36th Annual
Texas Partial Differential Equations Conference

The University of Texas at El Paso

El Paso Natural Gas Conference Center
UTEP Campus

El Paso, Texas, March 2-3, 2013

Saturday		
8:00 - 8:30	**Breakfast**	* * * * * at conference venue * * * * *
8:30	Dr. Stephen B. Aley,	Interim Dean, College of Science, UTEP
8:45	Dr. M. Christina Mariani,	Chair, Department of Mathematical Sciences, UTEP
9:00 - 9:20	M. Amine Khamsi	*Fixed Point of Nonlinear Semigroups in Modular function spaces*
9:25 - 9:45	Eleftherios Gkioulekas	*Energy and potential enstrophy flux constraints in quasi-geostrophic models*
9:50 - 10:10	Alfonso Castro	*Radial singular solutions for a class of elliptic boundary value problems*
10:15 - 10:25	Christian Jäh	*Recent results about uniqueness and continuous dependence in the Cauchy problem for backward-parabolic operators with low-regular coefficients*
10:30 - 10:50	Treena Basu	*Anomalous Diffusion and a fast methods for fractional diffusion equations*
10:55 - 11:15	Joe Lakey	*Numerical construction of certain bandpass prolates*
11:20 - 11:40	Olga Kosheleva and Vladik Kreinovich	*Cauchy Problem for the Brans-Dicke Scalar-Tensor Theory of Gravitation May Explain Time Asymmetry of Physical Processes*
11:45 - 12:05	Goong Chen	*Progress in the Mathematical and Computatonal Study of Wind Turbine Flows and Wind Energy*
12:10 - 1:35	**Lunch**	* * * * * at conference venue * * * * *
1:40 - 2:00	Granville Sewell	*Solving the KPI Wave Equation with a Moving Adaptive FEM Grid*
2:05 - 2:25	Jianxin Zhou	*Solving Semilinear Elliptic Eigensolution Problems by an Implicit Minimax Method*
2:30 - 2:50	Buthinah Bin Dehaish	*Fixed Point of Asymptotic Pointwise Mappings in Hyperbolic Metric Spaces*
2:55 - 3:15	Daniel Onofrei	*On the approximate control of electromagnetic fields*
3:20 - 3:40	Toshikazu Kuniya	*Analysis for a class of periodic SIS epidemic models with age-structure*
3:45 - 4:05	Kanadpriya Basu	*Mathematical modeling and computational studies using reaction-diffusion-advection system*
4:10 - 4:30	Maranda Bean	*A Second Order Immersed Interface Method For a 1D Poroelasticity Problem with Discontinuous Coefficients*
4:35 - 4:55	Behzad Djafari-Rouhani	*Asymptotic behavior of solutions to some second order evolution equations of monotone type*
5:00 - 5:20	Ranadhir Roy	*Modeling Blood Flow in a Brain Tumor Treated Concurrently with Radiotherapy and Chemotherapy*
5:25 - 5:45	Lokenath Debnath	*Linear and Nonlinear Rossby Waves in Oceans*
6:00 - 8:00	**Dinner**	* * * * * at conference venue * * * * *

Sunday		
8:00 - 8:30	**Breakfast**	* * * * * at conference venue * * * * *
8:30 - 8:50	Suleyman Tek	*Using Korteweg-de Vries Equation to Obtain Surfaces in Three Dimensional Minkowski*
8:55 - 9:15	Shapour Heidarkhani	*Non-trivial solutions for systems of n fourth order partial differential equations via variational methods*
9:20 - 9:40	Taoufik Meklachi	*On The Sensitivity of a Meta-Material Slab to an exterior Charge Distribution*
9:45 - 10:05	Eric Platt	*Modelling nonlinear properties and fracture mechanics of Elasto-viscoplastic materials by use of an integrity property*
10:10 - 10:30	Kamel Tahri	*Multiple solutions to singular fourth order elliptic equations*
10:35 - 10:55	Andrzej Pownuk	*Dynamic methods for parallel solution of nonlinear two phase flow equations by using the Finite Difference Method*
11:00 - 11:20	Maria Pia Beccar Varela	*Stochastic Differential Equations and Levy models*
11:25 - 11:45	Indranil SenGupta	*Bessel functions and Rainbow Option pricing PDE*
	Lunch	* * * * * at conference venue * * * * *

Abstracts presented to the 36 Texas PDE conference

El Paso, Texas, March 2-3, 2013

Kanadpriya Basu, University of North Texas.

