International Conference on Nonlinear Applied Analysis and Optimization 2021

National Mathematics Day

Schedule

Indian Institue of Technology (Banaras Hindu University), Varanasi India

Department of Mathematical Sciences

Time zone is GMT+5:30

NOTE:
To join your sessions click on the "Meet link" written against the sessions.

Day 1 Tuesday, December 21, 2021

Morning, Session A

Meet Link

Programs	Timings	Speakers
Inauguration	9:00-9:20	Join and Connect
Keynote Talk	9:30-10:30	M A Khamsi
Plenary Talk	10:30-11:15	N C Wong
Plenary Talk	11:30-12:15	S Chakraverty
Invited Talk	12:15-12:45	D Dutta
Paper Presentation	12:45-13:00	Jayanta Biswas
	13:00-13:15	Himanshu Kumar Pandey
	13:15-13:30	Archana Yadav
	13:30-13:45	Watanjeet Singh

Morning, Session B

Meet Link

Paper Presentation	12:45-13:00	Prabu S
	13:00-13:15	Puna Ram Sahu
	13:15-13:30	Bidhan Modok
	13:30-13:45	Nirmala Veeramanni

Day 1 Tuesday, December 21, 2021

Evening, Session A

Meet Link

Plenary Talk	14:45-15:30	A Petrusel
Keynote Talk	15:30-16:30	Radu Ioan Bot
Invited Talk	16:30-17:00	P. Marechal
Invited Talk	17:00-17:30	S M Grad
Paper Presentation	17:30-17:45 17:45-18:00 18:00-18:15 18:15-18:30 18:30-18:45 18:45-19:00 19:00-19:15 19:15-19:30 19:30-19:45 19:45-20:00	Yao-Te Huang Rita Pal K. Mahalik Mohd Asad Tirth Ram Shikher Sharma M U Khairoowala Uqba Rafat Vandana Tiwari Abhik Digar
Plenary Talk	20:00-20:45	B S Choudhury

Evening, Session B

Meet link

Invited Talk	16:30-17:00	G V R Babu
Invited Talk	17:00-17:30	Rajendra Pant
Paper Presentation	17:30-17:45	Salsabeela V
	17:45-18:00	Athira T M
	18:00-18:15	Fathima Parveen P.A.
	18:15-18:30	Sandhya S. Pai
	18:30-18:45	Aparna Sivdas
	18:45-19:00	Sangeeta Mishra
	19:00-19:15	Ankit Kumar
	19:15-19:30	Sneha
	19:30-19:45	Akash Pradhan

National Mathematics Day

Day 2 Wednesday, December 22, 2021

Morning, Session A

Meet Link

Plenary Talk	9:30-10:15	Oscar Castillo
Invited Talk	10:15-10:45	Samarjit Kar
Plenary Talk	11:00-11:45	Joydeep Dutta
Invited Talk	11:45-12:15	Sunil J John
Paper Presentation	12:15-12:30	T.M.C. Priyanka
	12:30-12:45	Subhash Chandra
	12:45-13:00	Alamgir Hossain
	13:00-13:15	Vishal Agrawal
	13:15-13:30	Madhubrata Bhattacharya
	13:30-13:45	Supriya Mukherjee

Morning, Session B

Meet Link

Invited Talk	11:00-11:45	Sujit Das
Invited Talk	11:45:12:15	Lakshmi Kanta Dey
Paper Presentation	12:15-12:30	Shashikant Kumar
	12:30-12:45	Kuldeep
	12:45-13:00	Ankit Kumar Nain
	13:00-13:15	Basharat Hussain
	13:15-13:30	Kanika
	13:30-13:45	Neha Trivedi

National Mathematics Day

Day 2 Wednesday, December 22, 2021

Talks Dedicated to Srinivasa Ramanujan

Plenary Talk	14:30-15:15	A Sankaranaryanan
Plenary Talk	15:15-16:00	R Munshi
Invited Talk	16:00-16:30	M M Singh
Invited Talk	16:30-17:00	Saurabh K Singh

Evening, Session A

Meet link

Paper Presentation	17:30-17:45 17:45-18:00 18:00-18:15 18:15-18:30 18:30-18:45 18:45-19:00 19:00-19:15 19:00-19:30	Megha Pandey MD Nazimul Islam Kshitij Kumar Pandey Sneha Garg Manuj Verma Manoj Kumar Archana K Prasad Shagun Sharma
Plenary Talk	20:00-20:45	MK Roychowdhury

Evening, Session B

Meet link

Invited Talk	16:00-16:30	A K Mishra
Invited Talk	16:30-17:00	S Verma
Paper Presentation	17:30-17:45 17:45-18:00 18:00-18:15 18:15-18:30 18:30-18:45 18:45-19:00 19:00-19:15 19:15-19:30	Nihar K Mahato Vivek Dhingra Souad Chentout Rakhi Tiwari Anshika Tanwar Jaya Bisht Sunny Kumar Manisha Mukherjee

