BOOK OF ABSTRACTS

Central Department of Mathematics
Tribhuvan University, Nepal
June 3–22, 2013

Edited by
Harihar Khanal and Stefan C. Mancas

EMBRY-RIDDLE
Aeronautical University
DAYTONA BEACH, FLORIDA

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KEYNOTE SPEAKERS

Vasilios Alexiades (University of Tennessee, TN, USA), *Laser Ablation*

Maciej Dunajski (University of Cambridge, UK), *Solitons from Geometry*

Diane Henderson (Penn State University, PA, USA), *The role of dissipation and bathymetry in the evolution of ocean swell*

Curtis Menyuk (University of Maryland Baltimore County, USA), *Self-Similarity, Integrability, and Accordions in Transient Stimulated Raman Scattering*

Masilamani Sambandham (Morehouse College, GA, USA), *On the real zeros of random polynomials*

Ilias Sibgatullin (Moscow State University, Russian Federation), *Chaotic motions in penetrative convection*

SPECIAL SESSIONS

Nonlinear Waves (Chair: Mahendra Panthee)

Nonlinear PDEs / Optics (Chair: Marcia Scialom)

Bio-Mathematics (Chair: Hem Raj Joshi)

Computational Fluid Dynamics (Chair: Sudarsan Tiwari)

Numerical Methods for PDEs (Chair: Bishnu P. Lamichhane)

Analytical PDEs / Operator Theory (Chair: Dhruba Adhikary)

Probability and Statistics (Chair: Arabin K. Dey)

Optimization (Chair: Tanka N. Dhamala)

General Session (Chair: Ghanashyam Bhatta)

SUMMER SCHOOL June 3–June 18, 2013

Stefan C. Mancas, (Embry-Riddle Aeronautical University) *Advanced Partial Differential Equations–Nonlinear Waves* (**PDE**)

Harihar Khanal, (Embry-Riddle Aeronautical University) *Numerical Methods for Partial Differential Equations* (**NUM**)

Dhruba Adhikary, (Southern Polytechnic State University) *Nonlinear Analysis* (**NLA**)

CONFERENCE PROGRAM

TUESDAY, JUNE 18, 2013

17:00 – 18:00 REGISTRATION
18:00 – 18:15 WELCOME
Prof. Kedar Uprety, Central Department of Mathematics
Prof. Gajendra Bahadur Thapa, Central Department of Mathematics
Prof. Hira Bahadur Maharjan, Vice Chancellor of Tribhuvan University
18:30 – 20:30 RECEPTION

WEDNESDAY, JUNE 19, 2013

08:00 – 8:30 REGISTRATION
08:30 – 09:30 OPENNING ADDRESS
Inauguration Ceremony
Welcome speech by Prof. Hira Bahadur Maharjan, Vice Chancellor (TU)
Program highlights by the Conference Coordinators Khanal/Mancas/Uprety

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09:30 – 10:30 KEYNOTE LECTURE 1. (W-K1)
Vasilios Alexiades: Laser Ablation
Chair: Harihar Khanal

10:30 – 11:00 COFFEE BREAK

11:00 – 13:00 **SESSION 1.** (W-S1) Computational Fluid Dynamics/Numerical PDEs
Chair: Sudarshan Tiwari
11:00 – 11:30 *Sudarshan Tiwari:* Particle Methods for a Hierarchy of Pedestrian Flow Models: From Microscopic to Non-local Continuum Models
11:30 – 12:00 *Dil B Gurung:* Temperature Distribution Model in Living Tissue based on Volume Averaging Theory
12:00 – 12:30 *Buddhi Sapkota:* A Study of Indoor Air Pollution using Navier-Stokes equations
12:30 – 13:00 *Frederique Drullion:* Influence of Grouping on Growth of Surface Gravity Waves by Turbulence

13:00 – 14:00 LUNCH

14:30 – 15:30 KEYNOTE LECTURE 2. (W-K2)
Maciej Dunajski: Solitons from Geometry
Chair: Stefan C. Mancas

15:30 – 16:00 AFTERNOON TEA

16:00 – 18:00 **SESSION 2.** (W-S2) Analytical PDEs / Operator Theory
Chair: Dhruba Adhikary
16:00 – 16:30 *Dhruba Adhikari:* Domain Invariance and Eigenvalues for Perturbed Maximal Monotone Operators
16:30 – 17:00 *Ghanshyam Bhatt:* Operators associated with sequences in Hilbert Spaces
17:00 – 17:30 *Vinod Mishra:* Haar Wavelet Approach for Solving Nonlinear Differential and Integral Equations
17:30 – 18:00 *Ishak Derrardjia:* Stability for linear neutral integro-differential equations with variable delays

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18:00 – 20:00 DINNER / CULTURAL SHOW 1

THURSDAY, JUNE 20, 2013

08:00 – 8:30 Program highlights by the Conference Coordinators Khanal/Mancas/Uprety
08:30 – 09:30 KEYNOTE LECTURE 3. (T-K1)
Ilias Sibgatullin: Chaotic motions in penetrative convection
Chair: Harihar Khanal

09:30 – 10:00 COFFEE BREAK

10:00 – 12:00 **SESSION 3.** (T-S1) Numerical Methods for PDEs / Dynamical Systems
Chair: Manoj Khanal

10:00 – 10:30 *Manoj Khanal:* Discrete Element Method in Particle Mechanics

10:30 – 11:00 *Bishnu Lamichhane:* Locally Supported Biorthogonal Bases with Approximation Properties for Nodal Finite Elements

11:00 – 11:30 *Shivakumar Karekal:* Understanding the non-linear behaviour of rock/rockmass by Heterogeneous Fractals