Mathematical modeling and computational studies using reaction-diffusion-advection system

Abstract: The mitogen-activated protein kinase (MAPK) cascades that are evolutionally conserved from yeast to mammals play a pivotal role in many aspects of cellular functions. The mating decision in yeast is switch-like or bistability response that allows cells to filter out weak pheromone signals or avoiding improper mating when a mate is sufficiently close. In many cases, scaffold proteins are thought to play a key role during this process. The molecular mechanisms that control the bistability decision is not yet fully understood. Here we show that bistability mechanism can arise from multisite phosphorylation system with substrate sequestration when phosphorylation and dephosphorylation occurs at different locations. This scaffold binding in a multisite phosphorylation system can robustly result in multiple steady states. By developing generic mathematical models, we argue that the scaffold protein plays an important role in creating bistability, and by treating parameters symbolically, we also thereby reduce the complexity of calculating steady states from simulating differential equations to find the roots of polynomials, the degree of which depends on the number of phosphorylation sites N. Moreover, we developed a generic mathematical model to incorporate MAPK cascade with two substrates in the presence of scaffold proteins, and, for the simplification of presentation while keeping the key components of MAPK cascades, we assume that each substrate has only one phosphorylation site. Even for this simplified model, our computation reveals that multisite phosphorylation with scaffold binding in cascade leads to bistability even more robustly than in the models without cascade. In addition, I'll discuss about some efficient numerical technique that we have designed to solve reaction-diffusion-advection system.

Treena S. Basu, Ithaca College.

Anomalous Diffusion and a fast methods for fractional diffusion equations

Abstract: Fractional diffusion equations model phenomena exhibiting anomalous diffusion that can not be modeled accurately by the second order diffusion equations. Because of the non-local property of fractional differential operators, the numerical methods have full coeffcient matrices which require storage of $O(N^2)$ and computational cost of $O(N^3)$, where N is the number of grid points. Together we develop a fast fnite difference method for the one-dimensional space fractional diffusion equation, which only requires storage of $O(N)$ and computational cost of $O(N \log^2 N)$, while retaining the same accuracy and approximation property as the regular finite difference method. Numerical experiments are presented to show the utility of the method. For example, with 1024 computational nodes, the new scheme developed for the one-dimensional problem has about 40 times of CPU reduction than the standard scheme. For the two-dimensional space fractional diffusion equation we devise a fast iterative scheme, which only requires storage of $O(N)$ and computational cost of $O(N \log N)$ while retaining the same order accuracy as the regular finite difference method. Our preliminary numerical example runs for two-dimensional model problem of intermediate size seem to indicate the observations: to achieve the same accuracy, the new method uses less than one thousandth of CPU time and one thousandth memory than the standard method does. This demonstrates the utility of the method.

Maranda Bean, The University of Texas at El Paso.

A Second Order Immersed Interface Method For a 1D Poroelasticity Problem with Discontinuous Coefficients

Abstract: We introduce an immersed interface method (IIM) based on a staggered grid for the 1D poroelasticity equations (Biot model) when the coefficients have discontinuities along material interfaces. The IIM uses a standard finite difference method away from the interface and modifies the numerical schemes near or on the interface to treat the irregularities using the method of undetermined coefficients. We will derive and analyze the new method, and show some numerical results to confirm the theoretical error estimates.

Maria Pia Beccar-Varela, The University of Texas at El Paso.

Stochastic Differential Equations and Levy models

Abstract: Analytical solutions for a class of Stochastic Differential Equations arising in population models are discussed. Levy models and applications to Financial mathematics will be also presented.

Buthinah Bin Dehaish, King Abdul Aziz University.
Fixed Point of Asymptotic Pointwise Mappings in Hyperbolic Metric Spaces

Abstract: The notion of asymptotic pointwise mappings was introduced by Kirk in 2003 and he employed ultrapower technique to prove some related fixed point results. In recent paper Kirk and Xu gave simple and elementary proofs for the existence of fixed points of asymptotic pointwise mappings without the use of ultrapowers. Shu in 1991 considered Mann modified iterations of asymptotically nonexpansive maps on a convex subset of a Banach space. Recently, Khan et al. have introduced and studied the convergence of a general iteration scheme of asymptotically quasi-nonexpansive maps in convex metric spaces and CAT(0) spaces; their scheme includes modified Mann iterations of Schu as a special case in Banach spaces. In this talk, we investigate the existence of fixed point of a single and a family of asymptotic pointwise mappings defined on uniformly convex hyperbolic metric spaces. Moreover, we discuss behavior of the modified Mann iteration process associated with asymptotic pointwise mappings.

