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ABSTRACTS

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Sections 1–5

An optimal control problem for an ecosystem with a hunter population

Narcisa C. Apreutesei

Technical University "Gh. Asachi", Iași

napreut@net89mail.dntis.ro

We study an optimal control problem for an ecosystem consisting of a herbivorous species (the number of individuals of which is y_1) and a carnivorous one (y_2). A hunter population is introduced in the ecosystem. Suppose that it acts on both populations and that the number of the hunted individuals from each population is proportional to the number of the existing individuals in that population. Denoting by u the proportionality factor, the differential system describing the controlled ecosystem is

$$\begin{cases} y_1' = y_1 (a_1 - b_1 y_2 - u) \\ y_2' = y_2 (-a_2 + b_2 y_1 - u), \end{cases}$$

where $a_1, a_2, b_1, b_2 > 0$ are given constants and $0 \leq u \leq 1$. Assume that the sizes of the two populations at the initial moment are $y_i(0) = y_i^0 > 0$, $i = 1, 2$.

We want to find the control u in order to maximize the total number of individuals at the end of a given time interval $[0, T]$. One proves that the optimal control is bang-bang and we find its switching points, depending on the sign of $b_1 - b_2$. Some numerical experiments are also presented.

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Theoretical aspects of credibility theory

Virginia Atanasiu

Academy of Economic Studies, Bucharest

e-mail:virginia_atanasiu@yahoo.com

The paper presents the mathematical theory of some credibility models, involving complicated properties of conditional expectations and conditional covariances. In Section 1 we first give Bühlmann's original model, which involves only one isolated contract. We derive the optimal linearized credibility estimate for the risk premium for this case. It turns out that this procedure does not provide us with a statistic computable from the observations, since the result involves unknown parameters of the structure function. In order to obtain estimates for these structure parameters, for Bühlmann's classical model

we embed the contract in a collective of contracts, all providing independent information on the structure distribution (Section 2). In Section 2 we introduce the classical Bühlmann model, which consists of a portfolio of contracts satisfying the constraints of the original Bühlmann model, and derive the best linearized credibility estimators for this model. The estimators obtained in the Section 1 contained structure parameters. In this section we assume the structure parameters as unknown, so the expressions for these (pseudo-)estimators are no longer statistics. But since the contracts are embedded in a collective of identical contracts, we now have more than one observation available on the risk parameter θ , so we can replace the unknown structure parameters by estimates. Of course, in this way, the attractive property of unbiasedness is lost in this way, but we can still expect the resulting estimators to be good. For instance, when an estimator is a maximum likelihood estimator for a parameter, so are functions of it for these functions of the parameter. The credibility estimator obtained in Section 1 has been criticized because it gives the claim amounts from all previous years the same weight; intuitively one should believe that new claims should have more weight than old claims. However, as the claim amounts of different years, were assumed to be exchangeable, it was only reasonable that the claim amounts should have equal weights. The following model, Recursive credibility estimation (Section 3) is an attempt to amend for this intuitive weakness. Our motivation for introducing the recursive credibility model was that we wanted new claims to have more weight than older claims. Theorem 3.1 shows that this goal is achieved. In the simple model of Section 1 we assumed that the risk volume was the same for all years. Often, in particular in reinsurance, one wants to allow for varying risk volumes, and for that purpose Bühlmann & Straub introduced the credibility model incorporating risk volumes (Section 4). In Section 1 we allowed $E \text{Var}(X_i|\theta)$ to vary. In the credibility regression model (Section 5) we are going to allow EX_j to vary. Section 5 contains a description of the Hachemeister regression model allowing for effects like inflation. Credibility models were designed to cope with heterogeneity, and give good estimates for the individual risk premiums. In credibility models, the heterogeneity is characterized by introducing a risk parameter θ or a structure random variable θ , giving a different value of the risk parameter θ_j for each contract j , where $j = \overline{1, k}$. So, the heterogeneity in a portfolio of k contracts can be formulated as: $\theta_1 \neq \theta_2 \neq \dots \neq \theta_k$ (the portfolio can be considered to be heterogeneous because of the different realizations of the risk parameter θ_j for each contract j , with $j = \overline{1, k}$). The heterogeneity between contracts can be illustrated, using the following classical statistical methods: 1) the likelihood ratio test; 2) the χ^2 test.

Submanifolds of constant mean curvature in Finslerian framework

Vladimir Balan

University Politehnica of Bucharest

vbalan@mathem.pub.ro

Recently, based on the notion of Busemann-Hausdorff measure, Z. Shen [6] has studied from the variational point of view the mean curvature on submanifolds of Finsler spaces. In the present work, within the framework of locally Minkowski Finsler spaces - which extend the Euclidean ones, the mean curvature field of immersed hypersurfaces for Randers and Kropina metrics is determined and studied. The obtained results generalize the ones obtained by Souza and Tenenblat [7]. For the two-dimensional case, the CMC PDES are explicitly determined and specified for Monge charts. The Kropina minimal surfaces of revolution are completely characterized. Illustrative plots accompany the developed theory.

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Geometrical methods in the study of some dynamical systems

Dumitru Bălă

University of Craiova

dumitru_bala@yahoo.com

In this paper the Lyapounov stability for three concrete dynamic systems is analyzed. For these systems the Lagrangian, Hamiltonian and energy density are calculated.

Numerical algorithms for evaluating the traffic coefficient in generalized queueing systems

Olga Benderschi* , Gheorghe Mishkoy** , Nicolae Andronati** , I.
Griza***,

State University of Moldova, **Academy of Science of Moldova, *Free
International University of Moldova, Chişinău, Republic of Moldova*

obenderschi@usm.md

The traffic coefficient is an important measure of a queueing system performance and it is responsible for the workload of the system. Analysis of queueing systems delivers formulae for system performance characteristics—many of such analytical expressions involve the traffic coefficient ρ . In the case of queueing systems $M|G|1|\infty$ and $M_r|G_r|1|\infty$ with priorities one can easily evaluate ρ via analytic formulae using rates of incoming flows and mean values of corresponding service times. However, in the case of priority systems with random switchover times, one should be able to evaluate the Laplace-Stieltjes transforms of system busy periods in order to estimate the value of the traffic coefficient. Generally, this can only be done numerically. Algorithms of evaluation of the traffic coefficient in general queueing systems is presented. Values of the traffic coefficient for some given values of the systems' parameters are also calculated. This work was done under support of the SCOPES grant IB7320-110720 and RFFI grant 0644CRF.

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Search engines over internet

Luminița Berechet

University of Bucharest

luminita_berechet@yahoo.com

Over the world of Web tools, the paper surveys the topics of search engines by describing a new built one.

Keywords: search engine, Web, JavaScript, Ajax.

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Communication and concurrent processes in multiprocessor approaches

Luminița Berechet

University of Bucharest

luminita_berechet@yahoo.com

Overviewing several models of synchronized concurrent processes, with application to client-server multiprocessor systems under Java approach.

Keywords: multiprocessor, parallel computing, JDBC, JavaScript, client-server, threads, random synchronization, mutual exclusion.

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An algorithm to find some kind of bifurcation points of approximate nonlinear equations

Cătălin Liviu Bichir

catalinliviubichir@yahoo.com

The method of extended systems is used to reduce a problem which presents bifurcation to a problem without bifurcation. We use it for the exact as well for the approximate problem for a nonlinear equation on real Banach spaces. The components of the exact and approximate bifurcation points are among the components of the solution of the extended systems. In order to find some kind of approximate bifurcation points (λ_{0h}, u_{0h}) , we formulate a numerical algorithm in a neighborhood ω of the solution s_{0h} of an extended system, where s_{0h} contains λ_{0h}, u_{0h} as components. The algorithm is based on an optimization problem and on an equation which relates s_{0h} to the points from ω .

On K_{s_1, s_2, \dots, s_r} - saturated graphs with minimal number of edges

Tom Bohman* , Maria Fonoberova** , Oleg Pikhurko*

**Department of Mathematical Sciences, University,
Pittsburgh, USA*

***Institute of Mathematics and Computer Science, Academy of Sciences of Moldova,
Chișinău, Republic of Moldova*

fonoberova@gmail.com

We investigate minimum saturated graphs problems, which exhibit links between different areas of mathematics, such as combinatorics, linear algebra, matroid theory. Determining the exact value of the sat-function for a given graph is quite difficult, and is known for relatively few graphs. In this note we determine the asymptotic behavior of the sat-function of a complete r -partite graph K_{s_1, s_2, \dots, s_r} with partite sets of sizes s_1, s_2, \dots, s_r , $s_1 \leq s_2 \leq \dots \leq s_r$.

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Viscous flows driven by gravity and a surface tension gradient

Emilia Rodica Borşa

University of Oradea

borsavasile@yahoo.com

In this paper we deduce the lubrication approximation used to investigate the flow of a thin layer. The starting point for the modeling flow of thin films are the Navier-Stokes equations. The lubrication, or reduced Reynolds number approximation to the Navier-Stokes equations has been used to describe several situations. Our attention is focussed on the cases in which the surface tension plays an important role.

Reflexive functors as monofunctors

Dumitru Botnaru* , Olga Cerbu**

**Academy of Transport, Computer Science and Communications, **State University of Moldova, Chişinău, Republic of Moldova*

Let us examine the category of locally convex topological vectorial Housdorff spaces $\mathcal{C}_2\mathcal{V}$. For a reflexive subcategory marked with a big letter \mathcal{A}, \mathcal{B} , etc., the same small letter $a : \mathcal{C}_2\mathcal{V} \rightarrow \mathcal{A}, b : \mathcal{C}_2\mathcal{V} \rightarrow \mathcal{B}$, etc. means the reflexive functor. In category $\mathcal{C}_2\mathcal{V}$ we have the following reflexive subcategories:

S - of the spaces with weak topology;

Γ_0 - of complete spaces;

Π - of complete spaces and weak topology

and the following bicategory structures:

$(\mathcal{E}pi, \mathcal{M}_f)$ =(epimorphisms, strict monomorphisms);

$(\mathcal{E}_u, \mathcal{M}_p)$ =(universal epimorphisms, exact monomorphisms);

$(\mathcal{E}_p, \mathcal{M}_u)$ =(exact epimorphisms, universal monomorphisms);

$(\mathcal{E}_f, \mathcal{Mono})$ =(strict epimorphisms, monomorphisms).

For any reflexive category \mathcal{R} of category $\mathcal{C}_2\mathcal{V}$ we note $\{\varepsilon\mathcal{R} = e \in \mathcal{E}pi | r(e) \in \mathcal{I}so\}$.

Definition. The class \mathcal{A} of morphisms of category $\mathcal{C}_2\mathcal{V}$ it names \mathcal{M}_u -hereditary if $fg \in \mathcal{A}$ and $f \in \mathcal{M}_u$ results $g \in \mathcal{A}$. We note \mathbb{B}_u class of all bicategory structures $(\mathcal{P}, \mathcal{I})$ in category $\mathcal{C}_2\mathcal{V}$ with the class of projections \mathcal{P} \mathcal{M}_u -hereditary. Let \mathcal{A} and \mathcal{B} be the class of morphisms. Then $\mathcal{A} \circ \mathcal{B} = \{ab | a \in \mathcal{A}, b \in \mathcal{B} \text{ and it exists the composition } ab\}$.

1. Theorem [1]. The application: $\mathcal{R} \mapsto ((\varepsilon\mathcal{R}) \circ \mathcal{E}_p, \mathcal{M}_u \cap (\varepsilon\mathcal{R})^\perp)$ establishes besides correspondent between lattice \mathbb{R} of reflexive non-zero subcategories and lattice \mathbb{B}_u .

2. Theorem [2]. Let \mathcal{R} be a reflexive subcategory of category $\mathcal{C}_2\mathcal{V}$:

1. $r(\mathcal{M}_u) \subset \mathcal{M}_u$.
2. $r(\mathcal{I}''(\mathcal{R})) \subset \mathcal{I}''(\mathcal{R})$.
3. Let $S \subset \mathcal{R}$ be. Then $r(\mathcal{Mono}) \subset \mathcal{Mono}$.

3. Examples. The reflexive functors $\pi : \mathcal{C}_2\mathcal{V} \rightarrow \Pi$ and $g_0 : \mathcal{C}_2\mathcal{V} \rightarrow \Gamma_0$ are not monofunctors: they do not transform the class \mathcal{Mono} in itself.

4. Theorem. Let $(\mathcal{E}, \mathcal{M})$ be a bicategory structure, \mathcal{R} a reflexive non-zero subcategory, $\mathcal{E} \subset \mathcal{P}''(\mathcal{R})$ and $r(\mathcal{M}) \subset \mathcal{Mono}$. Then $r(\mathcal{M}) \subset \mathcal{M}$.

5. Corollary. Let $(\mathcal{E}, \mathcal{M})$ be a bicategory structure that $\mathcal{E}_p \subset \mathcal{E} \subset \mathcal{P}''(\mathcal{R})$. Then $r(\mathcal{M}) \subset \mathcal{M}$.

6. Theorem. Let \mathcal{R} be a reflexive subcategory of category $\mathcal{C}_2\mathcal{V}$, $S \subset \mathcal{R}$ and reflector functor $r : \mathcal{C}_2\mathcal{V} \rightarrow \mathcal{R}$ is exact to the left. Let $(\mathcal{E}, \mathcal{M}) \subset \mathbb{B}_u$ and $\mathcal{P}''(\mathcal{R}) \subset \mathcal{E}$ be. Then $r(\mathcal{M}) \subset \mathcal{M}$. In particular, $r(\mathcal{M}_p) \subset \mathcal{M}_p$, $r(\mathcal{M}_f) \subset \mathcal{M}_f$

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Bicategorical structures generated by injective objects

Dumitru Botnaru* , Alina Turcanu** , Olga Cerbu***

*Academy of Transport, Computer Science and Communications, **Technical University of Moldova, ***State University of Moldova, Chisinau, Republic of Moldova

manageri.civis@moldnet.md

We fixed the category of locally convex topological vectorial spaces $\mathcal{C}_2\mathcal{V}$. The spaces Banach $\mathcal{B}(X) = m(\tau)$ of the limited functions that are defined on set X (card $X = \tau$) are spaces \mathcal{M}_p -injective, were \mathcal{M}_p is class of topological inclusions in the category $\mathcal{C}_2\mathcal{V}$.

