MATHEMATICAL METHODS IN ENGINEERING
International Symposium

Ankara, Turkey
April 27-29, 2006

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Invited Lecturers

- J.A. Tenreiro Machado, Institute of Engineering of Porto, Portugal
- B. Fisher, University of Leicester, U.K.
- H.J. Stetter, Technical University of Vienna, Austria
- O.P. Agrawal, University of Southern Illinois, Carbondale, USA
- F. Mainardi, University of Bologna and INFN, Italy
- S. Dahlke, Philipps University, Germany

List of Abstracts

• **ABDELKRIM, Aliouche**, University of Larbi Ben M'Hidi Oum, ALGERIA

A Common Fixed Point Theorem For Weakly Compatible Mappings In Fuzzy 2-Metric and Fuzzy 3-Metric Spaces

The following Theorem has been proved in [13, B. Singh and S. Jain, Semi-compatibility, compatibility and fixed point Theorems in fuzzy metric space, J. Chungcheong Math. Soc., 18 (1), 2005].

Let A, B, S and T be self-maps of a fuzzy metric space $(X, M, \bigstar)$ satisfying

1. $A(X) \subset T(X)$ and $B(X) \subset S(X)$
2. One of A and B is continuous
3. (A, S) is semi-compatible and (B, T) is weakly compatible,
4. $M(AX, By, t) \geq r(M(SX, Ty, t))$,

for all $x, y \in X$, where $r : [0, 1] \to [0, 1]$ is a continuous function such that $r(t) > t$ for each $0 < t < 1$. Then, A, B, S and T have a unique common fixed point in X.

It is our purpose in this paper to prove a common fixed point Theorem for weakly compatible mappings in fuzzy metric, fuzzy 2-metric and fuzzy 3-metric spaces.

• **ABU-ALSHAIKH, Ibrahim**, Fatih University, İstanbul, Turkey

One-dimensional Wave Propagation in Functionally Graded Cylindrical Layered Media

In this study, the numerical solution of one-dimensional wave equation in multilayered cylindrical media is investigated. The multilayered medium consists of different layers of Functionally Graded Material, i.e., it is assumed that the stiffness and the density of each layer are varying continuously in the radial direction but isotropic and homogeneous in the circumferential and axial directions. The inner surface of the layered medium is assumed to be subjected to a uniform dynamic in-plane time-dependent normal stress; whereas, the outer surface of the layered medium is assumed free of surface traction or fixed. The method of characteristics is employed to obtain the numerical solutions of this initial-boundary value problem. The obtained numerical results reveal clearly the scattering effects caused by the reflections and refractions of waves at the boundaries and at the interfaces of the lay-

and the effects of non-homogeneity in the wave profiles. Furthermore, based on the results obtained from this paper, one may conclude that when the inner surface is stiffer than the outer surface, the stress-wave levels throughout the functionally

• **AGRAWAL, Om P.**, Southern Illinois University, USA

Generalized Euler-Lagrange equations and the transversality conditions for fractional variational problems

This paper presents an extension to traditional calculus of variations for systems containing fractional derivatives. The formulations are presented for both the Riemann-Liouville and the Caputo derivatives. Some of the conditions which were not included in the previous work [1] are now included in these formulations. Specifically we consider two problems, the simplest fractional variational problem and the fractional variational problem of Lagrange. For both problems, we obtain the Euler-Lagrange equations, which are the necessary conditions for a fractional to be extremum. Results of the first problem are extended to problems containing multiple fractional derivatives and unknown functions and to unspecified boundary conditions. The unspecified boundary conditions lead to transversality and the natural boundary conditions, which must be satisfied for the given functional to be extremum. The relationship between the boundary conditions required by the fractional variational formulations and the Laplace transform technique is examined. For the second problem, we also present a Lagrange type multiplier rule. The formulations and the examples considered demonstrate that the fractional boundary conditions may be necessary even when the problem is formulated in terms of Caputo derivatives. The formulations presented and the resulting equations are very similar to those that appear in the field of classical calculus of variations. The formulations can be extended to other problems in the field of fractional calculus of variations.

1. O. P. Agrawal, "Formulation of Euler-Lagrange equations for fractional variational problems," J. Math. Anal. Appl., 272, (2002), 368-379.

• **AGRAWAL, Om P.**[a] **and BĂLEANU Dumitru**[b,c], Southern Illinois University, USA, Çankaya University[b], Turkey, Institute of Space Sciences[c], ROMANIA

A Hamiltonian Formulation and a Direct Numerical Scheme for Fractional Optimal Control Problems

Optimal control problems arise naturally in various areas of the decision science, applied mathematics and engineering. This paper deals with a direct numerical technique for Fractional Optimal Control Problems (FOCPs). In this study, we formulate the FOCPs in terms of Riemann-Liouville Fractional Derivatives (RLFDs). It is demonstrated that right RLFDs automatically arise in the formulation even when the dynamics of the system is described using left RLFDs only. For numerical computation, the FDs are approximated using the Grunwald-Letnikov definition. This leads to a set of algebraic equations which can be solved using numerical techniques. Two examples, one time-invariant and the other time-variant, are considered to demonstrate the effectiveness of the formulation. It is demonstrated that as the order of the derivative approaches an integer value, these formulations lead to solutions for integer order system. The approach requires diving of the entire time domain into several sub-domains. It is demonstrated that as the sizes of the sub-domains are reduced, the solutions converge to unique solutions but the convergence seems to be slow.

• **AKPOLAT, Çağatay**, Bahçeşehir University, TURKEY

Discrete Cosine Transform Based Palmprint Verification by Using Linear Discriminant Analysis

In this paper a new method is proposed for palmprint verification using Linear Discriminant Analysis. The verification system is consists of two steps: One is enrolment step; the second one is verification step. In the enrollment step the palm is scanned and its region of interest (ROI) is extracted. After then ROI and it is owners name stored in the database. Several palm images are stored database like using same methods. In verification steps palm image is scanned for verification. The images ROI is extracted. The feature vector has been obtained by applying discrete cosine transform to a data extracted from ROI. The proposed method is tested with ORL database and the results are compared with palmprint verification using line edge maps and palmprint verification using linear discriminant analysis. Verification

error rate obtained is approximately 3%, which is a significant result with respect to other available palm verification algorithms.

- **AKTAŞ, Hakan A.**[a]**, DİNÇ, Erdal**[b] **and PEKCAN, Güzide**[a], Süleyman Demirel University[a], Ankara University[b], TURKEY

Wavelet transform for the simultaneous prediction of the colorants in food product

Wavelet transform method was successfully applied to the multicomponent analysis of the binary mixtures containing different colorants in commercial food product. In this application, wavelet transform method is suitable for the quantitative resolution of the mixtures of these colorants and this hybrid approach doesn't require any separation and extraction steps. The method was tested by using various synthetic ternary mixtures and applied to the sample and successfully results were obtained.

- **AL-MOMANI, Raid**[a] **and ALMOMANI, Khalid**[b], Qatar University[a], QATAR, King Abdullah University Hospital[b], JORDAN

Dirichlet Problem for Orthotropic Bounded Cylinder with Combined Boundary Conditions

We solve Dirichlet problem of the two dimensional nonstationary heat conduction problem for orthotropic bounded cylinder with boundary conditions of the first and second kinds of circular discontinuity of temperature density of heat flow. The solution of such problem was derived with the help of Laplace and Hankel transformations.

- **AL-NASSAR, Y.N.**[a]**, KALYON, M.**[a]**, PAKDEMİRLİ, M.**[b] **and AL-BEDOOR, B.O.**[c], King Fahd University of Petroleum and Minerals[a], SAUDI ARABIA, Celal Bayar University[b], TURKEY, University of Jordan[c], JORDAN

Stability Analysis of Rotating Blade Vibration due to Torsional Excitation

This paper presents an approximate analysis of the vibration stability of a rotating blade due to shaft torsional vibration excitation. The

governing equation adopted in the study is a Hills type linear second order ordinary differential equation with multiple harmonically variable coefficient terms. The strained parameters method, a perturbation technique, is utilized in developing the stability transition curves in the plane of parameters related to the rotor speed, the torsional vibration excitation frequency and the blade natural frequency. The stable and unstable regions obtained by perturbations are contrasted to those obtained by numerical stability analysis performed using Floquet theory and an excellent match is observed for small torsional vibration amplitudes. Numerical integration of the original equation at selected points in the predicted stable and unstable regions showed that the predicted behavior of the responses is correct, wherein the unstable regions growing blade vibration is exhibited.

- **ALTAŞ, İsmail H.**[a] **and NEYENS, Jelle**[b], Karadeniz Technical University[a], TURKEY, Gent university[b], BELGIUM

A Fuzzy Logic Load-Frequency Controller for Power Systems

A fuzzy logic based load frequency controller model for power systems is developed and simulated in this paper. The proposed simulation model is compared with the classical regulating systems in order to verify and show the advantages of the model and controller developed. The design process of the proposed fuzzy logic controller is given in detail step by step to show a direct and simple approach for designing fuzzy logic controllers in power systems.

- **ALTIN, Aydın**, Dokuz Eylül University, TURKEY

Orbits and Real and Spherical Motions

In this paper, these definitions, theorems, proofs and figures are intended to be a rather complete and self-contained exposition of the theory of ergodicity and stability, presented in detail and in a form accessible to readers without any prior knowledge of the subjects described. In particular, I improve well-known results of repellor, attractor, ergodicity and stabilities regarding existence via arguments that are simpler than those that can be found in the literature of these areas. I present the proofs which are largely self-contained and does not rely on the theories of the old ones. In order to give proofs I use the

saddle surface S with negative curvature. These elementary geometric and topologic devices of the saddle surface S able the theory versatile and clear. A number of tools and issues encountered in the theory of real and dual unit spherical representations are illustrated here in an elementary and simple manner, usually free from difficult theories of the spherical motions themselves.

• **ALZABUT, Jehad**, Çankaya University, TURKEY

Piecewise Constant Control of Boundary Value Problem for Linear Impulsive Differential Systems

Necessary and sufficient conditions are established for the existence of piecewise constant control of the boundary value problem for linear impulsive differential systems. We present a result that explicitly characterizes the solving control.

• **AMIRULLAH, M. Mamedov**, Çukurova University, TURKEY

Jones Matrices of 2D Anisotropic System: Application to Eye Model

Jones Matrix formalism is used to describe electromagnetic wave propagation through cornea. We calculate the Jones matrices from the experimental measured Mueller matrices. Two algorithms for the calculation of effective Jones matrices from Mueller matrices were compared. Both algorithms give similar results for the set of experimental date considered. The correspondence between the matrices calculated theoretically and deduced from the experiment is evidence of the applicability of the model considered to real eye cornea.

• **AMIRULLAH, M. Mamedov**, Çukurova University, TURKEY

Holographic memories and optical signal processing in a ferroelectric crystal

3D optical storage is possible in semitransparent colored materials like alkali halides with color center and ferroelectric materials. With the use of coherent light sources like lasers, large amounts of information is accomplished by the formation of interference patterns between each two plane parallel waves. This work develops the theory of this form

of storage. It turns out that the information storage capacity is as if every little cube with sides equal to the wavelength of light acts as in independent information storage cell, and the essential noise is recovering this information is only the statistical fluctuation in the number of color centers (or photosensitive ferroelectric) in such a cube. The storage capacity is therefore of the order of 10^{12} bit per cm^3. The main property of this way of information storage is the appearance of a "ghostianage" partly, but not completely analogous to the one describe previously. This property moves 3D storage very suitable for associative memories. The theory lends support to Beurles proposed mechanism of information storage in the brain.

- **ARIKAN, Orhan[a], ARIKAN Feza[b], and EROL Cemil B.[c]**, Bilkent University[a], Hacettepe University[b], TUBITAK - ILTAREN[c], TURKEY

3-D Computerized Ionospheric Tomography with Random Field Priors

Computerized Ionospheric Tomography (CIT) is a method to reconstruct ionospheric electron density image by computing Total Electron Content (TEC) values from the recorded GPS signals. Due to the multi-scale variability of the ionosphere and inherent biases and errors in the computation of TEC, CIT constitutes an undetermined ill-posed inverse problem. In this study, CIT is performed by using a Bayesian approach with Gaussian random field priors. The 3-D mean and the covariance of the assumed Gaussian random field priors can either be obtained from ionospheric models such as IRI or they can be estimated by an iterative algorithm. Given sparse TEC measurements, the electron field is obtained from mean square estimation where the Gaussian random field structure provides regularization. The theory is tried on various sections of ionosphere initially for quiet days and the reconstructions are compared with available Global Ionospheric Maps from IGS centers.

