) = \mathbf{f}(\mathbf{y}(t))$, $\mathbf{y}(t_0) = \mathbf{y}_0$, $\mathbf{y}'(t_0) = \mathbf{y}'_0$. We start with an s-stage PTRKN method of order p^* with w implicit stages and apply the highly parallel PC iteration process which leads us to a parallel-iterated PTRKN method (in $P(CE)^mE$ mode). By replacing in the parallel-iterated PTRKN method the old predictor with a new one, we are led to a method (in $PE(CE)^mE$ mode) which will be called the improved parallel-iterated PTRKN (IPIPTRKN) method. The resulting IPIPTRKN method uses an optimal number of processors equal to $w \leq p^*/2$. By a number of numerical experiments, we show the superiority of the IPIPTRKN methods considered in this paper over both sequential and parallel methods available in the literature.

Robust stabilization of linear systems with delayed state and control

Phan Thanh Nam
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Abstract. The robust stabilization problem for linear uncertain systems with delay in both the state equation and the control is studied. An appropriate Lyapunov-Krasovskii functional is used for the establishment of sufficient conditions for robust exponential stabilization by means of a memoryless state-feedback linear control. The sufficient conditions are derived in terms of linear matrix inequalities, allowing an easy computation of bounds characterizing the exponential stability rate of the solution of the resulting closed-loop system.

Linear evolution equations of hyperbolic type in Hilbert space with applications to symmetric hyperbolic systems

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Abstract. Let $\{A(t); 0tT\}$ be a family of closed linear operators in a complex Hilbert space X. This talk is concerned with linear evolution equations of the form

$$du(t)/dt(E) + A(t)u(t) = f(t) \text{ on } [0,T].$$

Let S be a selfadjoint operator in X, satisfying $(u, Su) \geq u^2$ for $u \in D(S)$. Assume, as a simple case, that the following four conditions are satisfied:

(I) There is a constant $\alpha \geq 0$ such that

$$|\mathrm{Re}(A(t)v, v)| \leq \alpha \|v\|^2 \quad \forall v \in D(A(t)) \quad \forall t \in [0,T];$$

(II) $Y := D(S^{1/2}) \subset D(A(t)) \quad \forall t \in [0,T]$;

(III) There is a constant $\beta \geq \alpha$ such that

$$|\mathrm{Re}(A(t)u, Su)| \leq \beta \|S^{1/2}u\|^2 \quad \forall u \in D(S) \quad \forall t \in [0,T];$$

(IV) $A() \in C_*([0,T]; B(Y,X))$, where the subscript $_*$ is used to refer the strong operator topology in $B(Y,X)$, the space of all bounded linear operators on Y to X.

Unbounded components in the solution sets of strictly quasiconcave vector maximization problems

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Abstract. Let (P) denote the vector maximization problem

$$\max\{f(x) = \big(f_1(x), \ldots, f_m(x)\big) : \ x \in D\},$$

where the objective functions f_i are strictly quasiconcave and continuous on the feasible domain D, which is a closed and convex subset of $\mathbf{R}^n$. We prove that if the efficient solution set $E(P)$ of (P) is closed, disconnected, and it has finitely many (connected) components, then all the components are unbounded. A similar fact is also valid for the weakly efficient solution set $E^w(P)$ of (P). Especially, if f_i $(i = 1, \ldots, m)$ are linear fractional functions and D is a polyhedral convex set, then each component of $E^w(P)$ must be unbounded whenever $E^w(P)$ is disconnected. From these results and a result of E. U. Choo and D. R. Atkins [J. Optim. Theory Appl. 36 (1982), no. 2, 203-220] it follows that the number of components in the efficient solution set of a bicriteria linear fractional vector optimization problem cannot exceed the number of unbounded pseudo-faces of D.