Let \mathcal{A} be a class of objects of category $\mathcal{C}_2\mathcal{V}$. We note with \mathcal{A}^\perp the class of all morphisms $f : X \rightarrow Y \in \mathcal{C}_2\mathcal{V}$ with the property: for every object $A \in \mathcal{A}$, every morphism $g : X \rightarrow A$ expands through morphism f :

$$g = fg_1$$

for some morphism g_1 . We can say that \mathcal{A}^\perp is the class of all morphisms of category $\mathcal{C}_2\mathcal{V}$ for that every object of class \mathcal{A} is injective.

Theorem 1. Let \mathcal{A} be a class of spaces Banach \mathcal{M}_p -injective. Then $((\mathcal{A}^\downarrow)^\uparrow, \mathcal{A}^\downarrow)$ is a bicategorical structure in category $\mathcal{C}_2\mathcal{V}$.

Theorem 2. Let $\mathcal{C}_2\mathcal{V}$ be a category with products, \mathcal{A} - a family of objects so that $((\mathcal{A}^\downarrow)^\uparrow, \mathcal{A}^\downarrow)$ is a bicategorical structure. Then in category $\mathcal{C}_2\mathcal{V}$ exists sufficient objects \mathcal{A}^\downarrow -injective.

Theorem 3. [BG]. For field K of real or complex numbers ($K = m(1)$) we have

$$K^\downarrow = \mathcal{M}_u, (\mathcal{M}_u)^\uparrow = \mathcal{E}_p$$

where \mathcal{M}_u is the class of universal monomorphisms, and \mathcal{E}_p is the class of precise epimorphisms.

Remark. It is clearly that for every finite set X

$$B(X)^\downarrow = \mathcal{M}_u$$

Theorem 4. $\bigcap_\tau m(\tau)^\downarrow = \mathcal{M}_p$.

Theorem 5. 1. The bicategorical structures of the type $(m(\alpha)^\uparrow, m(\alpha)^\downarrow)$ form a proper class in category $\mathcal{C}_2\mathcal{V}$.

2. In category $\mathcal{C}_2\mathcal{V}$ exists a proper class of the bicategorical structures with sufficient injective objects.

3. In category $\mathcal{C}_2\mathcal{V}$ exists a proper class of the bicategorical structures with injections classes complete to the right .

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Chaos synchronization in complex nonlinear oscillators

Tassos Bountis*, Gamal M. Mahmoud**

**Department of Mathematics, University of Patras, Greece*

***Department of Mathematics, University of Assiut, Egypt*

tassos50@otenet.gr, gmahmoud@aun.edu.eg

We investigate the chaos synchronization of chaotic complex oscillators via the techniques of active control and global synchronization, using several models described by 3 first order ODEs: the so-called Chen and Lü systems as well as a system describing detuned lasers. Thus, we generalize earlier work on the synchronization of two *identical* oscillators in cases where the drive and response systems are different, the parameter space is larger and the dimensionality increases due to the complexification of the dependent variables. The idea of chaos synchronization is to use the output of the drive system to control the response system so that the output of the response system converges to the output of the drive system as time increases. Lyapunov functions are derived to prove that the “errors”, i.e. differences in the dynamics of the two systems converge to zero exponentially fast. Explicit expressions are derived for the control functions which are used to achieve chaos synchronization and numerical

simulations show the validity of these expressions and illustrate the success of our chaos synchronization techniques. **References**

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A class of commutative algebras and their applications in Lie triple systems theory

Ilie Burdujan

USAMV, Iași

burdujan_ilie@yahoo.com

It is especially important to solve the problem of representing the ternary composition of a LIE triple system by means of an appropriate binary composition defined on its ground space. In this paper, some necessary conditions for the existence of a binary algebra whose standardly associated h-system be a given LIE triple system are exhibited. They were used to classify, up to an isomorphism, some low-dimensional special LIE triple systems. Some examples show us that this problem does not always have a positive answer. Key words: LIE triple system, homogeneous system, LT-algebra.

On superextensions of T_0 -spaces

Laurențiu Calmuțchi

Tiraspol State University, Chișinău, Republic of Moldova

The concept of supercompactness was introduced by J.M.Aarts and J. de Groot [1] and studied by many authors (see [2]).

Let L be a collection of subsets of a set X . A linked system in L or an lL -system is a collection $\mu \subseteq L$ such that $H \cap M \neq \emptyset$ for any $H, M \in \mu$. A maximal linked system or an mlL -system is an lL -system not properly contained in another linked system.

A family L of subsets of a space X is called a closed base if L is a family of closed subsets of X , $\emptyset \in L$, $F = \bigcap \{H \in L : F \subseteq H\}$ for every closed subset F of X .

A family L of subsets the space X is a closed subbase of X if $X \in L$ and $\{H_1 \cup H_2 \cup \dots \cup H_n : H_1, H_2, \dots, H_n \in L, n \in N = \{1, 2, \dots\}\}$ is a closed base of X .

A topological space X is supercompact provided that there exists a closed subbase L of X such that $\cap \mu \neq \emptyset$ for any lL -system $\mu \subseteq L$. Every supercompact space is compact by Alexander's lemma ([3]).

The aim of the present article is to study the class of superextensions of topological spaces. Every space is considered to be a T_0 -space.

Definition 1. A pair (Y, f) is called a g -supercompactification of a space X if Y is a topological space, $f : X \rightarrow Y$ is a continuous mapping and there exists a closed subbase L of Y with the following properties:

- 1) $\cap \mu \neq \emptyset$ for every lL -system $\mu \subseteq L$;
- 2) $H \cap f(X) \neq \emptyset$ for every $H \in \mu$ and $H \neq \emptyset$.

If f is an embedding, then (Y, f) is called a supercompactification of X .

Let X be a space and L be a semiring of closed subsets of X , i.e. $H \cap M \in L$ for any $H, M \in L$ and $\emptyset, X \in L$. Denote by $\lambda_L X$ the set of all maximal lL -systems. By $s_L X$ we denote the family of all systems $\xi \subseteq L$ with the properties: if $H, M \in \xi$, then $H \cap M \in \xi$; if $H \in \xi$, $M \in L$ and $H \subseteq M$, then $M \in \xi$; $\emptyset \notin \xi$.

Every element $\xi \in L$ is called a simple L -filter.

Now we put $\Lambda_L X = \lambda_L X \cup s_L X$. For every $H \in L$ we put $H^+ = \{\xi \in \Lambda_L X : H \in \xi\}$. On $\Lambda_L X$ we consider the topology $T^+(L)$ generated by the closed subbase $L^+ = \{H^+ : H \in L\}$ and the topology $T(L)$. For every $x \in X$ we put $e_L(x) = \{H \in L : x \in H\}$. It is obvious that $e_L(x) \in s_L X$ for any $x \in X$.

Theorem 1. The space $\Lambda_L X$ is supercompact and $\lambda_L X$ is a supercompact subspace of $\Lambda_L X$.

Corollary 1. A pair $(\Lambda_L X, e_L X)$ is a g -supercompactification of the space X .

Corollary 2 If L is a base of closed subsets of X , then $(\Lambda_L X, e_L X)$ is a supercompactification of X .

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Some quadrature formulas for hypersingular integrals.

Applications to aerodynamics

Adrian Carabineanu, Virgil Damian

Faculty of Mathematics, University of Bucharest

acara@math.math.unibuc.ro

We derive some quadrature formulas for integrals which have both singular and hypersingular kernels. We apply these formulas to an integral equation for finding the jump of the pressure past an oscillatory wing in an incompressible fluid.

On certain classes of p-valent functions defined by multiplier transformations

Adriana Cătaș

University of Oradea

acatas@gmail.com

Various properties and characteristics of certain classes of p-valent functions in the open unit disc defined by new multiplier transformations are derived. The results are obtained by using techniques involving the Briot-Bouquet differential subordinations and superordinations. An integral transform is established too.

Parametrical weak completeness in acquaint non-chain extension of Intuitionistic logic

Vadim Cebotari

Institute of Mathematics and Computer Science, Academy of Sciences of Moldova, Chișinău, Republic of Moldova

cebotari@math.md

The problem of parametrical weak completeness in the 6-element non-chain extension of Intuitionistic logic is considered. The conditions permitting to determine the parametrical weak completeness of an arbitrary system of formulae in mentioned the logic are established.

Automorphisms of groups which fix the centralizers of the elements

Mihai Chiș, Codruța Chiș

West University of Timișoara

chis@math.uvt.ro

We establish properties of group automorphisms which fix the centralizers of the elements of the group, prove that the class of such automorphisms form a group, and establish relationships to other classes of automorphisms, like central automorphisms and arg-im-commuting automorphisms.

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On extended Lewis conformal mapping in hydrodynamics

Camelia Ciobanu, Marian Cata

"Mircea cel Batran" Naval Academy, Constanța

cciobanu@anmb.ro

The ship hull forms have been described by the well-known classic Lewis transformation, Lewis [7] and by Athanassoulis and Lowkakis [1]. We already have presented [2] an algorithmic method solving directly the problems that appear in the domain of naval architecture concerning the contour of ship cross-section. In this paper we present how we may extend the Lewis transformation to obtain the contour of ship cross section for various types of ships.

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Canonical algebraic stratifications on some generically algebraic schemes over a field

Adrian Constantinescu

Institute of Mathematics "Simion Stoilow" of the Romanian Academy, Bucharest

Adrian.Constantinescu@imar.ro

Let k be a field and A a subalgebra of a k -algebra of finite type. A problem raised by the author, related to the famous *Hilbert* 14-th Problem, asks under which conditions A is finitely generated over k ? This problem has applicability to many geometric questions. Among them it could be mentioned the recent last reduction of the hard *Program* of classification of algebraic varieties, initiated by *S. Mori* (Fields Medallist), to the finite generation of some particular concrete subalgebras (*V. V. Shokurov* (2002) and others).

Suppose that the subalgebra A above is a domain and has the property that all maximal chains of prime ideals have the same length. Let $X^* = \text{Spec } A$ be the affine scheme associated with the ring A . Assume more that X^* is a Noetherian topological space. Then X^* is canonically a finite disjoint union of locally closed subsets $\{Z_i\}_{i=0, \dots, n}$ such that :

- i) Z_i is a (reducible) algebraic k -variety with respect to the induced reduced subscheme structure, for each $i \in \{0, \dots, n\}$,
- ii) for each $i \in \{0, \dots, n-1\}$, Z_{i+1} is adherent to Z_i (i.e. $Z_{i+1} \subset \overline{Z_i}$),
- iii) for each $i \in \{0, \dots, n-1\}$ and $x \in Z_{i+1}$, x has no open algebraic neighborhood in the reduced closed subscheme $\overline{Z_i}$.

In particular, a) $\dim Z_{i+1} \leq \dim Z_i - 2$, b) all quotient rings of A with respect to the reduced ideals are still subalgebras of some k -algebras of finite type and all residue fields of A are finitely generated extensions of k . In particular, Hilbert Nullstellensatz holds for the subalgebra A . A situation as above for A appears when we have an inclusion $A \subseteq A'$ of k -algebras, with A' finitely generated over k , such that the induced morphism of affine k -schemes $\text{Spec } A' \rightarrow \text{Spec } A$ is surjective. A part of the proof is based on the theory of local algebraization of subalgebras "in codimension 1".

The algebraic stratification $\{Z_i\}_{i=0, \dots, n}$ above could offer a measure of the non-algebraicity of X^* and so of the non-finitely generation of A : X^* is algebraic over k , respectively A is finitely generated over k , iff $n = 0$.

Suppose now that A is Noetherian and k is a uncountable perfect field. We shall discuss the following question - Under the previous conditions, has $X^* = \text{Spec } A$ an algebraic stratification as above ?

This talk is dedicated to Professor Adelina Georgescu for her 65-th anniversary, in the sound of our traditional "La multi ani,/ Cu sanatate,/ Sa va dea Domnul,/ Tot ce doriti,/ ... !"

Limiter control of chaotic economic dynamics

Adriana-Daniela Costea

"Ovidius" Highschool, Constanta

adrianagurqui@yahoo.com

Economic booms and bouts affect strongly modern societies with a direct impact on population state. Cycles and crises are inherent in the evolution of the economy. If they could be predicted and their origin understood, they may be engineered to take a softer course. We prove in this paper that by using a Hard Limiter Control (HLC) a chaos state may be modified in a cycle or even equilibrium state. For this purpose it is used Mathcad, which is a very powerful and efficient program.

The impact of stochastic limiter in economic dynamics

Adriana-Daniela Costea

"Ovidius" Highschool, Constanta

adrianagurqui@yahoo.com

In this paper the impact of stochastic limiter on the resulting dynamic states shall be investigated. The economic model is extended to a version with multiplication or addition noise on the limiter. It will be shown that if the limiter has a stochastic component then is possible that the model state may be modified from equilibrium in cyclic state or, more important, from cyclic state to chaos state. For economist it is very useful to predict the economic states for limiting the undesired effects. On this purpose it is used Mathcad, which is a very powerful and efficient program.