Day 3 Thursday, December 23, 2021

Morning, Session A		Meet Link
Plenary Talk	9:30-10:15	Akhtar A Khan
Invited Talk	10:15-11:00	Q H Ansari
Plenary Talk	11:15-12:00	D K Ganguly
Invited Talk	12:00-12:30	Sanyasiraju Y V S S
Paper Presentation	12:30-12:45 12:45-13:00 13:00-13:15 13:15-13:30 13:30-13:45	Vivek Laha Jauny Ankita Panwar Saroj K Sahoo Sanchari Ganguly

Morning, Session B		Meet Link
Plenary Talk	10:15-11:00	R P Pant
Invited Talk	12:00-12:30	Mantu Saha
Paper Presentation	12:30-12:45 12:45-13:00 13:00-13:15 13:15-13:30 13:30-13:45	Kaushik Dehingia MD Arzoo Jamal N.K. Singh Sapna Baluni Shilpa Samadar

Day 3 Thursday, December 23, 2021

Evening, Session A

Meet link

Plenary Talk	14:45-15:30	M Banerjee
Plenary Talk	15:30-16:15	P Massopust
Invited Talk	16:15-16:45	S Mukhopadhyay
Invited Talk	16:45-17:15	R K Vats
Paper Presentation	17:15-17:30 17:30-17:45 17:45-18:00 18:00-18:15	K Anitha Sudipta Mishra Bethu Srikanth Dmitry Ivakhnil
Keynote Talk cont.	18:15-19:15	M A Khamsi
Valedictory Function	19:15-19:45	

Evening, Session B

Meet link

Invited Talk	15:45-16:15	D Gopal
Invited Talk	16:15-16:45	V Sankar Raj
Invited Talk	16:45-17:15	D K Jana
Paper Presentation	17:15-17:30 17:30-17:45 17:45-18:00 18:00-18:15	Kumari Jyoti Ravinder Kumar Sharma Mohamed Zaway Chandramohan Bhuma

Abstracts of Invited Speakers

S. Chakraverty
NIT Rourkela

Fuzzy-Affine Arithmetic in Over Estimation Problems: Case Studies with Fuzzy System of Equations

The solution of linear or nonlinear system of equations is essential for many engineering and science problems in an uncertain environment where the parameters are known in terms of fuzzy membership functions. Firstly, the uncertainty is considered in terms of different types of fuzzy numbers viz. triangular and trapezoidal. Then these fuzzy numbers are parameterized into a family of standard intervals. It is worth mentioning that, the solution of the converted interval system overestimates its range due to the interval dependency problem in the case of standard interval arithmetic computations. As such, affine arithmetic has been developed here to overcome it. In this regard, new fuzzy- affine arithmetic is defined to handle uncertain parameters more efficiently. The reliability and effectiveness of the arithmetic are shown by some illustrative example(s).

Sujit Das
NIT Warangal

Picture fuzzy set based decision making approach using Dempster-Shafer theory of evidence and grey relation analysis and its application in COVID-19 medicine selection

To offer better treatment for a COVID-19 patient, preferable medicine selection has become a challenging task for most of the medical practitioners as there is no such proven information regarding it. This article proposes a decision-making approach for preferable medicine selection using picture fuzzy set (PFS), Dempster-Shafer (D-S) theory of evidence and Grey relational analysis (GRA). PFS is an extended version of the intuitionistic fuzzy set (IFS), where in addition to membership and non-membership grade, neutral and refusal membership grades are used to solve uncertain real-life problems more efficiently. Hence, we attempt to use it in this article to solve the mentioned problem. Previously, researchers considered the neutral membership grade of the PFS similar to the other two membership values (positive and negative) as applied to the decision-making method. In this study, we explore that neutral membership grade can be associated with probabilistic uncertainty which is measured using D-S theory of evidence and FUSH operation is applied for the aggregation purpose. Then GRA is used to measure the performance among the set of parameters which are in conflict and contradiction with each other. In this process, we propose an alternative group decision making approach by the evidence of the neutral membership grade which is measured by the D-S theory and the conflict and contradiction among the criteria are managed by GRA. Finally, the proposed approach is demonstrated to solve the COVID-19 medicine selection problem.

Sanyasiraju Y V S S
IIT Madras

Some Upwind options for the meshless RBF schemes with pde points

Radial Basis Function (RBF) based Local Hermitian Interpolation (LHI) with PDE centres is an integration scheme which has some built in upwind effect and hence good for solving convection dominated problems. These equations can have sharp layers in their solutions and accurate computation of these layers is a big challenge for most of the numerical schemes. In this presentation, generation of upwind schemes for the RBF based meshless methods will be highlighted.

Adrian Petrusel
Babes-Bolyai University Cluj-Napoca, Romania

Step by step contraction principle for abstract Volterra operators.

In this talk, using the weakly Picard operator theory and the fibre contraction principle, we will present a step by step contraction principle for abstract Volterra operators in spaces of functions of several variables. An application illustrating the main results is also given.

