POLITEHNICA UNIVERSITY of TIMIŞOARA
DEPARTMENT of MATHEMATICS
Piaţa Victoriei Nr. 2, 300006 TIMIŞOARA, ROMÂNIA
Tel: +40-256-403099, +40-256-403098
www.mat.upt.ro

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ABSTRACT BOOK

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INVITED SPEAKERS

Dvoretzky's theorem and the complexity of entanglement detection

Guillaume AUBRUN *

* Institut Camille Jordan, Université Claude Bernard Lyon 1, France, Email address: aubrun@math.univ-lyon1.fr

Abstract

The well-known Horodecki criterion asserts that a state ρ on $\mathbb{C}^d \otimes \mathbb{C}^d$ is entangled if and only if there exists a positive map $\Phi : M_d \to M_d$ such that the operator $(\Phi \otimes I)(\rho)$ is not positive semi-definite. We show that that the number of such maps needed to detect all the robustly entangled states (i.e. states ρ which remain entangled even in the presence of randomizing noise) exceeds $\exp(cd^3/\log d)$. The proof is based on a study of the approximability of the set of states (resp. of separable states) by polytopes with few vertices or few faces, and ultimately relies on the Dvoretzky–Milman theorem about the dimension of almost spherical sections of convex bodies. The result can be interpreted as a geometrical manifestation of the complexity of entanglement detection. This is a joint work with S. SZAREK .

Ulam type stability and fixed points

Janusz BRZDĘK *

* Pedagogical University of Cracow, Poland, Email address: jbrzdek@up.krakow.pl

Abstract

The issue of Ulam stability of broad variety of mathematical objects (e.g., differential, difference, functional, integral and operator equations) has been a very popular subject of investigations for many years (see, e.g., [6, 16, 17]). It is connected with the following natural question.

When an approximate (in some sense) solution of an equation is somehow close to a solution of the equation?

It is important, because it arises in natural ways. For instance, if we cannot determine a solution to an equation, then we can try to find functions that satisfy the equation approximately (with some particular error) and next show that near (in some sense) each of such functions there is a solution to the equation (cf., e.g., [5]). It seems that the theory of Ulam stability provides very convenient tools for such investigations.

It has been noticed that numerous outcomes on that type of stability can be stated in the form of fixed point results in some function spaces (for various operators, also nonlinear) and several fixed point theorems can be applied to prove stability for equations of different kinds (see, e.g., [7, 12, 13, 14, 4]). Moreover, some fixed point theorems have been proved in recent years in connection with investigations of Ulam's stability (see, e.g., [1, 2, 3, 4, 8, 9, 10, 11, 15, 18]).

We discuss those connections and present several particular examples of them.

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Meta-analysis: past, present and future

Elena KULINSKAYA *

* University of East Anglia, United Kingdom, Email address: e.kulinskaya@uea.ac.uk

Abstract

Meta-analysis (MA) is a collection of statistical methods aimed at combination of evidence from independent studies. The origins of meta-analysis reach back at least to the beginning of the twentieth century, to work by Karl Pearson in 1904. Since the mid-seventies the term meta-analysis has become popular in several fields, among them medical statistics and the behavioral sciences. The most widely used procedures were perfected by mid-eighties. The use of MA increased exponentially since [1]. MA deeply affected development of science and society, enabling the drive for evidence-based practice and policies. Unfortunately, in the eagerness to make meta-analytic methods accessible to end users, a kind of groupthink has taken hold of MA. This is slowly starting to change with appropriate statistical methods being developed [2, 4]. The future is exiting. Big Data, arising in many fields, are usually too big to be stored or analysed on one computer. Distributed computing stores and processes randomly subdivided datasets, subsequently merging the results [3]. However, routinely merging results is appropriate only for homogeneous data. Merging heterogeneous data, which differ systematically across datasets, can yield biased answers. Meta-analysts have developed methods for handling and synthesizing multiple datasets, investigating sources of heterogeneity, evaluating data quality, adjusting for possible bias, and reporting results. Coupling methods of Big Data analysis with MA techniques, appropriately adapted, will lead to important advances in Big Data applications.

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Structured regression in evolving complex networks

Zoran OBRADOVIC *

* Data Analytics and Biomedical Informatics Center, Computer and Information Sciences Department, Statistics Department, Temple University, USA, Email address: zoran.obradovic@temple.edu

Abstract

Predictive modeling in complex networks is a challenging problem due to partially observed node attributes and links that often evolve over time. Additional challenges involve presence of multiple types of links among nodes that should be considered jointly where various nodes have different temporal dynamics. In this talk we will present an overview of the results of our ongoing big data project aimed to address some of these challenges by developing effective methods for structured regression with propagating uncertainty in evolving networks. The proposed methods will be discussed in context of applications to predicting admission and mortality rate for high impact diseases at a large number of hospitals.

Combinatorial nonpositive curvature: theory and applications

Damian OSAJDA *

* Uniwersytet Wrocławski and IMPAN, Poland, Email address: dosaj@math.uni.wroc.pl

Abstract

My main area of interest is the Geometric Group Theory, that is, studying groups by examining geometric features of spaces they act on. In this talk I will survey on various results concerning the notion of *Combinatorial Nonpositive Curvature*, shortly *CNPC*. This term refers to studying polyhedral complexes satisfying some local combinatorial conditions resulting in a nonpositive-curvature-like behavior of their universal covers. Ultimately, we aim at exploring properties of groups acting "nicely" on such complexes. Basic examples of CNPC complexes and groups are: Euclidean and hyperbolic buildings; small cancellation, Gromov hyperbolic, and CAT(0) cubical complexes and groups.

Over last few years, together with collaborators, we have been studying intensively various subclasses and generalizations of the classes above: systolic (bridged) [19][6][4][8], weakly systolic [13][5], bucolic [1], weakly modular [3], and 8–located [15][9][10]. We showed many non-positive-curvature-like features of such objects. In particular, we proved versions of the Cartan-Hadamard theorem, that is, local-to-global characterizations [13][5][1][15][3]. We exhibited further properties of some CNPC complexes and groups [17], some of them being rather exotic [11][12][18][16]. The theory and methods developed during these studies found numerous applications. These include constructing new interesting examples of groups [14][18], and exhibiting some properties of classical objects [7][18][15]. Moreover, we found further applications in other areas: matroid theory [2][3]; lattice theory, incidence geometries, and combinatorial optimization [3].

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Applications of some fixed point theorems in $\mathbb{R}_+^m$-metric spaces

Adrian PETRUŞEL *

* Babeş-Bolyai University Cluj-Napoca, Romania, Email address: petrusel@math.ubbcluj.ro

Abstract

The purpose of this talk is to present several applications of some fixed point results in $\mathbb{R}_+^m$-metric spaces to:

1) coupled fixed point problems
2) coincidence problems
3) systems of integral inclusions.

The singlevalued and the multivalued cases will be discussed.

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Positive linear operators, entropies and Heun functions

Ioan RAŞA *

* Technical University of Cluj-Napoca, Romania, Email address: ioan.rasa@math.utcluj.ro

Abstract

We consider a parameterized probability distribution $p(x) = (p_0(x), p_1(x), ...)$ and denote by $S(x)$ the squared l^2-norm of $p(x)$. The properties of $S(x)$ are useful in studying the Renyi entropy, the Tsallis entropy, and the positive linear operator associated with $p(x)$. We show that for a family of distributions (including the binomial and the negative binomial distributions) $S(x)$ is a Heun function reducible to the Gauss hypergeometric function. Several properties of $S(x)$ are derived, including integral representations and upper bounds. Examples and applications are given, concerning classical probability distributions and positive linear operators.

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Tensor-stable positive maps

David REEB *

* Institute for Theoretical Physics, Leibniz Universität Hannover, Germany, Email address: reeb.qit@gmail.com

Abstract

In this talk I will consider linear maps between matrix algebras that remain positive under tensor powers, i.e. under tensoring with n copies of themselves. Trivial examples of this kind are completely positive maps concatenated with either the identity or the transposition map. We show that for every $n \geqslant 1$ there exist non-trivial maps with this property, and that for two-dimensional Hilbert spaces there is no non-trivial map for which this holds for all n. For higher dimensions we reduce the existence question of such non-trivial "tensor-stable positive maps" to a one-parameter family of maps. It however remains an open question whether all tensor-stable positive maps originate in this way from the identity and the transposition map, which are already known to be the only maps satisfying various other sets of requirements.

After these theoretical results I will outline several applications that non-trivial tensor-stable positive maps would have in Quantum Information Theory. First, any such map would yield new upper bounds on the capacity of quantum channels for entanglement transmission. The second application is an implication for the notorious problem of NPPT bound entanglement, asking whether there exist entangled states with non-positive partial transpose from which no pure-state entanglement can be distilled.
(talk based on arXiv:1502.05630)

Orthogonalities in the theory of functional equations

Justyna SIKORSKA *

* University of Silesia, Katowice, Poland, Email address: justyna.sikorska@us.edu.pl

Abstract

On the example of the famous Cauchy functional equation we show how various notions of orthogonality appear in the theory of functional equations. We give solutions of the Cauchy equation postulated for orthogonal vectors. Presentation of applications of this conditional equation both inside and outside mathematics constitutes a significant part of the lecture. Furthermore, we plan to discuss various aspects of stability problem. Last, but not least, some open problems concerning the topic will be presented.