11:30 – 12:00 *Harihar Khanal:* Solutions to dissipative BBM Equation

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12:00 – 13:00 LUNCH BREAK

13:30 – 14:30 KEYNOTE LECTURE 4. (T-K2)
Diane Henderson: The role of dissipation and bathymetry in the evolution of ocean swell
Chair: Stefan C. Mancas

14:30 – 15:00 AFTERNOON TEA

15:00 – 17:30 **SESSION 4.** (T-S2) Nonlinear Waves
Chair: Mahendra Panthee

15:00 – 15:30 *Mahendra Panthee:* Fifth Order BBM Type Equation: Derivation and Well-posedness Theory

15:30 – 16:00 *Netra Khanal:* Complex-valued partial differential equations

16:00 – 16:30 *Kedar Uprety:* Mathematical modeling of a slider bearing

16:30 – 17:30 **SEMINAR.** (F-SEM)
Stefan C. Mancas: Integrable nonlinear ODEs via Abel's equation

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18:00 – 20:00 DINNER / CULTURAL SHOW 2.

FRIDAY, JUNE 21, 2013

08:00 – 08:30 Program highlights by the Conference Coordinators Khanal/Mancas/Uprety

08:30 – 09:30 KEYNOTE LECTURE 5. (F-K1)
Curtis Menyuk: Self-Similarity, Integrability, and Accordions in Transient Stimulated Raman Scattering
Chair: Kedar Uprety

09:30 – 10:00 COFFEE BREAK

10:00 – 12:00 **SESSION 5.** (F-S1) Nonlinear PDEs / Optics
Chair: Marcia Scialom

10:00 – 10:30 *Marcia Scialom:* On the supercritical KdV equation with time-oscillating nonlinearity

10:30 – 11:00 *M. Senthilvelan:* Breathers and Rogue Wave Solutions of General Coupled Nonlinear Schrödinger System

11:00 – 11:30 *Javier Villarroel:* Boundary conditions for a 2+1 dimensional nonlinear Schrödinger equation

11:30 – 12:00 *Izhar Uddin:* Ishikawa iterative process for a pair of single-valued and multivalued generalized nonexpansive map

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12:00 – 13:00 LUNCH

13:30 – 14:30 KEYNOTE LECTURE 6. (F-K2)
Masilamani Sambandham: On the real zeros of random polynomials
Chair: Hem Raj Joshi

14:30 – 15:00 AFTERNOON TEA

15:00 – 17:30 **SESSION 6.** (F-S2) Optimal Control / Probability and Statistics
Chair: Arabin Dey, Hem Joshi

15:00 – 15:30 *Arabin Dey:* Selecting Univariate and Bivariate extreme value distributions

15:30 – 16:00 *Ram Prasad Ghimire:* Transient analysis of preemptive-repeat unreliable M/M/n/n queueing system

16:00 – 16:30 *Buddhi Pantha:* Mathematically modeling inhalational Anthrax

16:30 – 17:00 *Navjot Kaur:* Assessing the effect of high-risk groups on the transmission dynamics of HIV/AIDS

17:00 – 17:30 *Hem Joshi:* Decreasing the Spread of HIV by increasing awareness through education

17:30 – 18:00 *Mudunuru, Venkateswara:* Sampling Techniques as Applied to Cancer Data

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18:00 – 20:00 BANQUET

SATURDAY, JUNE 22, 2013

08:30 – 10:30 **SESSION 7.** (S-S1) Optimization
Chair: Tanka N Dhamala

08:30 – 09:00 *Tanka N Dhamala:* Dynamic Network Models, Algorithms and Complexities of Evacuation Planning Optimization Problems: Revisited

09:00 – 09:30 *Urmila Pyakurel:* Earliest Arrival Contraflow Model for Evacuation Planning

09:30 – 10:00 *Shree Ram Khadka:* Determination of the lower and the upper bottlenecks for the total product rate variation problem

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10:00 – 10:30 COFFEE BREAK

10:30 – 13:00 **SESSION 8.** (S-S2) Functional Analysis
Chair: Ghanashyam Bhatt

10:30 – 11:00 *Priya Shahi:* Fixed Point Theorems for α-ψ-contractive multifunctions on Partial Metric Spaces

11:00 – 11:30 *Ramesh Karki:* The Sobolev gradient flow & applications to PDE & ΨDE

11:30 – 12:00 *Santosh Ghimire:* A Law of the iterated logarithm for dyadic martingale and lacunary series

12:00 – 12:30 *Umesh Rajopadhyaya, K.B. Manandhar:* On some contractions in metric space

12:30 – 13:00 *Chinta Mani Pokhrel: DCP* Property of Convex Combinations of de la Vallée Poussin Kernels

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13:00 – 14:00 LUNCH / END OF PROGRAM

OPTIONAL GUIDED TOURS AND MOUNTAIN TREKKING

T1. KATHMANDU - NAGARKOT (1 day)
1. June 17 (8:00 – 22:00)
2. June 22 (8:00 – 22:00)

T2. POKHARA - ANNAPURNA BASE CAMP (4 days)
1. Departure June 15 - Return June 18
2. Departure June 22 - Return June 25

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Pseudomonotone Homotopy for Perturbed Densely Defined Linear Maximal Monotone Operators

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ABSTRACT:10

Let X be an infinite dimensional real reflexive Banach space with dual space X^* and $G \subset X$ open and bounded. Assume that X and X^* are locally uniformly convex. Let $T : X \supset D(T) \to 2^{X^*}$ be maximal monotone and strongly quasibounded, $S : X \supset D(S) \to X^*$ maximal monotone, and $C : X \supset D(C) \to X^*$ strongly quasibounded w.r.t. S and such that it satisfies a generalized $(S+)$-condition w.r.t. S. Assume that $D(S) = L \subset D(T) \cap D(C)$, where L is a dense subspace of X, and $0 \in T(0), S(0) = 0$. With the help of the topological degree theory for $T + S + C$, the eigenvalue problem of the form $T + S + C(\lambda, \cdot) \ni 0$ will be discussed. Furthermore, the problem of existence of a pathwise connected set in the range of the operator $T + S + C$ will also be discussed. These theories have applications in the study of a class of time-dependent problems involving three operators.