Tendencies in Verifying Object-Oriented Software

Pompiliea Cozma

University of Pitești

pcosma99@hotmail.com

The main approaches to the concept of object-oriented systems verification are investigated. First the concept of systems verification and the classical techniques of system verification is defined. Then we examine the verification techniques that are used in the context of object-oriented systems, namely those developed after the classical techniques of system verification - model checking - and the techniques specific to the object-oriented context - class and collaboration diagrams. A special attention is payed to the checking approaches to the aspect-oriented programming (AOP) whose defining characteristic is the moment, depending on the woven program, when the systems verification is completed. In the first approach that we develop the aspects are considered as independent components which can be woven together with the other software system components. In this case the verification is completed before the software system starts its functionings. Another approach that we consider is based on the use of classical techniques (model checking) to verify aspect-oriented programming system after the woven program, that is verifying the programming code (Java) with familiar instruments (JPF/Java). The techniques of system verification are exemplified by checking the deadlock freedom propriety.

Completeness theorems of the linear micropolar thermoelasticity in the time-harmonic case

Ion Crăciun

"Gh. Asachi" Technical University, Iasi

ialcraciun@yahoo.com

In this paper, the linear theory of micropolar thermoelasticity of an isotropic homogeneous centrosymmetric elastic solid is considered. The governing equations of this theory are investigated in the case when the time-dependent parts are of the form $e^{\pm i\omega t}$. For the differential equations containing only the amplitudes \mathbf{u} , φ , θ of the displacement vector, microrotation vector, and increment of temperature, respectively, some completeness theorems are proved.

The recognition of completeness relative to implicit reducibility in the chain extensions of intuitionistic logic

Ion V. Cucu

Moldova State University, Chişinău, Republic of Moldova

ion_cucu2007@yahoo.com

We examine chain logics of pseudo-Boolean algebras of type $\langle E_m, \&, \vee, \supset, \neg \rangle$, where E_m is the chain $0 < \tau_1 < \tau_2 < \dots < \tau_{m-2} < 1$ ($m = 2, 3, \dots$). The formula F is called to be implicitly expressible in logic L by the system Σ of formulas if the relation

$$L \vdash (F \sim q) \sim ((G_1 \sim H_1) \& \dots \& (G_k \sim H_k))$$

is true, where q does not appear in F , and formulas G_i and H_i , for $i = 1, \dots, k$, are explicitly expressible in L via Σ . The formula F is said to be implicitly reducible in logic L to formulas of Σ if there exists a finite sequence of formulas G_1, G_2, \dots, G_l , where G_l coincides with F and for $j = 1, \dots, l$ the formula G_j is implicitly expressible in L by $\Sigma \cup \{G_1, \dots, G_{j-1}\}$. The system Σ is called complete relative to implicit reducibility in logic L if any formula is implicitly reducible in L to Σ . The conditions for recognition of completeness with respect to implicit reducibility in any chain extensions of intuitionistic logic are based on 13 closed classes of formulas.

Fictive facets method for hyperbolic stereohedra

Florin Damian

Moldova State University, Chişinău, Republic of Moldova

damian@usm.md

In contrast with Euclidean spaces, the reconstruction of a tile-transitive face-to-face tiling into one non-face-to-face tile-transitive that preserves the shape of the tile for hyperbolic spaces seems to be more difficult. But in some cases tiling determines a manifold as a quotient space and then this manifold is constructed from a fundamental polytope (tile) with hyperfaces incidences, for example from Coxeter polytopes. This gives the possibility to study the total geodesic submanifolds along some hyperfaces, when they do exist. The map of hyperfaces and the symmetry group of these submanifolds are essential in this construction. The gluing which does not preserve the map given by hyperfaces on submanifolds, yields non face-to-face incidences on the fundamental polytope. The fundamental groups of the new manifold generate a non-face-to-face (one-time tile-transitive) tiling of the considered hyperbolic space. New examples of non-face-to-face tilings of hyperbolic spaces H^n ($n = 3, 4, 5$) that arise by the reconstruction of hyperbolic n -manifolds are given. Geometrical and topological methods are elaborated for the considered case. This work is partially supported by the Grant 06.34 CRF of HCSTD ASM and CERIM-1006-06 of CRDF/MRDA.

On the stability of a viscous flow in a curved channel

Florica-Ioana Dragomirescu

University "Politehnica" of Timişoara

ioana.dragomirescu@mat.upt.ro

The eigenvalue problem governing the stability of a basic flow to rotationally symmetric perturbations, previously investigated in [1] by using isoperimetric inequalities, is studied here by means of spectral methods based on Legendre polynomials. Numerical evaluations for the critical Taylor number are obtained and compared to the ones existing in the literature. **Keywords:** convection, spectral methods, Taylor number; **MSC2000:**76E06

Spectral methods in linear stability. Applications to thermal convection with variable gravity field

Florica-Ioana Dragomirescu*, Călin Gheorghiu**

**Univ. "Politehnica" of Timișoara, **"T.Popoviciu" Institute of Numerical Analysis, Cluj-Napoca*

ghcalin2003@yahoo.com

The onset of convection in a horizontal layer of fluid heated from below in the presence of a gravity field varying across the layer is numerically investigated. The eigenvalue problem governing the linear stability of the mechanical equilibria of the fluid, in the case of free boundaries, is a sixth order differential equation with Dirichlet and hinged boundary conditions. It is transformed into a system of second order differential equations supplied only with Dirichlet conditions. Then it is solved using two distinct classes of spectral methods namely, weighted residuals (Galerkin type) methods and a collocation method, both based on Chebyshev polynomials. The methods provide a fairly good approximation of the lower part of the spectrum without any scale resolution restriction.

Keywords: convection, spectral methods, Taylor number

Mean square exponential stability of discrete-time time-varying linear systems with Markovian jumping

Vasile Drăgan , Toader Moroza

Institute of Mathematics "Simion Stoilow" of the Romanian Academy

vdrgan@rdslink.ro, Toader.Moroza@imar.ro

The problem of the mean square exponential stability for a class of discrete-time linear stochastic systems subject to Markovian switching is investigated. The case of the linear systems whose coefficients depend both on the present state and the previous state of the Markov chain is considered. Three different definitions of the concept of exponential stability in mean square are introduced and it is shown that they are not always equivalent. One definition of the concept of mean square exponential stability is done in terms of the exponential stability of the evolution defined by a sequence of linear positive operators on an ordered Hilbert space. The other two definitions are given in terms of different types of exponential behavior of the trajectories of the considered system. In our approach the Markov chain is not prefixed. The only available information about the Markov chain is the sequence of probability transition matrices and the set of its states. In this way one obtains that if the system is affected by the Markovian jumping, the property of exponential stability is independent of the initial distribution of the Markov chain. The definition, expressed in terms of exponential stability of the evolution generated by a sequence of linear positive operators, allows us to characterize the mean square exponential stability based on the existence of some quadratic Lyapunov functions. The results obtained

in this paper may be used to derive some procedures for designing stabilizing controllers for the considered class of discrete-time linear stochastic systems in the presence of a delay in the data transmission.

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Optimization of the number of executants for maintenance works

Simona Dziţac* , Horia Goia* , Ioan Dziţac** , Miltiade Cârlan*

*University of Oradea, **Agora University of Oradea

sdzitac@rdslink.ro, idzitac@rdsor.ro

In order to improve the maintenance works, integrated in the maintenance strategy focused on reliability, a idea is the optimized configuration of the human resources needed for the maintenance. The operationalization of the criteria: *minimal total costs* was made by adapting the Monte Carlo simulation method and the expertons method for computing the optimal staff number. In the article case studies for the transportation system and preparation of the solid fuel from the thermofication electrical power station from Oradea [1, 2, 3, 4] are presented.

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Basic reproduction ratio, stochastic models of a parasitic and martingale

Andreea Fulga

'Transilvania' University of Braşov

afulga@unitbv.ro

Two stochastic models of parasitic infection (one linear and one non-linear model) are studied. In them, the basic reproduction ratio R_0 can be defined to be the lifetime expected number of offspring of an adult parasite under ideal conditions. It is shown that there are separate ranges of parameters, in which different combinations of parameters are very important for separating growth from extinction; the proofs involve martingale and Markov processes.

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Numerical investigation of a penetrative convection

Arcangelo Labianca*, Adelina Georgescu**,

**University of Bari, Italy, ** University of Piteşti*

arclab@dm.uniba.it, adelinageorgescu@yahoo.com

The method of variation of coefficients, backwards integration technique and Budiansky-DiPrima method are applied to an eigenvalue two-point problem for a system of fourth and second order ordinary differential equations governing a particular penetrative convection. The secular equation defining the eigenvalues is found in the form of an equality to zero of an (infinite) series. Numerical results are provided. They involve a various number of terms in the truncated series ensuring some reasonable approximation for the smallest eigenvalue.

The finite singularities of total multiplicity four for the Lotka-Volterra systems

Raluca Mihaela Georgescu

University of Pitești

gemiral@yahoo.com

The type of the finite singularities of total multiplicity four for the Lotka-Volterra systems is studied. The corresponding phase portraits on the Poincaré disk are then presented.

The particular and first invariant $Aff(2, \mathbb{R})$ - integrals for a two-dimensional affine differential system and the functional basis of affine invariants and comitants for the complete quadratic differential system

N. N. Gherstega* , O. V. Diaconescu**

**Tiraspol State University, Chisinau, **Institute of Mathematics and Computer Science, Academy of Sciences of Moldova, Chișinău, Republic of Moldova*

gherstega@gmail.com, odiaconescu@math.md

A two-dimensional affine differential system is considered. For it the particular invariant $Aff(2, \mathbb{R})$ -integral as well as the first invariant $Aff(2, \mathbb{R})$ -integral is constructed with the aid of known Lie algebra of operators. For the complete quadratic two-dimensional differential system, the functional basis of affine invariants and comitants is constructed.

The work is partially supported by CSSDT grant Ref. Nr.07.411.05INDF.

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A direct boundary element approach with linear boundary elements for the compressible fluid flow around obstacles

Luminița Grecu

University of Craiova

lumigrecu@hotmail.com

The paper presents a solution for the problem of the compressible fluid flow around obstacles obtained when a direct boundary element method is used to deduce the boundary integral representation for the problem and linear boundary elements are used to solve it. The mathematical model of the problem is equivalent with a boundary singular integral equation, in terms of the components of the velocity, obtained using a direct technique. This singular boundary equation is solved using linear boundary elements for smooth profiles and for profiles with cusped trailing edge. Some computer codes in MathCAD are developed and numerical solutions are obtained. A comparison study between the numerical solutions and the analytical solutions that exist in some particular cases shows a good agreement between them.

QoS analysis at the level of network nodes

Olesia Groza

Moldova State University, Chișinău, Republic of Moldova

olesiagroza@yahoo.com

The problem of providing QoS in networks was an area of a very active research in the last few years. The first suggested mechanism of providing QoS end-to-end control in a network was called Integrated Service (IntServ). This is a complex of services which guaranteed a corresponding level of quality of service in network data routing and information transferring. A different mechanism appeared later, known as Differentiated Service (DiffServ), and it offered a different treatment to the network packets depending on their importance. Both these mechanisms accept the conjecture: every node inside the network can be analyzed as a simple queueing system. This work was done under support of the SCOPES grant IB7320-110720.

Attractors in affine differential systems with impulsive control

Valeriu Guțu

Moldova State University, Chișinău, Republic of Moldova

gut@usm.md

We are concerned with system of affine differential equations [1]:

$$\dot{x} = Ax + b \quad (x \in \mathbb{R}^m). \quad (1)$$

Suppose that at every moment $t = n \in \mathbb{N}$ an instantaneous control action acts, which changes the state of system as follows

$$\Delta x|_{t=n} := x(n+0) - x(n-0) \in C_{i_n}x(n-0) + d_{i_n} \quad (n \in \mathbb{N}^*), \quad (2)$$

where matrices C_{i_n} and vectors d_{i_n} belong to given (finite or infinite) sets. Between two kicks the motion obeys (1). At the moment $t = n$ the elements C_{i_n} and d_{i_n} , which determine the jump by (2), are chosen in some way, for example, randomly. Assume that the closure of the set of eigenvalues of all operators $(Id + C_n)e^A$ is situated strictly inside (or outside) the unit circle.

Let \mathcal{F} be the set of all maps $\{F_n : x \mapsto C_nx + d_n\}_{n \in \mathbb{N}^*}$. It is known [1] that in case $\{F_n\}_{n \in \mathbb{N}^*}$ is periodic the behavior of the system is quite simple: there exists a globally attracting (repulsing) periodic cycle, corresponding to a periodic motion. This situation may be changed drastically in the general case.

In our report we show that there exists a global attractor (repeller) in the extended phase space. For "typical" sequence $\{F_n\}_{n \in \mathbb{N}^*}$ this invariant set may have a non-integer Hausdorff dimension [2]. Moreover, the motions on this set are chaotic (in the sense that every trajectory on this set is dense) and so, asymptotically, every solution of the impulsive system (1)-(2) tends to a chaotic one.

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Aspects of ethernet traffic analysis

Monica Iacob , Corina Săraru

University of Pitești

monicaiacoi11b@yahoo.com, corina_sararu@yahoo.com

As the need of communication increases, traffic analysis has a more and more important role in the concern of specialists.

The first part of this paper reviews different kinds of approaches which are useful for modeling the behavior of network traffic. Models that try to improve the Poisson based models are presented here. The self-similar nature of the traffic data is also emphasized through the statistical models presented.

The second part contains an analysis made on captured ethernet traffic. During the traffic monitoring there are some particular aspects that are important for this study: the type of each packet, the number of packets that are captured at fixed intervals of time, the dimension of each group of packets in that interval. The data is then analyzed in order to obtain several features and possible anomalies in the network. Statistical tools are used to analyze the behavior of the traffic.