Below we give just few reference items from a long list of papers dealing with the subject.

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(Un-)decidable problems in quantum theory

Michael M. WOLF *

* Zentrum Mathematik, Technische Universität München, Germany, Email address: m.wolf@tum.de

Abstract

In the talk I will review recent results on the (un-)decidability of problems in quantum many-body physics and quantum information theory. In both fields there is a natural integer limit that opens the door to undecidability of some of the central properties: the thermodynamic limit in quantum many-body theory and the large block-size limit in information theory. I will try to illuminate the thin line between computable and uncomputable and to illustrate possible physical consequences of unprovable properties.

1. MATHEMATICAL ANALYSIS AND APPLICATIONS

A note on approximation properties of Bernstein Stancu type operators

Ana Maria ACU *, *Daniel Florin SOFONEA, Voichita Adriana RADU*

* Lucian Blaga University of Sibiu, Romania, Email address: acuana77@yahoo.com

Abstract

In the last years there is an increasing interest in modifying linear operators so that the new versions reproduce some basic functions. This idea motivated us to modify the sequence of linear Bernstein Stancu type operators. Using numerical examples we show that these operators present a better degree of approximation than the original ones. In this note the modified Bernstein Stancu operators are studied in regard to uniform convergence and global smoothness preservation. A quantitative variant of the classical Voronovskaya theorem using the least concave majorant of the modulus is considered.

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Stability problems on some functional equations in lattice environments

Nutefe Kwami AGBEKO *

* University of Miskolc, Hungary, Email address: matagbek@uni-miskolc.hu

Abstract

The motivation of dealing with functional equations and inequalities in lattice environments lies in the fact that many addition-related results or theorems can be extended and can be proved mutatis mutandis. Along this line we shall present some further Hyers-Ulam-Aoki stability problem and other problems as well.

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Convergence in variation for Bernstein-type operators

Gülen BAŞCANBAZ-TUNCA *, *Hatice Gül İNCE İLARSLAN*

* Ankara University, Ankara, Turkey

Abstract

In this work, we deal with Bernstein-type operators defined by Cárdenas-Morales, Garrancho and Raşa as $B_n\left(f\circ\tau^{-1}\right)\circ\tau$, where B_n is the $n-$th Bernstein polynomial [4]. Assuming that τ and f are absolutely continuous functions on $[0,1]$ and $\inf\tau'(x)\geqslant m>0$ as well as $\tau(0)=0$ and $\tau(1)=1$, we study the convergence of Bernstein-type operators to f in variation seminorm. Moreover, we give a Voronovskaja-type formula and a Jackson-type estimate in the sense of [2].

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On the Wold-Suciu-Slocinski type decompositions for commuting isometric semigroups

Tudor BÎNZAR *, *Cristian LĂZUREANU*

* Politehnica University of Timişoara, Romania, Email address: tudor.binzar@upt.ro

Abstract

In this paper we deal with n-tuples of commuting isometric semigroups on a Hilbert space and the product semigroup generated by them. Properties of the right defect spaces and characterizations of the semigroups of type "s" are presented. A Wold-Suciu-Slocinski type decomposition with 3^n summands for n-tuples of commuting isometric semigroups is introduced. The existence and uniqueness of such decomposition are analysed and several connections with the Wold-Suciu decompositions of each semigroup and their product semigroup are given.

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Generalized Wright-convex functions

Pál BURAI *, *Attila HÁZY and Judit MAKÓ*

* University of Debrecen, Hungary, Email address: burai.pal@zimbra.inf.unideb.hu

Abstract

The aim of this talk is to investigation of generalized Wright-convex functions.

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Some classical Tauberian theorems for triple improper integrals

İbrahim ÇANAK *, *Ümit TOTUR*

* Ege University, Turkey

Abstract

For a real-valued triple integrable function $f(x,y,z)$ over $[0,\infty)\times[0,\infty)\times[0,\infty)$, denote by $s(x,y,z)$ its integral over $[0,x]\times[0,y]\times[0,z]$ and by $\sigma(x,y,z)$ its $(C,1,1,1)$ mean, the average of $s(x,y,z)$ over $[0,x]\times[0,y]\times[0,z]$, where $x,y,z>0$. We give one-sided Tauberian conditions of Landau and Hardy type under which convergence of $s(x,y,z)$ in Pringshem's sense follows from $(C,1,1,1)$ integrability of $s(x,y,z)$. Next, we recover convergence of $s(x,y,z)$ in Pringsheim's sense out of its $(C,1,1,1)$ integrability if $s(x,y,z)$ is slowly oscillating in certain senses. Moreover, we extend a Tauberian theorem given by Móricz [Stud. Math. 138 (1), 41-52 (2000)] for double improper integrals to triple improper integrals.

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Approximation by complex modified genuine Szász-Durrmeyer-Stancu operators

Nursel ÇETİN *

* Turkish State Meteorological Service, Ankara, Turkey

Abstract

In this paper, we introduce complex modified genuine Szász-Durrmeyer-Stancu operators and study approximation properties of these operators. We obtain some estimates on the rate of convergence, a Voronovskaja-type result and the exact order of simultaneous approximation for these operators attached to analytic functions of exponential growth on compact disks.

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Integral inequalities for strongly convex functions on co–ordinates

Gabriela CRISTESCU *, *Muhammad Uzair AWAN, Mihail GĂIANU*

* Aurel Vlaicu University of Arad, România, Email address: gcristescu@inext.ro

Abstract

In this paper we introduce and study the concept of strongly convex function on co-ordinates. We derive integral and quantum integral inequalities of Hermite-Hadamard type for strongly convex function on rectangles.

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A new functional equation for generalized polynomials and its stability

Dan M. DĂIANU *

* Politehnica University of Timişoara, Romania, Email address: dan.daianu@upt.ro

Abstract

We prove that the equation

$$\Delta_x \Delta_y^n f(0) = 0$$

characterizes the generalized polynomials of degree less than or equal to n and we solve the generalized stability of this equation.

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Two theorems on the product of Abel and Cesàro summability methods

Yılmaz ERDEM *, *İbrahim ÇANAK, Bilender P. ALLAHVERDİEV*

* Department of Economy and Finance, Adnan Menderes University of Aydın, Turkey
Email address: yerdem@adu.edu.tr, yilmazerdem2019@gmail.com

Abstract

In this talk, we introduce one-sided Tauberian conditions to recover (C, α) summability and convergence of a sequence from its $(A)(C, \alpha)$ summability.

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Constrictors of Markov operators on KB-spaces

Nazife ERKURŞUN ÖZCAN *

* Hacettepe University, Ankara, TURKEY, Email address: erkursun.ozcan@hacettepe.edu.tr

Abstract

Several mathematicians used the concept of a constrictor to characterize asymptotic behavior of operators. In this talk firstly we investigate stability and lower-bound functions of Markov operators on KB-spaces. Later we show that a positive LR-net on KB-spaces is mean ergodic if the LR-net has a weakly compact attractor. Moreover if the weakly compact attractor is an order interval, then a Markovian LR-net converges strongly to the finite dimensional fixed space. As a consequence at the end we also investigate stability of LR-nets of Markov operators and existence of lower bound functions on KB-spaces.

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Reflexivity results of dual Banach modules

Ömer GÖK *

Yildiz Technical University, Mathematics Department, Esenler, Istanbul, Turkey, Email address: gok@yildiz.edu.tr

Abstract

In this talk, we give a characterization of dual Banach C(K)-modules by means of reflexivity.

References

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Generalized Alomari functionals

Heiner GONSKA *, *Ana Maria ACU*

University of Duisburg-Essen/Germany, Email address: heiner.gonska@uni-due.de

Abstract

We consider a generalized form of certain integral inequalities given by Guessab, Schmeisser and Alomari. The trapezoidal, mid point, Simpson, Newton-Simpson rules are obtained as special cases. Also, inequalities for the generalized Alomari functional in terms of the n-th order modulus, $n = \overline{1,4}$, are given and applied to some known quadrature rules.

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On Regularized Trace Formula of a Differential Operator with Operator Coefficients Defined on a Finite Interval

Erdal GŰL *

* Yildiz Technical University, Turkey

Abstract

In this work, we describe the concept of regularized trace of a differential operator with operator coefficients defined on a finite interval and obtain a formula about this concept.