- **ARSLAN, Turan[a] and KARACASU, Murat[b]**, Mustafa Kemal University[a], Osman Gazi University[b], TURKEY

A Heuristic Approach for Processing Public Assessments on Transportation Projects

Having an effective public participation in transportation planning and project development process has been a major concern for developed countries. In the United States, for instance, all state Departments of Transportation are subject to the Transportation Equity Act (TEA-21) that formally requires public involvement in transportation planning. Since transportation planning involves public resources and values, judgments by the public should play a key role determining final decisions. Therefore, all these agencies are required not only to disseminate information to the public, but also solicit and consider public opinion in forming transportation policy. This work presents a decision support model with public involvement and public oversight and, therefore, to help policy makers select appropriate transportation projects for implementation. Since focus groups will face multiple objectives and inexact information in the process, a hybrid model of fuzzy logic and analytical hierarchy process is proposed. A set of if-then rules based on Webers psycho-physical law of 1834 is presented to reason from fuzzy numbers to capture essential subjective preferences, pairwise, among the alternatives from focus groups. The AHP is then incorporated in to estimate preference allotments among alternatives. Based on stated preferences, the suggested method is exemplified in a survey that seeks public approval of appropriate public bus transportation system between the one run by municipal authorities or the one run by private agencies to show how this procedure works.

- **ASADA, Akira**, Sinsyu University, JAPAN

Zeta-regularization and Calculus on Infinite Dimensional Spaces

In the calculus of infinite dimensional geometry and analysis,we often meet the problem of divergence. For example, div. of a vector function contains infinite sum, so may diverges. To overcome this difficulty, a systematic way of application of zeta-regularization was proposed (Asada, A.: Regularized Calculus: An application of zeta-regularization to infinite dimensional geometry and analysis, to appear in Int. J. Geo. Meth. of Math. Physics). In this talk, taking mathematical justification of the appearance of Ray-Singer determinant in the calculation of Gaussian Path integral as the example, regularized calculus is explained.

- **ASHYRALYEV, Allaberen**, Fatih University, TURKEY

Fractional spaces generated by the positive differential and difference operators in a Banach Space

In the present paper we study the structure of the fractional spaces $E_{\alpha,q}(L_q[0,1],A^x)$ generated by the positive differential operator A^x defined by the formula

$$A^x u = -a(x)\frac{d^2u}{dx^2} + \delta u,$$

with domain $D(A^x) = \{u \in C^{(2)}[0,1] : u(0) = u(1), u^{'}(0) = u^{'}(1)\}$. Here $a(x)$ is a smooth function defined on the segment $[0,1]$ and $a(x) \geq a > 0, \delta > 0$. It is established that for any $0 < \alpha < \frac{1}{2}$ the norms in the spaces $E_{\alpha,q}(L_q[0,1],A^x)$ and $W_q^{2\alpha}[0,1]$ are equivalent. The positivity of the differential operator A^x in $W_q^{2\alpha}[0,1]\,(0 < \alpha < \frac{1}{2})$ is established. The discrete analogy of these results for the positive difference operator A_h^x a second order of approximation of the differential operator A^x, defined by the formula

$$A_h^x u^h = \{-a(x_k)\frac{u_{k+1} - 2u_k + u_{k-1}}{h^2} + \delta u_k\}_1^{M-1}, u_h = \{u_k\}_0^M, Mh = 1$$

with $u_0 = u_M$ and $-u_2 + 4u_1 - 3u_0 = u_{M-2} - 4u_{M-1} + 3u_M$ is established. In applications, the coercive inequalities for the solutions of the nonlocal boundary-value problem for two-dimensional elliptic equation and of the second order accuracy difference schemes for the numerical solution of this problem are obtained.

• **ASYALI, Musa H.[a], ALCI, Musa[b], ZHENG, Lei[c] and JUUSOLA, Mikko[c]**, Yaşar University[a], Ege University[b], TURKEY, The University of Sheffield[c], UK

Comparison of Fuzzy and Volterra Series Nonlinear System Modelling Approaches

In this study, we investigated modelling performances of two popular nonlinear system identification methods, namely fuzzy modelling and Volterra series. In literature a general approach to nonlinear structure modelling does not exist, therefore both fuzzy models and Volterra series are interesting and widely used as they can approximate a large class of nonlinear functions. In fuzzy modelling, a dynamic system is modelled using a set of fuzzy membership functions and rules. The fuzzy model parameters are trained using optimization techniques. In Volterra series approach, the dynamic system is modelled using a set of kernel functions that represent the first and higher order convolutions. The kernel functions are typically estimated using an orthogonal expansion technique using a set of suitable of basis functions such as Laguerre. We compared the modelling performance of these approaches

on a physiological system identification problem and observed that the fuzzy approach provides lower estimation error using fewer model parameters.

- **AŞIK, Mehmet Zülfü and İŞBUĞA V.**, Middle East Technical University, TURKEY

Non-linear Response of a Layered Medium

Response of a soil medium with stiffer and elastic layer on the top is presented by using the model introduced by Iwan [1] and the calculation procedure introduced by Joyner and Chen[2]. The problem analyzed is basically the response of horizontal soil layers bounded below by a semi infinite elastic medium and above by an elastic layer. Medium is shaken by a ground motion assumed to be originated at the top of the semi infinite elastic medium. The aim of the study is the introduction of the nonlinear soil-structure interaction problem by considering true nonlinear behavior of soil under seismic excitations.

- **AŞIK, Mehmet Zülfü and DURAL Ebru**, Middle East Technical University, TURKEY

Effect of Support Conditions on the Vibration of the Laminated Composite Beams

A Laminated glass plate or beam used in building industry is an architectural unit of the building formed by two or more thin glass plates or beams bonded together by an interlayer PVB (polyvinyl butyral). Behavior of the laminated glass beams is complicated because of the materials with the elastic modules having order difference. Laminated glass unit is very thin and can easily undergo large displacement. Therefore, the equilibrium equations governing their behavior should be based on the large deflection theory. In the present study, the effect of the boundary conditions on the vibration of laminated glass unit is investigated by considering the cases of simply supported and fixed supported laminated glass beams. Glass units considered in this study have two thin glass beams and an interlayer PVB. Mathematical model for the dynamic behavior of a laminated glass beam is developed through the variational principles. The assumptions of the classical beam theory are valid. Three coupled partial differential equations which express the dynamic behavior are obtained for lateral and axial displacements. By solving the equations, the effect of

boundary conditions on the natural frequencies is observed in figures of the displacement versus the angular frequency.

- **AYDIN, Baran and KÃNOĞLU, Utku**, Middle East Technical University, TURKEY

An Analytical Solution for Wind Set-down Relaxation Problem

The response of the ocean to the wind blowing over a long-narrow basin is governed by a nonlinear balance equation between the wind stress and the pres-sure gradient and called the wind set-down problem. Shoreline exhibits oscillatory behavior when the wind suddenly calms down and problem is now called the wind set-down relaxation. There exists an implicit analytical solution for the wind set-down problem. There is also numerical solution for the wind set-down relaxation problem employing the nonlinear shallow water-wave equations. Numerical solution uses the implicit solution of the wind set-down problem as an initial condition. We solve both problems analytically providing an explicit analytical solution for the former one and a nonlinear analytical solution for the latter one using hodograph-type transformation. The results are compared well with the existing numerical solution.

- **AYGÜN, Halis and BURAL, A. Arzu**, Kocaeli University, TURKEY

Fuzzy Inverse Compactness

In this paper, we introduce definitions of fuzzy inverse compactness, fuzzy inverse countable compactness and fuzzy inverse Lindelöfness on arbitrary L-fuzzy sets in L-fuzzy topological spaces, where L is a fuzzy lattice. We prove the goodness of the proposed definitions and obtain different characterizations of fuzzy inverse compactness.

- **AYTAR, Salih and PEHLİVAN, Serpil**, Süleyman Demirel University, TURKEY

Levelwise Statistical Convergence of a Sequence of Fuzzy Numbers

In the current work, we define the concepts of levelwise statistical convergence, levelwise statistical limit and cluster points of sequences of fuzzy numbers and give the relations among sets of ordinary levelwise limit points, levelwise statistical limit points and levelwise statistical cluster points of a sequence of fuzzy numbers. Finally, we prove a levelwise statistical convergence criteria depending on these concepts.

• **BĂLEANU, Dumitru**, Çankaya University, TURKEY, Institute of Space Sciences, ROMANIA

Equivalent Lagrangians within fractional calculus

The equivalent Lagrangians problem is analyzed within fractional calculus. By using the Riewe formalism the fractional Lagrangian and Hamiltonian are obtained for equivalent Lagrangians. Two illustrative examples are investigated in details.

• **BARBOSA, Ramiro S.[a], MACHADO, J. A. Tenreiro[a], VINAGRE B. M.[b], and CALDERÓN A. J.[b]**, Polytechnic Institute of Porto[a], PORTUGAL, Universidad de Extremadura[b], SPAIN

Study of the Van der Pol Oscillator with Fractional Derivatives

In this paper we propose a modified version of the classical Van der Pol oscillator obtained by introducing fractional-order time derivatives into the statespace equations. The resulting fractional order Van der Pol oscillator is analyzed in the time and frequency domains, by using phase portraits, spectral analysis and bifurcation diagrams. The describing function method of analysis is also introduced. The fractional-order dynamics is illustrated through numerical simulations of the proposed schemes by using approximations to fractional-order operators. Finally, the analysis is extended to the forced Van der Pol oscillator.

• **BARBOSA, Ramiro S, MACHADO, J. A. Tenreiro and GALHANO Alexandra M.**, Polytechnic Institute of Porto, PORTUGAL

Analysis of Fractional-Order Discrete Controllers in the Presence of Nonlinearities

Presently, the development of fractional-order controllers is one of the most promising fields of research. However, most of the work in this area addresses the case of linear systems. In this paper we consider the analysis of fractional-order control of nonlinear systems. The performance of discrete fractional-order controllers in the presence of several nonlinearities is discussed. Some results are provided that assesses the superior robustness of such algorithms.

- **BASHIROV, Agamirza[a,b] and MAZHAR, Zeka[a]**, Eastern Mediterranean University[a], TURKEY, National Academy of Sciences[b], AZERBAIJAN

On Asymptotical Behavior of Solution of Riccati Equation Arising in Linear Filtering with Shifted Noises

In this paper we consider a linear signal system together with the two linear observation systems. The observation systems differ from each other by the noise processes. The noise of one of them is a constant shift in time of the signal noise. In the other one the shift is neglected. Respectively, we consider two best estimates of the signal corresponding to two different observation systems. The following problem is investigated: whether the effect of the shift on the best estimate becomes negligible as time increases. This leads to a comparison of the asymptotical behaviors of the respective Riccati equations. It is proved that under a certain relation between the parameters, the effect of the shift is not negligible.

- **BAYRAMOV, Sadi and GÜNDÜZ, Çiğdem (Aras)**, Kocaeli University, TURKEY

Limits of inverse and direct spectra in category of fuzzy modules

In this study, we first define the concept of inverse and direct spectra in category of fuzzy modules.We investigate whether or not the inverse and direct spectra limits of exact sequences of fuzzy modules is exact. Later, we show that direct spectra limits of exact sequences of fuzzy modules is exact. Generally, the inverse spectra limit of exact sequences is not exact.

• **CANSIZ, Ahmet and GÜNDOĞDU, Ömer**, Atatürk University, TURKEY

Translational and Rotational Dynamic Analysis of a Superconducting Levitation System

The rotational dynamics of a disk-shaped permanent-magnet levitated over a superconductor was studied experimentally and theoretically. The interaction between permanent magnet and the superconductor was modelled in terms of diamagnetic approach. In the magnetomechanical analysis the frozen image concept was combined with the diamagnetic image. The interaction of the system is constructed on the combination of magnetic and gravitational potential. From the dynamical analysis the equations of motion of the permanent magnet were stated as a function of lateral, vertical, tilt angle, precision angle and rotating angle. The vibration behavior and correlation of the vibration of one direction to another were determined with a numerical calculation obtained by the Runge-Kutta method. The tests performed for experimental verifications were translational and rotational. The permanent magnet was spun up under vacuum conditions to analyze dynamics of the free spin behavior of the permanent magnet.