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Examples of differential games with stochastic perturbation associated with Nash equilibrium solutions and open loop strategy

Daniela Ijacu

Academy for Economical Studies, Bucharest

danijacu@yahoo.com

The stochastic system, which describes the stochastic dynamics of a differential game, is assimilated with a characteristic system associated with Hamilton-Jacobi equation. An example of stochastic differential game where the calculus can be explained as an algorithm if the hypothesis (H) on the diffusion coefficients

is personalized as linear fields with constant coefficients is presented in detail. A differential game with stochastic perturbation is determined by a dynamics of state variable $x \in X \subseteq R^n$ defined by a system of stochastic differential equations

$$(1) \begin{cases} d_t x = f(t, x, u_1, \dots, u_N) dt + \sum_{j=1}^d g_j(t, x) \otimes dw_j(t) \\ x(0) = x_0, (t, x, u_1, \dots, u_N) \in [0, t_f] \times X \times U_1 \times \dots \times U_N \end{cases}$$

where $U_i \subseteq R^{m_i}$ are fixed closed sets and $w(t) = (w_1(t) \dots w_d(t))$ is a standard Wiener d-dimensional process over a complete filtered probability space $\{\Omega, \mathcal{F}, P, \{\mathcal{F}_t\} \uparrow \mathcal{F}\}$ and " \otimes " is a special type of stochastic integral.

Remark. Choosing admissible comand (open loop strategy) is a key point in the analysis of some differential stochastic systems as much in defining the sense of associated solution with (1) as in formulating some required conditions "resonable" associated with Nash equilibrium solutions.

A gradient-based optimization approach for free surface viscous flows

Tiberiu Ioana, Titus Petrila

"Babes-Bolyai" University, Cluj-Napoca

tioana@math.ubbcluj.ro, tpetrila@cs.ubbcluj.ro

A gradient-based optimization approach to solve the free surface viscous flows is purposed. The main problem to overcome is to compute the gradient itself. The Navier-Stokes equation is used to model the fluid flows and the problem is formulated as an optimization one. Then the adjoint problem and the gradient are obtained.

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Dynamics of a rigid body in a central gravitational field

Ioan Aurel Iojă*, Petronela Angela Iojă**

**West University "Vasile Goldiș", **Theoretical Lyceum "Vasile Goldiș"
Arad*

ioaniojaaurel@yahoo.com

The paper discusses the dynamics of a rigid body in a central gravitational field along three chapters. The first chapter builds upon several "geometrical aspects of the rigid body in a central gravitational field", namely the fact that a fixed body C of mass M, with spherical symmetry, influences the motion of a rigid body B of mass m. Using the expression for kinetical energy of a rigid body T and the angular speed Ω , we presume the expression of the gravitational energy of the rigid body of mass m is deduced. Then, starting with the Lie SO(3) group, which canonically acts upon SE(3,R), it follows the identification of Hamiltonian H as a function of the angular momentum of the rigid body B and the spatial linear momentum of the same body. The second chapter "Zero Order Approximation" presents practical applications to modeling planets and artificial satellites of the Earth. To this aim, we consider of various approximations orders of the gravitational potential, realized by Taylor series expansions and by truncating these series at a finite number of terms. In the final chapter "Numerical integration via lie-trotter algorithm", starting with the Hamiltonian field X_H and the corresponding flows/fluxes, the Lie-Trotter integrator is determined, as a first order integrator.

An improvement of an inequality concerning the solution of the two-dimensional Navier-Stokes equations

Anca-Veronica Ion

University of Pitești

averionro@yahoo.com

The aim of the paper is to assert and prove an improvement of a classical estimate of the norm of a certain projection of the solution of the two-dimensional Navier-Stokes equations, for periodic boundary conditions. More precisely, the Hilbert space of functions used as phase space for this problem is split into a direct sum of two subspaces: one is the finite dimensional space spanned by the eigenfunctions of the linear operator $A = -\Delta$, corresponding to a finite set, Γ_m , of eigenvalues of A, and the other is the orthogonal complement of the first. The solution u of the Navier-Stokes equations is projected on these spaces. Let P be the projector on the finite dimensional space, and then define $Q = I - P$, $p = Pu$, and $q = Qu$ (hence $u = p + q$). In [1] an

estimate is proved for q , namely, the $[L^2(\Omega)]^2$ norm of this function is found to be less than $K_0 L^{1/2} \delta$, with K_0 depending on the data of the problem (kinematic viscosity coefficient, dimensions of periodicity cell, body forces), $\delta = \lambda/\Lambda$, where λ is the least eigenvalue of \mathbf{A} , Λ is the least eigenvalue of \mathbf{A} not belonging to Γ_m , and L depends increasingly on the number of eigenvalues in Γ_m (it is of the order of $\ln \Lambda$). This inequality is used in literature for instance to estimate the distance between an approximate inertial manifold of the Navier-Stokes problem and the exact solution. For the n^{th} approximate inertial manifold defined in [2], this distance is found to be less than $\kappa_n L^{(n+1)/2} \delta^{(n+3)/2}$, with κ_n depending on the data of the problem. It is clear that the presence of L affects the accuracy of the estimate. In our paper we obtain independent of L estimates for the norm of q .

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Computational techniques for time dependent non-Newtonian fluid flow

Stelian Ion

*"Gheorghe Mihoc-Caius Iacob" Institute of Statistical Mathematics and
Applied Mathematics, Bucharest*

ro_diff@yahoo.com

A numerical algorithm for computing a class of non-Newtonian fluid flow is investigated. The method is based on finite volume technics and on a time step adaptive backward differentiation formulae. A solver for computing the evolutionary 1D flow of a pseudo-plastic fluid is presented and the numerical results obtained indicate a fast and robust code. Some basic components of a 2D solver as the discrete gradient of a discrete scalar field, the discrete divergence of a discrete vector field, the discrete Hodge decomposition formula etc, defined on a nonuniform rectangular grid, are also presented.

Numeric approaches in turbulent mixing. The perturbed 2-D model

Adela Ionescu, Mihai Costescu

University of Craiova

adela0404@yahoo.com, miracos2003@yahoo.com

In the previous works, the study of the 3D non-periodic models revealed a quite complicated behavior [1]. In agreement with experiments, they involved some significant events - the so-called rare events. The variation of parameters had a great influence on the length and surface deformations. The 2D (periodic) case is simpler, but significant events can occur for irrational values of the length and surface unit vectors, as in 3D case. Also, the graphic analysis previously realized showed that in 2D case the mixing has also a nonlinear behavior and the rare events can appear. This paper continues the computational analysis for 2D basic mixing model realized in [2,3], in a modified version. A little perturbation of the model is realized, and, in the first stage, the length deformation for different values of the basic parameters is analyzed. The statistic behavior for irrational values of unit vectors is further used to analyze the mixing efficiency. Key words: turbulent mixing, stretching, folding, efficiency, rare event

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A semiotic approach of textual warehouse summary

Cristian Kevorchian* , Laurențiu Modan**

*University of Bucharest, **Computer Science Faculty, Bucharest

*ck@fmi.unibuc.ro, **laurent@yahoo.fr

Semiotics is the general science of signs, as icons, images, objects, tokens or symbols and shows how their meaning is transmitted and understood. A sign is viewed as something that stands for something else. Composed of three fundamental elements: syntax (about form), semantics (about meaning) and pragmatics (about content) (Peirce 1960), textual warehouse [Khrouf, 2004] is a subject-oriented information source, filtered, integrated, archived (versions) and organized for retrieval, integration or analysis process.

Textual warehouse is characterized by three semiotical dimensions. The first is the syntactical one and it provides rules for well-formatted documents, for example, to evaluate the representativeness of terms [Jones 1972]

$$TermWeigh_{ij} = TF_{ij}(1 + \log(\frac{N \cdot TF_{ij}}{A \cdot F_i})),$$

where TF_{ij} the frequency of the term is i in the concerned specific element j , N is the number of specific elements in the warehouse document collection and $A \cdot F_i$ absolute frequency of terms i in the documents of warehouse. The second one is the semantical dimension, that is oriented towards logical well-formatted documents and the third one, is the pragmatic dimension, oriented to analyze the relations between signs and sign interpretations for interpreters. All these relations are used in a content consolidation and analysis process on a textual warehouse level. A query language similar to SQL, MDX, XPath is an important issue for textual warehouse designers, but we can not reduce the analysis process to a query textual warehouse. For example the Yager's concept on the linguistic database summaries [Yager,95], [Szczepaniak,2006]

$$Q \ P \ [have] \ S_1, S_2, \dots, S_n \ [T]$$

where Q is the amount of determination, P is subject of summary, S_1, S_2, \dots, S_n are proprieties and T is the quality of summary, provide an important query pattern but it is not strong enough to obtain a query semantic oriented. The textual warehouse analysis is achieved at the pragmatic level. This means that it will ask for patterns, as Yager's summarization, and will apply predefined rules to find patterns within or across documents stored in textual warehouse. Practically we have to implement a scenario *autonomous information integration*, based on semantic query. As an example, consider a simple database. The Database content provides information based on it we can classify companies by size. Let, a query *How many small companies have good financial results?*. It is necessary to build a linguistic variable set X , as $X = \{almost, few, big, small, \dots\}$.

Relative to this set we provide the summary level.

This approach is not enough to characterize a semantic query into a textual warehouse. Due to its inferential capabilities, an ontological query approach can provide, only, an improved level of query. The ALN-CARIN(logical language combining Description Logics and DATALOG rules) language can be chosen as the query ontology implementation language.

One dimensional boundary-value problem with two displacements and pseudoperturbation method

Luiza R. Kim-Tyan* , Boris V. Loginov , Olga V. Makeeva*****

**Moscow Institute of Steel and Alloys,
**Ulyanovsk State Technical University,
Ulyanovsk State Pedagogical University***,
Russia*

kim-tyan@mail.ru loginov@ulstu.ru omakeeva@hotmail.ru

The most general statement of boundary value problems with displacements is contained in the articles [1,2], where as examples the spectral problems $u'' + \lambda u = 0$ with the displacement conditions at the first kind

$$\begin{aligned} u(0) &= \sum_{j=1}^n \alpha_j u(x_{1j}), & 0 < x_{11} < x_{12} < \dots < x_{1n} < 1 \\ u(1) &= \sum_{j=1}^n \beta_j u(x_{2j}), & 0 < x_{21} < x_{22} < \dots < x_{2n} < 1 \end{aligned} \quad (1)$$

or second kind

$$\begin{aligned} u'(0) &= \sum_{j=1}^n \alpha_j u'(x_{1j}), & 0 < x_{11} < x_{12} < \dots < x_{1n} < 1 \\ u'(1) &= \sum_{j=1}^n \beta_j u'(x_{2j}), & 0 < x_{21} < x_{22} < \dots < x_{2n} < 1 \end{aligned} \quad (2)$$

are considered. Here α_j, β_j are nonpositive or nonnegative numbers, such that $-\infty < \alpha_1 + \alpha_2 + \dots + \alpha_n \leq 1$ and the sets of points can be situated between each other in any relation.

Here the partial cases of these problems are considered: **1.** $u(0) = u(x_1), u(x_2) = u(1)$; **2.** $u(0) = u(x_1), u'(x_2) = u'(1)$; **3.** $u'(0) = u'(x_1), u(x_2) = u(1)$; **4.** $u'(0) = u'(x_1), u'(x_2) = u'(1)$ are considered in the space $C^2[0, x_1] \cup (x_1, x_2) \cup (x_2, 1) \cap C^1[0, 1], 0 < x_1 < x_2 < 1$. Exact magnitudes of eigenvalues and eigenvectors for direct and conjugate spectral problems are considered.

Then numerical experiments of pseudoperturbation method are made for each of these spectral problems. M.K. Gavurin pseudoperturbation method consists in construction of perturbation operator, such that the given approximations to eigenvalue and eigenvectors of

direct and adjoint problems are exact feveryor the perturbed operator [3].

The obtained results are supported by RFBR, grant N 07-01-91680.

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Survival optimization for a diffusion process

Mario Lefebvre

*Département de mathématiques et de génie industriel, École Polytechnique,
Montréal, Canada*

mlefebvre@polymtl.ca

We consider the problem of optimally controlling a one-dimensional diffusion process in the interval $[-d, +d]$ when there is a reflecting boundary at $-d$ and an absorbing boundary at $+d$. Moreover, the constant d can actually be a random variable. The model can be used to represent the flight of an airplane between ground level and a level at which radar detection is likely. The objective is to maximize the survival time in the continuation region, while taking the quadratic control costs into account.

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**On crystallization problem in statistical crystal theory
with symmetries of composite lattices**

Boris V. Loginov , Oleg V. Makeev

Ulyanovsk State Technical University, Russia

loginov@ulstu.ru o.makeev@ulstu.ru

Crystallization of liquid phase state in the case of composite lattice is described by the system of nonlinear integral equations with kernel depending on modulus of arguments difference, obtained by uncoupling the N.N. Bogolyubov equation hierarchy on second distribution function. Suppose that forming crystal molecules belong to M different classes and the number of i -th class molecules in the volume V is equal to N_i , $N = \sum_{i=1}^M N_i$

$$\frac{\partial F_i}{\partial q^\alpha} + \frac{1}{\theta v} \sum_{j=1}^M n_j \frac{\partial \Phi_{ij}(|q - q'|)}{\partial q^\alpha} F_{ij}(q, q') dq' = 0, \quad q = (q^1, q^2, q^3) \quad (1)$$

Here $\theta = kT$, k – Boltzman constant, T – temperature, $n_i = \frac{N_i}{N}$, $v = \frac{V}{n} \Rightarrow \frac{n_i}{v} = \frac{N_i}{V} = \frac{1}{v_j}$, $\Phi_{ij}(|q - q'|) = \Phi_{ji}(|q - q'|)$ – the potential energy of i -th and j -th molecule classes interaction which are disposed at the points q and q' .