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On approximately (H,K)-convex functions

Attila HÁZY *

* University of Miskolc, Hungary, Email address: matha@uni-miskolc.hu

Abstract

A real valued function $f : D \to \mathbb{R}$ defined on an open convex subset D of a normed space X is called *rationally* (k,h,d)*-convex* if it satisfies $f\left(k(t)x + k(1-t)y\right) \leqslant h(t)f(x) + h(1-t)f(y) + d(x,y)$ for all $x, y \in D$ and $t \in \mathbb{Q} \cap [0,1]$, where $d : X \times X \to \mathbb{R}$ and $k, h : [0,1] \to \mathbb{R}$ are given functions.

Our main result is of a Bernstein-Doetsch type. Namely, we prove that if f is locally bounded from above at a point of D and rationally (k,h,d)-convex then it is continuous and (k,h,d)-convex.

Commutativity properties of genuine Baskakov-Durrmeyer type operators and their k-th order Kantorovich modification

Margareta HEILMANN *

University of Wuppertal, Wuppertal, Germany, Email address: heilmann@math.uni-wuppertal.de

Abstract

Let $c \in \mathbb{R}$, $n \in \mathbb{R}$, with $n > c$ if $c \geqslant 0$ and $n = -cm$ for some $m \in \mathbb{N}$ if $c < 0$ and $j \in \mathbb{N}_0$. Denote $I_c = [0, \infty)$ for $c \geqslant 0$ and $I_c = [0, -1/c]$ for $c < 0$. For $x \in I_c$ we define

$$p_{n,j}(x) = \begin{cases} \dfrac{n^j}{j!} x^j e^{-nx} & , c = 0, \\ \dfrac{n^{c,\overline{j}}}{j!} x^j (1 + cx)^{-\left(\frac{n}{c} + j\right)} & , c \neq 0, \end{cases}$$

with the notation $n^{c,\overline{j}} = \prod_{l=0}^{j-1}(n + cl)$, if $j \in \mathbb{N}$, $n^{c,\overline{0}} = 1$.
Then we define the genuine Baskakov-Durrmeyer for $c \geqslant 0$ by

$$B_{n,c}(f,x) = f(0)p_{n,0}(x) + \sum_{j=1}^{\infty} p_{n,j}(x)(n+c) \int_{I_c} p_{n+2c,j-1}(t)f(t)dt$$

and for $c < 0$ by

$$\begin{aligned} B_{n,c}(f,x) &= f(0)p_{n,0}(x) + f\left(-\frac{1}{c}\right) p_{n,-\frac{n}{c}}(x) \\ &\quad + \sum_{j=1}^{-\frac{n}{c}-1} p_{n,j}(x)(n+c) \int_0^{-\frac{1}{c}} p_{n+2c,j-1}(t)f(t)dt \end{aligned}$$

for every function $f : I_c \longrightarrow \mathbb{R}$ for which the integrals and the series on the right-hand side are convergent.
For $k \in \mathbb{N}$ we also consider the k-th order Kantorovich modification $B_{n,c}^{(k)}$ of the operators $B_{n,c}$, i. e.,

$$B_{n,c}^{(k)} = D^k \circ B_{n,c} \circ I_k,$$

where D^k denotes the k-th order ordinary differential operator and

$$I_k(f,x) = \int_0^x \frac{(x-t)^{k-1}}{(k-1)!} f(t)dt, \text{ if } k \in \mathbb{N}, \ I_0 f = f.$$

We summarize known results concerning commutativity properties, present an outline of the corresponding proofs and show some generalizations. For $c \neq 0$ we also consider the eigenfunctions and eigenvalues of the operators.

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Bernstein operators of second kind and blending systems

Daniela INOAN *, *Ioan RAŞA*

* Technical University of Cluj-Napoca, Romania, Email address: daniela.inoan@math.utcluj.ro

Abstract

We consider the fundamental polynomials associated with the Bernstein operators of second kind. They form a blending system for which we study some shape preserving properties.

Modified operators are introduced; they have better interpolation properties. The corresponding blending system is also studied.

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Fixed point results and its applied aspects in generalized metric spaces

Kanhaiya JHA *

* School of Science, Kathmandu University, Nepal, Email address: jhakn@ku.edu.np

Abstract

Inspired from the impact and utility of metric space, several generalizations of this notion have been attempted such as semi-metric space, fuzzy metric space, probabilistic metric (Menger) space, dislocated metric space, cone metric space. The fixed point theory as a part of non-linear analysis is a study of function equation in metric or non-metric setting. It provides necessary tools for the existence of theorems in non-linear problems. The classical Banach contraction principle in metric space is one of the fundamental results in metric space with wide applications. The main purpose of this presentation is to discuss some developments of classical metric sub-spaces with applications to other disciplines.

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On (c, α)-Jensen convex functions

Judit MAKÓ *, *Attila HÁZY*

* University of Miskolc, Email address: matjudit@uni-miskolc.hu

Abstract

Let D be a nonempty convex subset of the normed space X and denote by D^* the set $\{\|x-y\| : x, y \in D\}$. Let $c > 0$ and $\alpha : D^* \to \mathbb{R}$ be a given continuous error function such that $\alpha(0) = 0$. We say that $f : D \to \mathbb{R}$ is (c, α)-Jensen convex, if, for all $x, y \in D$,

$$f\left(\frac{x+y}{2}\right) \leqslant cf(x) + cf(y) + \alpha(\|x-y\|).$$

In this talk, we are looking for functions $\varphi :]0,1[\to \mathbb{R}$ and $T^c_\alpha :]0,1[\times D^* \to \mathbb{R}$, such that, for all $t \in]0,1[$ and $x, y \in D$, the locally upper bounded, (c, α)-Jensen convex function $f : D \to \mathbb{R}$ satisfies the following convexity type inequality:

$$f(tx + (1-t)y) \leqslant \varphi(t)f(x) + \varphi(1-t)f(y) + T^c_\alpha(t, \|x-y\|).$$

New results on frames for operators in Hilbert spaces

Laura MANOLESCU *

Politehnica University of Timişoara, Romania, Email address: manolescu.laura@gmail.com

Abstract

Frames for operators are generalizations of vector frames, which allow to reconstruct the elements from the range of a linear and bounded operator, in a stable way. In general, range isn't a closed subspace. In this talk, we give some new results on atomic decomposition and frames for operators in reproducing kernel Hilbert spaces.

The last squares method for fractional equations

*Constantin MILICI *, Gheorghe DRĂGĂNESCU*

Politehnica University of Timişoara, Romania, Email address: constantin_milici@yahoo.com

Abstract

Consider the equation

$$D^{2\alpha}y(t) + y(t) + f(t) = 0,$$
$$y(0) = 0, \qquad y(1) = 0, \quad (0 < \alpha \leqslant 1),$$

for

$$y_{app} = \sum_{i=1}^{n} C_i v_i,$$

where C_i are constants, and $v_i = v_i(t)$ are test functions.

$$L[y_{app}] = D^{2\alpha}y_{app} + y_{app},$$

we have the functional:

$$I[C_1, C_2, \ldots, C_n] = \int_0^1 \Big[L[y_{app}] + f(t)\Big]^2 (dt)^{\alpha} - > min$$

which, by minimization, impose solving the system

$$\frac{\partial I[C_1, C_2, \ldots, C_n]}{\partial C_i} = 0, \quad i = 1, 2, \ldots n.$$

C_0-semigroups generated by second order differential operators Hormander representation - Applications in physics

*Gabriela MOCANU **

Astronomical Observatory Cluj-Napoca, Romanian Academy, Romania, Email address: gmocanu@mail.utcluj.ro

Abstract

Let $W(u)(x) = a(x)u''(x) + b(x)u'(x)$. We consider the C_0-semigroups generated by this operator on the spaces of continuous functions, respectively square integrable functions. The connection between these semigroups, together with suitable approximation processes are studied. The Hörmander representation and resulting trajectories are presented and discussed, in connection to diffusion processes found in physics.

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On Convergence of Bernstein-Stancu Polynomials in the Variation Seminorm

*Özlem ÖKSÜZER *, Harun KARSLI, Fatma TASDELEN*

* Ankara University, Turkey

Abstract

This paper is devoted to study the variation detracting property and rate of approximation of the Bernstein-Stancu Polynomials in the space of functions of bounded variation with respect to the variation seminorm. And this paper deals with Voronovskaya-type theorems for Bernstein- Stancu polynomials and its derivative. We add some computational results.

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On logarithmic averages of sequences and its applications

*Muhammet Ali OKUR *, Ümit TOTUR*

* Adnan Menderes University, Turkey, Email address: mali.okur@adu.edu.tr

Abstract

In this paper, we investigate summability methods of logarithmic averages of the numerical sequences and its applications such as Tauberian type theorems.

References

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Hyers-Ulam stability of the linear difference equation

*Dorian POPA **

* Technical University of Cluj-Napoca, Romania, Department of Mathematics

Abstract

We obtain a result on generalized Hyers-Ulam stability of the linear difference equation with nonconstant coefficients. Some estimates of Ulam's constant are given.