Stability radii of positive linear systems under affine parameter perturbations in infinite dimensional spaces

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Abstract. The authors investigate the stability radii of positive linear discrete systems

$$x(t+1) = Ax(t), \quad t \in \mathbb{N},$$

under arbitrary affine parameter perturbations of the form $A \to A + D\Delta E$, in infinite-dimensional spaces. Here, A is a bounded linear operator on a Banach lattice X, $D \in L(U, X)$ and $E \in L(X, Y)$ are given bounded operators specifying the structure of the perturbation, $\Delta : Y \to U$ is an unknown disturbance operator, and U and Y are further Banach lattices.

The obtained results generalize some recent results by A. Fischer [Math. Control Signals Systems 10 (1997), no. 3, 223-236]. It is shown that the complex, real, and positive stability radii of positive systems coincide. Moreover, estimates and computable formulas of these stability radii are derived. These results are illustrated using an example in $X = l^1(\mathbb{C})$.

C^1-Generic Diffeomorphisms with Specification Property

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Abstract. Let f be a diffeomorphism of a compact C manifold. In this paper we introduce the notion of specification property for a closed f-invariant set, and prove that C^1-generically, if f has the specification property on a locally maximal f-invariant set Λ then Λ is hyperbolic. As a corollary, we get C^1-generically, f is Anosov if and only if f has the specification property. Moreover, we show that C^1- generically, f has the specification property on the chain recurrent set $\mathcal{R}(f)$ if and only if $\mathcal{R}(f) = M$ is hyperbolic for f. (This is a joint work with K. Lee)

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Admissible shock waves and traveling waves of conservation laws with diffusion and dispersion coefficients

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Abstract. Shock waves of conservation laws are admissible under certain admissibility criteria. One of the common admissibility conditions is to require the shock to be the limit of the so-called traveling waves when viscosity and capillarity effects are taken into accounts. This talk presents the method of estimating attraction domain for the existence of traveling waves of conservation laws with diffusion and dispersion, which are represented by viscosity and capillarity coefficients. The left-hand and right-hand states of a shock wave correspond to a stable node and a saddle point of an ordinary nonlinear system of differential equations, supplemented by boundary conditions. The goal is to find a trajectory leaving the saddle point at $-\infty$ and converging to the stable node at $+\infty$, or vice-versa. The method is based on LaSalle's invariance principle. Level sets of a Lyapunov-type function provide us with reasonable estimates of the domain of attraction of the stable node. Then, we show that exactly one stable trajectory of the saddle point enters the domain of attraction of the stable node. This establishes a sole saddle-to-stable connection and therefore gives us a unique traveling wave.

Controllability radius of linear systems under structured multi-perturbations

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Abstract. In this paper we develop a unifying approach to the computation of the controllability radius of linear control systems. By using linear multi-valued operators in representing and estimating the system's equations and matrices involved we are able to derive computable formulas of the distance from a controllable linear system to uncontrollability under the assumption that the system's matrices are subjected to structured multi-perturbations and measured by arbitrary operator norms. In the case of spectral norms, the obtained results unify and extend some previous works as well as a recent interesting result in M. Karrow, D. Kressner, On the structured distance to uncontrollability, Systems and Control Letters, 58(2009) 128-132. Some illustrating examples are given.

Hyperbolicity of Chain Components and Homoclinic Classes for C^1-Vector Fields

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Abstract. In this talk, we introduce the notions of robustly expansive homoclinic classes and shadowable chain components for a C^1-vector field on a compact C manifold, and study their hyperbolic structures using an extended version of Manes techniques in [7]. The homoclinic class of a hyperbolic periodic orbit is the closure of the transverse intersections of its invariant manifolds.

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Probability measures with big kernels

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Abstract. It is shown that in an infinite-dimensional dually separated second category topological vector space X there does not exist a probability measure μ for which the kernel coincides with X. Moreover, we show that in 'good' cases the kernel has the full measure if and only if it is finite-dimensional. Also, the problem posed by S. Chevet [in Probability in Banach spaces, III (Medford, Mass., 1980), 51–84, Lecture Notes in Math., 860, Springer, Berlin, 1981] is solved by proving that the annihilator of the kernel of a measure μ coincides with the annihilator of μ if and only if the topology of μ-convergence in the dual space is essentially dually separated.