Carrying out the approximation $F_{ij}(q, q') = F_i(q)F_j(q')G_{ij}(|q - q'|)$, $\lim_{|q - q'| \rightarrow \infty} G_{ij}(|q - q'|) = 1$; $G_{ij}(|q - q'|) = 0$ at $|q - q'| \leq a$, where $G_{ij}(|q - q'|)$ is the radial distribution function of two types particles, transform (1) to the form

$$u_i(q) + \frac{1}{Mv\theta\lambda} \sum_{j=1}^M \int K_{ij}(|q - q'|) e^{u_j(q')} dq' = 0 \quad (2)$$

$$K_{ij}(|q - q'|) = K_{ji}(|q - q'|) = \int_{\infty}^{|q - q'|} \frac{d\Phi_{ij}(r)}{dr} G_{ij}(r) dr.$$

Using the bifurcation theory with symmetry methods [2] the asymptotics of branching solutions is constructed for the symmetry under nonsymmorphic crystallographic group C_{2h}^5 of monoclinic syngony [3].

System (2) possesses the group symmetry of nonsymmorphic crystallographic group corresponding to the composite lattice consisting of M sublattices of one type molecules oriented by point group $K = C_{2h}$ ($|K| = M$, $|C_{2h}| = 4$) transformations. Nonsymmorphic group transformations transfer equations of the system (2) into each other, leaving whole system invariant. The connection between sublattices of composite lattice and equations are realized by screw rotation and glide reflection.

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Bifurcation and symmetry in differential equations nonresolvable with respect to derivative

**Boris V. Loginov , Oleg V. Makeev , Irina V. Konopleva, Youri
B. Rousak**

Ulyanovsk State Technical University, Russia

*loginov@ulstu.ru, o.makeev@ulstu.ru, i.konopleva@ulstu.ru,
irousak@gmail.com*

In developing N. I. Makarenko results about the solutions branching of nonlinear equations with potential nonlinear operators [1, 2] in previous articles [3, 4] in Banach spaces E_1, E_2 the general problem of branching theory $F(x, \varepsilon) = 0, F(x_0, 0) = 0$ with Fredholm operator $B_{x_0} = -F'(x_0, 0)$ under group symmetry conditions $\mathcal{K}_g F(x, \varepsilon) = F(L_g x, \varepsilon)$ ($g \in G$ is a Lie group element) was investigated in the assumption about potentiality or pseudopotentiality of the relevant branching equation (BEq), i.e. the nonlinear operator of the left-hand-side of the BEq possesses an invariant functional. The general theorem on the inheritance of the group symmetry of original nonlinear equation by the relevant BEq was proved. By means of it the cosymmetric identity for nonlinear operator of BEq with Lie algebra operators and, as its corollary, the theorem about the BEq reduction (dimension lowering) were proved. Applications to bifurcation symmetry breaking problems were given.

In this paper the Andronov-Hopf bifurcation for the differential equations $F(p, x, \varepsilon) = 0$, non-resolvable with respect to the derivative $p = \frac{dx}{dt}, F(0, x_0, \varepsilon) \equiv 0$ with Fredholm operators $A_{x_0} = F'_p(0, x_0, 0), B_{x_0} = -F'_{x_0}(0, x_0, 0)$ under Lie group symmetry is investigated by the same methods under potentiality or pseudopotentiality of the relevant branching equation. The analogous BEq reduction theorem is proved.

If compared with the stationary problem, the basic difficulties are connected with the fact that the tangent manifold to the bifurcation point (under action of Lie group) is turned out to be formed by tangent planes generated by infinitesimal operators.

Applications to potential and partially potential Andronov-Hopf bifurcation problems $A \frac{dx}{dt} = Bx - R(x, \varepsilon), R(0, \varepsilon) = 0, R_x(0, 0) = 0$ with symmetries of rotation groups $SO(2), O(2)$ and hyperbolic rotation groups $SH(2), H(2)$ are given.

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Standard wreath product of two groups and symmetry of geometrical space by load

Alexandru Lungu

State University of Moldova, Chişinău, Republic of Moldova

lungu@usm.md

Consider the geometrical space S of constant curvature by discrete group of symmetry G and finite set $N = 1, 2, \dots, m$ of "indexes", which mean a non-geometrical feature. Ascribe to each point of space S at least one "index" i out of set N and fix a certain transitive group P of permutations over N . General structure of obtained geometrical space with summary load N is described by the subgroups of left standard wreath product (or crossed standard wreath product) of groups P and G , if the "indexes" i of set N have a scalar nature (or the "indices" are homogeneous oriented magnitudes).

On the reconstruction of the state space of a dynamical system

Maria Mădălina Mazilu* , Stephane Azou , Alexandru Şerbănescu***

**Military Technical Academy, Bucharest, **Universit de Bretagne Occidentale, France*

madalinamazilu@yahoo.com, azou@univ-brest.fr, serbal@mta.ro

The study of time series with the aim of characterizing the underlying dynamical system (or data generating process) is a field of study of great interest in chaos based communications, namely spread spectrum communications with chaotic spreading code. In order to perform any kind of analysis upon a data series first there should be correctly reconstructed the phase space with the key parameters time

delay and embedding dimension. In this paper there are presented several methods to determine these parameters and their applicability in communications is discussed. As the spread spectrum communication have the power spectra lower than the spectra of noise the influence of noise is taken into account too. Also the modulation of informational symbols influence the dynamics of the data therefore the parameters of interest are much more difficult to determine.

Framework-Oriented Programming

Mihai Ștefan Mocanu

University of Pitești, Romania

mocanushtefan@yahoo.com

As software grows in complexity and volume, reusability, as a key component to software development, also has to take a step forward. Simply one can not encapsulate a large volume of logic into a single object, thus a collection of classes that perform a specified functionality is grouped together in a library. But just packaging a group of classes into one archive is not enough to ensure that a new release can replace an old one at no cost. Object-oriented programming provides a good way of ensuring this (and also proved efficient over time), in the form of inheritance. So how can one have the features of an object, but for large groups?

This paper introduces a new way of encapsulation, one level higher than classical Object-Oriented approach.

Although classes have been packed in libraries for quite some time, there is no standard way of defining what the library does. Usual ways include readme documents, API documentation, tutorials, FAQs, etc. Major problems appear when a new version of the library is released and natural questions arise: Will the new version be usable with no modifications? Will the component behave the same way? Will the obtained results be improved? And so on. By creating a framework in a standard way and defining its basic requirements in order to facilitate reusability, we can learn from the lessons of Object-Oriented Programming. By standardizing the way a framework exposes its features it is possible to go a step further in one of software architectures goals: creating software applications from software components. However, as a large part of software lifecycle consists in maintenance, just by gluing in pieces of software this goal can not be achieved. By ensuring new versions of libraries can be integrated seamlessly into the existing applications, we are one step closer.

Based on the de facto standard of the current library development, the article aims at creating a theoretical basis for further standardizing the way a framework exposes its features. Later on, we will see the similarities and discrepancies compared to OOP. We will see how a framework's reusability depends on basic object properties. An

analogy between object-oriented concepts and framework concepts will be drawn. We will also see current proposals for packaging and how current software components comply (or how it can be adjusted to comply) with the theoretical constructs in this paper.

Approximation of solid region in the continuous casting process of steel via phase field transition system

Costică Moroşanu

University of Iaşi

e-mail: cmoro@uaic.ro

The 2D phase field transition system introduced by G. Caginalp [4] to distinguish between the phases of the material that is involved in the solidification process is considered. On the basis of the convergence of an iterative scheme of fractional steps type, a numerical algorithm is constructed. The advantages of such approach is that the new method simplifies the numerical computations due to its decoupling feature. The finite element method (mef) is used to deduce the discrete equations. Numerical results concerning the physical aspects (separating zone of solid and liquid states) are reported.

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The reliability of a system with two reparable units

Bogdan Gheorghe Munteanu

Transilvania University of Braşov

b.munteanu@unitbv.ro

The reliability of a system with two reparable components is investigated. In order to study the probabilistic behaviour, we assume that the evolution of the system is of a Markov type (for example: birth and death process).

One of them has the lifetime $\tau \sim \text{Exp}(\lambda)$ and the second has the lifetime $\tau_s \sim \text{Exp}(\lambda_s)$. In the case when the second unit is in repair, then lasts random time is $\eta \sim G(x)$. Consider a sequence of cumulative distribution functions $G_n(t)$, $n = 1, 2, \dots$ such that $\mathbb{P}(\eta > \tau) = \alpha_n \xrightarrow{n \rightarrow \infty} 0$.

Theorem. *Under the previous conditions, we have*

$$\mathbb{P}(\xi \alpha_n (\lambda + \lambda_s) > t) \xrightarrow{n \rightarrow \infty} e^{-t}.$$

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On manifolds for prey-predator models

Cristina Nartea

Technical University of Civile Engineering Bucharest

cristina.nartea@yahoo.com

A comparison between various manifolds (invariant, inertial and approximate inertial manifolds) for prey-predator model is done.

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Macroeconomic model with rational expectations for Republic of Moldova

Elvira Naval

*Institute of Mathematics and Computer Sciences, Academy of Sciences of
Moldova, Chişinău, Republic of Moldova*

nvelvira@math.md

A small macroeconomic model for Republic of Moldova is estimated using annual data. Three goods model with one domestically produced good consumed both at home and abroad and one imported good is examined. The aggregate demand, the aggregate supply, the money market and the government sector are considered. The consumption is the sum of the real rate interest, disposable income, lagged consumption term and lagged disposable income term. Consumer disposable income is defined as GDP plus the earnings on net assets held abroad, minus the interest paid on domestic debt and taxes. Investment is a linear function of the real interest rate, real output and the beginning-of-period capital stock. Export is a function of the real exchange rate, level of real output abroad, and a lagged export term. Real import is the function of the real exchange rate and real domestic output, a lagged import and a lagged reserve-import ratio.

Conditions of the single Nash equilibrium existence in informational extended two-matrix games

Ludmila Novac

Moldova State University, Chişinău, Republic of Moldova

NOVAC-LUDMILA@yandex.ru

The informational aspect in the game theory is manifested by: the devise of possession information about strategy choice, the payoff functions, the order of moves, and optimal principles of players; the using methods of possessed information in the strategy choice by players. The inclusion of information as an important element of game have imposed a new structure to the game theory: the games in complete information (the games in extended form), the games in not complete information and the games in imperfect information (the Bayes games). The player's possession of supplementary information about unfolding of the game can influence appreciably the player's payoffs. An important element for the players represents the possession of information about the behaviour of his opponents. Thus the information for the players about the strategy choice by the others players has a significant role for the unfolding of the game.

Securing methods for protection and segregating network data

Nicolae Objelean

Moldova State University, Chişinău, Republic of Moldova

objelean@yahoo.com

A new method of network security and virtualization is presented which allows us the consolidation of multiple network infrastructures dedicated to single security levels or communities of interest onto a single virtualized network. An overview of the state of the art of network security protocols is presented, including the use of SSL, IPSec, and HAIPE IS, followed by a discussion of the SecureParser technology and MLS-Net architecture, which in combination allow the virtualization of local network enclaves.

Center-affine invariant conditions for stability of motion of three-dimensional differential affine system

V. M. Orlov , M. N. Popa

Institute of Mathematics and Computer Sciences, Academy of Sciences of Moldova, Chişinău, Republic of Moldova

orlovictor@gmail.com

Consider the three-dimensional affine differential system

$$\dot{y}^j = a^j + a_\alpha^j y^\alpha \quad (j, \alpha = \overline{1, 3}), \quad (3)$$

The variables and coefficients are defined in the field of real numbers \mathbb{R} . Consider also the group of center-affine transformations $GL(3, \mathbb{R})$. It is known [1] that $A_1 = a_\alpha^\alpha$ is the invariant of system (1) with respect to the group $GL(3, \mathbb{R})$. As shown in [2], the system (1) is remarkable, because, for $A_1 = 0$ and $j, \alpha = \overline{1, 5}$, it connects the indicators of economic and energy safety e.g. in the Republic of Moldova. Therefore, that steady work of the energy system provides the normal work of all areas of economy. In the work for the system (1) the differential system of the equations of indignant motion was constructed [3]. According to [4], the last one is transformed, by the group $GL(3, \mathbb{R})$, to the following

$$\dot{x}^1 = \overline{x}^2, \quad \dot{x}^2 = \overline{x}^3, \quad \dot{x}^3 = L\overline{x}^1 + M\overline{x}^2 + N\overline{x}^3, \quad (4)$$

where L, M, N are invariants [4], but x^j ($j = \overline{1, 3}$) are sweeps of quantity y^j ($j = \overline{1, 3}$). Center-affine invariant conditions for stability of motion are obtained for system (1).

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Some numerical results for Saffman-Taylor instability

Gelu Paşa

*Institute of Mathematics "Simion Stoilow" of Romanian Academy,
Bucharest*

Gelu.Pasa@imar.ro

We study the linear stability of immiscible displacement in Hele-Shaw cells or porous media. A steady basic solution exists, with a sharp interface between the two fluids (water and oil). If the displacing fluid (water) is less viscous, the interface is unstable. A third region is considered between the fluids, containing a given amount polymer solute. The viscosity in this region is a parameter used for minimizing the interface's instability. A Sturm-Liouville problem governs the linear stability of the two interfaces. The corresponding eigenvalues are the growth constants (in time) of the perturbations. Some estimates of the growth constants are given in recent papers. In this paper we give some details for the numerical computation of growth constants. We consider the finite-difference method to obtain an approximate solution of our differential equation. We use also the discretization of the integral equation obtained by using the corresponding Green functions. In some particular cases, the obtained linear systems are equivalent.