Laser Ablation

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ABSTRACT:32

Laser ablation in an ambient environment is becoming increasingly important in science and technology. It is used in applications ranging from chemical analysis via mass spectroscopy, to pulsed laser deposition and nanoparticle manufacturing.

We survey the main features of pulsed nanosecond laser ablation and outline a multiphase hydrodynamic model describing energy, momentum, and mass conservation in the target material, in the plasma and plume, along with collisional and radiative processes for laser-induced breakdown (plasma formation). Numerical simulations for copper in helium background gas will be presented.

Operators associated with sequences in Hilbert Spaces

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ABSTRACT:40

A nice basis is always needed for practical applications in Hilbert spaces. Over the past few years, frames (an over-complete spanning set) have been studied because of their applications. There are several desired properties of frames for specific applications. An operator theory point of view can provide some deep insight towards the construction of the desired frames. We study some of the operators associated with given sequences in a Hilbert space and characterize them according to the operators. The construction of the frames then depends on the operators. We will provide specific examples.

Stability for linear neutral integro-differential equations with variable delays

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ABSTRACT:2

In this talk we study a linear neutral integro-differential equation with variable delays and give suitable conditions to obtain asymptotic stability of the zero solution, by means of fixed point technique. An asymptotic stability theorem with a necessary and sufficient condition is proved, which improves and generalizes previous results due to Burton, Becker and Burton and Jin and Luo. We provide an example that illustrates our results.

Selecting Univariate and Bivariate extreme value distributions

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Shyam Sundar Soumitra Josyula
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ABSTRACT:20

In this talk we choose the problem of selecting proper distributions from the class of extreme value distributions by peak over threshold method in univariate set-up. Usual way to select the distributions is through mean excess plot. But the method fails for high threshold value. We adapt an alternative procedure through Akaike Information criteria. Simulation results shows it works very well in small sample too. We extend the work in higher dimension.

Dynamic Network Models, Algorithms and Complexities of Evacuation Planning Optimization Problems: Revisited

Tanka N. Dhamala[1], **M. Goerigk** [2] **and Horst W. Hamacher** [3]
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ABSTRACT:35

Worldwide threats of large-scale disasters over the last decade extremely motivate the emerging field of dynamic network optimization. The models are not limited to the emergency evacuation but also in the network communication and scheduling, logistics, transportation, assignment and facility location-allocation [3]. Scattered modelings, algorithms, simulations, heuristics and implementations are proposed [2]. These range from nonlinear nonconvex programming to variational inequality, cell-based transmission, macroscopic-microscopic models and integrated model for discrete and continuous time dynamic flows based on measure theory [4]. More realistic results depend on the time-varying and dynamic time frame with continuous time. Most of the problems are computationally challenging.

Our presentation covers most of the approaches, critically present the results, relate and analyze them. A report on their time performance and result quality recommends their scalability, extensibility, practicability and reliability. We highlight the obtained results on contraflow and suggest its research perspectives [1]. Our objectives will be the maximum flow and the quickest flow for a building or a region evacuation network.

References

[1] T.N. Dhamala, M. Goerigk and H.W. Hamacher, *Models and Algorithms for Discrete Evacuation Planning Network Problems: A Survey*. Report, Department of Maths, TU Kaiserslautern.

[2] H.W. Hamacher and S.A. Tjandra, Mathematical modeling of evacuation problems: a state of the art, In: *Pedestrain and Evacuation Dynamics*, Springer (2002), 227-266.

[3] S. Heller and H.W. Hamacher, The multi-terminal q-FlowLoc problem: a heuristic, *Proceedings of the Int'l Network Optimization Conference*, Springer (2011), 523-528.

[4] R. Koch, F. Nasrabadi and M. Skutella, Continuous and discrete flows over time - a general model based on measure theory, *Math. Methods of OR* **73** (2011), 301-337.

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Influence of Grouping on Growth of Surface Gravity Waves by Turbulence

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ABSTRACT:17

The influence of grouping on growth of surface gravity waves is considered by constructing a numerical model for turbulent airflow blowing over them. The air flow is assumed to be two-dimensional and neutrally stratified and the wave surface is assumed to be aerodynamically rough with flow conditions at the wave surface prescribed. The numerical model used is a new cubic high-Reynolds-number stress closure scheme based on that recently developed by Sajjadi et al. [1] which satisfies the two component limit of turbulence. In this model the geometry specific quantities such as the wall-normal vector or wall distance are replaced by invariant dimensionless gradient indicators. Also, the model captures the diverse behavior of the different components of the stress dissipation near the wall and uses a novel decomposition for the fluctuating pressure terms. The computational procedure for the governing equations is based on the fully conservative, structured finite volume framework, within which the volumes are non-orthogonal and collocated such that all flow variables are stored at one and the same set of nodes. To ease the task of discretization and to enhance the conservative property of the scheme, a Cartesian decomposition of the velocity field is used. The solution algorithm is iterative in nature, approaching the steady solutions with the aid of pressure-correction scheme. Convection is approximated with a higher-order upstream-weighted scheme QUICK of Leonard [2] for mean momentum equations and with the TVD-type MUSCL scheme of van Leer [3] for the turbulent stress equations. The model is also used to study the dynamics of critical layer, where the wave speed equals the wind speed, over groups of waves for various grouping configuration and how this affects the growth of surface waves in the open sea.