• **CENK, Murat[a] and ÖZBUDAK, Ferruh[b]**, Çankaya University[a], Middle East Technical University[b], TURKEY

Isomorphism Classes of Ordinary Elliptic Curves over Fields of Characteristic 3

Ordinary elliptic curves over fields of characteristic 3 can be represented by $y^2 = x^3 + ax^2 + b$ where $a, b \neq 0 \in F_{q=3^n}$. In this paper we count the number of different isomorphism classes of ordinary elliptic curves over finite fields of characteristic three. We show there are $(2q - 2)$ different isomorphism classes.

• **CIOBANU, Brindusa and RADINSCHI, Irina**, Gh. Asachi Technical University, ROMANIA

A Mathematical Method for Study of the Electromagnetic Field in a Rotating Universe

The first important model of the universe in rotation to which corresponds a new cosmological solution of the Einstein's equations is the model proposed by Kurt Gödel. In another our paper it was shown that the Gödel universe has a completely democratic energy structure, and how this model may be treated as a space-time describing a stage of the gravitational collapse, or an elementary particle. The purpose of this paper is to obtain and integrate the Maxwell equations in vacuum, in the Gödel universe. In this context, it was established and interpreted the tetradic form of the electromagnetic field equations. Supposing the private case of an electromagnetic field characterized by the nonvanishing components A^2 and J^2 only, of the quadripotential and quadricurrent magnitude respectively, we have suggested to establish the concrete dependence on the space-temporal coordinates of the electric and magnetic field.

- **CIOBANU, Brindusa and RADINSCHI, Irina**, Gh. Asachi Technical University, ROMANIA

One Computational Method for Modelling the Energy of a Dilaton-Maxwell Solution

In this paper we calculate the energy distribution of a metric which describes a recently derived non-asymptotically flat black hole solution in dilaton-Maxwell gravity and was given by Chan, Mann and Horne. The calculations are performed with the Papapetrou energy-momentum complex. The energy distribution depends on the mass , charge of the black hole and coordinate. The calculations are performed with the Mathematica and Maple programs which have attached the GrTensor platform. Also, we make a discussion of the expression of the energy distribution in the Papapetrou prescription.

- **CIOBANU, Lucian and CIOBANU, Iulia Brindusa**, Gh. Asachi Technical University, ROMANIA

Reliability of the Robots and the Flexible Cells

The paper presents some problems about the calculation the reliability of the robots, flexible cells of service the machines and equipments and for the flexible production lines. The number of the serving machines in the time $[0, t]$ and the number of the waiting machines in the time $[0, t]$ is a Poisson process. The calculation of the reliability parameters is very important for the availability but is very difficult, because

the elements are very complex and the robots work in the different exploitations conditions.

- **CIOBANU, Lucian and CIOBANU, Iulia Brindusa**, Gh. Asachi Technical University, ROMANIA

Holonic Galvanization or Hardening Line

The paper presents a flexible manufacturing system with autonomous manufacturing devices and production management agents that communicate with one another, to accomplish galvanization or hardening production tasks. The holonic architecture is a hierarchy of self-regulating holons which function as autonomous wholes in supra-ordination to their parts, as dependent parts in subordination to controls on higher levels, and coordination with their local environment. The holonic robotic system has management and executive layers. The management layer has three layers: task, process, and operation. The execution holon allows control of the agenty and the negotiation between the operation and the execution holons. The holonic system allows independently manufacturing devices and reconfiguration to adapt to changes.

- **COŞKUN, Safa Bozkurt**, Niğde University, TURKEY

Analytical Solutions for Radial Buckley-Leverett Flow in Polar and Spherical Coordinates

In this study an extension of Buckley-Leverett solution for one dimensional two-phase immiscible flow through homogeneous porous medium is presented. Governing equations for horizontal two-dimensional and three dimensional immiscible two-phase flow can be rewritten in one-dimensional radial coordinate system by assuming the porous medium is homogeneous and isotropic in any direction perpendicular to radial direction. Based on the governing equations in radial coordinate system by neglecting capillarity, gravity and liquid compressibility effects, analytical solutions are obtained for two-dimensional and three-dimensional immiscible two-phase flow. A sample problem is considered, analytical solutions are produced and then the results are compared with fine-scaled finite difference solutions called exact solution in previously published studies.

• **DAHLKE, Stephan**, Philipps University, GERMANY

Adaptive Wavelet Schemes for Elliptic Operator Equations: Theoretical Analysis and Practical Realization

The aim of this talks is to give an overview on recent developments concerning the numerical treatment of (elliptic) operator equations by means of adaptive wavelet methods. The first part of the presentation is devoted to the theoretical analysis of adaptive schemes. We intend to give a rigorous answer to the fundamental question: when does adaptivity pay? It turns out that the efficiency of an adaptive scheme is determined by the regularity of the exact solution of the operator equation in the specific scale $B^\alpha_\tau(L_\tau(\Omega))$, $\tau := (\alpha/d + 1/p)^{-1}$ of Besov spaces. Thus, at least for some simple model problems, the regularity of the solution in this scale is investigated with the aim of determining the largest α for which the solution is in $B^\alpha_\tau(L_\tau(\Omega))$. It turns out that the Besov regularity is high enough to justify the use of adaptive schemes.

In the second part of the talk, we shall discuss some recent developments concerning the practical realization of adaptive wavelet schemes. Using the equivalence of Sobolev norms with weighted sequence norms of wavelet expansions, it is possible to derive reliable and efficient a posteriori error estimators. Moreover, based on these error estimators it is possible to derive an adaptive refinement strategy which is guaranteed to converge for a large class of problems including operators of negative order. We also discuss generalizations to discretization schemes based on frames.

We finish this talk with some numerical experiments for the Poisson equation.

• **DARIESCU, Ciprian[a], DARIESCU, Marina – Aura[a] and MURARIU Gabriel[b]**, Al. I. Cuza University[a], Dunãrea de Jos University[b], ROMANIA

Electromagnetic Radiating Modes in Einsteins Universe

The aim of the present paper is to derive physically meaningful solutions of Maxwell equations on $S^3 \times R$ spacetime, pointing out significant differences from the Minkowskian background. Thus, by integrating the corresponding Maxwell equations, we get the essential components of the electromagnetic 4-potential as linear superposition of the α and β-polarized, left- and right-moving modes of positive and

negative frequencies. The corresponding orthonormal components of the electric and magnetic fields allow us to compute the components of the UmovPoynting vector and the energy density of the electromagnetic field. Finally, we end up with the static $S^3 \times R$ background, and get, in the canonical basis, the components of the effective momentum.

- **DARIESCU, Marina – Aura[a], DARIESCU, Ciprian[a] and MURARIU Gabriel[b]**, Al. I. Cuza University[a], Dunãrea de Jos University[b], ROMANIA

Quantum Hall-type behavior of charged bosons

Starting with the NielsenOlesen Lagrangian in cylindrical coordinates, we derive the system of EulerLagrange equations. We focus on the term in the vector-potential which expresses pure topological effects, as being important for the study of both integral and fractional Hall effect. We compute the corresponding current density pointing out values of the AharonovBohm flux where the current density reaches its maximum. For integer flux quanta, the radial and azimuthal parts in the scalar modes decouple, exhibiting a radially non-homogeneous azimuthal current, of pure quantum origin. Finally, we deal with the bidimensional quantum-type evolution of the charged bosons and derive the Hall electric field. Our results agree with the experimental data on modulation-doped GaAs film, which have pointed out that, at high magnetic fields, the Hall resistance shows plateaus, which can not be explained unless one considers quantum effects in Landau levels formation.

- **DARVISH, Hamit, DEVRİM, Cihangir and ÜLKER, Mustafa Musa**, Çankaya University, TURKEY

SecurEvote

SecurEvote is a secure online voting system that can be accessed from every internet point. This is a project that has been developed by two senior project students in computer engineering. The goal of SecurEvote is to develop and demonstrate a highly secure and verifiable e-voting system using internet technologies. Advanced cryptographic techniques to be used in the project will ensure integrity, privacy and authentication of the votes and voters, also during vote counting and auditing process.

In traditional voting system is done with using ballot and ballot- box. Every voter goes voting places and votes their citizen. But our solution provides that you can vote everywhere all over the world, that you can access internet.

SecurEvote will be tested during student council elective in Cankaya University.

The project is expected to revolutionize the established practices in traditional voting.

- **DARVISH, Hamit, ÇELİK, Ömer and ALUŞ, Cüneyt**, Çankaya University, TURKEY

National Emergency Data Network

National Emergency Data Network is a system that allows our public bodies to get connected. The main idea in this project is developing a distributed application for interconnection between systems of hospitals, police station, military office, etc. With this system, on emergency situation required data can be reached in seconds, System can be explained as National Emergency Data Network.

By using National Emergency Data Network, information about a person in an urgent situation will be accessible from a web page, with an SMS message or with a mobile system easily a person can determine who can reach his/her information by giving permission. System uses .NET architecture.

- **DEFTERLİ, Özlem[a] and BĂLEANU, Dumitru[b]**, Çankaya University[a], TURKEY, On leave of absence from Institute of Space Sciences[b], ROMANIA

Hidden symmetries of two dimensional superintegrable systems

Classification of the invariants of two - dimensional superintegrable systems is presented. The hidden symmetries associated to the existence of Killing - Yano tensors are investigated.

- **DİNÇ, Erdal**, Ankara University, TURKEY

Continuous wavelets transform analysis and the mathematical resolution of the overlapping absorption spectra and their ratio signals for the multicomponent determination

Continuous wavelets transform is a powerful tool for the data reduction, denoising, compressing and baseline correction of the analytical signals and resolution of multicomponent overlapping signals Recently, continuous wavelet transform in combination of zero-crossing approach and spectral ratio treatment has been used for the quantitative resolution and prediction of multimixtures in the presence of the original overlapping signals. This combined approach provides a short analysis time, accurate, precision, rapid and low cost for the quality control and routine analysis of the commercial products. This hybrid approach indicates that this technique is perfectly suitable for the multicomponent resolution of the overlapping analytical signals in the various fields of the analytical chemistry.

- **DİNÇ, Erdal[a], BĂLEANU, Dumitru[b,c] and TAŞ, Kenan[b]**, Ankara University[a], Çankaya University[b], TURKEY, National Institute for Laser, Plasma and Radiation Physics, Institute of Space Sciences[c], ROMANIA

Continuous wavelet analysis for the ratio signals of the absorption spectra of binary mixtures

Wavelet analysis is successfully applied to the quantitative determination of the components in the binary mixture. This mathematical application is based on the use of the division of the absorption signals by the standard absorption signal and the transformation of the ratio signals. Calibration functions are obtained by measuring the continuous wavelet amplitudes corresponding to the minimum points of the wavelengths. The method is validated and is applied to one example of binary mixture analysis.

- **DİNÇ, Erdal[a], BĂLEANU, Dumitru[b,c] and TAŞ, Kenan[b]**, Ankara University[a], Çankaya University[b], TURKEY, National Institute for Laser, Plasma and Radiation Physics, Institute of Space Sciences[c], ROMANIA

A new fractional wavelet analysis for the composite signals of the components in binary mixtures

A new fractional wavelet analysis of the composite signals of the components in a binary mixture was performed. In the quantitative evaluation of hydrochlorothiazide and cilazapril, partial least squares (PLS)

calibration was applied to the fractional wavelet coefficients. The validation of the PLS approach was tested by analyzing various synthetic mixtures. The real samples containing was analyzed by using the contracted PLS calibration.

• **DİNÇ, Erdal[a] and BĂLEANU, Mihaela – Cristina[b]**, Ankara University[a], TURKEY, College Mihail Sadoveanu[b], ROMANIA

Quantitative Resolution of a Binary Mixture of Quinapril and Hydrochlorothiazide by Continuous Wavelet Analysis

The quantitative resolution of the mixture of quinapril and hydrochlorothiazide was achieved by using continuous wavelet transform. This technique is based on the evaluation of the transformed signal in combination with graphical approach. This hybrid approach does not require any separation procedure for the resolution of mixture. In this application we obtained successful results for the synthetic mixtures and commercial tablets.

• **DOSIEV, Anar**, Atılım University, TURKEY

Quantizations of locally convex spaces

The known [1] representation theorem for operator spaces asserts that each abstract operator space V can be realized as a subspace of the space $B(H)$ of all bounded linear operators on a Hilbert space H. By realization we mean a complete isometry $\Phi : V \to B(H)$ of V onto the subspace $\Phi(V) \subseteq B(H)$. This result plays one of the central role in the operator space theory and allows us to have an abstract characterization of a linear space of bounded linear operators on a Hilbert space. Physically well motivated, operator spaces can be thought as quantized normed spaces, where we have replaced functions with operators regarding classical normed spaces as abstract function spaces. To have more solid justification of the quantum physics it is necessary to consider an operator analogues of locally convex spaces too, that is, a quantization of locally convex spaces. This amounts considering linear spaces of unbounded Hilbert space operators or more generally, projective limits of operator spaces. In recent years, this theory started to develop by Effros and Webster in [2] under the title of "local operator spaces", or quantizations of locally convex spaces.