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The finite volume method for electrostatic problem in heterogeneous media

Vladimir Pațiuț

Moldova State University, Chișinău, Republic of Moldova

e-mail: patsiuk@usm.md

The problem of defining the potential $\varphi(x, y)$ of the electrostatic field in the domain Ω , where absolute dielectric permittivity $\epsilon_a(x, y)$ has piecewise constant value is considered. The Dirichlet problem for the function $\varphi(x, y)$ is solved by the method of finite volumes [1]. In order to do this, in the domain $\bar{\Omega} = \Omega + \Gamma$ the Delaunay triangulation is made and the Voronoi diagram is built. The approximate solution $\varphi_h(x, y)$ represents a piecewise linear function. The system of linear algebraic equations is built by the approximation of contour integrals along the borders of the Voronoi cells.

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Bit reversal through direct Fourier permutation method and vectorial digit reversal generalization

Nicolaie Popescu-Bodorin

"Spiru Haret" University, Bucharest

bodorin@ieee.org

This paper describes the direct Fourier permutation algorithm, an efficient method of computing Bit Reversal of natural indices $[1, 2, 3, \dots, 2^k]$ in a vectorial manner (k iterations). The vectorial digit reversal algorithm, a natural generalization of direct Fourier permutation algorithm enabling us to compute the r-digit reversal of natural indices $[1, 2, 3, \dots, r^k]$, where r is an arbitrary radix, is proposed too. Matlab functions implementing these two algorithms and various test and comparison codes are presented in this paper to support the idea of inclusion of these two algorithms in the next Matlab Signal Processing Toolbox official distribution package as much faster alternatives to current Matlab functions `bitrevorder` and `digitrevorder`.

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Distribution of the number of claims in a layer and of the k -th largest claim

Alexandrina Maria Proca

"Transilvania" University of Braşov

alexproca@unitbv.ro

In this paper we discuss an application of extreme value theory to reinsurance starting with the concept of k -th order statistic and their properties. We will touch on two important questions in reinsurance. The first one is: "how many claims can occur in a layer $(D_1, D_2]$ or (D_1, ∞) ?" and "what do we know about the size of the largest claims?"

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Recursive unsolvability of a problem of expressibility in the logic of provability

Mefodie Rață

Institute of Mathematics and Computer Sciences, Academy of Sciences of Moldova, Chișinău, Republic of Moldova

ratsa@math.md

It is proved that there does not exist an algorithm which, for every formula F and for every list of formulae Σ , enables us to determine whether F is expressible by means of Σ in the Gödel-Löb logic of provability.

Determination of asymptotic waves in Maxwell media by double-scale method

Liliana Restuccia*, Adelina Georgescu**

**University of Messina, Italy, **University of Pitești*

lrest@dipmat.unime.it

New results in thermodynamics of specific media and wave propagation through them are presented by using the double scale method. Older facts are reformulated in a more appropriate way.

On some approach to numerical grid generation

Galina Ribacova

Moldova State University, Chişinău, Republic of Moldova

ribacus@yahoo.com

The large number of problems connected with numerical modeling of different physical processes leads to necessity of creation of effective methods of discretization of the computational fields with complicated shape. The numerical grid generation now became a common tool for use in the numerical solution of partial differential equations on arbitrary shaped regions. Numerically generated grids obviate the difficulties in description of the arbitrary boundary shape from finite difference method. With such grids all numerical algorithms (including the finite difference) are implemented on a square or rectangular computational region regardless of the shape and configuration of the initial physical region. In order to solve this problem there are often used the methods based on application of the elliptical type partial differential equations for description of the interconnection between the computational (ξ, η) and physical (x, y) regions. In present article the method of creating the regular two dimensional curvilinear grids based on the solution of the problem of longitudinal elastic plate deformation is presented.

To formulate the problem let us consider the rectangular elastic plate. Let the rectangular uniform grid with the grid points (x_i, y_j) , $x_i = ih_x$, $y_j = jh_y$, $i = \overline{0, n}$, $j = \overline{0, m}$, , ($h_x = l_1/n$, $h_y = l_2/m$ – the steps of the grid on corresponding variable, l_1 and l_2 – the dimensions of rectangular plate) is marked on this plate. If now the plate is exposed to longitudinal deformation so as its boundaries take some given form (the form of boundaries of the region where the grid must be constructed), then the grid, which was marked on plate, will be deformed too. As a result of such deformation we obtain the unknown grid. The displacements u and v of the plate points by coordinates x and y respectively satisfies the following system of equations [2]:

$$\begin{aligned} \frac{\partial^2 u}{\partial x^2} + \frac{1-\mu}{2} \frac{\partial^2 u}{\partial y^2} + \frac{1+\mu}{2} \frac{\partial^2 v}{\partial x \partial y} &= 0 \\ \frac{\partial^2 v}{\partial y^2} + \frac{1-\mu}{2} \frac{\partial^2 v}{\partial x^2} + \frac{1+\mu}{2} \frac{\partial^2 u}{\partial x \partial y} &= 0 \end{aligned} \quad (5)$$

where μ is Poisson's ratio, the choice of which have an influence upon the grid lines.

The equations (1) can be solved numerically by means of finite difference method on the rectangular grid that has been introduced above. For that the equations (1) must be completed with boundary conditions, i.e. the shape of boundaries of initial region is to be known. Than the displacements of boundary points are given, i.e. the following values are known

$$\begin{aligned} u(0, y), v(0, y), u(l_1, y), v(l_1, y), y \in [0, l_2] \\ u(x, 0), v(x, 0), u(x, l_2), v(x, l_2), x \in [0, l_1] \end{aligned}$$

Let denote by $u_{ij} = u(x_i, y_j)$ and $v_{ij} = v(x_i, y_j)$ - the values of unknown functions in the grid points. Than the finite difference approximation of equations (1) is the following:

$$\begin{aligned} u_{ij,x\bar{x}} + \frac{1-\mu}{2}u_{ij,y\bar{y}} + \frac{1+\mu}{4}(v_{ij,\overleftarrow{y}x} + v_{ij,y\overleftarrow{x}}) = 0 \\ v_{ij,y\overleftarrow{y}} + \frac{1-\mu}{2}v_{ij,x\overleftarrow{x}} + \frac{1+\mu}{4}(u_{ij,\overleftarrow{y}x} + u_{ij,y\overleftarrow{x}}) = 0 \end{aligned} \quad (6)$$

where $i = \overleftarrow{1}, n-1, j = \overleftarrow{1}, m-1$ (we use here the generally accepted designation for finite difference derivatives [3]). The created finite difference scheme (2) approximates the initial differential problem (1) with second order relative to h_x and h_y and represents the system of linear algebraic equations with dimensions $2 \times (n-1) \times (m-1)$. The values $v_{0j}, u_{0j}, v_{nj}, u_{nj}, j = \overleftarrow{0}, m$ and $v_{i0}, u_{i0}, v_{im}, u_{im}, i = \overleftarrow{0}, n$ are determined from boundary conditions. Taking into account the large dimensions of the system, its solution must be found by means of iterative method [3].

The developed algorithm is easy in realization and can be applied for discretization of the regions with complicated geometrical structures. References

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On μ - scale invariant linear relations

Adrian Sandovici

University of Bacău

adrian.sandovici@gmail.com

The concept of μ -scale invariant operator with respect to a unitary transformation in a separable Hilbert space is extended to the case of linear relations (multi-valued linear operators). It is shown that if S is a nonnegative linear relation which is μ -scale invariant for some $\mu > 0$, then its adjoint S^* and its extreme selfadjoint extensions are also μ -scale invariant.

Exact solutions of the equations of motion of a micropolar fluid for the laminar flow between two concentric cylinders

Valeriu Al. Sava

Technical University "Gh. Asachi", Iași

valsava@gmail.com

Analytical solutions of the equations of motion of a micropolar fluid for the fully developed laminar flow between two concentric cylinders are presented, when an oscillating circumferential pressure gradient is imposed.

To the Noether's theory of Winer-Hoph type systems of equations in the singular case

Alexandra Scherbakova

Transnistrian State University, Republic of Moldova

alexma@inbox.ru

The paper is devoted to the theory of the solvability of Winer-Hoph type systems of equations as

$$P_1(x)\varphi(x) + \frac{1}{\sqrt{2\pi}} \int_0^{\infty} k(x-t)P_2(t)\varphi(t)dt = h(x), x > 0, \quad (1)$$

where $P_1(x) = \sum_{k=0}^m a_k x^k$, $P_2(x) = \sum_{\nu=0}^s a_{\nu} x^{\nu}$ are known polynomials; $h(x) \in L_2$ is the known vector-function, $k(x) \in L$ - is the known matrix-function. Using the properties of the Fourier transformation, the investigation of the system of equations (1) is led to the investigation of the following matrix differential boundary problem

$$\left[\sum_{k=0}^m A_k (-1)^k \Phi^{+(k)}(x) + \sum_{\nu=0}^s (-1)^{\nu} K_{\nu}(x) \Phi^{+(\nu)}(x) \right] - \Phi^{-}(x) = H(x), x \in \mathbf{R}, \quad (2)$$

where $K(x), H(x)$ are the Fourier transformations of the matrix function $k(x)$ and the vector function $h(x)$ respectively, and $\Phi^{+}(x)$ ($\Phi^{-}(x)$) is a boundary value at the real axis of an unknown vector function $\Phi^{+}(z)$ ($\Phi^{-}(z)$), which is an analytical one in the domain $Imz > 0$ ($Imz < 0$). It is proved that (1) and (2) are equivalent and their solutions are related by

$$\varphi(x) = \frac{1}{\sqrt{2\pi}} \int_{\mathbf{R}} \Phi^{+}(t) \exp^{-ixt} dt, x > 0. \quad (3)$$

As solutions of the problem (2) will be found in the form of limiting values of the Cauchy type integral, then $\Phi^{+(k)}(\infty) = 0$, $k = \overline{0, m-1}$, so the problem (2) has null entry conditions. It is determined that the equation (1) is not a normally solvable or it is not a Noetherian one. The conditions, when equation (1) is a Noetherian and solvable, are determined. We investigate the singular case when $m = s$ and the condition $\det(A_m + B_m K(x)) \neq 0$ is not satisfied on the real axis \mathbb{R} and this matrix- function goes to zero at such points as $\alpha_1, \alpha_2, \dots, \alpha_u$ with integer orders $\gamma_1, \gamma_2, \dots, \gamma_u$. The special representation for this matrix-function was built at that case; the number of linearly independent solutions of (1) and the number of conditions of solvability of the heterogeneous system of equations (1) for $m = s$ was determined too. In the same case the summary index of the system of equations (2) is determined too. The problem was also investigated for $m < s$ and $m > s$. This detailed investigation was made at every case because of the dependence of the system of partial indexes of the matrix function of the characteristic part of differential boundary problem (2). The summary index of (2) in every singular case was determined too. Besides it was shown that the conditions of solvability for (1) at that singular case will be more complicated when the polynomials $P_1(x)$, $P_2(x)$ have different degrees.

Design sensitivity analysis and ships stern hydrodynamic flow field improvement by using some original concepts and ideas

Horatiu Tanasescu* , Nasta Tanasescu**

**ICEPRONAV, Galați, **"Dunărea de Jos" University, Galați*

horatiu.tanasescu@icepronav.ro

The paper draws attention and briefly focuses on ships hull stern flows in the light of two ideas (concepts) of the authors in ship hydrodynamics: 1. a new stern hydrodynamic concept (NSHC), with radial crenellated-corrugated sections (Tanasescu's stern shape); 2. the use of an inverse piezoelectric effect [(electric current high-frequency power generator piezoelectric driver made of certain ceramic material, which induces an elliptical vibratory movement of high frequency (more than 20 kHz), into the elastic side plates of 15 mm thick in the streamlines direction (of the external flowing water)], able to reduce the total forward resistance. Present achievements and prospectives are discussed.

Continuous selections for continuous multifunctions. The Darboux problem for third order hyperbolic inclusions

Georgeta Teodoru

"Gh. Asachi" Technical University, Iași

teodoru@math.tuiasi.ro

In this paper we consider the Darboux Problem for a third order hyperbolic inclusion of the form

$$\frac{\partial^3 u(x, y, z)}{\partial x \partial y \partial z} \in F(x, y, z, u), \quad (x, y, z) \in D = [0, a] \times [0, b] \times [0, c], \quad u \in \Omega \subset \mathbb{R}^n, \quad (1.1)$$

with the initial conditions

$$\begin{cases} u(x, y, 0) = \varphi(x, y), & (x, y) \in D_1 = [0, a] \times [0, b], \\ u(0, y, z) = \psi(y, z), & (y, z) \in D_2 = [0, b] \times [0, c], \\ u(x, 0, z) = \chi(x, z), & (x, z) \in D_3 = [0, a] \times [0, c], \end{cases} \quad (1.2)$$

where φ, ψ, χ are functions absolutely continuous in the Carathéodory's sense, $\varphi \in C^*(D_1, \mathbb{R}^n)$, $\psi \in C^*(D_2, \mathbb{R}^n)$, $\chi \in C^*(D_3, \mathbb{R}^n)$ and they satisfy the conditions

$$\begin{cases} u(x, 0, 0) = \varphi(x, 0) = \chi(x, 0) = v^1(x), & x \in [0, a], \\ u(0, y, 0) = \varphi(0, y) = \psi(y, 0) = v^2(y), & y \in [0, b], \\ u(0, 0, z) = \psi(0, z) = \chi(0, z) = v^3(z), & z \in [0, c], \\ u(0, 0, 0) = v^1(0) = v^2(0) = v^3(0) = v^0, \end{cases} \quad (1.3)$$

and $F : D \times B \rightarrow A$ is a continuous multifunction whose values are non-empty compact and not necessarily convex subsets of \mathbb{R}^n , A is a closed ball centered at the origin of \mathbb{R}^n of radius M and B is the closed ball centered at the origin of radius $r = M_1 + Mabc$. We prove an existence theorem of a continuous selection for each function $(x, y, z) \rightarrow F(x, y, z, u(x, y, z))$ with respect to a given family of continuous functions $(x, y, z) \rightarrow u(x, y, z)$. The approximation that we obtain, which is basically elementary, consists in systematically using the continuous partition of the unit and also in building some appropriate approximate selections. The role thereof is somehow analogous to the role played by step functions in approximating continuous real values functions defined on a compact interval, and to the role played by the approximate solutions in building the solutions of the ordinary or generalized differential equations, that is of the differential inclusions as well. Using this result an existence theorem of an absolutely continuous solution for the Darboux problem for the specified inclusion is obtained.