References

[1] S. G. Sajjadi, T. J. Craft, Y. Feng, A Numerical Study of Turbulent flow over a two dimensional hill, *Int. J. Numerical Methods*, **35** (2001), 1-23.

Solitons from Geometry

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ABSTRACT:8

Solitons are localised non-singular lumps of energy which describe particles non perturbatively. Finding the solitons usually involves solving nonlinear differential equations, but I shall show that in some cases the solitons emerge directly from the underlying space-time geometry: certain abelian vortices arise from surfaces of constant mean curvature in Minkowski space, and skyrmions can be constructed from the holonomy of gravitational instantons.

Transient Analysis of preemptive-repeat unreliable M/M/n/n queuing system

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ABSTRACT:39

This paper deals with the study of multi-servers queuing system in which there is no provision of formation of queue. The n homogeneous parallel placed servers are subjected to breakdowns. The objective of this paper is to find- mean number of customers in the service, utilization of servers, mean number of broken servers, utilization of repair capacity at any given time.

A law of the iterated logarithm for dyadic martingale and lacunary series

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ABSTRACT:41

In this talk, we will discuss how the law of the iterated logarithm was introduced in analysis and then discuss a tail law of the iterated logarithm. Finally, we discuss the tail law of the iterated logarithm in the context of dyadic martingales and lacunary series.

References

[1] Ghimire S. and Moore C.N. A lower bound in the tail law of the iterated logarithm for lacunary trigonometric series (to appear in Proceedings of American Mathmatical Society)

Temperature Distribution Model in Living Tissue based on Volume Averaging Theory

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ABSTRACT:21

There being wide applications of bioheat transfer in medical and biology, a considerable interest is developing to accurate thermal models within living tissue with blood perfusion. Till to date, many researchers have proposed models on the assumptions of appropriate modification of vascular architectures for blood perfusion. The latest developed model is based on volume averaging theory, and is the generalization of previous models [1]. The theory is underlying the consideration of energy equations for the blood and tissue phases, and are combined together to form a single equation for tissue temperature. The paper deals the temperature distribution model in living tissue based on volume averaging theory.

References

[1] A. Nakayama, Y. Sano, and K. Yoshikawa, A rigorous derivation of the bioheat equation for local tissue heat transfer based on a volume averaging theorey, *Heat and Mass Transfer*, **46** (2010),739-746.

The role of dissipation and bathymetry in the evolution of ocean swell

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ABSTRACT:13

Here we use a modified nonlinear Schroedinger equation (MNLSE) as a theoretical framework to consider the role of dissipation on the stability of ocean swell in deep water. Though dissipation is generally considered to be a small effect, we show with theory and with data from the lab and ocean, that it plays a role in stabilization of the Benjamin-Feir instability. We further investigate the causes of dissipation that occur at the air-water interface and compare predictions of four models with lab and ocean data. When the waves enter finite, variable depth, the coefficients of the MNLSE become variable. We carry out the dissipative analysis for this non-homogeneous system to investigate the surfers claim that every 7th wave is the largest.

Decreasing the Spread of HIV by Increasing Awareness Through Education

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ABSTRACT:25

Throughout the world, the HIV epidemic continues to pose major problems for health care. While researchers are still trying to find a cure, other efforts are being made to decrease the spread of HIV by increasing awareness through education. One of these campaigns presented by Uganda's government was the ABC campaign, which promotes Abstinence, Be Faithful, and Condoms to decrease the spread of HIV. The HIV/AIDS infection rates have decreased significantly due to organizations promoting this campaign and other educational information. A SIR model will be used to evaluate the effectiveness of these organizations on the HIV epidemic. Changed behavior as a result of the campaign will create a new SIR model based on this campaign and divide those susceptible into four different subgroups. These four susceptible classes will have different infection rates due to their differing beliefs on sexual conducts. The model is a system of ordinary differential equations in which data from Uganda about the epidemic and educational influences will be used to help estimate the parameters of infection rates. We will also develop an optimal control model of SIR type, discuss stability of the disease-free equilibrium, run numerical simulations, and present our mathematical findings.

Understanding the non-linear behavior of rock and rockmass by Heterogeneous Fractals

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ABSTRACT:26

Ever since Mandelbrot coined the Fractal dimension, many non-linear problems have been solved. Fractals represent scale invariant and self similar behavior of a system. Highly non-linear chaotic dynamical systems are often modeled by Fractal techniques. In this paper, the author has attempted to understand the non-linear behavior of the rock and rockmass that are governed by the fracturing process using Fractals. The research suggests that homogeneous fractals may not be sufficient to characterize the heterogeneous structure of a rockmass and therefore a heterogeneous fractal technique is made use of to characterize the heterogeneity of the rock mass at regional scale with a fractal length scale of several meters. A brief case study is presented to investigate the regional scale behavior of rockmass vis a vis the causative factors for impending rock bursts in deep underground mines.

The Sobolev Gradient Flow & Applications to PDE & ΨDE

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Abstract. We consider the functional of type

$$E^{\alpha}(u) = \frac{1}{2}\langle u, A^{\alpha}u\rangle_{L^2} + \int_{\Omega} V(x,u)dx$$

where $\alpha \in (0,1]$, A is a self-adjoint, uniformly elliptic operator of order 2 with suitable conditions on coefficient functions and V is a nonlinear functional with required smoothness on a bounded domain Ω of Euclidean space.

We consider the steepest descent equation for E^{α} ,

$$\partial_t u = -\nabla_{\alpha\beta} E^{\alpha}(u),$$

where the gradient $\nabla_{\alpha\beta}E^{\alpha}(u)$ is an element of Sobolev space $H^{\alpha\beta}$, $\beta \in (0,1]$ and impose the suitable boundary and initial conditions.