Existence of solutions for a resonant problem under Landesman-Lazer conditions

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Abstract. This talk shows the existence of weak solutions in $W_0^1(\Omega)$ for a class of Dirichlet problems of the form

$$-\mathrm{div}(a(x,\nabla u)) = \lambda_1|u|^{p-2}u + f(x,u) - h$$

in a bounded domain $\Omega \subset \mathbb{R}^N$. Here $a : \Omega \times \mathbb{R}^N \to \mathbb{R}^N$ satisfies

$$|a(x,\xi)| \le c_0\big(h_0(x) + h_1(x)|\xi|^{p-1}\big),$$

for all $\xi \in \mathbb{R}^N$, a.e. $x \in \Omega$, in which $h_0 \in L^{\frac{p}{p-1}}(\Omega)$, $h_1 \in L^1_{\mathrm{loc}}(\Omega)$ satisfies $h_1(x) \ge 1$ for a.e. $x \in \Omega$, λ_1 is the first eigenvalue for $-\Delta_p$ on Ω with zero Dirichlet boundary condition and f and h satisfy some suitable conditions.

Maximal stability bound for generalized singularly perturbed systems

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Abstract. In this report, we propose computable formulas for the maximal stability bound for implicit systems of linear differential equations which contain an uncertain small parameter in the leading term. It is supposed that the systems are previously transformed into an appropriate sparse form and they are roboustly stable. To find the maximal stability bound of the systems, the time-domain method is used. This leads to generalized eigenvalue problems for matrix pencils. Details of the numerical algorithms and some illustrative examples are given.

Floquet theorem for linear implicit nonautonomous difference systems

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Abstract. A linear implicit difference system

$$A_n x_{n+1} + B_n x_n = q_n, \tag{3}$$

where $A_n, B_n \in \mathbb{R}^{m\times m}$, $q_n \in \mathbb{R}^m$, and $n \geq 0$, is said to be of index 1 if $\operatorname{rank} \mathrm{A_n} = \mathrm{r}$ for all $n \geq 0$, where $1 \leq r \leq m-1$, and $\{\xi \in \mathbb{R}^m : B_n\xi \in \operatorname{im} \mathrm{A_n}\} \cap \ker \mathrm{A_{n-1}} = 0$ for all $n \geq 0$. The first result says that such a system can be reduced to the Kronecker normal form

$$\operatorname{diag}(\mathrm{I_r}, \mathrm{O_{m-r}})\overline{\mathrm{x}}_{\mathrm{n+1}} + \operatorname{diag}(\mathrm{W_n}, \mathrm{I_{m-r}})\overline{\mathrm{x}}_{\mathrm{n}} = \overline{\mathrm{q}}_{\mathrm{n}},$$

where $W_n \in \mathbb{R}^{r\times r}$ are certain matrices. A system (3) is said to be N-periodic if $A_{n+N} = A_n$, $B_{n+N} = B_n$, and $q_{n+N} = q_n$ for all $n \geq 0$. Let P_{N-1} be a projection onto $\{\xi \in \mathbb{R}^m : B_{N-1}\xi \in \operatorname{im} \mathrm{A_{N-1}}\}$ along $\ker A_{N-1}$. A matrix $X_n \in \mathbb{R}^{m\times m}$ satisfying the initial value problem

$$A_n X_{n+1} + B_n X_n = 0, \quad P_{N-1}(X_0 - I) = 0$$

is called the fundamental matrix of the system (3). The following Floquet type theorem is proved: there exist N-periodic nonsingular matrices F_n and a nonsingular constant matrix $R \in \mathbb{C}^{r\times r}$ such that the fundamental matrix of an index-1 periodic system (3) with nonsingular matrices B_n can be represented as

$$X_n = F_{n-1}\operatorname{diag}(\mathrm{R^n}, \mathrm{O_{m-r}})\mathrm{F_{N-1}^{-1}}$$

for all $n \geq 0$. Some applications of the results obtained and examples are discussed.