Application of partial differential equations to finance

Delia Teselios

"Constantin Brâncoveanu" Univ., Pitești

delia_teselios@yahoo.com

As part of the Securities Market, an important place is being occupied by derivatives, e.g. options, forward contracts, futures contracts. They are financial instruments whose value depend on the value of the underlying asset (ex. equities, currencies, commodities). Derivatives are used mainly by investors, for the following aims: speculation, hedging and arbitrage. A very important role in derivative theory is being occupied by the solving of the partial differential equations and their analysis. This paper presents a few applications of partial differential equations to finances. In finances, the boundary conditions represent agreement clauses of different derivative products and they show the way in which the solution behaves as $S \rightarrow \infty$ or $S = 0$, where S represents the value of the underlying asset. The initial and final values of derivative contracts are the most obvious boundary values. The final conditions generally consist in payoff function. Starting with a stochastic differential equation, designing a risk free portfolio and applying the 1-dimensional Ito formula, the Black-Scholes equation is obtained. The hypotheses in which Black-Scholes partial differential equation is relevant are shown. The equation solutions of the European CALL and European PUT options are presented. There are much more situations in which one or several Black-Scholes hypotheses are not fulfilled, case in which a new partial differential equation is obtained. The cases in which the underlying asset generates constant continuous dividend are presented, and an evaluation of the options on futures contracts is made.

Linguistics approach of ambient intelligence adaptable tools

Dumitru Todoroi , Diana Micusha , Zinaida Todoroi,

Academy of Economical Studies, Chișinău, Republic of Moldova

todoroi@ase.md

Ambient Intelligence (AmI) enthusiasts foresee a future information society where the emphasis is on greater user-friendliness, more efficient services, user empowerment and support for human interactions. The adoption rate of ambient intelligence environments will however depend on how secure it can be made, how privacy and other rights of individuals can be protected and how individuals can come to trust the intelligent world that surrounds them and through which they move. The ambient intelligence adaptable tools (AmIAT)

as knowledge based systems BASIS, represented by ambient intelligence adaptable languages (AmIAL) and ambient intelligence adaptable processors (AmIAP), are characterized by a lot of advanced linguistics and processor's features. AmIAL integrate such linguistics features as multilanguageability, universality, speciality, exensibility, dialectability, compactibility of Basis, reducability, effectivity of modification, continuity of human and machine experience, touchability to the formal natural language level of human-machine interaction. AmIAP integrate translator interaction features, e.g. universality, mobility, transferability, cognisability, speciality, minimizing of processors quantity raising the level of human-machine interaction to the level of problem formulation. The goal of adaptable software research direction consists in creation, usage, maintenance, and development of the AmIAT. These tools form [Tod-98] the basis of the XXIst century societal information and development human-machine interactions systems [Mic-05, Tod-05]. Formalisms for adaptable processors interactions and algorithmic demonstrations of adaptable processors automatically creation are represented. These results represent development of ideas from the Fulbright 1997/1998 research project No. 22131, UNO, USA. References

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Asymptotic stability of trivial solution of DE in Banach space with unbounded linearity

Vladilen Trenogin

*Department of Mathematics, Moscow State Steel and Alloys Institute,
Russia*

trenogin@km.ru

Let X be real or complex Banach space. Consider the Cauchy problem for the differential equation (DE)

$$\dot{x} = Ax + R(t, x), \quad x(0) = x_0.$$

Below we assume that the following conditions are fulfilled:

I. A is a closed linear operator, mapping its domain $D(A)$, dense in X , to X which is the generator of the semigroup $U(t) = \exp(At)$ of C_0 class. $U(t)$ is exponentially decreasing: there exist the constants

$M > 0$ and $\alpha > 0$ such that the inequality $\|U(t)\| \leq M \exp(-\alpha t)$ is valid;
II. the nonlinear operator $R(t, x)$ is defined for x on the ball $S = \{x \in X : \|x\| < p\}$, for t on the semiaxis $\mathfrak{R}^+ = [0, \infty)$ and there exist continuous function $C(t) > 0$ and the constant $\beta > 0$ such that in this ball the inequality

$$\|R(t, x_1) - R(t, x_2)\| \leq C(t) \max^\beta(\|x_1\|, \|x_2\|) \|x_1 - x_2\| \text{ is fulfilled.}$$

We investigated the generalized solution of the Cauchy problem as the continuous on \mathfrak{R}^+ solution of the integral equation

$$x(t) = U(t)x_0 + \int_0^t U(t-s)R(s, x(s))ds.$$

If the function $C(t)$ has a not very big growth on the infinity then for all sufficiently small $\|x_0\|$ there exists the unique generalised solution which tends to zero as $t \rightarrow +\infty$. It is possible also to indicate the sufficient restrictions where the solution is the classical one. These facts are the wide extension of our results established in the articles [1]-[5] and others.

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GTZ maximal principles in product spaces

Mihai Turinici

"A. Myller" Mathematical Seminar; "A. I. Cuza" University Iasi

mturi@uaic.ro

The product type maximal statement in Goepfert, Tammer and Zălinescu [Nonl. Anal., 39 (2000), 909-922] is logically reducible to the ordering principle in Brezis and Browder [Advances Math., 21 (1976), 355-364]. Moreover, its "graph" corollaries are nothing but variants of the (scalar) monotone variational principle in Turinici [Libertas Math., 20 (2000), 161-172].

Keywords Locally convex (vector) space, convex cone, closure, quasi-order, decreasing lsc function, maximal element, complete metric structure, self-closedness, gauge function, archimedean property.

Continuum information sources and channels - a critical analysis

Eugen Vasile

"Politehnica" University of Bucharest

evas@alpha.imag.pub.ro

In the framework of the Information Theory, sources and channels with continuum alphabet are studied as a extension of discrete case passing to probability-densities $w(x)$. Usually, the infinite value of Shannon-entropy in the continuum case is avoided by retaining only the finite term $w(x)\ln[w(x)]dx$. We show that the remaining term has a physical meaning and may be not infinite and must be considered in a dynamic sense in all demonstrations of general relations of communications channels. The whole problem is close and naturally related to the physical dimensions of probability-densities $w(x)$. Key words: information theory, entropy, information sources, communication channels.

Boundedness problems for jumping Petri nets

Cristian Vidraşcu

University "Al. I. Cuza" of Iaşi, România

vidrascu@infoiasi.ro

A Petri net ([1]) is a mathematical model used to specify and the analyze parallel/distributed systems. One type of problems related to Petri nets is that of finding algorithms which take a Petri net Σ and a property π as input and answer, after a finite number of steps, whether or not Σ satisfies π . The behaviour of some distributed systems cannot be adequately modelled by classical Petri nets. Many extensions which increase the computational and expressive power of Petri nets have been thus introduced. One direction has led to various modifications of the firing rule of nets. One of these extension is that of jumping Petri net, introduced in [2]. A jumping Petri net is a classical net Σ equipped with a (recursive) binary relation R on the markings of Σ . The meaning of a pair $(m, m') \in R$ is that the net Σ may "spontaneously jump" from m to m' (this is similar to λ -moves

in automata theory). In this paper we prove some decidability results regarding boundedness for jumping Petri nets.

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Boolean dynamical systems

Serban E. Vlad

City House, Oradea

serban_e_vlad@yahoo.com

The asynchronous circuits from the digital electrical engineering are modeled by the so-called asynchronous systems. An autonomous asynchronous system is a set X of 'nice' $\mathbf{R} \rightarrow \{0, 1\}^n$ functions $n \geq 1$, called signals, representing non-deterministically the models of the tensions that describe the behavior of an asynchronous circuit without inputs. A special case of such a system X is the one when a function $\Phi : \{0, 1\}^n \rightarrow \{0, 1\}^n$ is given such that any $x \in X$ fulfills a 'differential' equation involving Φ . In such conditions, by analogy with the 'real' semi-dynamical systems, the Boolean dynamical systems may be defined.

Our paper defines: the nullclines, fixed points, motions and their speed, invariant subsets of $\{0, 1\}^n$, attraction, limit cycles, evolutions of $x \in X$, stable manifolds, Huffman systems and several properties of invariance which are very important in electrical engineering (such as the delay insensitivity). The relation with the discrete time systems is also suggested.

Pseudoquaternion representations in the theory of mappings and their applications

Muhamadi Zakhirov , Hurshidbek Yusupov

"Mirzo Ulugbek" National University of Uzbekistan, Tashkent, Uzbekistan

hurschidbek@yahoo.de

The given work deals with setting correspondence between main directions, main curvatures and theorems regarding a surface with imaginary units, coefficients and discriminants of quadratic form, Beltrami equations system. Their applications to describe the birth and

uptake operators of bosons and fermions are investigated. in particular, in transonic gas dynamics, a connection between Mach number and imaginary units is established. Pseudoquaternions' matrix representation is investigated. New representation of Beltrami equations system solutions enable the Riemann theorem on mappings be valid on hyperbolical plains as well as the issue on Poincare's problem solution variant is investigated.

Mathematical description of the process of removing some ions from aqueous-alcohol solutions using of cation-exchange resins

Veaceslav I. Zelentsov , A. M. Romanov

*The Institute of Applied Physics, Academy of Sciences of Moldova,
Chişinău, Republic of Moldova*

vzelen@yandex.ru

Purification of aqueous-alcohol solutions from Fe and Ca cations is a very important question in vine industry. The results of calculation of ion-exchange equilibrium for the system Fe-Ca-H are presented. Argumentation of assumptions adopted at the derivation of equation of ion-exchange isotherm of above components on the cationits KU-2x8 and C100 (both in H-form) is given. The constants of ion-exchange equation are calculated. A good agreement between the values of adsorption of these ions determined experimental and calculated by means of the derived equation is shown.

Section 6

The role of statistics in school mathematics

Liliana Antonescu

"Liviu Rebreanu" School, Mioveni, Argeş

The mathematical statistics plays an important role in many branches of sciences with applications in daily life. We are, at every step, confronted with statistics about events, more or less probable, that are published in journals, reviews and scientific publications, that we have to analyse. In spite of her importance, the statistics was never as profoundly studied as it should be during the education of the teachers and in the school mathematics. We see that the place of statistics in the actual curriculum is not better. In this paper, the role of statistics is carefully examined. Some ways to reduce the discrepancies between what should be done and what is really done are suggested. The purpose is that of improving the instruction of teachers and the teaching of statistics.

The predictable test - method of school achievement anticipation

Marius Antonescu* , Florina Protopopescu**

**Leiceşti High School, **"Ion I. Petrică" High School, Domneşti, Argeş*

marius2antonescu@yahoo.com

There are different modalities and various points of view in which the problem of scholastic evaluation appears. The complex status and multiple functions that evaluation has in the learning process make inappropriate every simplistic treating of this action. As a integrated action of the learning process evaluation is, in the first place, a pedagogical action with formative functions using objectives methods and specific modes. The evaluation is efficient when the instructive program is well done is a modern conception using pupils level of knowledge, capacities, abilities that are going to be developed. When verifying and appreciating are based on general and operative objectives using predictable, formative and final tests and the methods are various, then the evaluation is efficient. The predictable tests are used for a initial evaluation, being administrated in the beginning of the instructional program. They offer to the teachers information about pupils previous level of knowledge and their capacity of learning, and the future instructional program is based on this tests.

Students' perceiving of exponential and linear growths

**Teodor-Petre Cioacă, George-Ionuț Ioniță , Oana-Mihaela
Lozneau , Cristian-Ioan Popa**

University of Bucharest

oanamihaela01@yahoo.com

Analyzing international test conducted in several countries, we have ascertained that formulating hypotheses on the way that intuition intervenes in pupils thinking and verifying these hypotheses is proving to be a challenge for those who are involved in the learning process. The present work studies pupils' tendencies to interpret models which describe exponential or linear growth and to choose the most effective growth. In this purpose we have gathered data from 3 middle-schools and 3 high-schools from different locations: Petroșani, Slatina, Bucharest, Olanu. The growth phenomenon was transcribed in a problem using natural language, without any mathematical expressions. The study was conducted on 224 students. From these students, 14% chose the exponential growth to be the fastest. This means that the subjects cannot make use of correct reasoning in order to solve various situations and are confronted with difficulties when adapting mathematical instruments to another context than the one they were used to in school.

Educative potential of mathematics

Ioana Florea, Ionel Florea

"Al. Odobescu" National College, Pitești

florea.ionel@yahoo.com

The paper reveals some educational features of the lyceum mathematics. These are connected to the education and the development of logical thinking and of reasoning, to the pass from the learning formulae, definitions and theorems by heart, to the exploration and investigation, from individual learning, to learning together. The paper presents also some concrete mathematical activities, that were the result of the work at class. These mathematical activities are intended to lead the pupils toward an active thinking, to make them formulate questions, confront their opinions, participate at interdisciplinary projects, assume some collective responsibilities, evaluate the work of the team, to express their ideas and to listen to the others.

Methods to detect creativity

Anișoara Gherghe

"George Topârceanu" School, Mioveni, Argeș

anna_gherghe@yahoo.com

The paper presents the way of understanding and of approaching the problems of mathematics by the means of detecting creative thinking, and by a better knowledge of the pupils. Thus, we can detect the talented pupils that will be trained through extra work or at mathematical circles, in order to obtain good results at mathematical contests and not only. The creativity being the principal dimension of the contemporary human being, it represents a central problem of the today school. The school must ensure the complete development of modern human beings and from this point of view, every domain of study can bring its contribution to the development of creativity.