References

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Rhaly operators and statistical boundedness

*George POPESCU **

* University of Craiova, Romania, Email address: grgpop@gmail.com

Abstract

We present some basic properties for Rhaly operators R_a on Hilbert spaces, that is operators defined by "terraced matrices" or sequences $a = (a_n)_{n\geqslant 1}$

Some necessary conditions for a terraced matrix to define a bounded operator, as well as a sufficient condition, namely the defining sequence should be statistically bounded, in other words bounded except for a rare subsequence. In this case, statistical convergence appears to be more "natural" than classical convergence for sequences. We reduce such a matrix to nonzero elements of the defining sequence (a_n).

Consider the unilateral shift V on l^2 and the diagonal operator $diag(a_n)$. We get the factorisation $R_a = diag(a_n)(I-V)^{-1}$ and $R_a = so-n \to \infty\lim \sum_{k=0}^{n} diag(a_n)V^k$. Therefore Rhaly operators are *so*-limit of compacts operators.

We compute the spectrum and eigenvalues for particular terraced matrices defined by a geometric progression and use the spectral radius to describe how "far" a Rhaly operator is from being a normal or hyponormal operator, also some lower or upper bounds for the norm of Rhaly operators.

Hyers-Ulam stability of the second order linear differential equation

Georgiana PUGNA *

* Technical University of Cluj-Napoca, Romania

Abstract

We give a result on generalized Hyers-Ulam stability of the second order linear differential equation

$$y''(x) + p(x)y'(x) + q(x)y(x) = f(x)$$

where p, q, f are continuous real functions.

Some particular cases of the equation are studied and estimates of Hyers-Ulam constant are given.

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Iterates of q-Bernstein operators, via contraction principle

Voichita Adriana RADU *, *Ana Maria ACU*

* Babes-Bolyai University, Cluj-Napoca, Romania, Email address: voichita.radu@gmail.com

Abstract

In the last decades the iterated Bernstein operators were intensively investigated. The methods employed to study the convergence of iterates of some linear operators occurring in approximation theory include probability theory, spectral theory, matrix theory and the theory of semigroups of operators. Several researchers provided useful contributions to this problem, as U. Abel, I. Gavrea, H.H. Gonska, M. Ivan and I. Rasa. In this note we are concerned with q-Bernstein operators. We study the convergence of the iterates of this operators and some approximation properties using contraction principle (weakly Picard operators theory).

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Bounded variation functions - applications to measure differential equations

Bianca SATCO *

* Stefan cel Mare University of Suceava, Faculty of Electrical Engineering and Computer Science; Integrated Center for Research, Development and Innovation in Advanced Materials, Nanotechnologies, and Distributed Systems for Fabrication and Control (MANSiD), Romania, E-mail: bianca.satco@eed.usv.ro

Abstract

We focus on ordinary differential equations driven by measures, seeing these measures as Stieltjes measures associated to bounded variation functions. Several results related to existence of solutions of bounded variation will be presented and particular situations (such as, impulsive differential equations) will be treated. The more general framework of regulated functions will be also considered. Our results are more general comparing to [1], where Lebesgue-Stieltjes integrability was imposed, as well as comparing to [3].

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Three periodic solutions for discontinuous perturbations of the vector p-Laplacian operator

Călin - Constantin ŞERBAN *
* West University of Timişoara, Romania, Email address: cserban2005@yahoo.com

Abstract

Using a variational approach we obtain the existence of at least three periodic solutions for discontinuous perturbations of the vector p-Laplacian operator $u \mapsto \left(|u'|^{p-2}u\right)'$. The talk is based on joint work with Gabriele Bonanno and Petru Jebelean.

Acknowledgements: The work of the speaker was supported by the grant POSDRU/159/1.5/S/137750, "Project Doctoral and Postdoctoral programs support for increased competitiveness in Exact Sciences research".

Approximate solutions to inverse problems associated to integral operators using wavelet transform

Eduardo P. SERRANO *, *María Inés TROPAREVSKY, Marcela A. FABIO*
* Universidad Nacional de San Martín, Argentina, Email address: eduardo.eduser@gmail.com

Abstract

We construct approximate solutions to Inverse Problems associated to equations of the form $Af(x) = g(x), \quad x \in I\!R$ where $A : X \to Y$ is an integral operator $Af(x) = \int_{I\!R} h(x,\omega)\widehat{f}(\omega)e^{i\omega x}d\omega$ and X, Y are appropiate Banach spaces. For a given $f \in X \subset L^2(I\!R)$, the Forward Problem (FP) consists in calculating its image through A, while the Inverse Problem (IP) looks for $f \in X$ for a given $g \in Y \subset L^2(I\!R)$. From the definition due to Hadamard, the IP is well-posed if there exists an unique solution and it is continuous with respect to the data. This last condition refers to the continuity of the inverse of A. When A is a compact operator, it is satisfied only if X and Y are finite dimensional.
Based on these observations, we build approximate solutions to the IP calculating the preimages u_{jk} of the wavelet basis ψ_{jk}, $Au_{jk} = \psi_{jk}$, and projecting the data into finite dimensional subspaces of wavelets, X_j, in the context of a multiresolution analysis. In order to accuratly compute the inverse of the basis, we implement an appropiate discretization of the kernel h of the operator. The well localization of the chosen wavelet basis warranties the efficiency of the numerical approximation scheme. We theoretically analize the error introduced by this approximation. We also present some numerical examples.

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About detection of oscillation patterns in SEEG with wavelet's coefficients

Eduardo P. SERRANO *, *Marcela A. FABIO, Ricardo O. SIRNE and Mariel ROSENBLATT*
* Universidad Nacional de San Martín, Argentina, Email address: eduardo.eduser@gmail.com

Abstract

Stereoelectroencephalography (SEEG) is the practice of recording electroencephalographic signals via depth electrodes applied in epileptic patient candidates to surgery. Previous studies on these signals have shown the presence of interictal oscillating patterns, particularly *chirps*. Therefore, the characterization of such modulated frequency structures is a promissory method to analysis and prediction of seizures. There are several definitions of chirps and time varying frequencies waves, as well as, varied and efficient timefrequency methods for detection and characterization of free noise test signals. However, detection in recorder signals with complex structures it is a problem currently open. Beyond of time-frequency techniques, wavelet analysis has been applied for these problems. Recently, 2-microlocal analysis allows properly extract the information contained in the wavelet's coefficients of the signal around of points of interest, where the presence of the oscillating structures is presumed. Our studies are based on different authors as J. Benedetto, D. Colella, S. Jaffard, Y. Meyer, S. Seuret, L. Levy Vehel et al. In this presentation, we focus 2-microlocal analysis for applications on EEG signals and exhibit some progress with the mentioned purposes.

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Some Tauberian conditions for the logarithmic method of summability

*Sefa Anıl SEZER *, İbrahim ÇANAK*

* Ege University, Turkey

Abstract

In this talk, we give some Tauberian conditions of slowly decreasing type in order to obtain convergence of a sequence from its logarithmic summability.

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On interpolation of locally convex couples with real methods

*Ilie STAN *, Nicolae COFAN, Ciprian HEDREA, Dan LUPULESCU*

* Politehnica University of Timişoara, Romania, Email address: stan@math.uvt.ro

Abstract

We consider a general form of Peetre's $\mathcal{K}$-and $\mathcal{J}$-methods of interpolation for locally convex couples. A theorem on interpolation of bilinear operators is given.

References

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On (h, k)–trichotomy and (h, k)–splitting for cocycles of linear operators in Banach spaces

*Codruţa STOICA *, Mihail MEGAN, Claudia MIHIŢ*

* "Aurel Vlaicu" University of Arad, Romania, Email address: codruta.stoica@uav.ro

Abstract

The paper studies some concepts of (h, k)–trichotomy and (h, k)–splitting for the general case of skew-evolution semiflows in Banach spaces. We emphasize characterizations for these notions, as well as connections between them.

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On a C*- module normed space and its topological properties

*SUPAMA *, A. ZULIJANTO, I. SOLEKHUDIN, SUMARDI*

* Department of Mathematics,Universitas Gadjah Mada, Yogyakarta, 55281, INDONESIA
Email address: supama@ugm.ac.id

Abstract

Hilbert and complete normed spaces have important roles in many area, such as statistics, quantum mechanics, etc. In 1953, Irving Kaplansky generlized the notion of Hilbert spaces. He introduce C*-module Hilbert spaces by defining an inner product like function on a left module, which take values in a C*-algebra. In this work, inspired by the Kaplansky's, we construct a notion of a C*-module normed space. Further, we observe some topological properties of the spaces as well.

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A mathematical model of oncolytic virus therapy

*Mónika SZŰCS *, Gergely RÖST*

* Department of Medical Physics and Informatics, University of Szeged, Hungary
Email address: szucs.monika@med.u-szeged.hu

Abstract

The malignant neoplasm is such a common disease that is no surprise that the number of treatments has increased and the efficacy of these treatments have improved in the last decades. Cancer is usually treated with chemotherapy, radiation therapy and surgery, however these methods affect both healthy and cancer cells. An oncolytic virus is a virus that preferentially infects and kills cancer cells. In this presentation, we study impulsive differential equations modeling tumor growth controlled by oncolytic virus. A mathematical model is examined to determine what are the critical parameters and how to propose an effective treatment.