In this paper we propose an elementary introduction to these topics and as a final aim we will have an intrinsic description of local operator

spaces as above mentioned characterization for operator spaces. More precisely, we prove that each local operator space can be realized as a subspace of unbounded operators on a Hilbert space. Furthermore, if the given local operator space has a bounded locally convex topology then it can be realized as bounded operators on a Hilbert space. This result generalizes the representation theorem for operator spaces.

References

[1] Effros E.G., Ruan Z.-J., Operator spaces, London Math. Soc. Clarendon Press-Oxford (2000).

[2] Effros E.G., Webster C., Operator analogues of locally convex spaces, Operator Algebras and Applications, (NATO Adv. Sci. Inst. Ser. C Math. Phys. Sci., 495), Kluwer (1997).

• **DOSIYEV, A.A. and CIVAL S.**, Eastern Mediterranean University, TURKEY

A Fourth Order Accurate Difference-Analytical Method For Solving Laplaces Boundary Value Problem With Singularities

High accurate difference-analytical method of solving the mixed boundary value problem for Laplaces equation on graduated polygons (which can have broken sections and be multiply connected) is described and justified. The uniform estimate for the error of the approximate solution is of order $O(h^4)$, where h is the mesh step, for the errors of derivatives of order p, $p = 1, 2, ...,$ in a finite neighbourhood of reentrant vertices, of order $O(h^4/r_j^{p-\lambda_j})$, where r_j is the distance from the current point to the vertex in question, $\lambda_j = 1/\alpha_j$ or $\lambda_j = 1/2\alpha_j$ depending on the types of boundary conditions, $\alpha_j\pi$ is the value of the angle. The last part of the paper is devoted to illustrate numerical experiments.

• **DOUKHNITCH, E., SALAMAH, M. and SANDOUKA, A.**, Eastern Mediterranean University, TURKEY

Novel Hardware-Oriented Algorithms for TDOA Positioning Technique in Cellular Networks

Finding the location of an object is one of the important features of robotics applications, electronic warfare positioning, and the $3G/4G$ wireless communication systems. Many valuable location based services can be enabled by this new feature. Position estimation from

Time Difference of Arrival (TDOA) measurements is one of the commonly used methods. This approach is based on intersections of hyperbolic curves defined by the time differences of arrival of signals received from different sources. The location is determined using standard complex computation methods that are usually implemented in software. In this paper, we propose new hardware-oriented algorithms that use only simple add and shift operations in the computation and therefore can be easily implemented in hardware.

- **EFE, Mehmet Önder**, TOBB University of Economics and Technology, TURKEY

Modeling of PDE Processes with Finite Dimensional Non-Autonomous ODE Systems

Processes governed by Partial Differential Equations (PDE) display very rich dynamical behavior, which is continuous spatially. Influencing the behavior of PDE systems through boundaries is an interesting research as it is involves the handling of infinite dimensionality, due to which the traditional tools of control theory do not apply directly. This paper demonstrates how a nonlinear PDE is converted into a reasonably descriptive Ordinary Differential Equation (ODE) model. The approach is based on Proper Orthogonal Decomposition (POD), which separates the temporal and spatial components of the dynamics. The finite term expansion of the solution results in an autonomous ODE and this paper demonstrates how the external excitations are made explicit in the dynamical model. 2D Burgers equation is used to illustrate the effectiveness of the approach and a finite dimensional dynamical model is shown to be capable of capturing the essential response.

- **EKİCİ, H. Onur and BOYACI, Hakan**, Celal Bayar University, TURKEY

Effects of Non-Ideal Boundary Conditions on Vibrations of Microbeams

Effects of non-ideal boundary conditions on the vibrations of microbeams are investigated. Stretching effect as well as axial force is included along with the non-ideal boundary conditions. Method of Multiple Time Scales (a perturbation technique) is employed for solving the non-dimensional equation of motion for subharmonic and superharmonic resonance cases. The frequencies and mode shapes obtained

are compared with the ideal boundary conditions case and the differences between them are contrasted on frequency-response curves.

- **ELMENREICH, Wilfried and SCHÖRGENDORFER, Angela**, Vienna University of Technology, AUSTRIA

Fusion of Continuous-Valued Sensor Measurements using Statistical Analysis

This paper presents a method for fusing measurement samples from multiple sensors into a dependable robust estimation of a variable in the control environment. Each sensor measurement is represented by a measurement value and a confidence marker that corresponds to the respective variance of the measurement. We propose a Confidence-Weighted Averaging (CWA) algorithm to fuse the measurements with respect to their variance. For calibrated sensors with uncorrelated error functions this algorithm is optimal for producing the minimum possible variance of the result.

- **FERREIRA, Fernanda[a,b], FERREIRA, Flávio[b] and PINTO, Alberto[a]**, Universidade do Porto[a], Instituto Politécnico do Porto[b], PORTUGAL

Bayesian price leadership

In this paper, we consider a linear price setting duopoly competition with differentiated goods and with unknown costs. The firms aims are to choose the prices of their products according to the well-known concept of Bayesian Nash equilibrium. There is a firm (F1) that chooses first the price p1 of its good; the other firm (F2) observes p1 and then chooses the price p2 of its good.

We suppose that each firm has two different technologies, and chooses one of them following a probability distribution. The utilization of one or the other technology affects the unitary production cost. We show that there is exactly one Bayesian Nash equilibrium for this game. We analyze the advantage profits, for the firms and for the consumers, of the utilization of technology with most expensive cost versus the utilization of technology with cheapest cost.

• **FERREIRA, Fernanda[a,b], FERREIRA, Flávio[b], FERREIRA, Miguel[a], OLIVEIRA, Bruno[a] and PINTO, Alberto[a]**, Universidade do Porto[a], Instituto Politécnico do Porto[b], PORTUGAL

Cournot model: repeated R&D investments for non-identical firms

We present new deterministic and stochastic dynamics on the production costs of Cournot competitions, based on Nash and Bayesian Nash equilibriums of nonlinear R&D investment strategies to reduce the production costs of the firms at every period of the game. We study some behaviors of the firms in the case of similar firms and in the case of non-identical firms with different R&D programs. In the deterministic case, we study the transients and the asymptotic dynamics on the production costs of the duopoly competition and their profound implications on the profit and persistence of the firms in the market. In the stochastic case, we analyze the importance of the uncertainty to reverse the initial advantage of one firm with respect to the other.

• **FERREIRA, Fernanda[a,b], FERREIRA, Flávio[b] and PINTO, Alberto[a]**, Universidade do Porto[a], Instituto Politécnico do Porto[b], PORTUGAL

Unknown costs in a duopoly with differentiated products

We consider a duopoly model with unknown costs. The firms' aims are to maximize their profits by choosing the levels of their outputs. The chooses are made simultaneously by both firms.

In this paper, we suppose that each firm has two different technologies, and chooses one of them following a probability distribution. The utilization of one or the other technology affects the unitary production cost. We show that this game has exactly one Bayesian Nash equilibrium.

We analyze the advantage profits, for the firms and for the consumers, of the utilization of technology with most expensive cost versus the utilization of technology with cheapest cost. We also analyze the total quantity produced in each situation, which is of particular importance in the case of scanty natural resources be used at the production.

• **FERREIRA, LMMS[a], FINKENSTÃDT, BF[b], OLIVEIRA, BMPM[a] and PINTO, AA[a]**, Universidade do Porto[a], PORTUGAL, University of Warwick[b], UK

Nonlinearity in an Edgeworthian Exchange Economy

We present a model of an Edgeworthian exchange economy where two goods are traded in a market place. The novelty of our model is that we associate a greediness factor to each participant which brings up a game alike the prisoners dilemma into the usual Edgeworth exchange economy. Along the time, random pairs of participants are chosen, and they trade or not according to their greediness. If the two participants trade then their new allocations are in the core determined by their Cobb-Douglas utility functions. The exact location in the core is decided by their greediness with an advantage to the greedier participant. However, if both participants are too greedy, they are penalized by not trading. We analyze the effect of the greediness factors in the variations of the individual amount of goods and in the increase of the value of their utilities. We show that it is better to be in minority. For instance, if there are more greedy participants, the increase of the value of their utilities is smaller than the increase of the value of the utilities of the non greedy participants.

• **FISHER, Brian**, University of Leicester, UK

The Composition and Neutrix Composition Of Distributions

Let F be a distribution in D' and let f be a locally summable function. The neutrix composition $F(f((x))$ is said to exist and be equal to the distribution h if the neutrix limit of the sequence $\{F_n(f(x))\}$ is h, where $F_n(x) = F(x) * \delta_n(x)$ for $n = 1, 2, ...$ and $\{\delta_n(x)\}$ is a certain regular sequence converging to the Dirac delta function. In particular, the composition $F(f(x))$ is said to exist and be equal to the distribution h if the sequence $\{F_n(f(X))\}$ converges to h in the normal sense. Some results are proved.

• **GARADZHAEV, A.**, Turkmen State University, TURKMENISTAN

On spectral theory of problems on normal oscillations of an ideal compressible fluid in rotating elastic containers

In this paper the structure of the spectrum for certain problems involving normal oscillations of an ideal compressible fluid in rotating elastic container is investigated. The equivalent system of equations of the problems involving normal oscillations of an ideal compressible fluid in rotating elastic container is obtained. The case of an elastic container filled with an ideal compressible fluid is studied.

- **GAVRILOVA, Elena**, St. Ivan Rilski University of Mining and Geology, BULGARIA

Coupled Frequencies of a Fluid in a Circular Cylindrical Tank with a Membrane on its Upper Base and Permanent Axis Loading

A compressible and inviscid fluid fills some closed circular cylindrical tank. The tank bottom and its side wall are rigid. The whole upper base is covered with a flexible weightless clamped membrane. The tank is under the conditions of some given permanent axis loading. The obtained fluid-structure interaction system is supposed to have small vibrations. Such tanks are used in the aviation technique, etc. That is why the study of the dynamic behavior of the fluid in the tanks is important for their design and reliability assessment.

The problem about the determination of the coupled vibrations of this fluid-structure interaction system is under consideration. The frequency equation is obtained using the Bubnov-Galerkin method. Some numerical examples are made and represented graphically. They show that with the increase of the axis loading the corresponding first dimensionless frequency of the fluid-structure interaction system increases as well.

- **GLAZUNOV, Nikolaj M.**, Glushkov Institute of Cybernetics NASU, National Aviation University, UKRAINE.

Homotopy Invariant Algebraic Models and Homotopical Methods to Engineering

We show in the talk how mathematical models and methods can be substantially improved by the use of homotopical theory with elements of category theory. We apply the approach to the development of mathematical models of systems (section 2), to the modelling and verification of real-time systems (section 3) and to the problem of simplification (section 4).

- **GONÇALVES, Rui, CALHEIROS, Francisco and PINTO Alberto**, Center of Mathematics, University of Porto, PORTUGAL, Faculty of Engineering, University of Porto, PORTUGAL

Comparison of methodologies in river flow prediction. The Paiva river case.

The aim of this work is to predict a future value of the daily mean discharge of the river Paiva. Several approaches are considered. Prediction methods from dynamical systems, temporal data-mining and stochastic processes are used. Good predictability is found for river flow in the absence of rainfall and the nearest neighbors method was found to be the best in prediction. The Paiva river daily runoff intermittency seems not to be of a dynamical type in the sense that using the daily runoff series the methods were unable to predict the runoff increase due to the precipitation occurrence. The Paiva intermittency is linked to the occurrence of rain which seems to be unpredictable. We may conclude then that the Paiva river daily series is not chaotic.

- **GRAHOVSKI, Georgi G.**[a,b] **and DANDOLOFF Rossen**[a], Laboratoire de Physique Théorique et Modélisation, Université de Cergy-Pontoise[a], FRANCE, Laboratory of Solitons, Coherence and Geometry, Institute for Nuclear Research and Nuclear Energy[b], BULGARIA

A XY Spin Chain Models on Space Curves and Analogy with Kirchhoff Rods

A XY Heisenberg spin chain model with two perpendicular spins par site is mapped onto a Kirchhoff thin elastic rod. It is shown that in the case of constant curvature the EulerLagrange equation leads to the static sine-Gordon equation. The case of a double-helical DNA-like configuration corresponds to two interacting Heisenberg spin chains and the corresponding EulerLagrange equation gives a system of coupled static sine-Gordon-type equations. The kink-antikink type and periodical static solutions for these models are derived. The soliton dynamics and the the nonlinear excitations of the systems are investigated. The interplay between curvature and nonlinear excitations is analyzed as well.