First we will discuss the existence and uniqueness of such gradient flow, weak comparison principle for the flow using the abstract semigroup thoery and spectral theory of an unbounded self-adjoint operator on a Hilbert space and mention some of its applications. One such application is to find a critical point of the functional E^{α} (i.e. a solution of a ΨDE or particularly a solution of a PDE when $\alpha = 1$ satisfied by the critical points of E^{α}) that has nonselfintersecting property and is in the bounded distance from a fixed hyperplane.

Assessing the effect of high-risk groups on the transmission dynamics of HIV/AIDS

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ABSTRACT:30

In the present work we have formulated a non-linear stage structured model for HIV to study the effect of high risk group (commercial sex workers, mobility of truck drivers and injecting drug users) on the transmission of HIV/AIDS. The model has two equilibriums namely disease free equilibrium and endemic equilibrium. Disease free equilibrium is stable for $R_0 < 1$, whereas endemic equilibrium is stable for $R_0 > 1$. The model is analyzed using stability theory of differential equations. It has been observed that sex workers and truck drivers are at high infection risk. Targeted interventions under HIV control and prevention programs must focus on high-risk groups to control the prevalence and spread of HIV/AIDS in population. Numerical simulations are performed to illustrate the analytical results.

Determination of the Lower and the Upper Bottlenecks for the Total Product Rate Variation Problem

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ABSTRACT:33

The mixed-model just-in-time sequencing problem (MMJITSP) minimizes both the earliness and the tardiness penalties that respond to the customer demands for a variety of models of a common base product without holding large inventories or incurring large shortages. The rate of usage of all parts used by the assembly lines are to be kept as constant as possible. The problem that minimizes the total variations of the rate at which different models are produced on the line is the total product rate variation problem (TPRVP) [1].

TPRVP with a nonlinear integer programming formulation has been solved reducing into an assignment problem with a pseudo-polynomial time [1]. In this presentation, we determine a lower and an upper bottleneck for the problem. The determination of the bottleneck helps to establish a better algorithm for the solution of the problem.

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Solutions to dissipative Benjamin, Bona and Mahony (BBM) Equation

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ABSTRACT:43

We consider the modified BBM equation adding a small amount of dissipation on waves

$$u_t + u_x + uu_x - u_{xxt} = \nu u_{xx} \tag{1}$$

where ν is transformed kinematic viscosity coefficient of the liquid. It has been shown that the dissipative BBM equation (1), in certain regions, has bounded traveling wave solutions in the form of solitary waves, periodic and elliptic Weierstrass functions [1]. Here we present some numerical solutions to the Cauchy problem of the modified BBM equation (1) based on the pseudo-spectral method. Finally, numerically analysing the traveling wave reduced ODEs, we show that the wave speed is a bifurcation parameter that makes transition between different classes of waves.

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Discrete Element Method in Particle Mechanics

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ABSTRACT:15

Finite element modeling and discrete element modeling are two frequently used numerical tools to analyze fracture and fragmentation behavior of heterogeneous particles. Finite element analysis provides stress distribution before and at the time of fracture whereas the discrete element analysis provides insight into the fragmentation mechanism of the particles. The proposed paper deals with discrete element method simulation to investigate fracture behavior of heterogeneous particles. The discrete element method treats the specimen as constituents of different individual primary particles which are governed by laws of motion and material constitutive behavior. Compared to continuum models, the DEM needs to specify micromechanical properties and contact parameters such as stiffness and bond strength.

Complex-valued partial differential equations

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ABSTRACT:31

In this talk, I will discuss the complex-valued solutions of some nonlinear partial differential equations, specifically Burgers equation, KdV equation, KdV-Burgers equation, Kawahara equation, and BBM equation. I will show the regularity of series-type solutions of these equations under some mild conditions and discuss blow-up solutions.

Locally Supported Biorthogonal Bases with Approximation Properties for Nodal Finite Elements

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ABSTRACT:12

We show the construction of locally supported basis functions which are biorthogonal to conforming nodal finite element basis functions of arbitrary degree. The support of these newly formed basis functions is the same as that of the associated nodal finite element basis functions. Their application in approximating the solution of partial differential equations will be highlighted.

Integrable nonlinear ODEs via Abel's equation

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ABSTRACT:46

In this seminar I will show how one can find exact solutions to many nonlinear second order ODEs via integrability of Abel's equation. I will explain how some old techniques used by Lemke, Appell, Liouville, Chiellini and Chini can be applied to different equations.

Self-Similarity, Integrability, and Accordions in Transient Stimulated Raman Scattering

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ABSTRACT:14

Accordions, like their better-known mathematical cousins — solitons — are similarity solutions of integrable partial differential equations. In the case of solitons, the similarity variable is $x - vt$, where x denotes position, t denotes time, and v denotes a velocity. In the case of accordions, the similarity variable is xt^{α}. It can be shown that the solutions to the transient stimulated Raman scattering equations will always tend toward one of a two-parameter set of accordion solutions for any initial condition. The history of these equations and related experiments is reviewed, including the recent observation of accordions by the Russell group at the Max-Planck Institute for Light in Erlangen, Germany. Related work at Princeton by Suckewer, Fisch, and colleagues that is aimed at applications to high-energy laser pulse generation will also be described.

Haar Wavelet Approach for Solving Nonlinear Differential and Integral Equations

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ABSTRACT:7

Haar wavelet function is considered to be a power tool for solving a number of problems of numerical analysis. We apply Haar wavelet approach for solving nonlinear dynamical systems governed through ordinary differential equations such as boundary value problems, oscillator equations, Emden Fowler and stiff problems. We also consider few nonlinear integral equations. The Haar solutions so obtained have been compared with counter solutions obtained by other methods.