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On Tauberian theorems for statistical weighted mean method of summability

Ümit TOTUR *, *İbrahim ÇANAK*

* Department of Mathematics, Adnan Menderes University, Aydin, Turkey
Email address: utotur@yahoo.com, utotur@adu.edu.tr

Abstract

In this talk we establish some new Tauberian theorems for the statistical weighted mean method of summability via the weighted general control modulo of the oscillatory behavior of nonnegative integer order of a real sequence. The main results improve the well-known classical Tauberian theorems which are given for weighted mean method of summability and statistical convergence.

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L-weakly and M-weakly compact operators−I

Damla YAMAN *, *Selim YAVUZ*

* Department of Mathematics, Yildiz Technical University, İstanbul, Turkey, Email address: dyaman@yildiz.edu.tr

Abstract

This study concerns approximately order bounded operators and L-weakly and M-weakly compact operators with their connection. The characteristics of L-weakly and M-weakly compact operators are investigated and some results concerning these classes of operators are given in order to their properties of compactness. Some conditions in which weakly compact operators are L-weakly and M-weakly compact are given.

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L-weakly and M-weakly compact operators−II

Selim YAVUZ *, *Damla YAMAN*

* Department of Mathematics, Yildiz Technical University, İstanbul, Turkey, Email address: selimyyavuz@gmail.com

Abstract

This study concerns the invariant subspace problem. Some circumstances in which L-weakly and M-weakly compact operators have non-trivial closed invariant subspace are investigated in consideration of properties of these subclasses on Banach lattices.

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On exponential dichotomy and exponential trichotomy of cocycles over semiflows

Larisa BIRIŞ *, *Raluca Lolea*

* Department of Mathematics, West University of Timişoara, Romania, Email address: larisa.biris@e-uvt.ro

Abstract

The paper considers some concepts of exponential dichotomy respectively exponential trichotomy for a cocycle over a semiflow. Characterizations and connections beetwen these concepts are given. Some illustrating examples which motivate the obtained results are presented.

2. ALGEBRA AND GEOMETRY, COMPUTER ALGEBRA SYSTEMS IN RESEARCH

Extending Lebesgue and Knaster-Kuratowski-Mazurkievicz theorems

Đorđe BARALIĆ *

* Mathematical Institute, Serbian Academy of Sciences and Arts,Kneza Mihaila 36, p.p. 367, 11001 Belgrade, Serbia, Email address: djbaralic@mi.sanu.ac.rs

Abstract

In the talk we present generalizations of Lebesgue and Knaster-Kuratowski-Mazurkievicz theorems for the cube and the simplex that are obtained using methods of toric topology. The classical theorems are analogues of Brower fixed point theorem and Sperner's lemma and play important role in set theory, combinatorics, topology, etc. Our results allow us to formulate the corresponding statements for two classes of simple polytopes with low chromatic numbers which include standard case.

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Maurer-Cartan one-forms on Z_3-Graded Quantum Group $GL_q(2)$

Fatma BULUT *

Department of Mathematics, Yildiz Technical University, İstanbul, Turkey

Abstract

In this presentation, we construct invariant Maurer-Cartan one-forms on the Z_3-graded quantum group $GL_q(2)$. Let A be a Hopf algebra with unit element 1 and let $(\Gamma^\wedge, \delta)$ be a differential calculus over A . In order to determine $q-$commutation relations between elements of $\Gamma^\wedge$ and elements of A we use a convenient basis of $\Gamma^\wedge$. It consists of the quantum analogues of the Maurer-Cartan one-forms defined by $\omega = \delta\mathsf{T} \cdot \mathsf{S}(\mathsf{T})$.

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Euler-Poincaré-Arnold equations on semi-direct products

Emanuel Ciprian CISMAS *

* Leibniz University, Hannover, Germany, Email address: cismas@ifam.uni-hannover.de

Abstract

Using a geometric approach we study the well-posedness of the so called Euler-Poincaré-Arnold equations, on semi-direct products of the group of orien-tation-preserving diffeomorphisms of the circle with itself. To achieve this goal we had to extend the results obtained in [3] for the general case of inertia operators of pseudo-differential type. Surprisingly the semi-direct structure used can be reduced to a direct structure.

References

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Elastic line is exposed to static force field for null cartan curves

Nevin GÜRBÜZ *

* Eskişehir Osmangazi University, Türkiye

Abstract

In this paper we study intrinsic equations for elastic line is exposed to a static force field using null Saban frame in Minkowski 3-space.

References

[1] K. Duggal, Jin Dae Ho, "Null curves and hypersurfaces of semi-Riemannian manifolds", World Scientific (2007).
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Motion of curves according to bishop 2-type frame in Euclidean 3-space

Nevin GÜRBÜZ *

* Eskişehir Osmangazi University, Türkiye

Abstract

In this work we give three formulation are associated with nonlinear Schrödinger equation according to Bishop 2-type frame in Euclidean 3-space.

References

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On the spacelike ruled Weingarten surfaces

Filiz KANBAY *

* Yildiz Technical University, Istanbul, Turkey

Abstract

In three dimensional Minkowski space, the conditions that a non-developable spacelike ruled surface to be a Weingarten surface are given. The non-developable spacelike Weingarten ruled surfaces are classified and some examples are given.

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The Gromov hyperbolicity of 5/9-complexes

Ioana-Claudia LAZĂR *

* Politehnica University of Timişoara, Dept. of Mathematics, România, Email address: ioana.lazar@upt.ro

Abstract

We introduce and study a local combinatorial condition, called the 5/9–condition, on a simplicial complex, implying Gromov hyperbolicity of its universal cover. We hereby give an application of another combinatorial condition, called 8-location, introduced by Osajda in [3]. Along the way we prove the minimal filling diagram lemma for 5/9-complexes.

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On the stabilization of an optimal control problem

*Camelia PETRIŞOR *, Camelia POP*

* Politehnica University of Timişoara, Romania, Email address: camelia.petrisor@upt.ro

Abstract

Stability problem is one of the most important issue in the study of a dynamical system. For a Hamilton-Poisson system, like the considered system, the energy-methods are used in order to establish stability results (see [2] or [3] for instance). Unfortunately, for some equilibrium points these methods failed so, trying to stabilized them, a specific control is found.

The method was successfully applied in a lot of examples: for Maxwell-Bloch equations (see [5]), for the rigid body (see [1]), for the Chua's system (see [4]), for the Toda lattice, and so on.

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Eulerian subalgebras of combinatorial Hopf algebras

*Tanja STOJADINOVIĆ **

* Faculty of Mathematics, Belgrade University, Belgrade, Serbia, Email address: tanjas@matf.bg.ac.rs

Abstract

For a combinatorial Hopf algebra $(\mathcal{H}, \zeta)$ we define the Eulerian subalgebra $\mathcal{E}(\mathcal{H}, \zeta)$. It is a subalgebra of the odd subalgebra $S_{-}(\mathcal{H}, \zeta)$ and therefore its elements satisfy the generalized Dehn-Sommerville relations. Hence determining the Eulerian subalgebra is connected with solving the generalized Dehn-Sommerville relations. The motivating example is given by Eulerian posets. In the case of clutters we obtain a nontrivial class of Eulerian clutters and in the dual setting the class of Eulerian simplicial complexes. In the cases of graphs and matroids this approach is noneffective since the corresponding Eulerian subalgebras are trivial.

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3. APPLIED MATHEMATICS IN ENGINEERING AND ECONOMICS

Approximate solutions of nonlinear integro-differential equations of the mixed Volterra-Fredholm type

*Constantin BOTA *, Bogdan CĂRUNTU, Olivia BUNDĂU*

∗ Politehnica University of Timişoara, Romania, Email address: constantin.bota@upt.ro

Abstract

In the present paper we apply the polynomial least squares method to obtain approximate solutions for nonlinear integro-differential equations of the mixed Volterra-Fredholm type. Some numerical examples are given to illustrate the validity and the applicability of the method. A comparison with previous results is also presented and it emphasizes the accuracy of the method.

Analytical investigations on the flow of Williamson fluid with power-law pressure dependent viscosity model: effect of the power-law parameter

*Remus-Daniel ENE *, Bogdan CĂRUNTU*

* Politehnica University of Timişoara, Romania, Email: remus.ene@upt.ro

Abstract

A recently modified version of the Optimal Homotopy Asymptotic Method (OHAM) is employed to compute for the first time approximate analytic solutions for the flow of a Williamson fluid with power-law pressure dependent viscosity model. The effect of the power-law parameter under the flow is discussed. The comparison with numerical results obtained by means of the fifth-order explicit Runge-Kutta-Fehlberg method show that our approximate analytic solutions are very accurate. The procedure presented is valid even if the nonlinear differential equation does not contain any small or large parameters.