• **GÜNDÜZ, Çiğdem (Aras) and BAYRAMOV, Sadi**, Kocaeli University, TURKEY

Inverse and direct spectra limits of exact sequences in categories of fuzzy modules

Recently, methods of homology algebra have a widespread application in fuzzy topology. The aim of this study is to investigate whether or not the inverse and direct spectra limits of exact sequences of fuzzy modules is exact. We also show that direct spectra limits of exact sequences of fuzzy modules is exact. We prove that the homology module of direct spectra limit of chain complexes of fuzzy modules is isomorphic to the direct spectra limit of homology module of its chain complexes. Generally, the inverse spectra limit of exact sequences is not exact. We define the notion $\varprojlim^{(1)}$ which is derivative functor of the inverse limit functor. Finally, by using the $\varprojlim^{(1)}$ we show that the inverse spectra limits of exact sequences of fuzzy modules is exact.

• **GÜRAY, Ersan and TARMAN, Hakan I.**, Middle East Technical University, TURKEY

Thermal Convection In the Presence Of a Magnetic Field : Numerical Simulation

The interaction between thermal convection and magnetic field is of interest in geophysical and astrophysical problems as well as in metallurgical processes such as casting or crystallization. A magnetic field may act in such a way to damp the convective velocity field in the melt or to reorganize the flow aligned with the magnetic field. This ability to manipulate the flow field is of technological importance in industrial processes. In this work, a direct numerical simulation of three-dimensional Boussinesq convection in a horizontal layer of electrically conducting fluid confined between two perfectly conducting horizontal plates heated from below in a gravitational and magnetic field is performed using a spectral element method. Periodic boundary conditions are assumed in the horizontal directions. The numerical model is then used to study the effects of imposing magnetic field.

• **GÜRKAN, Zeynep Nilhan and PASHAEV, Oktay**, İzmir Institute of Technology, TURKEY

Vortex and Vortex Lattice Dynamics in Magnetic Fluid Model

Integrable dynamical models of the point magnetic vortex interactions in the plane are studied. We consider the problem of magnetic vortices in a magnetic fluid model. The holomorphic reduction of topological magnetic system to the linear complex Schrödinger equation, allows us to construct N vortex configurations in terms of the complex Hermite polynomials, the vortex chain lattices and study their mutual dynamics. By the complexified Cole-Hopf transformation, integrable N vortex dynamics is described by the complex Burgers equation. Mapping of the point vortex problem to N-particle problem, the complexified Calogero-Moser system, showing its integrability and the Hamiltonian structure is given.

- **GUSEINOV, Gusein**, Atılım University, TURKEY

On Solutions of Discrete Nonlinear Elliptic Boundary Value Problems

In this paper, we consider a boundary value problem (BVP) for second order nonlinear elliptic partial difference equations on the lattice rectangles. Existence and uniqueness results for solutions of the considered BVP are established.

- **HACINLIYAN, Avadis, ERENTÜRK, Murat and ŞAHİN Gökhan**, Yeditepe University, TURKEY

Possible Chaotic Structures in the Turkish Language with Time Series Analysis

The aim of this work is to investigate the possibility of chaotic structures in Turkish texts of length varying between 1000 and 3000 words by performing a time series analysis based on the word frequencies reported by the Turkish Language Association (Türk Dil Kurumu) and syllable frequencies derived from these word frequencies. The analysis has been repeated on texts of comparable length in the English language and on a set of randomly generated words in order to characterize similarities and differences. One short and one longer correlation lengths have been noticed, the fact that the latter points to the existence of an attractor has been confirmed by the observation of a positive Liapunov exponent in both cases. The observation of a slightly longer second zero in the autocorrelation function for certain Turkish texts can arise from the difference in verb position or the role of an article for the two language.

• **İŞCAN, Zafer, DOKUR, Zümray and ÖLMEZ, Tamer**, Istanbul Technical University, TURKEY

Improved Incremental Self-Organizing Map for the Segmentation of Ultrasound Images

This paper presents an Improved Incremental Self-Organizing Map (I2SOM) network that utilizes automatic threshold (AT) value for the segmentation of ultrasound (US) images.

I2SOM network has been compared with the well-known unsupervised Kohonen's SOM network (KSOM) and a supervised Grow and Learn (GAL) network in terms of classification accuracy, learning time and number of nodes. For the feature extraction process, two-dimensional discrete cosine transform (2D-DCT) and 2D continuous wavelet transform (2D-CWT) were individually considered and were comparatively investigated to form the feature vectors of US breast and phantom images.

It is observed that the proposed automatic threshold scheme has significantly enhanced the robustness of I2SOM algorithm. Obtained results show that I2SOM can segment US images as good as Kohonen's network.

• **KANBUR, Murat[a], DİNÇ, Erdal[b], AKSOY, Halil[c], AKDİ, Yılmaz[b] and TAŞ, Ayşegül[d]**, Erciyes University[a], Ankara University[b], Marmara University[c], Çankaya University[d], TURKEY

Coiflets wavelet transform for the quantitative analysis of commercial veterinary powder product

Wavelet transform was used for the simultaneous quantitative determination of chlortetracycline and benzocaine in the commercial veterinary powder product without using any chemical separation procedure. In this study the absorption data vectors were processed by the coiflets wavelet transform and calibration functions were obtained by measuring the transform signals. The method was applied to the real samples after the validation of the constructed calibration function.

• **KAPTANOĞLU, H. Turgay**, Bilkent University, TURKEY

Some spaces of analytic functions defined through radial fractional derivatives

Continuous radial differential operators of all real orders are introduced on the space of analytic functions on the unit ball of the complex N-space. These operators are invertible, and are integral when their orders are negative. The operators are defined using coefficient multipliers on Taylor series, but a large number of them have also integral representations. Besov spaces of analytic functions are defined by requiring derivatives of sufficiently large orders of their members to have finite weighted integrals. Properties of these spaces are discussed. Bergman projections and a solution to the Gleason problem on Besov spaces are identified.

- **KELEŞ, Hasan**, Karadeniz Technical University, TURKEY

On Some Numbers Related to the Differential Equation System of d-Dimensional Fuzzy Linear Spaces(FLS)

In this paper for differential equations on known structure $S = (N, D)$ FLS is studied and characteristics properties of the ordered L^1-lattice are discussed in specific case.

In general, characteristic properties in this structure are investigated with simple examples. The set of d-dimensional fuzzy matrices is defined. The definitions L-fuzzy eigenvalues, eigenvectors and incident matrices are extended to d-dimensional FLS. The system of differential equations of incident matrices are constructed and their solutions are given. The solution of higher-order linear differential equation systems corresponding to characteristic polynomial of matrices with constant coefficients are obtained when $|N|^2 = 3$.

And furthermore the number of L-fuzzy eigenvalues is given when $|N| \geq 3$.

- **KHAN, Mohammad Saeed**, Sultan Qaboos University, SULTANATE OF OMAN

Some Fuzzy Fixed Point Theorems

In this paper, we introduced the concept of R-fuzzy metric spaces, and the generalized fuzzy version of Banach contraction principle is proved. We also provide examples to support our results which generalize and extend a number of previously published work in the literature.

- **KULA, Levent, YAYLI, Yusuf**, Ankara University, TURKEY

Split Quaternions and Rotations in E_2^4

We review the algebraic structure of $H^{'}$ and show that $H^{'}$ has a scalar product that allows as to identify it with semi Euclidean E_2^4. We show that a pair q and p of unit split quaternions in $H^{'}$ determines a rotation $R_{qp} : H^{'} \to H^{'}$. Moreover, we prove that R_{qp} is a product of rotations in a pair of orthogonal planes in E_2^4. To do that we call upon one tool from the theory of second ordinary differential equations.

- **KURT, Erol, BUSSE, Friedrich H. and PESCH Werner**, University of Bayreuth, GERMANY

Pattern Formation in the Rotating Cylindrical Annulus with an Azimuthal Magnetic Field at low Prandtl numbers

Patterns are theoretically formed in the frame of a hydromagnetic convection induced by radial buoyancy in an electrically conducting fluid contained by a rotating cylindrical annulus with a homogeneous magnetic field (B) in the azimuthal direction. The annulus is assumed to rotate with an angular frequency, Ω under the small gap approximation with rigid cylindrical boundaries. The onset of convection is found in the form of axial, axisymmetric or oblique rolls with a broken symmetry. The roll angle Ψ depends on the ratio between the Chandrasekhar number, $Q \sim B^2$, and the Coriolis number, $\tau \sim \Omega$. In addition to fully three-dimensional ($3D$) numerical simulations, weakly nonlinear and Galerkin analysis for roll patterns are performed for Prandtl number $P = 0.1$. At finite amplitudes, secondary instabilities are encountered in the form of longwave and shortwave.

- **LÉANDRE, Rémi**, Université de Bourgogne, FRANCE

Positivity theorem in semi-group theory

We translate in semi-group theory the proof of the theorem of Ben-Arous and Léandre got by the Malliavin Calculus giving a sufficient condition such that an heat-kernel is strictly positive.

• **LI, C.K.**[a] **and AGUIRRE, M.A.**[b], Natural Sciences and Engineering Research Council of CANADA[a], Partially supported by the Comisión de Investigaciones Científicas, ARGENTINA

The distributional products by the Laurent series

Following the complex analysis approach and the Laurent series, we evaluate the product $\delta^{(m)}(x) \cdot \delta^{(l)}(x)$ by induction, and compute $x_+^{-k} \cdot \delta^{(p)}(x)$ of one variable and $r^{-n-2m} \cdot \delta^{(2s)}(r)$ of n variables.

• **MACHADO, J.A. Tenreiro and SILVA, Manuel F.**, Polytechnic Institute of Porto, PORTUGAL

An Overview of Legged Robots

The objective of this paper is to present the evolution and the state-of-the-art in the area of legged locomotion systems.

In a first phase different possibilities for mobile robots are discussed, namely the case of artificial legged locomotion systems, while emphasizing their advantages and limitations. In a second phase an historical overview of the evolution of these systems is presented, bearing in mind several particular cases often considered as milestones on the technological and scientific progress. After this historical timeline, some of the present day systems are examined and their performance is analyzed. In a third phase are pointed out the major areas for research and development that are presently being followed in the construction of legged robots. Finally, some of the problems still un-solved, that remain defying robotics research, are also addressed.

• **MAHMUDOV, N.I. and MATAR M.M.**, Eastern Mediterranean University, TURKEY

Approximate controllability of one-dimensional SDE driven by countably many Brownian motions

We are given $(\Omega, \mathcal{F}, P)$ as a complete probability space with right continuous complete σ-algebra filtration $(\mathcal{F}_t)_{t\in[0,T]}$, generated by the infinite sequence of independent Brownian motions $(W^i)_{i\geq 1}$. Let, for every $t \in [0,T]$, $L_p(\Omega, \mathcal{F}_t, R)$ be the Banach space of all $\mathcal{F}_t$-measurable, and p-integrable variables in R, and $\mathcal{C}([0,T], L_p)$ be the space of all L_p-continuous functions on $[0,T]$ equipped the norm

$|X| = sup_{t\in[0,T]}(E|X(t)|^p)^{1/p}, p \geq 2$ $L_p^{\mathcal{F}}([0,T],R)$ denotes the Banach space of all p-integrable and adapted $\mathcal{F}_t$-measurable processes with values in R. Define $\sigma(x) = (\sigma_i(x))_{i\geq 1}$, where for each $i \geq 1$, $\sigma_i(x) \in \mathcal{C}(I,R)$ and that $\sigma(x) \in l_2$, i.e. $|\sigma(x)|^2 = \sum_{i=1}^{\infty} |\sigma_i(x)|^2 < \infty$. In this paper we study the approximate controllability of the one-dimensional semi-linear stochastic differential equation

$$\begin{aligned} dX(t) &= [AX(t) + Bu(t) + b(X(t))]dt + \sum_{i=1}^{\infty} \sigma_i(X(t))dW^i(t) \\ X(0) &= X_0,\ t \in [0,T], \end{aligned} \tag{1}$$

where $A, B \in R$, $u \in L_p^{\mathcal{F}}([0,T],R)$ is a control. Assuming controllability of the corresponding linear system we obtain sufficient conditions for approximate controllability of the above system when coefficients f, and σ satisfy non-Lipschitz conditions.