Alfonso Castro, Harvey Mudd College.
Radial singular solutions for a class of elliptic boundary value problems

Abstract: For semilinear elliptic equations with nonlinearities growing as u^p and $p \in (N/(N-2), (N+2)/(N-2)$ on $[0, +\infty]$ we prove the existence uncountably many radial singular solutions. This includes cases where the nonlinearity grows supercritically or linearly on $(-\infty, 0]$.

Goong Chen, Texas A&M University at Qatar.
Progress in the Mathematical and Computatonal Study of Wind Turbine Flows and Wind Energy

Abstract: Wind energy is a primary component of contemporary renewable energy development. In this talk, the speaker will describe his efforts in the study of wind energy. Issues involved are wind turbine flow control, modeling of structural vibrations of turbine towers, offshore structures, etc. Computational method based on the Finite Volume Method (FVM) using OpenFOAM and FLUENT softwares is being developed. The speaker will show short animations of wind turbine flow motion obtained by these computational fluid dynamics softwares ANSYS/FLUENT and OpenFOAM.

Lokenath Debnath, University of Texas - Pan American.
Linear and Nonlinear Rossby Waves in Oceans

Abstract: Using the Navier-Stokes equations in a rotating ocean , properties of linear and nonlinear Rossby Waves will be discussed. Special attention will be given to derivation of the amplitude of nonlinear Rossby waves with their stability properties.

Behzad Djafari-Rouhani, The University of Texas at El Paso.
Asymptotic behavior of solutions to some second order evolution equations of monotone type

Abstract: In this talk, we report on some of our recent results on the asymptotic behavior of solutions to some second order evolution equations of monotone type, and present some applications to partial differential equations and optimization. In particular, we establish the strong convergence of solutions, and determine their rate of convergence. Our results are new even for the one dimensional case of ordinary differential equations (where of course weak and strong convergence coincide).

Eleftherios Gkioulekas, University of Texas - Pan American.
Energy and potential enstrophy flux constraints in quasi-geostrophic models

Abstract: We investigate an inequality constraining the energy and potential enstrophy flux spectra in two-layer and multi-layer quasi-geostrophic models. Its physical significance is that it can diagnose whether any given multi-layer model that allows co-existing downscale cascades of energy and potential enstrophy can allow the downscale energy flux to become large enough to yield a mixed energy spectrum where the dominant k^{-3} scaling is overtaken by a subdominant $k^{-5/3}$ contribution beyond a transition wavenumber k_t situated in the inertial range. The validity of the flux inequality implies that this scaling transition cannot occur within the inertial range, whereas a violation of the flux inequality beyond some wavenumber k_t implies the existence of a scaling transition near that wavenumber.

This flux inequality holds unconditionally in two-dimensional Navier-Stokes turbulence, however, it is far from obvious that it continues to hold in multi-layer quasi-geostrophic models, because the dissipation rate spectra for energy and potential enstrophy no longer relate in a trivial way, as in two-dimensional Navier-Stokes. We derive the general form of the energy and potential enstrophy dissipation rate spectra for a generalized symmetrically coupled multi-layer model.

From this result, we prove that in a symmetrically coupled multi-layer quasi-geostrophic model, where the dissipation terms for each layer consist of the same Fourier-diagonal linear operator applied on the streamfunction field of only the same layer, the flux inequality continues to hold. It follows that a necessary condition to violate the flux inequality is the use of asymmetric dissipation where different operators are used on different layers. We explore dissipation asymmetry further in the context of a two-layer quasi-geostrophic model and derive upper bounds on the asymmetry that will allow the flux inequality to continue to hold. Asymmetry is introduced both via an extrapolated Ekman term, based on a 1980 model by Salmon, and via differential small-scale dissipation.

The results given are mathematically rigorous and require no phenomenological assumptions about the inertial range. Sufficient conditions for violating the flux inequality, on the other hand, require phenomenological hypotheses, and will be explored in future work.

Christian Jäh, Technische Universität Bergakademie Freiberg.
Recent results about uniqueness and continuous dependence in the Cauchy problem for backward-parabolic operators with low-regular coefficients

Abstract: This is joint work with Marius Paicu (University Bordeaux 1), Daniele Del Santo (University Trieste) and Martino Prizzi (University Trieste).