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Modeling inhalational anthrax: deposition to germination

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ABSTRACT:36

Bacillus anthracis is a Gram-positive spore-forming bacterium that causes anthrax disease in humans and animals. This rod-shaped germ can form endospores and can survive in harsh environment for years or even decades which make it a difficult organism to control. When the spores find a new host (animal or human), they change to the rod-like form and begin to multiply rapidly. The ability to survive in extreme conditions for long periods of time and the high fatality associated with are some of the major reasons *Bacillus anthracis* has been used as biological weapon. Inhalational anthrax is considered as one of the most fatal form of anthrax with a mortality rate approaching 100%. The initial symptoms are normally vague and flu-like, making health care providers ignore it at the beginning. Inhalational anthrax starts when victim breaths in *Bacillus anthracis* spore. These spores can easily reach in Lung's alveolar region, where they are then engulfed by phagocytic cells (eg: Macrophages or Dendritic cells). The engulfed spores can then germinate within these host cells. The newly germinated spores are susceptible to phagocytic cell killing but some still manage to survive and become vegetative bacteria that are capable of replicating and producing deadly toxins. Both survived germinated and un-germinated spores in Phagocytes travel into Lung Associated Lymph Nodes (LALN) where the major bacterial outgrowth occurs. The bacteria then disseminate into the bloodstream, produce toxins that cause cardiovascular dysfunction and shock leading to death of the patient.

We develop an ODE model that focuses on the early events in infection of inhalational anthrax: i.e, from deposition to germination. This part play vital role in infection because the number of spores that germinate and the growth of the germinated spores determines the fate of infection. Although there are still many questions about which mechanism are most important in disease progression and why some low dose exposure are not fatal, our model will try to answer some of these questions.

Fifth Order BBM Type Equation: Derivation and Well-posedness Theory

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ABSTRACT:23

We use *second order approximation* to the higher-order Boussinesq type system to derive a single Benjamin-Bona-Mahony (BBM) type equation. Using multilinear estimates, we prove that the associated Cauchy problem for given data in the $L^2(\mathbf{R})$-based Sobolev space $H^s(\mathbf{R})$, is locally well-posed if $s \geq 1$. Also, with certain restriction on parameters we find a conserved quantity in $H^2(\mathbf{R})$ and use it along with the splitting of the initial data in low and high frequency parts to prove that the local solution can be extended globally in time.

DCP Property of Convex Combinations of de la Vallée Poussin Kernels

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ABSTRACT:28

Let $\mathcal{C}(\phi)$ denote the set of all univalent functions in the unit disk $\mathcal{D}$ which are convex in the direction $e^{i\,\phi}$. A function g anlytic in the unit disk $\mathcal{D}$ is said to be in the class DCP (Directional Convexity Preserving) if it preserves the class $\mathcal{C}(\phi)$ under the Hadamard product, i.e. $f * g \in \mathcal{C}(\phi)$ whenever $f \in \mathcal{C}(\phi)$. In [1] and [2] Ruscheweyh and Salinas charecterized the class DCP. The class DCP is not an isolated one but has a bearing on the geometric function theory and has been used to prove various results in this filed of mathematics. It has been proved in the literature that some well known and most applicable functions of a complex variable like exponential function e^{rz} for $0 < r \leq 1$ belongs to the class DCP. In this paper we further enlarge this class by establishing a criterion for closed convex hull of the de la Vallée Poussin kernels $V_\lambda(z) = \frac{\lambda z}{\lambda+1}{}_2F_1(1, 1-\lambda; 2+\lambda; -z),\ z \in \mathcal{D}$ to be in the class DCP.

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Earliest Arrival Contraflow Model for Evacuation Planning

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ABSTRACT:37

The transportation network problem was modeled as a non-linear problem in the continuous time that makes complication during evacuation planning. To solve the evacuation problem approximately as quickly as possible we adopt the model of simple graph in discrete time setting [1, 3].

We consider the earliest arrival flow (EAF) and the contraflow problems that have been highly focused in evacuation planning. The EAF problem obtains the maximum amount of flow for every time steps from the sources to the sinks. In general, no polynomial algorithm has been found. A polynomial algorithm for the EAF problem has been presented on series-parallel graph [4]. Contraflow reduce the traffic jam by increasing the outbound evacuation route capacity. Integer programming formulation and some heuristics are presented. A polynomial time algorithm for single-source single-sink maximum dynamic contraflow has been presented [3]. The problem in the multiple sources and multiple sinks are NP-hard.

We formulated the earliest arrival contraflow problem, where as many evacuees as possible should be sent from the sources to the sinks in every time period by reversing the road directions at time zero. A polynomial time algorithm for this problem on a two-terminal series-parallel graph having capacities and transit times on the arcs has been presented [2].

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On Some Contractions In Metric Space

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ABSTRACT:42

The notion of metric space was first introduced by French Mathematician Maurice Frechet in 1906. The contraction mapping principle was formulated by Stephan Banach in his 1920 Ph.D. thesis. Since then several types of contraction in metric space have been introduced. The purpose of this presentation is to briefly discuss different types of contractions in metric space.

On the real zeros of random polynomials

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ABSTRACT:11

The study of random polynomials is of independent theoretical interest and this study leads to probabilistic generalization of classical results on algebraic polynomials. Further many problems in applied mathematical sciences lead to random algebraic polynomials and other related polynomials. Random algebraic polynomials naturally arises in the study of differential and difference equations with random coefficients, random matrices whose elements are random variables, spectral theory of random matrices, polynomial regression equations, in the discussion of present value formula in economics, statistical communications theory, applications to the GSM (Global System for Mobile Communications)/ EDGE (Enhanced Data Rates for GSM Evolution) standard for mobile phones, etc. We will present a survey of the average number of real zeros of random algebraic polynomial, random trigonometric polynomial, random orthogonal polynomial, random hyperbolic polynomial and applications.