Some results and applications of non-standard theta methods

*Fatih ER *, Mevlüde YAKIT ONGUN*

* Department of Mathematics, Suleyman Demirel University, Isparta, Turkey
Email: mathsfatiher@gmail.com

Abstract

In this talk, the theta method which is one way of the numerical solution method of ordinary differential equations will be investigated. Some theorems and applications will be given from the point of nonstandard finite difference methods discovered by Mickens. Moreover, the performance of the nonstandard theta method will be tested by comparing with other classical numerical methods.

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A growth model with a C.E.S. production function with physical and human capital

*Adina JURATONI *, Olivia BUNDĂU*

* Politehnica University of Timişoara, Romania, Email: adina.juratoni@upt.ro

Abstract

In this paper we will analyze a mathematical model associated to an economic growth process. Mathematical modeling of this economic growth process leads to an optimal control problem. We find the first-order conditions for our mathematical problem. Using the optimality conditions we will determine the steady-state value of the ratio of physical to human capital $(K/H)^*$.

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Survey of topological methods in robotics

Sorin LUGOJAN *

* Politehnica University of Timişoara, Romania, Email: sorin.lugojan@upt.ro

Abstract

A new area of Computational Topology, gathering applications in Robotics, is on course of organizing itself under the name Topological Robotics. There are presented the main topics of that new domain, contributions of the author included.

Fuzzy failure modes and effects analysis with weighted summarized center of gravity defuzzification

László POKORÁDI *

* Óbuda University, Hungary

Abstract

The Failure Modes and Effects Analysis (FMEA) is a well-known reliability estimation method to identify potential failures which have significant consequences affecting the system performance. The criticality level Risk Priority Number (PRN) of the given failure is determined depend on Probability of Failure (PoF), Consequence of Failure (CoF) and Detectability of Failure (DoF). The estimation of the parameters mentioned above has some inaccuracy from different linguistic interpretation. The Fuzzy rule-based FMEA (F-FMEA) is a quantitative method of reliability or risk analysis which involves the study of the failure modes can occur in every part of an integrated system. The traditional F-FMEA uses averages of input data; therefore the full spectrum of experts opinions can be eliminated. The Weighted Summarized Center of Gravity DeFuzzification (WSCoGDF) can handle the extremeness of experts opinion. The aim of this paper is showing the Summarized Weighted Center of Gravity DeFuzzification method and its possibility of use by exemplification of case study of a Fuzzy Rule-based Failure Modes and Effects Analysis.

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Applications of the maximal dynamic network flow problem

Camelia ŞCHIOPU *

* Transilvania University of Braşov, Romania, Email address: camelia.s@unitbv.ro

Abstract

In big cities, the criteria used to design a building like university or hospital, the architects must ensure sufficient capacity to quickly evacuating the building to answer at: fire, earthquake, bomb attack, gas leak, collective uncontrolled reactions and other circumstances in which occupants look for the exit. Nowadays, there exist different offers to find the solution of the building evacuation problem. We studied this problem as a problem of optimization using the maximal dynamic network flow problem.

In this paper, we show how to evacuate a building problem is modelled as a dynamic flow problem and enumerate other applications of the maximal dynamic freight systems, material handling systems.

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Stochastic fractal interpolation with random variable parameter

Ildikó SOMOGYI *

* Babeş-Bolyai University Cluj-Napoca, Romania, Email address: ilkovacs@math.ubbcluj.ro

Abstract

The classical methods of real data interpolation can be generalized with fractal interpolation. We will study the fractal interpolation functions for variable scaling values. These fractal interpolation functions provide new methods of approximation for experimental data.

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4. PROBABILITY AND STATISTICS, APPLICATIONS IN HEALTH AND CLINICAL RESEARCH

Fixed Point Theorems in Fuzzy Metric Spaces

Ioan GOLEŢ *

* Politehnica University of Timişoara, Romania, Email address: ioan.golet@upt.ro

Abstract

The notion of metric space have plaid a fundamental role in the analysis of many phenomena. The important generalizations of the metric spaces were given [5]. The fuzzy metric spaces were defined by Kramosil and Michalek [3]. George A. and Veeramani P. have modified the notion of fuzzy metric space and defined a Hausdorff topology on a fuzzy metric space [2].

Many researchers have obtained fixed point theorems for mappings satisfying to different contraction types [1], [4], [6].
This paper presents a generalized concept of contraction in fuzzy metric spaces. Some coincidence point theorems, fixed point theorems and common fixed point theorems for these contractions are proved. These theorems generalize some known results, give new results and assure a large elasticity and applicability of this concept of contraction in fuzzy metric spaces.

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Asymptotic behavior of the tail index estimators

Jelena STANOJEVIĆ *

* Faculty of Ecomomics, University of Belgrade, Serbia, Email address: jelenas@ekof.bg.ac.rs

Abstract

The tail index estimator is important parameter of the tail distribution and it has been considered here. The well known estimators are Hill estimator, Pickands estimator and moment estimator. The conditions of their asymptotic behavior and conditions of their weak and strong convergence also have been considered in this paper.

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Kernel type estimator of a bivariate average growth function

Zsolt KARÁCSONY *, *István FAZEKAS, Renáta VAS*

* University of Miskolc, Department of Applied Mathematics, Hungary, Email address: matkzs@uni-miskolc.hu

Abstract

The usual regression problem is considered and a bivariate function with general error is observed. We are concerned with the nonparametric estimation of the average growth function. The theory and the methods connecting to this subject have been developed intensively since the beginning of the sixties. The Gasser-Mller method is used to obtain the estimator of the unknown function. Under general and realistic conditions on the covariance structure of the error random field an upper bound is obtained for the mean squared error. Our result can be used for several particular covariance structures. We made simulations in MATLAB to verify our results so numerical evidence is presented.

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Suboptimal solutions to LPG homing problems

Mario LEFEBVRE *

* Polytechnique Montréal, Canada, Email address: mlefebvre@polymtl.ca

Abstract

The problem of optimally controlling a diffusion process until it leaves a given region is considered in one dimension. Depending on the form of the cost function, the aim is either to maximize the time spent by the controlled process in the continuation region, or to make the process leave this continuation region as soon as possible, taking the quadratic control costs into account. Here, instead of trying to find the optimal solution by making use of dynamic programming, one looks for the best constant control and for the best linear control. The case when the controlled diffusion process is a standard Brownian motion is solved explicitly, and the solutions obtained are compared to the optimal solution.

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On the Consideration of Time Series Analysis of Tacit Knowledge in Nursing Art

Takeshi MATSUDA *

* Shizuoka Institute of Science and Technology, Japan, Email address: matsuken.tit@gmail.com

Abstract

A lot of analytical methods had been studied and developed in the theory of Statistical inference, before now. Therefore, we have a number of approach methods to analyze the given data. In the statistical inference, it is important to investigate the generalization performance of the inference method for an unknown data. However, there is no guarantee that the inference method is effective even if the criteria of generalization performance indicates good results. In particular, we need to take care on the data which depends on human behavior because the rule of data can be changed easily. For example, it is difficult to imitate the craftspersonship, generally. In this study, we propose two distinct mathematical models (smooth and nonsmooth) which extract the feature of hand motion in an intravenous injection, and investigate the difference between parameter space of proposed model using computer algebra system. In general, the comparison between mathematical models is investigated by an experiment using the given data, our approach can measure the difference between mathematical models for arbitrary data. Moreover, we show that our proposed model may discriminate between experts and others.

An alternative approach for the assets pricing in unstable financial markets

Romeo NEGREA *, *Adrian PUGNA*

*Politehnica University of Timişoara, Romania, Email address: romeo.negrea@upt.ro

Abstract

An alternative approach to stochastic calculus for a financial model on some imperfect and unstable financial markets is proposed. Following the most recent instrument for the financial modeling, we study the solvability of a class of forwardbackward stochastic differential equations (FBSDE) in the framework of McShane stochastic calculus, in some general hypothesis on the initial value and the coefficient functions.

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Causes and consequences of hip fracture in the elderly of Western Romania, a critical review of the study design

Simona Claudia TĂMĂŞAN (ŞTEF) *, *Marius ARDELEAN, Diana LUNGEANU*

* Politehnica University of Timişoara, Romania, Email address: simona_tamasan@yahoo.com

Abstract

The paper covers a comparative approach – clinical reality versus statistical ideal – of data collection and analyses. We attempt a critical analysis of a longitudinal pilot study that enrolled a number of 100 elderly subjects with femoral neck fracture admitted in Timişoara County Hospital in 2014. We collected socio-demographic and cognitive performance characteristics, interventional strategy, and medical and functional outcome status. Statistical analysis of the data validated some of the initial medical hypothesis and assumptions. There was no consistent evidence regarding the quality of life and survival rate after such a traumatic event for the different subgroups of elderly patients. The interim results combined with the acknowledged limits of the pilot study are discussed from a dual perspective: daily basis clinical reality versus mandatory statistical rigor.