We consider the Cauchy problem for backward-parabolic operators

$$\mathcal{P}u = \partial_t u + \sum_{i,j=1}^{n} \partial_{x_i}(a_{i,j}(t,x)\partial_{x_j} u) + \sum_{k=1}^{n} b_k(t,x)\partial_k u + c(t,x)u$$

and look for sufficient and necessary conditions to ensure the uniqueness of the solutions or the continuous dependence [**?**] of the solutions on the Cauchy data. We are especially interested in the connections between the regularity of the principal part coefficients and the mentioned properties. It is almost classical that the questions about uniqueness and stability have a positive answer if $a_{i,j}(t,x)$ are Lipschitz continuous with respect to time and bounded with respect to the spatial variable [**?**]. We follow two possibilities to weaken the Lipschitz condition:

(P1) *Local irregularity*: Suppose that $a_{ij} = a_{ij}(t)$ with $|F(t)d_t a_{ij}(t)| \leq C_{small}$, where F is a suitable function like $F(t) = t$ or $F(t) = t^2$.

(P2) *Global irregularity*: Suppose that $a_{ij} = a_{ij}(t,x) \in C^{\mu}([0,T], L^{\infty}(\mathbb{R}^n) \cap L^{\infty}([0,T], C^{\omega}(\mathbb{R}^n))$, where we investigate also the possible interactions between ω and μ.

We will illustrate the necessity of our conditions by suitable counterexamples. To prove our results we will use the Carleman estimate method and to prove suitable Carleman estimates we will use, e.g, Bony's para-differential calculus. the results about local irregularity are connected to singular Carleman weight functions.

Khamsi, Mohamed Amine, The University of Texas at El Paso.
Fixed Point of Nonlinear Semigroups in Modular function spaces

Abstract: Nonlinear semigroup theory is not only of intrinsic interest, but is also important in the study of evolution problems. In the last forty years, the generation theory of flows of holomorphic mappings has been of great interest in the theory of Markov stochastic branching processes, the theory of composition operators, control theory, and optimization. It transpires that the asymptotic behavior of solutions to evolution equations is applicable to the study of the geometry of certain domains in complex spaces. In this talk, we will discuss the existence of common fixed points of nonlinear semigroups acting in modular function spaces. Modular function spaces are natural generalizations of both function and sequence variants of many important, from applications perspective, spaces like Lebesgue, Orlicz, Musielak-Orlicz, Lorentz, Orlicz-Lorentz, Calderon-Lozanovskii spaces and many others. Many of the results discussed in this talk are new.

Olga Kosheleva and Vladik Kreinovich, The University of Texas at El Paso .
Cauchy Problem for the Brans-Dicke Scalar-Tensor Theory of Gravitation May Explain Time Asymmetry of Physical Processes

Abstract:

(i) Observable Time Asymmetry: A Problem

Most equations of fundamental physics are time symmetric, starting from the ordinary differential equations (e.g., the classical Newton's equations of motion) to partial differential equations describing physical fields like electromagnetism or gravitation. As a result, if we start with a physically reasonable solution to these equations (e.g., with the observed Universe) and simply reverse the direction of time t, the resulting fields will satisfy the same differential equations. From this theoretical viewpoint, all physical processes should be reversible: a time reversal of a physically reasonable process should also be physically reasonable.

In practice, however, many physical processes are not reversible. For example, if we drop a cup, it is reasonable to expect that it breaks into pieces. However, it is not physically reasonable to expect that the pieces of a broken cup would magically get together to form a whole cup.

(ii) How This Problem Is Explained Now

The problem of time asymmetry is known since Bolzmann's 19 century work on statistical physics and its foundations. In modern physics, this problem is usually resolved by making an additional assumption: that the initial conditions should be random (in some reasonable sense). This additional assumption, however, it outside the usual formulation of physical equations as a system of partial differential equations. It is therefore desirable to come up with an alternative explanation of the observed time asymmetry, an explanation that is within the usual formulation.

(iii) Cauchy Problem for the Brans-Dicke Scalar-Tensor Theory of Gravitation

To come up with such an explanation, we analyze the equations describing gravitation. According to General Relativity, space-time and gravitation are described by Einstein's partial differential equations, in which the only field responsible for gravitation is the metric tensor. In General Relativity – similarly to the original Newton's theory of gravitation – the gravitational field generated by a body is proportional to its mass, with the gravitation constant G as the proportionality coefficient. To experimentally check this theory, we need to make some assumptions about the mass distribution in the Universe (and in the Sun).