The explanation of the formation of the rainbow

Monica-Gabriela Gruia

"Liviu Rebreanu" School, Mioveni, Argeș

The rainbow is one of the most spectacular optical natural phenomenon. The first attempts to explain its formation are due to Aristotheles, that asserted that it appeared as a consequence of the "unusual" reflections suffered by the rays of Sun on the clouds. Later, in 1266, Roger Bacon succeeded to measure the angle between the incident and the reflected rays, finding an approximate value of 420° . Among the moment of the first theoretical considerations of Aristotheles and the next significant moment there is an interval of 1700 years. In 1304, the german monk Teodorik from Freiburg, by giving up Aristotheles' speculative hypothesis, considered that the rainbow consists of the set of all water drops and verified this hypothesis with the help of a spherical retort, full of water. More than that, he followed experimentally the trajectory of the light rays and reached very close to that admitted nowadays as correct interpretation.

The dimensions of the creativity

Angela Ion

School nr. 6 "Nicolae Bălcescu", Pitești

angelaion06@yahoo.com

The creativity is the capacity of creating something, while the creation act is a process of evaluation by invention or by discovery, with the help of the creative imagination, of some new ideas or theories. The psychologist Guilford conceives the creativity as a stage of learning and he identified five factors of creativity:

1. Fluidity of thinking
2. Flexibility of thinking
3. The elaboration
4. Sensitivity to problems
5. Redefinition

In our paper we discuss the factors of creativity. The flexibility of creative thinking re-structures and modifies the trajectory of thinking. You should not go on with the same method when you don't succeed, detach yourself from the problem and imagine new possibilities, try to see new relations, re-structure, combine, transform the data of the problem. We presented three problems that rely on this factor. The increase of the fluidity of thought implies the capacity of giving out in a certain interval of time, new ideas, two establish connections between facts. Concerning this factor, we selected a problem proposed at the International Mathematical Contest, problem that was solved through six different methods, some found by the pupils from the high level group that I am training, others found by myself or by other solvers.

Applications of Hippocratic lunes

Stelian Ionescu

School nr. 19, Pitești

sion_47@yahoo.com

The calculus of the area of Hippocrates lunes represents one of the first examples of calculus of the area of a plane surface bounded by curved lines. As interesting problems connected to the Hippocratic lunes we consider and investigate:

- the lunes constructed on the edges of a rectangle (and, as a particular case, a square);
- the lunes constructed on the edges of a regular hexagon;
- an extension of the Archimedes spiral, from where a spiral of lunes results.

On the exponential function

Marcela Mihai

"Gheorghe Asachi" Industrial School Group, Bucharest

mmihai58@yahoo.com

The paper presents the properties of the solution of a scalar linear differential equation, and the proof of the fact that this solution is identical with an exponential function.

The mathematics of the third millenium

Gherghina Nicolescu, Florica Gorneanu

"Liviu Rebreanu" School, Mioveni

This paper intends to be the starting point for a comprehensive debate on the state of school mathematics at the beginning of the third millenium. The content of some developing branches of mathematics, some pedagogical principles, as well as the relation between computer and teaching mathematics are analysed.

Methods of teaching-learning used at mathematical classes in school

Valerian Opreșor

"Iulia Zamfirescu" Theoretical HighSchool, Mioveni, Argeș

oprisor_valerian@yahoo.com

The society of present, and especially that of the future belongs to information and to complexity. That is why the investition in intelligence, creativity and th capacity of innovating of each person and of groups will be extremely profitable in the future. Fenelon compares the brain of a child to a lightened candle in the blowing wind, this one detemining the shiver of the little light. The contemporary spirit has to face great challenges: the informational explosion, the stress, the acceleration of the rythm of life, the growth of uncertainty.

These challenges lead to the necessity of an educational ecology, that assumes: the development of a holistic thinking, of some competences of informational processing, of living memory. The role of the schoolmaster in the process of modelling of the human being is perhaps the most important. By leading his pupils in various instruction situations, he transforms the school "in a temple and a laboratory" (M. Eliade). Active learning means, by the dictionary, the process of learning adjusted to the interests/ level of understanding of the participants to this process. The methods presented in the paper refer to the classical as: the mathematical proof, the systematic exposition of knowledge, the conversation method, the formulation of problems and the learning through discovery, the modelisation, the exercising, the work with the textbook, the method of learning on groups, the learning through collaboration, the use of algorithms, the programmed instruction, but also to the modern methods as: the KWL -know, want to know, learn (strategy of assuming by the pupils of what they know or believe they know on a certain subject and also of what they don't know or are not sure they know and would like to learn), INSERT - Interactive Noting System for Effective Reading and Thinking (teaching-learning technique due to be a convenient reference for the level of pupils' knowledge at a certain moment), the method of cluster (teaching-learning technique due to encourage the pupils to think free and to stimulate the connexions between ideas), the Jigsaw method (the use of small groups of pupils such that they can work together, such as every member of the group may improve his/her records and contribute to the improvement of the others' records).

The Romanian Mathematical Education System in the perspective of our European integration

Mihaela Predescu

"Ion Barbu" High School, Pitești

In the first part of the paper, some general ideas concerning the Romanian Mathematical Education System viewed in the perspective of Romania's integration in EU are presented. These are: the increase of the quality of mathematical teaching, a better communication between teacher and pupil, the simplification of the mathematical curricula, the creation of some excellence centers in every city, the correlation between theory and practice in the study of mathematics, the improvement of the evaluation of the learning results, the elaboration of new, more suited to the necessities of pupils handbooks.

In the second part, the mathematical journal "Omicron" is presented. It is elaborated together with a group of pupils from the HighSchool "Ion Barbu", Pitești and it contains articles on:

- pages from the history of mathematics,
- the School in Pythagora's age,
- contemporary mathematicians,
- the School in the perspective of EU integration,
- dialogues with the "champions" of mathematics,
- dialogues with pupils from other countries, about the study of mathematics,
- interviews with some well-known mathematics teachers.

The third part of our paper contains a presentation of the life and work of Lagrange and some problems from among the subjects for the 2007 Bacalaureate Exam, that require the well-known "Theorem of Lagrange".

The reform of the curricula - the necessity of an interdisciplinary approach

Elena Pufu

"Liviu Rebreanu" School, Mioveni, Argeş

pufuelena@yahoo.com

The necessity of an interdisciplinary approach of the problems of science, social life and education stems from the impossibility of any science to make a global research of the complex problems of reality. Since science is the basis of all the components of modern education, including the school curriculum, we can assert that the contemporary school itself cannot avoid interdisciplinarity. The modern science does not represent anymore some insulated facts of knowledge, but a continuously restructured assembly, a production of knowledge, continuously regenerating itself, an endless "struggle of thinking", an permanent activity of research, a ceaseless fight with the unknown, a processus of creating new knowledge. The science does not consists in the already known truth, but in seeking this truth, in the experimental activity and in the research activity that aims to the discovery and to the master of the laws of nature and society.

Means and modern techniques of evaluation of the pupils
in the "Sciences" curricular area

***Viorel Bocancea, **Elena Pufu, **Constantin Gheorghe
Năstase , **Elena Năstase**

**State University of Tiraspol, Republic of Moldova, **"Liviu Rebreanu"
School Mioveni, Argeş*

pufuelena@yahoo.com

The evaluation of pupil's results aims to determine the level at which the learning objectives are attained. The evaluation is a long term and continuous process, the moments in which the evolution takes place being different, depending on the the purpose assumed at the beginning of the instruction program, during this program and at its end. The data obtained in all these evaluations define together a complex image of the evaluated person and of her/his progress during the instruction process. The purpose of the paper is to present some means and modern techniques for the evaluation of the pupils from the "Sciences" curricular area.

Some applications of the notion of integer part

Mariana Rădulescu , Daniela Berechet

"Liviu Rebreanu" School, Mioveni, Argeş

anairamradulescu@yahoo.com

Grigore Moisil asserted that "mathematics is the science that cultivates thinking, where there is any thinking". In this paper we remind some of the properties of the notion of integer part and we present some problems relative to this notion, most of them for the $V^{th} - VIII^{th}$ form level (i.e. solving some equations, inequations, systems of equations, the proving of some equality relations, the calculus of some sums, the determination of some sets).

Past, present and future in eLearning

Nicoleta Sămărescu

Faculty of Educational Sciences, University of Pitești

nicolbr2000@yahoo.com

The paper presents the eLearning in the framework of the educational systems and the evolution from dLearning to mLearning. The provisions of the specialists of UE concerning the evolution of eLearning are also presented.

Categories for assessing problem solving

***Mihaela Singer , **Cristian Voica**

**Institute for Educational Studies, **University of Bucharest*

msinger@ise.ro, voica@gta.math.unibuc.ro

While reading the text of a problem, the student's activity is driven by the purpose of solving it. This purpose orients all the subsequent steps. Thus, the constraints of the text lead to the understanding of the relationships between the data and the operations, through a primary decoding. These relationships induced by the various constraints of the text are transposed in configurations of a mental model through a process of representation. The junction between the mental configurations suggested by the problem and the mathematical knowledge and capacities of the student generates a series of relations that lead to a mathematical model associated to the problem. The implementation of the techniques that are specific to the identified mathematical model leads to solving the problem.

Based on the analysis of various problem solving strategies, we identify the following operational categories which allow structuring five polarized criteria: the nature of the problem topic (criteria: practical-quotidian versus theoretical); the dominant processing code (criteria: linguistic versus iconic); the kinematics of the mental model (criteria: static versus dynamic); the processing type of the suggested configuration (criteria: standard versus non-standard); the dominant procedure to get the solution (criteria: algorithmic versus creative). These operational categories and criteria are powerful tools in assessing problem solving.

A study about the graphics representations

Corina Andreea Sultana, Andrei Florea

University of Bucharest

andrei_florea2000@yahoo.com

This study is about the way pupils understand distinct graphics related to the same problem. For this study we questioned 231 subjects. The test consisted in three problems: in the first one, the subject had to correlate two graphics where one of the coordinate was distinct, in the second and the third they had to understand a graphic and to find the error in another one. Our conclusion after this study is: the pupils had difficulties when they had to correlate two graphics, and the same when on the axe of coordinates are represented other things than those that represent a material size like space. The subject of the project was suggested at the "Didactic of the mathematics" class.

Future starts into school financial mathematics

Mariana Urziceanu* , Liliana Săndulescu**

**The School Center for Inclusive Education, Voluntari, Ilfov, **S.C. Floyd Advertising Design & Consulting S.R.L. Bucharest*

urziceanumariana@yahoo.com, lucsandra@yahoo.com

"The one hundred miles road starts with the first step"-Lao Tse

Coming of age, of "entrance" into life, the young people measure their strength against difficulties, worry their brains with questions like this: "How shall I achieve my future aspiration ? " At this age dreams and aspiration are without limits. How school helps these young peoples, how it prepares for a butler life? During last years biome concepts about enterprizing were inserted into the school programmers, guiding the pupils to make the first steps their own business, the way for their dreams achievement. The first step for a young man to start his own business is to find a financial support. How could be to have the money needed to start a business? Three possibilities exists:

1. Saving money. They can save money to a bank, during the school period, with as interest: simple or complex.
2. Loaning money from a bank: on a short period or on a long period.
3. Network marketing - future business.

This paper will present, by comparison, these 3 ways for a business financing, the mathematics modes that are their foundation with relevant examples.

Francois Viete, a precursor of contemporary mathematics and informatics

Ion I. Văluță, Evelina Tihonov

Technical University of Moldova, Chișinău, Republic of Moldova

valutse@mail.ru

A hystorical overview of the evolution of the algebraic formalism and of the basis of informatics is presented. The contribution of Francois Viete to this evolution is emphasized.

Applications of Darboux Property

Mariana Vladu

Vehicles Construction School Group Colibași, Mioveni

vladuflorentin@yahoo.fr

The study of the general properties of functions grew impetuously. Properties of the correspondence law as well as properties of the definition domain or of the image set were stated. As an example, the Darboux property refers to the correspondence law, and to the definition domain and to the image set as well. In this paper some applications of the Darboux property are presented. Long time it was thought that the Darboux property characterizes the continuous functions. Darboux gave the first example of a discontinuous function that enjoys the property that bears his name.

Using computer facilities in teaching and assessing mathematics

Consuela Luiza Voica

School nr.12, Bucharest

consuelavoica@yahoo.com

All successful learning experiences involve an engaged and motivated learner and the delivery of information in an environment that supports both its comprehension as well as its retention. The study reported on in this paper examined the effectiveness of the use of software on mathematics learning and assessing at secondary level. Traditional teaching methods were continued throughout the period of the study for all students involved. Computer use did not replace, it rather enhanced, these traditional methods.

On Mandelbrot sets

***Claudia Voiculescu , **Ion Dumitru Voiculescu**

***"Liviu Rebreanu" School, Mioveni, **The School Technological Group
Câmpulung*

claudiavasilica@yahoo.com

The Mandelbrot set is a fractal that became famous for its beauty as well as for its complicate structure, based on a simple definition. This fame is partially due to the efforts made by Benoit Mandelbrot and some others to make this field known. The Mandelbrot set is defined as the set of those points c from the complex plane for which, by repeatedly applying the complex polynomial $z^2 + c$ (starting from $z = 0$), the result remains in the interior of a finite radius disk.

Debate:

*The actual estate of the Romanian Education
System*

About the actual estate of the Romanian Education

Laurențiu Modan

Computer Sciences Faculty, Bucharest

modan_laurent@yahoo.fr

In our work we aim to realise a study based on a careful analysis of the present teaching and learning system of our country. For this, our starting point is the precarious mathematical education in contemporary Romania, and equally, the research since 2005, about Bologna Program, of the French professor in Amiens University, Bertrand Kalaora.