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5. WORKSHOP ON MATHEMATICAL METHODS IN QUANTUM INFORMATION THEORY

Unitary matrices generating classical like completely positive trace preserving maps

Tristan BENOIST *

* Laboratoire de Physique Théorique, Université Toulouse III - Paul Sabatier, France,
Email address: tristan.benoist@gmail.com

Abstract

We will present some ongoing work on the characterization of unitary matrices generating completely positive trace preserving (CPTP) maps mapping diagonal density matrices in a given basis to diagonal density matrices in the same basis whatever is the environment state. Namely we study the unitaries generating a classical evolution of a system whatever is the environment state. We are led to define a new class of unitary matrices: bistochastic unitary matrices. We show how they are related to classical bistochastic matrices and study of some basic properties of the CPTP maps generated by these unitary matrices. We conclude with a proposal of algorithm generating bistochastic matrices. This is a joint work with Ion NECHITA.

Fusion frames and operator-values frames for quantum information theory

Pasc GĂVRUŢA *

* Politehnica University of Timişoara, Romania, Email address: pgavruta@gmail.com

Abstract

A frame for an inner product space is a redundant set of vectors which give, in a stable way, a representation (in general non-unique) for each vector in space. Fusion frames and operator-valued frames are two important generalizations of vector frames. I will present basic and recent results on fusion frames and operator-valued frames. Some connections with notions, results and problems in quantum information theory are also given. Some discussions and results jointly with M.A. Jivulescu and I. Nechita are also briefly presented.

Incompatibility breaking quantum channels

Teiko HEINOSAARI *

* Turku Centre for Quantum Physics, Department of Physics and Astronomy, University of Turku, Finland,
Email address: heinosaari@gmail.com

Abstract

A typical bipartite quantum protocol relies on two quantum features, entanglement of states and incompatibility of measurements. Noise can delete both of these quantum features. In this talk I present recent studies on the behavior of incompatibility under noisy quantum channels. The starting point is the observation that compatible measurements cannot become incompatible by the action of any channel. The focus of the talk are those channels which completely destroy the incompatibility of various relevant sets of measurements. Such channels are called incompatibility breaking, in analogy to the concept of entanglement breaking channels. The main claim of the talk is that incompatibility is more fragile than entanglement.

Dynamics of quantum correlations in Gaussian open systems

Aurelian ISAR *

* Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering, Bucharest-Magurele, Romania, Email address: isar@theory.nipne.ro

Abstract

In the framework of the theory of open quantum systems we analyze the dynamics of quantum correlations in a system consisting of two bosonic modes embedded in a common thermal environment. In the axiomatic formalism based on completely positive quantum dynamical semigroups, the Markovian irreversible time evolution of an open system is described by the Kossakowski-Lindblad master equation.

The initial state of the open system is taken of Gaussian form and the evolution under the quantum dynamical semigroup assures the preservation in time of the Gaussian form of the state (Gaussian bosonic channel).

We describe the dynamics of the quantum entanglement, Gaussian entropic discord and Gaussian geometric discord in terms of the covariance matrix for initial squeezed thermal states. The asymptotic state of the considered open system is assumed to be the Gibbs state corresponding to two independent bosonic modes in thermal equilibrium. The evolution of logarithmic negativity, which characterizes the degree of quantum entanglement, and the dynamics of both entropic and geometric discord strongly depend on the parameters characterizing the system and the coefficients describing the interaction of the system with the thermal reservoir.

Asymptotic strength of necessary conditions for separability

Cécilia LANCIEN *

Université Claude Bernard Lyon 1, France & Universitat Autònoma de Barcelona, Spain,
Email address: lancien@math.univ-lyon1.fr

Abstract

Deciding whether a given bipartite quantum state is separable or entangled is a central problem in quantum information theory. It is known, though, to be a computationally hard task, which is why several easier to check necessary conditions for separability have been proposed. I will present some of them (such as positivity under partial transposition, k-extendibility etc.) And I will be interested in trying to quantify how "powerful" these tests typically are to detect the entanglement of high-dimensional bipartite quantum states. In that aim, two strategies may be followed:

- The first one consists in comparing the "sizes" of the sets of states which are either separable or satisfying the separability criterion.

- The second one consists in looking at when random states obtained by partial tracing uniformly distributed pure states over an environment are with high probability either entangled or violating the separability criterion.

In both cases, the techniques used come from random matrix theory: to put it roughly, one has to study the properties of some "modified" Gaussian or Wishart matrix ensembles, which I will describe in greater depth.

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On a special class of bipartite unitary operators

Clément PELLEGRINI *

Laboratoire de Statistique et Probabilités, Université Toulouse III - Paul Sabatier, France
Email address: clement.pellegrini@math.univ-toulouse.fr

Abstract

This talk is devoted to the study of a special class of bipartite unitary operators acting on $\mathcal{H}_A \otimes \mathcal{H}_B$. This class, denoted by $\mathcal{U}_{prob}$, is defined as follows:

$$U \in \mathcal{U}_{prob}$$

if and only if for all density matrices β on $\mathcal{H}_B$ there exists unitary operators $U_i(\beta), i = 1, \ldots, n(\beta)$ and a vector of probability $(p_1(\beta), \ldots, p_{n(\beta)}(\beta))$ such that

$$\phi_\beta(\rho) = \mathrm{Tr}_{\mathcal{H}_B}(U(\rho \otimes \beta)U^*) = \sum_{i=1}^{n(\beta)} p_i(\beta)U_i(\beta)\rho U_i(\beta)^*.$$

That is, for all density matrices on the environment $\mathcal{H}_B$, a unitary operator $U \in \mathcal{U}_{prob}$ yields a quantum channel which is a convex combination of unitary conjugation. Such class is non empty. Indeed, let

$e_i, i = 1, \ldots, dim(\mathcal{H}_B)$ and $f_i, i = 1, \ldots, dim(\mathcal{H}_B)$ be two orthonormal basis of $\mathcal{H}_B$ and let U_i be unitary operators on $\mathcal{H}_A$, a unitary operator of the form

$$U = \sum_i U_i \otimes e_i f_i^*, \tag{1}$$

is clearly an element of $\mathcal{U}_{prob}$.

In this talk we are going to investigate more precisely operators of the form (1). The talk will be divided into two independent parts. In a first part we shall link the operators of the form (1) to the notion of complex obtuse random variables. In a second part we shall see that imposing some additional conditions on the set $\mathcal{U}_{prob}$ all the elements of $\mathcal{U}_{prob}$ are of the form (1).

The solution to the Kadison-Singer problem

Dan TIMOTIN *

* Institute of Mathematics of the Romanian Academy, Romania, Email address: Dan.Timotin@imar.ro

Abstract

In the summer of 2013 Marcus, Spielman, and Srivastava gave a surprising solution to the old Kadison-Singer problem. We will give a presentation of this beautiful result, trying to explain as clearly as possible, in a limited amount of time, the main arguments. Some of them have an unexpected elementary flavour and may find applications in other directions.

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6. WORKSHOP ON DYNAMICAL SYSTEMS AND THEIR APPLICATIONS

The study of some fractional versions of the transport equation. Applications in physics and economics

Dana CONSTANTINESCU *, *Marian NEGREA, Iulian PETRIŞOR*

* University of Craiova, Romania, Email address: dconsta@yahoo.com

Abstract

A generalized fractional version of the transport equation is proposed and studied. The model includes local effects (through Fokker-Planck equation) and non-local spatial effects (Levy flights modeled using fractional derivatives). External perturbations are introduced in the model as source term in the fractional equation. Some fractional models involving memory effects -through fractional time derivatives- or non-local spatial effects -through fractional space derivatives- are numerically studied using a code based on matrix approach. The results are applied in modeling phenomena from physics and economics.

Key words: fractional, transport equation, fusion plasma physics, economics.

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Multifractality in nonlinear neural dynamics

Andre FONSECA *, *Jeferson CASSIANO, Gheorghe ŢIGAN*

ABC Federal University - Brazil, Email address: andre.fonseca@ufabc.edu.br

Abstract

In this work we review the dynamical system concept of generalized dimensions, related to the attractor geometry, and develop a numerical estimator based on statistical descriptions. We compare the results with the analytical expression derived for the tent map. The estimator is also suitable for empirical data, trough a state space reconstruction following Whitney and Takens Embedding Theorems. We analyze the multifractal structure changes in the context of nonlinear and nonstationary neural dynamics, specifically in the scenario of probably Alzheimer disease electroencephalogram data, establishing dynamical correlates.

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Linearization and geometrical methods for prey-predator dynamical systems

Adela IONESCU *, *Florian MUNTEANU*

University of Craiova, Romania, Email address: adela0404@yahoo.com

Abstract

In this paper we take into account the problem of finding a state feedback control law for the $2D$ Lotka-Volterra system, in order to obtain a linear time invariant form of this system. The feedback linearization method and the results will be used both for $3D$ Lotka-Volterra models, and for further generalizations.