It turns out that if we stick with General Relativity, then to get a good fit with the experimental data, we must make somewhat strange assumptions about the mass distribution: e.g., we must assume that the mass distribution in the Sun is not proportional to observed brightness, and we must assume that on the cosmological level, 95% of the mass is formed by not directly observable "dark matter" and "dark energy".

Some physicists argue that it is more reasonable to assume less exotic mass distributions – and change the gravitation theory to fit the observations. One such (reasonable) change consists of assuming that G is not a universal constant but rather a new scalar physical field – whose value can change from one point to another. The corresponding scalar-tensor theory of gravitation was indeed proposed by Brans and Dicke.

At first glance, from the viewpoint of time symmetry, the Brans-Dicke Theory (BDT) is similar to Einstein's General Relativity: it is described by second order partial differential equations which remain invariant if we reserve the order of time t i.e., change t to $-t$. In general, in such a second-order theory, if on some Cauchy

surface (e.g., for some moment of time t_0), we know the values of the gravity tensor, the scalar field f, and their first time derivatives, then we can uniquely determine the second time derivatives, and thus (at least locally) integrate the corresponding equations.

We prove a new (somewhat unexpected) result: that with respect to the scalar field f, this theory is actually first order. Specifically, if on some Cauchy surface, we know the values of the gravity tensor, its first time derivative, and the field f, then we can determine the first time derivative of f from a quadratic equation. This quadratic equation, in general, has two solutions. This means that in principle, for each initial condition, we can have _two_ different dynamics – corresponding to these two solutions.

In plain English, this means that the time-symmetric Brans-Dicke Theory (BDT), in effect, consists of two different theories – each of which is second order in metric tensor and first order in f. Each solution of BDT is a solution of one of these two theories. In particular, our Universe satisfies one of the corresponding two systems of partial differential equations. The transformation $t \longrightarrow -t$ transforms each of these two theories into another one, but none of these two theories is time-symmetric. In other words, in the presence of the additional scalar gravitational field, the equations describing our Universe are _not_ time symmetric. This may explain the observed time asymmetry of physical phenomena.

Toshikazu Kuniya, University of Tokyo.
Analysis for a class of periodic SIS epidemic models with age-structure

Abstract: Seasonal spread of infectious diseases can be modeled by periodic systems of partial differential equations. In this study, we are concerned with a class of periodic SIS epidemic models with age- structure, in which total host population is divided into two classes, susceptible and infectious, and in which an infectious individual recovered from illness goes back to the susceptible class without gaining immunity. The problem of finding a nontrivial periodic solution, which corresponds to the situation where the disease repeats spreading seasonally, is interpreted as a fixed point problem in a Banach space consisting of locally integrable L1-valued periodic functions. We prove that the spectral radius of the Fréchet derivative of a nonlinear operator at zero plays the role of a threshold value for the existence of a nontrivial (endemic) periodic solution. That is, if the value is greater than unity, then such a periodic solution exists. Epidemiologically, the value corresponds to a well-known threshold value, the basic reproduction number R0.

Joe Lakey, New Mexico State University.
Numerical construction of certain bandpass prolates

Abstract: A method will be introduced to construct numerically those time limited functions that are most bandlimited to an annulus, that is, the difference of two intervals centered at the origin. The method was motivated in part by recent work of Sengupta, Sun, Jiang, Chen and Mariani.

Taoufik Meklachi, University of Houston.
On The Sensitivity of a Meta-Material Slab to an exterior Charge Distribution

Abstract: On the expansion of the work of Professor Graeme A Milton and Nicolae-Alexandru P Nicorovici, about the sensitivity of a meta-material slab to exterior charges, this presentation will illustrate the localized resonance due a dipole charge distribution, and to a square integrable charge distribution. The divergence of the energy in the material and nearby is related to distance between the charge and the slab and to the parameters of the media.

Daniel Onofrei, University of Houston.
On the approximate control of electromagnetic fields

Abstract: In this talk I will present a brief account of the problem to be discussed, namely, the active control of electromagnetic fields with applications to radar cloaking. A history of recent ideas in approximating a solution to this control problem will be presented and the talk will conclude with the presentation of some of the most recent results and ideas on this topic.

Eric Platt, University of Houston.
Modelling nonlinear properties and fracture mechanics of Elasto-viscoplastic materials by use of an integrity property

Abstract: Elastic materials can be modelled with the elasticity equation. However no real material is purely elastic. When under enough strain a material undergoes nonlinear behavior, plastic deformation and eventually fracture. By use of an additional variable of which I call integrity and an additional coupled differential equation most of the properties can be described. With a numerical model stress-strain curves as well as the location and time of fracture can be determined.