• **MAINARDI, Francesco[a], MURA, Antonio[a], PAGNINI Gianni[b] and GORENFLO Rudolf[c]**, University of Bologna and INFN[a], ENEA: National Agency for New Technologies, Energy and the Environment[b], ITALY, Free University of Berlin[c], GERMANY

Sub-diffusion equations of fractional order and their fundamental solutions

The time fractional diffusion equation is obtained from the standard diffusion equation by replacing the first-order time derivative with a fractional derivative of order $\beta \in (0,1)$ ¿From a physical view-point this generalized diffusion equation is derived from a fractional Fick law which describes transport processes with long memory. The fundamental solution for the Cauchy problem is interpreted as a probability density of a self-similar non-Markovian stochastic process related to a phenomenon of sub-diffusion (the variance grows in time sub-linearly). A further generalization is obtained by considering a continuous or discrete distribution of fractional time derivatives of order less than one. Then the fundamental solution is still a probability density of a non-Markovian process that, however, is no longer self-similar but exhibits a corresponding distribution of time-scales.

- **MAKHALDIANI, Nugzar**, Joint Institute for Nuclear Research, Laboratory of Information Technologies, RUSSIA

Fractal Geometry and Calculus with some Applications

After a short introduction in the fractal geometry and calculus (FGC), some applications of FGC in the problems of the high energy physics and cosmology are given.

- **MARINOVA, Daniela[a], LUKARSKI, Dimitar[a] and STAVROULAKIS, Georgios[b]**, Technical University of Sofia[b], BULGARIA, Technical University of Crete[b], GREECE

Modeling and Optimal Control for Plates with Defects

This paper presents modelling and vibration control of thin lightweight plates taking into account defects. The classical plate theory is used for the finite element dynamical model. The defects are modelled in a smeared-type way by changing the physical parameters of the corresponding element. Optimal control is further studied for the plates with defects supplied with sensors and actuators. LQR and H2 control schemes are considered for vibration suppression. The influence of the plates defects on the control of the vibrations is investigated. The placement of the control forces and its influence on the quality of the vibration regulating process is considered. Numerical simulations are carried out in order to demonstrate the efficiency of the proposed control strategies.

- **MUSLIH, Sami[a] and BĂLEANU, Dumitru[b,c]**, Al-Azhar University[a], PALESTINE, Çankaya University[b], TURKEY, Institute of Space Sciences[c], ROMANIA

Fractional Euler-Lagrange equations of motion in fractional space

The fractional variational principles are investigated for the fractional space. The fractional Euler-Lagrange equations are obtained and two examples are investigated in details.

• **NEUMANN, Nicolai, SATTEL, Thomas and WALLASCHEK, Jörg**, Heinz-Nixdorf Institute, University of Paderborn, GERMANY

On Set-Oriented numerical methods for global analysis of non-smooth mechanical systems

A large number of systems from engineering include non-linear or even non-smooth behavior. During development and optimization of mechanical systems, a comprehensive dynamical analysis may be essential. Set-Oriented Numerical Methods offer a new and efficient approach for global dynamic analysis without the requirement for an a priori knowledge of the system dynamics. This paper shows the basic concepts behind this method and presents its application to a simple model of a vibro-impact device for ultrasonic/sonic drilling. In this drilling device an impacting mass transmits vibrational energy from a piezoelectric transducer as shock waves into a drill stem. The model will be analyzed for varying sets of parameters. Relative global attractors will be derived which show statistical distributions for the occurrence of all possible states. Periodic solutions can be identified parallel to the evaluation of chaotic behavior. Thus a global understanding of the systems performance can be obtained, offering new ways for model verification and system design.

• **NIGMATULLIN, R.R.**, Kazan State University[a], TATARSTAN, RUSSIAN FEDERATION

The Statistics of the Higher (Fractional) Moments: Quantitative "Reading" of Any Randomness

The statistical meaning of higher $\Delta_N^{(p)}(p = 1, 2, ...)$ and fractional $\Delta_N^{(p)}(0 < p < \infty.)$ moments for an arbitrary random sequence of the length N has been found. The higher moments help to reduce the sequence analyzed to a finite set of k *statistically stable* parameters, keeping invariant the values of the first kth moments $\Delta_N^{(p)}(p = 1, 2, ..., k)$. The conditions of statistical stability and proximity expressed in terms of higher moments $\Delta_N^{(p)} = \Delta_{N+1}^{(p)}(p = 1, 2, ..., k)$ help to find k unknown stable points and predict possible future behavior of the random sequence analyzed. The generalized mean value (GMV)- function defined as $G_N^{(p)} = (\Delta_N^{(p)})^{1/p}$ is turned to be very effective in analysis of statistically close random sequences or containing large numbers of measured points ($N >> 1$). The approximate analytical expression for an arbitrary p value from the range ($-\infty < p < \infty$) entering into

$G_N^{(p)}$ has been found. It gives a possibility to transform any random sequence to the determined GMV curve and express *quantitatively* the reduced characteristics of any random sequence in terms of a 'universal' set of the fitting parameters defined by the determined GMV-function. Statistical proximity factor can be used for construction of *calibration curves*, when it is necessary to compare one random sequence with another one to respect of variations of some given external factor (small signal). The higher moments are easily generalized for the fractional and even complex moments. In turn, the GMV-function can be also generalized and then calculated for 2D and 3D random sequences. The approach developed in this paper is free from *any* model assumption and can be extremely helpful in comparison of different random sequences using for these purposes the 'unified' quantitative language based on introduction of the given set of fractional moments. The relationship between the value of the fractional moment and non-extensive parameter q entering into the definition of the non-extensive Tsallis entropy has been found. A possible model of statistical protection of plastic cards and other valuable documents demonstrating the effectiveness of the statistics of fractional moments has been considered. Some instructive examples in detection of superweak signals embedded into the basic random sequence ($S/N = 10^{-2}, 10^{-3}$) based on model and real data confirm the effectiveness of new approach and can serve a new basis for numerous practical applications. Analysis of dielectric spectroscopy data by means of fractional moments gives unique possibility to compare *quantitatively* each measurement with each other and express the influence of a neutral additive in terms of calibration curve *without* concrete knowledge of the corresponding fitting function.

- **NIGMATULLIN, R.R.**[a], **ARBUZOV, A.A.**[a], **SALEHLI, F.**[b], **GIZ, A.**[b], **BAYRAK, I.**[b], **CATALGIL-GIZ, H.**[b], Kazan State University[a], TATARSTAN, RUSSIAN FEDERATION, İstanbul Technical University[b], TURKEY

The First Experimental Confirmation Of The Fractional Kinetics Containing The Complex Power-Law Exponents: Dielectric Measurements Of Polymerization Reactions

In the first time we achieved incontestable evidences that the real process of dielectric relaxation during of the polymerization reaction of polyvinylpyrrolidone (PVP) is described in terms of the fractional kinetic equations containing the complex power-law exponents. A possibility of existence of the fractional kinetics containing non-integer

complex power-law exponents follows from the general theory of dielectric relaxation that has been suggested recently by one of the authors (RRN). Based on the physical/geometrical meaning of the fractional integral with complex exponents there is a possibility to develop a general theory of dielectric relaxation based on the self-similar (fractal) character of the reduced (averaged) microprocesses that take place in the mesoscale region. This theory contains some essential predictions related to existence of the non-integer power-law kinetics and the results of this paper can be considered as the first confirmation of existence of the kinetic phenomena that are described by fractional derivatives with complex power-law exponents. We want to stress here that with the help of new complex fitting function that was obtained for the complex permittivity it becomes possible to describe the whole process for real and imaginary parts simultaneously in all admissible frequency range (30Hz-13MHz). The fitting parameters obtained for the complex permittivity function for three temperatures (70 ^{0}C, 90 ^{0}C and 110 ^{0}C) confirm qualitatively the picture of reaction that was known before and help to reveal some new features that add and correct the interpretation of the whole polymerization process. We hope that these first results obtained in the paper will serve a good stimulus for other researches to find the traces of existence of new fractional kinetics in other relaxation processes related not only with dielectric relaxation. These results should lead to the reconsideration and generalization of irreversibility and kinetic phenomena that can take place for many linear nonequilibrium systems.

• **ÖZBİLGE, Ebru**, Kocaeli University, TURKEY

A numerical analysis of variational finite difference schemes for steady state heat conduction problems with discontinuous coefficients

A class of monotone conservative schemes is derived for the boundary value problem related to the Sturm-Liouville operator $Au := -(k(x)u^{'}(x)) + q(x)u(x)$, with discontinuous coefficient $k = k(x)$. The discrete analogous of the law of conservation are compared for the finite element and finite difference approaches. In the class of discontinuous coefficients, the necessary condition for conservativeness of the finite difference scheme is derived. The obtained one parametric family of conservative schemes permits one to construct well-known as well as new conservative schemes. The examples, presented for different discontinuous coefficients, and results show how the conservativeness conditions need to be taken into account in numerical solving boundary value problems.

• **ÖZÇAĞ, Emin, EGE, İnci, GÜRÇAY, Haşmet and JULEVSKA-TUNESKA, Biljena**, Hacettepe University, TURKEY

Some Remarks on the Incomplete Gamma Function

The incomplete Gamma function $\gamma(\alpha, x)$ is defined for $\alpha > 0$ and $x \geq 0$ by

$$\gamma(\alpha, x) = \int_0^\infty u^{\alpha-1} e^u du$$

and by using the recurrence formula

$$\gamma(\alpha + 1, x) = \alpha\gamma(\alpha, x) - x^\alpha e^{-x}$$

the definition of $\gamma(\alpha, x)$ can be extended to negative value of α. Recently Fisher et al. [6] defined $\gamma(-m, x)$ for $m = 0, 1, 2, ...$ In this paper we consider the derivatives of the incomplete Gamma function $\gamma(\alpha, x)$ and the derivatives of locally summable function $\gamma(\alpha, x_+) = H(x)\gamma(\alpha, x)$ for negative integers, where $H(x)$ denotes the Heaviside function.

• **ÖZER, Mahmut**, Zonguldak Karaelmas University, TURKEY

The natural and anticausal paths for the dynamics of ion channel gates based on the path probability method

Voltage-gated ion channels are involved in the generation and propagation of electrical signals in the excitable cell membranes. The voltage-dependent gating of these channels between conducting and non-conducting states is major factor in controlling the transmembrane potential. How these channels response to changes in the potential across the membrane has arisen as a challenging problem, and different approaches were proposed to address the mechanism of voltage sensing and gating in these channels. In this study, we derive the path probability function, the natural and anticausal paths, the two-gate probability and the general solution of the two-gate paths for an ensemble of two-level isolated particles in an ion channel gate based on the path probability method. The proposed derivations are based on the principles of statistical physics and conceptually quite different from those of conventional models.

- **ÖZER, Mahmut and UZUNTARLA, Muhammet**, Zonguldak Karaelmas University, TURKEY

Synchronization between neuronal spiking activity and sub-threshold sinusoidal stimuli based on the FitzHugh-Nagumo model

The FitzHugh-Nagumo (FHN) model was proposed as a simplification of the neuronal model and provided insight into the more complex neuronal models. Recently, an analytical approach has been proposed for determining the response of a neuron or of the activity in a network of connected neurons based on the FHN model with Gaussian white noise current. In this study, we investigate the synchronization between neuronal spiking activity and sub-threshold sinusoidal stimuli. For this purpose, we obtain the phase probability density of the spiking events for the sub-threshold stimuli. We show that the system exhibits the phase locking behavior. We also show that the phase synchronization clusters the spiking activity on the positive phase of the sub-threshold sinusoidal driving for smaller frequencies while it shifts the spiking activity towards the negative phase for larger frequencies.

- **ÖZER, Mahmut and TÜRKER, İlker**, Zonguldak Karaelmas University, TURKEY

A comparative analysis for the regularity of the neuronal spike train based on the five different algorithms with stochastic ion channels

Ion channel noise has important effects on neuronal dynamics. The origin of the channel noise is basically due to fluctuations of the number of open ion channels around the corresponding mean values. Finite populations of stochastic ion channels may give rise to random current fluctuations that result in variability of spike threshold, spike timing and interspike intervals. The effect of the channel noise has been involved by using different computational algorithms. For this purpose, five different algorithms were proposed by incorporating stochastic ion channels into the Hodgkin-Huxley type models. In this study, we compare these algorithms in the context of regularity of the generated spike train. To measure the regularity we use the coefficient of variation (CV) defined as a relative dispersion of the interspike interval distribution. We obtain the CV for ten different membrane patch sizes for each algorithm and compare the results.