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Algorithm for searching separation variables in the Kowalevski type systems

*Katarina KUKIĆ *, Vladimir DRAGOVIĆ*

Faculty of transport and traffic engineering, University of Belgrade, Serbia, Email address: k.mijailovic@sf.bg.ac.rs

Abstract

In few recent papers [1], [2] and [3] a new approach to the Kowalevski integration procedure has been suggested. That approach resulted by possibility to generalize Kowalevski integration procedure on a whole class of systems, so called Kowalevski type systems. Such systems have common characteristic that they can be explicitly integrated in theta functions of genus two. Here we present how with the help of an algorithm introduced in [4] one can get the separation variables in the case of Kowalevski type systems. Results are joined with Vladimir Dragović.

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A computational analysis of the Hamilton-Poisson structures of the Kermack-McKendrick Sir model

*Florian MUNTEANU *, Adela IONESCU, Romulus MILITARU, Cătălin ŞTERBEŢI*

University of Craiova, Romania, Email address: munteanufm@gmail.com

Abstract

In this talk we will present the Hamilton-Poisson realizations of some mathematical models of the evolution of epidemics and we will describe a numerical approach for the Kermack-McKendrick SIR model from the Poisson geometry point of view. The evolution of this $3D$ dynamical system is given by

$$\begin{cases} \dot{x} &= -k_1xy \\ \dot{y} &= k_1xy - k_2y \\ \dot{z} &= k_2y \end{cases}, \; k_1, k_2 > 0.$$

This dynamical system is also known as the SIR model, where S is the number of individuals suspected of being infected, I is the number of infected individuals and R denotes the number of individuals removed.

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Linear Chaos

*Gabriel PRĂJITURĂ**

* State University of New York, USA, Email address: gprajitu@brockport.edu

Abstract

We will discuss how various notions of chaos translate to the case of Hilbert space operators. We will present some specific connections that are specific to this setting and some $0-1$ laws also specific to this setting.

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Inverse problem in the modelling of human cortical bone behaviour. Numerical approach

*Mihaela RACILĂ *, Ştefan-Andrei CONSTANTIN, Jean-Marie CROLET*

University of Craiova, Romania, Email address: mihaela.racila@gmail.com

Abstract

Since many years human cortical bone is investigated both from an experimental point of view ([1], [2]) as from a numerical one ([1], [5]). The interest is to be able to have an approximation of its mechanical behaviour, in the both cases of healthy or pathological bone. The necessity of this knowledge is obvious, especially that cortical bone is a natural composite material and its behaviour may inspire the conception of other composite materials.

In this work, we will focus on a biomechanical inverse problem, namely, finding the possible architectural configurations of a human cortical bone elementary volume, which could give the mechanical properties measured experimentally. This problem in of great interest for the biomechanics researchers and clinicians, who are able to measure in vivo some macroscopic properties, but they cant provide any information of the sample tested, such as architectural or local properties.

The idea of this inverse problem is quite simple and is based on our previous studies, in which a mathematical model of human cortical bone was build, named SiNuPrOs [4] and on the numerical interpolation methods [3].

The result of this study is a very useful and convivial application, which may be used by any researcher, mathematician or not, making this application very interesting, especially for the biomechanics colleagues, who are not always familiar with the mathematical software or they dont own one.

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Osserman generalized locally symmetric spaces with the generalized 2-nilpotent Jacobi operator

Cătălin ŞTERBEŢI *

* University of Craiova, Romania

Abstract

In this paper we construct a family of semi-Riemannian metrics with neutral signature.
These are metrics defined as

$$g_\Phi(x,y) = \sum_{i=1}^{p} dx^i \otimes dy^i + \sum_{i,j=1}^{p} \Phi_{ij}(x,y) dx^i \otimes dx^j$$

and generalize the complete deformed lift of usual Riemannian metric on $\mathbb{R}^n$ and they generates k-Osserman spaces for each admissible k.

In the following we will study important properties of these spaces.

Bautin bifurcations in the T system

Gheorghe ŢIGAN *

Politehnica University of Timişoara, Romania, Email address: gheorghe.tigan@upt.ro

Abstract

Bautin-type codimension-2 bifurcations are investigated in the present work in a three-dimensional autonomous differential system. The analytical expression of the second Lyapunov coefficient is determined and the conditions of existence of the Bautin bifurcation are obtained. The results are exemplified on a numerical case.

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On some invariance properties of the asynchronous flows

Serban E. VLAD *

* Oradea City Hall, Romania, Email address: serban_e_vlad@yahoo.com

Abstract

The asynchronous flows are generated by Boolean functions $\Phi : \{0,1\}^n \longrightarrow \{0,1\}^n$ that iterate their coordinates $\Phi_1, ..., \Phi_n$ independently on each other, and they are the models of the asynchronous circuits from the digital electronics. In this framework we introduce the invariance of the sets $A \subset \{0,1\}^n$, as well as the maximal and the minimal invariant subsets of A. Finally, we introduce the connected sets and the path connected sets.

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Conditions for Polynomial Liénard Centers

Zhiheng YU *, *Weinian ZHANG*

Sichuan University, China, Email address: yuzhiheng9@163.com

Abstract

In 1999 Christopher gave a necessary and sufficient condition for polynomial Liénard centers, which requires a coupled functional equations, where the primitive functions of the damping function and the restoring function are involved, to have polynomial solutions. In order to judge if the coupled functional equations are solvable, in this paper we give an algorithm to compute a Gröbner basis for irreducible decomposition of algebraic varieties so as to find algebraic relations among coefficients of the damping function and the restoring function. We demonstrate the algorithm for polynomial Liénard systems of degree $\leqslant 5$, which are divided into 25 cases. We find all conditions of those coefficients for the polynomial Liénard center in 13 cases and prove that the origin is not a center in the other 12 cases.

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Dynamic complexities in a discrete predator-prey system with lower critical point for the prey

*Limin ZHANG *, Chaofeng ZHANG, Min ZHAO*

College of Mathematics, Sichuan University, Sichuan, China, Email address: lmzhang2000@163.com

Abstract

In this paper, a discrete predator-prey system is proposed and analyzed. It is assumed that the prey population has a lower critical point, which is also referred to as extinction threshold. Such behavior has been reported for many flowering plants, many fishes, epidemiology, and so on. The existence and stability of nonnegative fixed points are explored. The conditions for the existence of flip bifurcation and Hopf bifurcation are obtained by using manifold theorem and bifurcation theory. Numerical simulations, including bifurcation diagrams, phase portraits and Maximum Lyapunov exponents, not only show the consistence with the theoretical analysis but also exhibit other complex dynamics and certain biological phenomena. Complex dynamics include quasi-periodicity, perioddoubling bifurcations leading to chaos, chaotic bands with periodic windows, intermittent, supertransient, and so on. Simulations suggest that appropriate growth rate can stabilize the system, but the high growth rate may destabilize the stable system into more complex dynamics. As well, simulations suggest that the system is stable when the lower critical point parameter c is small, but when c increases beyond the critical values, the system changes from quasi-period to collapses. Furthermore, the simulated results are explained according to a biological point of view.

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Dynamics of an extended Lorenz system

*Qiuyan ZHANG *, Gheorghe ŢIGAN, Weinian ZHANG*

Sichuan University, China, Email address: zhangqiuyan752@163.com

Abstract

An extended Lorenz system with 5 parameters is discussed. The parameter conditions for the exact number and qualitative properties of equilibria are given. Further, the pitchfork bifurcation, Bogdanov-Takens bifurcation and fold-Hopf bifurcation are analyzed. The parameter conditions for pitchfork bifurcation are analytically obtained. It is shown that the degenerate Bogdanov-Takens bifurcation and degenerate fold-Hopf bifurcation will occur. Finally, we use the software Matlab to demonstrate those bifurcations numerically.

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Bifurcations of a Second-order Difference Equation Related to a Class of Reaction-diffusion Equations

Jiyu ZHONG *
* Sichuan University, China

Abstract

In this paper we consider a second-order difference equation which was related to a class of reaction-diffusion equations. Firstly, we discuss the topological types of its fixed point in order to investigate bifurcations. Secondly, by applying center manifold reduction theorem, we study local codimension 1 bifurcations, such as transcritical bifurcation, pitchfork bifurcation and flip bifurcation. Finally, by computing Poincaré-Birkhoff normal forms we investigate a generalized Neimark-Sacker bifurcation. More concretely, we give the conditions of existence of two invariant cycles, those of only one and those of no one.

Hopf bifurcations in an extended Lorenz system

Zhiming ZHOU *, *Gheorghe ŢIGAN, Zhiheng YU*
Shanghai Normal University, China, Email address: zzmcm@sina.com

Abstract

In this work we study the Hopf bifurcation in a three-dimensional Lorenz-type system, called the *extended* Lorenz system. We point out the conditions for both non-degenerate and degenerate Hopf bifurcations.

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