A study of indoor air pollution using Navier-Stokes equations

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ABSTRACT:27

Most of the people in the developing countries use biomass as the main resource of energy for cooking and heating. Generally the kitchen in the rural households are not properly ventilated. It is one of the major cause for the indoor air pollution (IAP). Other factors affecting the indoor air quality are source of pollution, HVAC system, pollutant pathways and building occupants. Computational Fluid Dynamics has widely been used for the study of IAP through different approaches and methodology. The well-known Navier-Stokes equations have different applications especially in the field of fluid dynamics. In this paper Navier-Stokes equations and advection-diffusion equations will be used to study the distribution of IAP in a room. The finite volume method will be used for the study of the two dimensional steady motion of the compressible fluid.

On the supercritical KdV equation with time-oscillating nonlinearity

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ABSTRACT:6

For the initial value problem (IVP) associated to the generalized Korteweg-de Vries (gKdV) equation with supercritical nonlinearity,

$$u_t + \partial_x^3 u + \partial_x(u^{k+1}) = 0, \qquad k \geq 5, \tag{1}$$

numerical evidence shows that, there are initial data $\phi \in H^1(\mathbf{R})$ such that the corresponding solution may blow-up in finite time. Also, with the evidence from numerical simulation, it has been claimed that a periodic time dependent coefficient in the nonlinearity would disturb the blow-up solution, either accelerating or delaying it.

In this work, we investigate the IVP associated to the gKdV equation

$$u_t + \partial_x^3 u + g(\omega t)\partial_x(u^{k+1}) = 0, \tag{2}$$

where g is a periodic function and $k \geq 5$ is an integer. We prove that, for given initial data $\phi \in H^1(\mathbf{R})$, as $|\omega| \to \infty$, the solution u_ω converges to the solution U of the initial value problem associated to

$$U_t + \partial_x^3 U + m(g)\partial_x(U^{k+1}) = 0, \tag{3}$$

with the same initial data, where $m(g)$ is the average of the periodic function g. Moreover, if the solution U is global and satisfies $\|U\|_{L_x^5 L_t^{10}} < \infty$, then we prove that the solution u_ω is also global provided $|\omega|$ is sufficiently large.

Breathers and Rogue Wave Solutions of General Coupled Nonlinear Schrödinger System

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ABSTRACT:44

In this talk, we discuss certain physically interesting solutions including breathers, rogue waves, dark-bright and dark-dark soliton solutions of a general coupled nonlinear Schrödinger system. To begin with, we derive one and two soliton solutions by using the Darboux transformation method. We then construct Akhmediev breather solutions in the self focusing media. From Akhmediev breathers we isolate Peregrine solitons, which has greater temporal localization and which can be written in terms of rational functions of coordinates that play the role of rogue waves. We also analyze the effect of four wave mixing terms in the formation of rogue waves. Finally, we consider the self defocusing regime and explore dark-bright and dark-dark soliton solutions to this model.

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Fixed Point Theorems for α-ψ-contractive multifunctions on Partial Metric Spaces

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ABSTRACT:29

Recently, Samet *et al.* [1], introduced a very interesting new category of contractive type mappings known as α-ψ contractive type mappings. The results obtained by Samet *et al.* [1] generalize the existing fixed point results in the literature, in particular the Banach contraction principle. Further, Asl et al. [2] generalized the concept of α-ψ contractive type mappings by introducing the notion of α_*-ψ-contractive multifunctions and obtained a fixed point result for these multifunctions. Recently, Aydi et al. [3] initiated the study of fixed point theory for multi-valued mappings on partial metric space by introducing the concept of a partial Hausdorff metric and proved an analogous to the well-known Nadler's fixed point theorem. In this paper, we generalize the results of Samet *et al.* [1], Asl et al. [2] and Aydi et al. [3] on partial Hausdorff metric spaces. Also, a homotopy result is given.

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Chaotic motions in penetrative convection

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ABSTRACT:47

The circulation in fresh water reservoirs is greatly affected by the fact that the density maximum of fresh water is about 4 °C. This can lead to convective modes that differ from the known patterns of classical Rayleigh-Bénard convection. A number of works have been devoted to convection with density maximum. In the fundamental work [1] G. Veronis called this kind of motion penetrative convection. We analyze highly nonlinear time-dependent motions and show the bifurcation diagram for two-dimensional problem. Bifurcations sequence is very different from classical convection and lead to subcritical bifurcation of Neimark-Sacker if the density maximum is located in the middle of the layer. Quasiperiodic modes lose stability through intermittency with chaotic bursts on the background of quasiperiodic modes. The position of the density maximum inside the layer also affects the regimes. For some given aspect ratios three-dimensional steady and unsteady patterns are analyzed. The direct numerical simulation was performed using pseudospectral methods.

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A new construction of the Hoffman-Singleton graph using a well-known peculiarity of A_6

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ABSTRACT:38

The Hoffman-Singleton graph $\mathcal{H}$, a member of the small family of Moore graphs, is a well known 7-regular undirected graph with 50 vertices and 175 edges. It is the unique strongly regular graph with parameters (50,7,0,1). We construct $\mathcal{H}$ as a rank 3 graph with $|I(x)| = 1$, $|\Delta(x)| = 7$ and $|\Gamma(x)| = 42$, using the alternating group A_7. There are 84 distinct A_5's in A_7 which fall into exactly two conjugacy classes of subgroups, each class of size 42. An A_5 of the first class fixes two points, whereas an A_5 of the second class fixes one point and acts transitively on the remaining 6 points. We use the 42 A_5's of the second class to construct the Hoffman-Singleton graph. This construction is possible because S_6 is the only member of the family of symmetric groups S_n to posses outer-automorphisms.