Andrzej Pownuk, The University of Texas at El Paso.
Dynamic methods for parallel solution of nonlinear two phase flow equations by using the Finite Difference Method

Abstract: Contemporary mathematical models of multiphase flow are based on a system of nonlinear PDE. In order to solve system of nonlinear Partial Differential Equations it is possible to apply many different approaches (e.g. explicit FEM, implicit FDM, structured grids, unstructured grids etc.). In order to solve a system of nonlinear equation Continuation Method was applied. Presented methodology is capable to automatically generate some class of solution methods and apply them in the computational process. Computational process will be significantly speed up by using parallel computing. Several numerical examples with appropriate visualizations will be presented (1D, 2D, and 3D models).

Ranadhir Roy, University of Texas - Pan American.
Modeling Blood Flow in a Brain Tumor Treated Concurrently with Radiotherapy and Chemotherapy

Abstract: Blood flow through a tumor plays a critical role in tumor growth and cancer therapies. Hence, fluid dynamics is an appropriate method to study blood through a tumor. Drug transport in the tumor interstitium depends on convection and diffusion. To investigate characteristic of flood flow through a spherical tumor, a couple convection-diffusion-reaction models for simulating interaction between two anti cancer drugs has been developed. This model provides the computational transportation that needed to be study systematically and quantitatively evaluate the effects of interaction on the concentration within the tumor. Mathematical expressions for the spatial variations of the interstitial velocity and interstitial pressure have been developed, and calculated analytically; while variations of drug concentrations within a tumor are determined numerically. We determine the way the interstitial pressure and velocity vary in the radial direction, which agree with the experiments, as well as we study the way one drug concentration changes in the presence or absence of a second drug concentration within the tumor. We find that the concentration of a drug in the tumor can be improved in the presence of another drug in the tumor.

Indranil SenGupta, North Dakota State University.
Bessel functions and Rainbow Option pricing PDE

Abstract: Rainbow option is a derivative exposed to two or more sources of uncertainty, as opposed to a simple option that is exposed to one source of uncertainty, such as the price of underlying asset. In this presentation we present a method of solving rainbow option pricing problem in terms of series solution. Spherical and hyper-spherical harmonics will be used and Bessel function will play a crucial role.

Granville Sewell, The University of Texas at El Paso.
Solving the KPI Wave Equation with a Moving Adaptive FEM Grid

Abstract: The Kadomtsev-Petviashvili I (KPI) equation is the difficult nonlinear wave equation: $u_{xt} + 6u_x^2 + 6uu_{xx} + u_{xxxx} = 3u_{yy}$. We solve this equation using PDE2D (www.pde2d.com) with initial conditions consisting of two lump solitons, which collide and reseparate. Since the solution has sharp, moving, peaks, an adaptive finite element grid is used with a grading which moves with the peaks.

Kamel Tahri, Preparatory School in Economics, Business and Management Sciences, Algeria .
Multiple solutions to singular fourth order elliptic equations

Abstract: Using the method of Nehari manifold, we prove the existence of at least two distinct weak solutions to elliptic equation of four order with singularities and with critical Sobolev growth.

Suleyman Tek, University of the Incarnate Word.
Using Korteweg-de Vries Equation to Obtain Surfaces in Three Dimensional Minkowski (M3) Space

Abstract: We consider 2-surfaces arising from the Korteweg-de Vries (KdV) hierarchy, KdV equation and fifth order KdV equation. The surfaces corresponding to KdV are in a three dimensional Minkowski (M3) space. They contain a family of quadratic Weingarten and Willmore-like surfaces. We show that some KdV surfaces can be obtained from a variational principle where the Lagrange function is a polynomial function of the Gaussian and mean curvatures. We also give a method for constructing the surfaces explicitly, i.e., finding their parameterizations or finding their position vectors.

Jianxin Zhou, Texas A & M University.
Solving Semilinear Elliptic Eigensolution Problems by an Implicit Minimax Method

Abstract: By considering a constraint on the energy profile, a new implicit minimax method is developed to numerically find eigen solutions in the order of their eigenvalues to a semilinear elliptic eigen solution problem that arises from nonlinear optics and other nonlinear diffusion systems. It turns out that the new approach also enables people to establish some interesting new properties, such as wave intensity preserving/control, bifurcation identification, etc. Numerical results are presented to illustrate the method.