• **ÖZER, Mehmet[a,b], VALARISTOS, Antonis[c], POLATOĞLU, Yaşar[a], HACIBEKİROĞLU, Gürsel[a], ČENYS, Antanas[b] and ANAGNOSTOPOULOS, Antonis N.**[c], İstanbul Kültür University[a], TURKEY, Semiconductor Physics Institute[b], LITHUANIA, Aristotle University of Thessaloniki[c], GREECE

A Characterization of the Dynamics of Newtons Derivative

In the present report the dynamic behavior of the one dimensional family of maps $F_{a,b,c}(x) = c[(1-a)x - b]^{1/(1-a)}$ is examined, for different ranges of the control parameters a , b and c. These maps are of special interest, since they are solutions of $N_F^{'} = a$, where $N_F^{'}$ is the Newton's method derivative. In literature only the case $N_F^{'} = 2$ has been completely examined. Simultaneously, they may be viewed as solutions of normal forms of second order homogeneous equations, $F^{''}(x) + p(x)F(x) = 0$, with immense applications in mechanics and electronics. The recurrent form of these maps, $x_n = c[(1-a)x_{n-1} - b]^{1/(1-a)}$, after excessive iterations, shows an oscillatory behaviour with amplitudes undergoing the period doubling route to chaos. This behaviour was confirmed by calculating the corresponding Lyapunov exponents.

• **PAMUK, Serdal**, Kocaeli University, TURKEY

On the Solution of the Porous Media Equation by Decomposition Method: A Review

The particular exact solutions of the porous media equation that usually occurs in nonlinear problems of heat and mass transfer are obtained using Adomians decomposition method.

Also, numerical comparison of particular solutions in the decomposition method indicate that there is a very good agreement between the numerical solutions and particular exact solutions in terms of efficiency and accuracy. Most of the work presented here has been published at Physics Letters A, 344 (2005) 184-188, and presented at "Mathematical Methods in Engineering International Symposium, Çankaya University, Ankara-Turkey, 27-29 April 2006".

• **PAN, Tao and LI, Jiemin**, Jinan University, CHINA

The Polygonal Approximations of Nonconvex Conservation Laws in Finite Interval

By using polygonal approximations methods, we construct the approximates to the initial-boundary problem for nonconvex conservation laws $u_t + f(u)_x = 0$ on $(0, l) \times (0, +\infty)$, with the initial data $u(x, 0) = u_0(x)$ and the boundary data $u(0, t) = u_{b0}(t)$, $u(l, t) = u_{bl}(t)$, where $u_0(x)$, $u_{b0}(t)$, and $u_{bl}(t)$ are bounded and locally bounded variation functions, and f is a locally Lipschitz continuous function, and proved its convergence through compactness argument suggested by Oleinik. We also proved that the approximates on $[0, l] \times [0, +\infty)$ can be constructed in a finite number of steps. Based on this numerical method, we developed a simulation system for observing structure and behavior of the global weak entropy solution with two-side boundary effect by Visual C++ language procedure, and presented some simulation results in the last section.

- **PASHAEV, Oktay**, Izmir Institute of Technology, TURKEY

Dissipative Solitons and Nonlinear Resonance Dynamics in 2+1 Dimensions

We show that dissipative solitons (dissipatons) of the second and the third members of $SL(2, R)$ hierarchies in $1 + 1$ dimension give rise to the real $2 + 1$ dimensional solitons of $KP - II$ and $MKP - II$. By the Hirota bilinear form for both flows, we find new bilinear system for these equations, and one and two soliton solutions. For special values of parameters our solutions show resonance behaviour with creation of four virtual solitons. We first time created four virtual soliton resonance solution for $KP-II$ and established relations of it with degenerate four-soliton solution in the Hirota-Satsuma bilinear form for $KP - II$. Our approach allows one to interpret the resonance soliton as a composite object of two dissipative solitons in $1 + 1$ dimensions.

- **PINTO, Carla M.A.**[a] **and GOLUBITSKY, Martin**[b], University of Porto[a], PORTUGAL, University of Houston[b], USA

Central Pattern Generators for Bipedal Locomotion

Golubitsky, Stewart, Buono and Collins proposed two models for central pattern generators (CPGs): one for bipeds (which we call leg) and one for quadrupeds (which we call quad). In this paper we use symmetry techniques to classify the possible spatiotemporal symmetries of periodic solutions that can exist in leg (there are 10 nontrivial types)

and we explore the possibility that coordinated arm/leg rhythms can be understood, on the CPG level, by a small breaking of the symmetry in quad.

Rhythms produced by leg correspond to the bipedal gaits: *walk, run, two-legged hop, two-legged jump, skip, gallop, asymmetric hop, and one-legged hop.* We show that breaking the symmetry between fore- and hind limbs in quad leads to periodic solution types corresponding to the interlimb coordination rhythms associated to the biped gaits of *two-legged hop, run, and gallop.* Even though all quadruped gaits perturb to periodic solutions identified with the leg rhythms of biped gaits, the same statement is not valid for arm/leg coordination patterns. For example, the biped gait walk, along with its arm rhythms, cannot be obtained by a small perturbation of any quadruped gait. This observation is in agreement with Schmidt.

- **RABEI Eqab M.**[a,b]**, TARAWNEH, Derar M.**[b]**, MUSLIH, Sami I.**[c]**, BĂLEANU, Dumitru**[d,e], Jerash Private University[a], Mutah University[b], JORDAN, Al-Azhar University[c], PALESTINE, Çankaya University[d] TURKEY, Institute of Space Sciences[e], ROMANIA

Heisenberg's Equations of Motion with Fractional Derivatives

Fractional calculus used to obtain the Hamilton formalism of the non-conservative systems, the definition of Poisson bracket used to obtained the equations of motions in term of Poisson bracket then the commutator relations are written as well as obtain the Heisenberg equations of motions.

- **RAMADAN, Omar**, Eastern Mediterranean University, TURKEY

Unconditionally stable ADI-FDTD implementation of Maxwell equations for truncating frequency dispersive debye media

An efficient, unsplit-field and unconditional stable formulations of the perfectly matched layer (PML) are presented for truncating frequency dispersive first order debye media. The formulations are based on the alternating direction implicit finite difference time domain method and the auxiliary differential equation PML approach. One dimensional numerical examples are included to validate the proposed formulations.

- **ROSARIO, J.M.**[a]**, DUMUR, D.**[b] **and MACHADO, J.A.Tenreiro**[c], Laboratory of Automation and Robotics[a], BRAZIL, Department of Automatic Control, SUPELEC[b], FRANCE, Polytechnic Institute of Porto[c], PORTUGAL

A Mechatronic Approach to Control of 6 DOF Parallel Manipulator

This work presents a practical implementation, using reconfigurable computing applied to robotic problems. Through the proposal a hierarchical architecture, distributing the several control actions in growing levels of complexity and using resources of reconfigurable computing is possible to take into account the easiness of future modifications, updates and improvements in the robotic applications. A practical example is presenting using reconfigurable computing, of Stewart-Gough platform control, where the developed software and hardware are structured in independent blocks, through open architecture implementation, allowing the easy expansion of the system, better adapting the platform to the tasks associated to it. The Stewart-Gough platform is applied in the solution of countless practical problems.

- **SERT CÜNEYT**, Middle East Technical University, TURKEY

hp-Spectral Element Solutions of Partial Differential Equations

Spectral Element Method (SEM) is a high order multi-element method that can be utilized for the accurate solution of partial differential equations in complex geometries. In this paper Galerkin weak formulation of an unsteady, two-dimensional PDE using SEM, based on Legendre polynomials on quadrilateral elements, is presented in detail. Advantages of using high order methods, such as spectral convergence, tolerance for skew elements and diffusion/dispersion characteristics, is demonstrated using sample problems based on Poisson, convection-diffusion and Helmholtz equations. Solutions using the Pointwise Matching Method (PMM) on h-type and p-type nonconforming grids are also provided.

- **STETTER, Hans J.**, Technical University of Vienna, AUSTRIA

Mathematics with Perturbed Information a Core Technique in Scientific Computing

Most concepts in mathematics, in analysis as well as in algebra, assume exact relations with exact data. In the mathematical modelling of real-life engineering situations, we commonly use relations which include principal effects only, and data of limited, often quite low accuracy. In the analysis and numerical evaluation of such models, this may require a reassessment of standard mathematical approaches and tools.

The lecture will explain the mathematical basis for this analysis and discuss a number of such situations, with practical examples.

• **SÜSLÜ, İncilay[a], DİNÇ, Erdal[b] and ALTINÖZ Sacide[a]**, Hacettepe University[a], Ankara University[b], TURKEY

An application of continuous wavelet transform to electrochemical signals for the quantitative analysis

Continuous wavelet transform (CWT) is a new powerful tool for removing noise, irrelevant information and signal baseline correction of voltammograms. In this application, morlet continuous wavelet transforms (ML-CWT) for signal treatments were found to be suitable among the wavelet families. ML-CWT approach was applied to the peak current data vectors consisting of 135 data points in the potential range of (-1004) - (-1556) mV versus Ag/AgCl reference electrode. Peak current data for the calibration and prediction steps in the concentration range of 83.0-375.0 ng/mL zafirlukast were obtained by using Osteryoung Square Wave Adsorption Stripping Voltammetry (OSWAdSV). Three different calibration models namely mean centering calibration (MCC), principal component regression (PCR) and partial least squares (PLS) were constructed by using the relationship between concentration set and CWT-coefficients of the peak current data. The proposed methods were validated by analyzing the synthetic samples and standard addition samples. These methods were successfully applied to the quantitative analysis of zafirlukast in tablets and satisfactory results were reported.

• **ŞAHİN, Suhap and KAVAK, Adnan**, Kocaeli University TURKEY

Implementation of Floating Point Arithmetic Using an FPGA

Floating point numbers represent a good approximation to real numbers so that floating point algorithms are frequently used in modern applications requiring millions of calculations per second such as many

mathematical optimization methods, digital signal and image processing algorithms, and Artificial Neural Network (ANN) applications. Despite their advantages, floating point operations require much area and time for ordinary implementation. However, meaningful floating point arithmetic implementation on FPGAs is almost impossible with low level design specifications because of mapping difficulties and the complexity of floating point arithmetic. With the usage new generation FPGAs that have more area (gate number) than traditional FPGAs and high level languages such as VHDL tools that can automate synthesis, design and implementation of floating point arithmetic and mapping of this into an FPGA become easier. This paper presents the implementation methodologies of various floating point arithmetic operations such as addition, subtraction, multiplication, and division using 32-bit IEEE 754 floating point format. The implementation is performed using Xilinx's Spartan 2e FPGAs. The algorithms and implementation steps used for different operations are discussed in detail. As an example, an ANN application is studied using these algorithms.

- **ŞENÇİMEN, Celaleddin and PEHLİVAN, Serpil**, Süleyman Demirel University TURKEY

Some Results on Interval Valued Fuzzy Sets

In this work, we extend the usual notions such as cardinality, weak inclusion, level fuzzy set and complement defined in the classical fuzzy set theory to the setting of interval valued fuzzy sets. We also investigate some algebraic structures using interval valued fuzzy sets.

- **TAKAČI, Arpad and TAKAČI, Djurdjica**, University of Novi Sad, SERBIA and
MONTENEGRO

On the solution of a mathematical model of a viscoelastic bar

A hyperbolic type equation with certain initial and boundary conditions, appropriate for application of the Mikusiński calculus, is considered. Similar problems appeared as mathematical models of the shock between a solid body and a viscoelastic bar.

The exact solution of the corresponding problem in the field of Mikusiński operators is constructed, and the character and regularity of the operational function solution of the problem is analyzed. Then

the solution of the starting problem is obtained as a finite sum of continuous functions. An algorithm for constructing an approximate solution is given, and an example is presented.

• **TANOĞLU, Gamze**, İzmir Institute of Technology, TURKEY

Vector Shock Soliton of Vector Wave Equation in Three Space Dimension

The Hirota bilinear method is applied to find exact solitary wave solutions of the vector wave equation in three dimension for n-component vector order parameter, with reaction part in the form of the third order polynomial determined by three distinct constant vectors. The bilinear representation is derived by extracting one of the vector roots, which allows us reduce cubic nonlinearity to the quadratic one. Shock soliton solution, implementing transition between other two roots, as a fixed points of the potential from the continuum set of values, is constructed in a simple way. The velocity of solitary wave is found in terms of these three roots. Extensions of model, by including the second-time derivative term and the nonlinear transport term, as well as the corresponding solitary waves are derived. The numerical solutions illustrating generation of solitary wave in special cases are given.