Particle Methods for a Hierarchy of Pedestrian Flow Models: From Microscopic to Non-local Continuum Models

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ABSTRACT:18

A hierarchy of models for pedestrian flow is derived and investigated. It includes microscopic models based on interacting particle system coupled to an Eikonal equation, hydrodynamic models using equations for density and mean velocity, nonlocal continuum equations for the density and diffusive Hughes equations. The Eikonal equation is used to compute optimal paths for pedestrian. We have used a meshfree Lagrangian particle method to solve all levels of the hierarchy. These particles are numerical grid points. The microscopic model consists the system of ODEs including positions and velocities of particles. The other models are hyperbolic types of PDEs. For solving these PDEs, we first approximate the spatial derivatives at each particle position from its neighbor values. Then we obtain the system of ODEs, which is similar to microscopic model. The resulting system of ODEs can be solved by a standard ODEs solver. However, we solve the Eikonal equation by a fast marching method, which is a mesh based method. We require two types of grid points, one for solving the pedestrian flow models, and another for solving the Eikonal equations. Therefore, we establish two clusters of grid points, which are decoupled from each other, however, we interchange the necessary information from one cluster of grids to another and vice-versa. Finally, we present numerical results where several physical situations are investigated compared the above models.

Ishikawa iterative process for a pair of singlevalued and multivalued generalized nonexpansive Map

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ABSTRACT:16

In 2010 Sokhuma and Kaewkhao [Fixed Point Theory Appl. 2010, Art. ID 618767, 9 pp.] introduced a modified Ishikawa iteration scheme for a pair of single valued and multivalued nonexpansive mappings in Banach spaces and proved some convergence theorems. In this paper, we study about the convergence of modified Ishikawa iteration process for a pair of single valued and multivalued generalized nonexpansive mappings in Banach spaces. In this process, we generalize some result of Sokhuma and Kaewkhao [Fixed Point Theory Appl. 2010, Art. ID 618767, 9 pp.] and Akkasriworn et al. [Int. Journal of Math. Analysis, Vol. 6, 2012, no. 19, 923-932].

Mathematical modeling of a slider bearing

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ABSTRACT:45

To reduce tear and wear of machinery lubrication is essential. Lubricants form a layer between two surfaces preventing direct contact and reduce friction between moving parts and hence reduce wear. The choice of lubricant is important for a given application. In this model the lubrication of the slider bearing is studied. A simple slider bearing has two plates of given profile separated by a gap between the plates is filled with the lubricant. One of the plates is fixed and other is moving horizontally. Due to the viscosity of the lubricant, motion of the plate's results in work done on the lubricant increasing the temperature. This study will be helpful in finding the condition under which the safe operation of the bearing is ensured. That is, in finding the condition under which the temperature of the lubricant is lower than the ignition temperature. When the viscosity is variable, new solutions are found in terms of Weber functions.

Sampling Techniques as Applied to Cancer Data

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ABSTRACT:50

The purpose of the present study is to identify a suitable sampling method that describes a desired situation. Using the cancerous tumor size as the key variable, we have identified the appropriate sample size necessary as a representation of the population. Sampling techniques: Simple random sampling, stratified sampling, clustered sampling were employed to extract the required sample size. These sampling methods were compared to identify the best sampling technique for the desired situation.

Boundary conditions of the 2+1 dimensional nonlinear Schrödinger equation

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ABSTRACT:5

We consider a natural generalization of the defocusing nonlinear Schrödinger equation to 2+1-dimensions and perform a complete classification of the admissible boundary conditions for the fields and study the implications that ensue. Concretely we consider the system of equations

$$iu_t + u_{xx} + 2uV_x = 0, \quad V_y + |u|^2 = 0 \tag{1}$$

where $u(x, y, t)$ is a complex function, depending on three real variables x, y, t. This system is a generalization of the defocusing NLS equation to 2+1-dimensions, alternative to the Davey-Stewartson (DS) system.

Since Eq. (1) is integrable one expects that it possesses an infinite number of conserved quantities. We study the basic conservation laws like mass, momentum, center of mass and Hamiltonian. It turns out that *the existence of conserved quantities is also related to the BCs taken* and it appears that, under certain boundary conditions, momentum and Hamiltonian are not conserved. We consider a general, two-parameter family of BC for the fields of the form

$$r \to \infty \lim |u|(x, y, t) = c, \; r \to \infty \lim u_x = r \to \infty \lim u_t = 0 and$$
$$\lambda \tilde{V}(x, y = -\infty) + \hat{\lambda} \tilde{V}(x, y = \infty) = 0 \tag{2}$$

where $r^2 = x^2 + y^2, c, \lambda \in R$ are real numbers.

We find that if if either $c \neq 0$ or if $c = 0, \lambda = 1/2$ physical functionals evolve trivially under the dynamics.

By contrast if $c = 0$ one has the following dichotomy, depending on a certain object $m^y(x, t)$:

If $m^y(x, 0) = 0$ then $m^y(x, t) = 0, \forall t$ and conserved quantities exist.

If $m^y(x, 0) \neq 0$ then $m^y(x, t) \neq 0, t > 0$ and the physical functionals may not be conserved.

ON Some Contractions In Metric Space.

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ABSTRACT

The concept of fuzzy set was introduced by L.A. Zadeh in 1965. Then, O. Kramosiland J. Michalek introduced the fuzzy metric space in 1975 as generalization of metric space. Since then, the concept of a fuzzy metric space has been extended and generalized in different ways by others too. The purpose of this paper is to study briefly the development ofgeneralized forms of fuzzy metric space with application.

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