• **TİRYAKİ, Fatma[a] and ÇETİN, Nurdan[b]**, Yıldız Technical University[a], Turkish Naval Academy[b], TURKEY

A Compensatory Fuzzy Approach to Multiple-Objective Linear Fractional Transportation Problem (MOLFTP)

As known, transportation problems and their solution techniques play an important role in logistics and supply chain management for reducing cost and improving service. In multiple- objective transportation problems, several criteria the minimization of the cost, the minimization of average shipping time to priority customers, the maximization of production using a given process, the minimization of fuel consumption, etc. and sometimes fractional criteria such as the maximization of transport profitability, etc. are considered. In this paper, we propose a compensatory fuzzy approach using Werners' fuzzy "and" (μ_{and}) operator for solving MOLFTP. We know from literature that the solution generated by Zimmermann's "min" operator is non-compensatory and

does not always guarantee Pareto optimal, whereas our method generates a compromise solution which is both compensatory and Pareto-optimal. An illustrative numerical example will be given to explain this approach.

- **TİRYAKİ, Fatma and GONCE, Hale**, Yıldız Technical University TURKEY

A Compensatory Fuzzy Approach to Multi-objective Solid Transportation Problem

The classical Transportation Problem (TP) of which purpose is to transport the goods from sources to destinations is a special type of linear programming problem. When the heterogeneous (different) transportation modes are available for the shipment of goods, the Solid Transportation Problem (STP) arises. Here, the different modes of transportation called conveyance, such as the land transportation by car or train, air freight and ocean shipping. If it is considered that in most of cases, it is required to solve the problem taking into account more than one decision criterion, the Multi-objective STP (MSTP) becomes more important. This paper presents a compensatory fuzzy approach using Werners fuzzy "and" (μ_{and}) operator to solve MSTP. Using and μ operator, our model generates a compromise solution which is both compensatory and Paretooptimal. For different values of compensation parameter, our approach finds out a set of Pareto-optimal solutions. Finally, a numerical experiment is executed to explain the approach.

- **TUĞLUK, Ozan and TARMAN, Hakan I.**, Middle East Technical University, TURKEY

Dynamics Of Wall Bounded Flow

There proposed various scenarios in literature for transition in plane channel (Poiseuille) flow. In this work, Navier-Stokes (N-S) equations are numerically integrated using a spectral element technique for flow driven by a constant pressure gradient between two parallel plates. The resulting database is then used to generate empirical Karhunen-Loeve (K-L) basis parameterizing the flow optimally in energy norm. Since K-L basis is specific to underlying phenomena, each basis element carries an independent characteristic of the flow and has physical interpretation. A system of model amplitude equations is then obtained

by Galerkin projection of the N-S equations onto the space spanned by the K-L basis. The physical interpretation of the basis elements is used to truncate the resulting system to obtain a low dimensional model. The model is then used to test transition scenarios, numerically.

- **TUSALIU, Petre[a], STROICA, Paul[b], TUSALIU, Dan Costin[a], ÖZDEMİR, Aydoğan[c], VOICU, Viorica[d]**, University of Craiova[a], Company for Maintenance of the Romanian Power Grid SMART S.A.[b], Research Development and Testing National Institute for Electrical Engineering Craiova[d], ROMANIA, Technical University of Istanbul[c], TURKEY

About Modelling and simulation of Transient Phenomena at the Unloaded Line Switching

In this paper, it is evaluated the main disturbances which appear in Power systems, also the electric fields at the ground level of a 380 kV overhead transmission line and the corresponding busbars in a substation, under the unload line switching effect. The modelling and simulation was performed using the EMTDC/PSCAD software package, to obtain the transient overvoltages in the transmission line and in the busbars. The electrical field was calculated using the CIGRE equivalent charge model.

The proposed simulation is applied for an unload transmission line connected between KEPEZ and YATAĞAN in 380 kV Turkish National Power Transmission Systems. Finally some conclusions that provide a valuable contribution to the understanding of the electromagnetic compatibility and of the electric field distribution in a substation due to the unload line switching-off effect will be pointed out.

- **UDOVIČIĆ, Zlatko**, University of Sarajevo, BOSNIA AND HERZEGOVINA

The Threshold of Compression in Wavelet Transform with Haars Coefficients - Numerical Examples

A couple of numerical examples, which justify one way of determining the threshold in dependence of the allowed relative error, are given. Specificity of the mentioned way is the fact that geometric interpretation of the pyramidal algorithm and basic laws of the theory of probability were used in determining the threshold.

• **UMUT, Ömür**, Abant İzzet Baysal University, TURKEY

Generalized Synchronization of Nuclear Spin Generator System via Linear Transformations

Generalized synchronization (GS) of two unidirectionally coupled dynamical systems is a generalization of identical synchronization. This study ad-dresses a special case of generalized synchronization in which the synchronization manifold is linear; e.g., linear generalized synchronization of two nuclear spin generator (NSG) systems.

• **ÜSTÜNDAĞ, Özgür, DİNÇ, Erdal**, Ankara University, TURKEY

Wavelet analysis for the simultaneous determination of angiotensin II receptor antagonist and Hydrochlorothiazide in mixtures

In the pharmaceutical industry, the routine analysis and quality control of drugs in synthesis, formulation, purity analysis, and production steps require the optimized and validated analytical methods.

The wavelet analysis in combination with zero-crossing technique is rapid, very cheap, and very easy to be applied and has higher accuracy and precision. For these reasons this hybrid approach assures the best quantitative determination of an angiotensin II receptor antagonist (losartan potassium) and hydrochlorothiazide in mixtures.

• **VINAGRE, Blas M., MONJE, Concepción A., CALDERÓN, José A., and SUÁREZ, José I.**, University of Extremadura, SPAIN

Fractional PID Controllers Design and Implementations for Industry Application

In recent years the increasing number of works related to the application of Fractional Calculus (FC) is remarkable in many areas of science and engineering. In what concerns to automatic control, the use of Fractional Order Control (FOC) needs, for real applications, to develop methods for controllers design and parameters tuning, and efficient strategies for controllers implementation. On the other hand, the Proportional Integral Derivative (PID) controller is by far the most dominating form of feedback controller used today in industry applications. In this work, after a brief introduction to FC and FOC, we deal with methods for fractional PID controllers tuning, including autotuning, and some software and hardware strategies for efficient implementations of the controllers in industry applications.

• **YAKHNO, Valery and SEVİMLİCAN, Ali**, Dokuz Eylül University, TURKEY

A method for the recovery of the electric field vibration inside vertical inhomogeneous anisotropic dielectrics

Electromagnetic waves inside anisotropic materials are modelled by Maxwells system with matrices of dielectric permittivity and magnetic permeability [1]. The time dependent Maxwells system for electric and magnetic fields with the matrix permittivity is considered in the paper. The components of these fields are functions of the space variable $x = (x_1, x_2, x_3) \in R^3$ and the time variable $t \in R$. We assume that the permittivity ε is the symmetric positive definite matrix whose elements are functions depending on x_3 variable, magnetic permeability $\mu = 1$, the density of electric current $j = (j_1, j_2, j_3), j_k = j_k(x, t), k = 1, 2, 3$ and charges $\rho(x, t)$ satisfy the conservation law. There is no electromagnetic field, currents or electric charges at the time $t < 0$. Using these assumptions we can find (see [2]) that the electric field $E = (E_1, E_2, E_3)$ satisfies the vector equation

$$-curl_x curl_x E = \varepsilon \frac{\partial^2 E}{\partial t^2} + \frac{\partial j(x,t)}{\partial t}$$

and initial data

$$E|_{t=0} = 0, \frac{\partial E}{\partial t}|_{t=0} = 0$$

The main object of the paper is the Initial Value Problem (1), (2). A new method for solving this problem is the result of the study. This method is based on the reduction of (1), (2) to a system of integral equations for which the method of successive approximations is applied.

References

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2. Yakhno V. G. , Constructing Greens function for the time-dependent Maxwell system in anisotropic dielectrics, Journal of Physics A: mathematical and General, v.38, 2005, pp. 2277-2287.

• **YAKHNO, Valery G. and YAKHNO, Tatyana M.**, Dokuz Eylül University, TURKEY

Simulation of Magnetic Fields from Impulse Point Current in Anisotropic Materials

This paper deals with the simulation of magnetic fields in homogeneous anisotropic materials such as dielectrics. Models of electromagnetic wave propagations in these materials are described by the time-dependent Maxwell's system with general tensors of permittivity. Such kind of Maxwell's system is considered in our paper. We have obtained a new exact formula for the magnetic field of initial value problem for the Maxwell's system describing the process of electromagnetic wave propagation in homogeneous non-dispersive anisotropic dielectrics with general structures of anisotropy. We have used the obtained formula to generate 3-D images of magnetic field components inside different anisotropic dielectrics using MATLAB. Such images can be considered as pat- terns when we study the structure of anisotropic materials. At the same time this approach can be used for accuracy analysis of new numerical methods of initial value problems solving for the Maxwell's system.

- **YARIMPABUÇ, Durmuş, YILDIRIM, Cihan and TARMAN, Hakan I.**, Middle East Technical University, TURKEY

Transitional Dynamics In Thermal Convection Between Rigid Plates

Rayleigh-Benard thermal convection problem is the instability of a Boussinesq fluid layer on an infinite horizontal plane heated from below and cooled from above in the presence of gravity in the vertical pointing downward. The dynamics of this phenomena is governed by Boussinesq equations. In this work, Boussinesq equations are numerically integrated using a spectral element technique. The resulting numerical database is then used to generate Karhunen-Loeve (K-L) basis. The K-L basis is an empirical basis in nature that can be computed from an experimentally or numerically generated database representative of the underlying physical phenomena. The K-L basis is, in turn, used to study the dynamics in the transitional regimes of thermal convection.

- **YAYLI, Yusuf and ÜNAL, Zafer**, Ankara University, TURKEY

Screw Motions In Lorentzian Space L^3

In Euclidean space E^3, for one parameter rigid body motions, there is one screw motion (instantaneous motion) in every moment. Moreover, it is well-known that to every screw is associated a helicoidal vector

field in R^3. In this study, we generalized to Lorentzian space L^3, as in Euclidean 3- space, with respect to velocity distribution of one parameter motions.

- **YILTAŞ, Derya**, İstanbul University, TURKEY

The Comparison of Prime Number Test Algorithms Under Their Performances

In this study I researched the success of primality test algorithms. These primality test algorithms have been divided into two main groups: deterministic and probabilistic. I compared four of these primality tests through my programs according to their effectivenes. The selected algorithms are Lucas-Lehmer, Goldwasser -Kilian deterministic tests and Miller-Rabin, Solovay-Strassen probabilistic tests. It was determined that the deterministic approaches are less productive than the probabilistic ones. At the same time in the probabilistic models the Miller-Rabin primality test results in shorter running time than the Solovay-Strassen primality test. Besides, probabilistic tests are more successful than deterministic tests while the global minimum running time is found. In the algorithms of probabilistic tests, the curves in the graphics are hilly because of the random variables. Primality test programs are made by the C programming language.

- **YÜKSEL, Seniha E.**[a], **EL-BAZ, Ayman**[b], **and FARAG, Aly A.**[b], University of Florida[a], University of Louisville[b], USA

A Kidney Segmentation Framework for Dynamic Contrast Enhanced Magnetic Resonance Imaging

In the United States, more than 12000 renal transplantations are performed annually; but the transplanted kidneys face a number of surgical and medical complications that cause a decrease in their functionality. To understand the reasons of this functionality decrease; recently, Dynamic Contrast Enhanced Magnetic Resonance Imaging (DCE-MRI) has found considerable attention due to its superior functional and anatomical information. The biggest challenge in the analysis of DCE-MRI is seen in the segmentation of the kidneys from the abdomen images; because of the high noise and partial volume effects introduced during the rapid and repeated scanning process. In this paper, we introduce a general framework for the segmentation of the

kidneys from DCE-MR images of the abdomen. The proposed segmentation algorithm consists of three main steps. In the first step, an average kidney shape is constructed from a data set of previously segmented kidneys; and an average signed distance map density is obtained describing the shape of the kidneys. In the second step, the gray level density is calculated for a given new kidney image using a modified expectation maximization (EM) algorithm. In the third step, a deformable model is evolved based on the two density functions obtained from the previous two steps: the first one describes the prior shape of the kidney, and the second one describes the distribution of the gray level inside and outside the kidney region. The new deformable model is able to handle intricate shapes without getting stuck in edge points; and gives very promising results that are comparable to radiologists segmentation.

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