References :

C. Corduneanu: Abstract Volterra equations: a survey, Math. Comput. Modeling, 32 (2000), 1503-1528.
A. Petrusel, I.A. Rus: Fixed point equations with abstract Volterra Operators, (to appear).
I.A. Rus: Some variants of contraction principle in the case of operators with Volterra property: step by step contraction principle, Adv. Theory of Nonlinear Anal. Appl., 3 (2019), no. 3, 111-120.
E.S. Zhukovskii, M.J. Alves: Abstract Volterra operators, Russian Math. (Iz. VUZ), 52 (2008), no. 3, 1-14.

M. Banerjee
IIT Madras

Effect of slow-fast time scale on transient dynamics

Dynamical analysis of mathematical models for interacting populations is intended to study the position, stability and bifurcation of various attractors. The available data for interacting species rarely indicate the existence of such attractors. In reality, we often find transient dynamics, recently, researchers are interested to study the nonlinear dynamical aspect which can capture the transient dynamics. Detection of transient dynamics depends upon rigorous bifurcation analysis and detailed numerical simulation for a wide range of parameter values. On the other hand, the difference in time scales for the intrinsic growth rates of constituent species is modelled by incorporating slow-fast time scales. In the presence of a slow-fast time scale, we find interesting dynamic features like canard oscillation, canard explosion, relaxation oscillation. The introduction of the slow-fast time scale also alters some local and global bifurcation thresholds. The main objective of this talk is to discuss the effect of the slow-fast time scale on the transient dynamics exhibited by a class of two species interacting populations.

Sorin-Mihai Grad
Department of Applied Mathematics, ENSTA Paris, France

Stochastic incremental mirror descent algorithms with Nesterov smoothing

We propose a stochastic incremental mirror descent method constructed by means of the Nesterov smoothing for minimizing a sum of finitely many proper, convex and lower semicontinuous functions over a nonempty closed convex set in a Euclidean space. The algorithm can be adapted in order to minimize (in the same setting) a sum of finitely many proper, convex and lower semicontinuous functions composed with linear operators. Another modification of the scheme leads to a stochastic incremental mirror descent Bregman-proximal scheme with Nesterov smoothing for minimizing the sum of finitely many proper, convex and lower semicontinuous functions with a prox-friendly proper, convex and lower semicontinuous function in the same framework. Different to the previous contributions from the literature on mirror descent methods for minimizing sums of functions, we do not require these to be (Lipschitz) continuous or differentiable. Applications in Logistics, Tomography and Machine Learning modelled as optimization problems illustrate the theoretical achievements. The talk is based on joint work with Sandy Bitterlich.

M. M. Singh
Dept of Basic Sciences & Social Sciences, NEHU, Shillong-793022

'Group of signed quadratic residues and its applications to cryptography'

The application of the group of signed quadratic residues (SQR) is first observed by Hofheinz and Kiltz. This group is useful in cryptography because the elements of this group are efficiently recognizable and it has some nice properties of quadratic residues. SQR is an example of 'Gap-group' in which the computational problem is as hard as factoring, while the corresponding decisional problem is easy. We will discuss its properties for the implementation in cryptography. Despite its various interesting properties they have found up to now in a very few cryptographic applications, we will also discuss some of its applications in cryptography to motivate the researcher.

Sunil Jacob John
Department of Mathematics, National Institute of Technology Calicut, Kerala

STENTHOMOLOGY: A TOOL FOR TOPOLOGICAL DATA ANALYSIS

There are many sources of high dimensional data which are believed to be structured but are hard to visualize. Our goal will be to extract information or pattern sout of this high dimensional data using some very fundamental notions of algebraic topology likes implicial complexes. Persistent homology is a recently developed tool for this purpose. Small signals or features, often regarded as noise, need to be eliminated for de-noising or smoothing images and other records of observation. This is more important insituations where the space is not a fixed one and mostly depends on the scale of the observation. These themes will be introduced with suitable examples of typical high-dimensional data set derived from natural images.

MOHAMED AMINE KHAMSI
University of Texas at El Paso

RECENT GEOMETRIC PROPERTIES OF: VARIABLE EXPONENT SPACES

On an intuitive level, the variable exponent space is obtained by replacing the energy (also known as modular)

$$\int_\Omega |f(x)|^p \quad with \quad \int_\Omega |f(x)|^{p(x)},$$

where $p(x)$ is a function defined on Lately variable exponent spaces have attracted quite a bit of attention. Variable exponent spaces are connected to variational integral swith nonstandard growth and coercivity conditions. These nonstandard variational problems are related to modeling of theso- calledelectrorheological fluids and also appear in some models related to image restoration.
In this talk, we start by a simple introduction to variable exponent spaces. Then we move to discuss some recent results related to the modular geometry of such spaces.

Muoi Bui Ngoc and Ngai-Ching Wong
Department of Applied Mathematics, National SunYat-sen University, Taiwan

Amenability of semitopological semigroups and fixed point properties

The amenability was first introduced [1, 2, 3] to study the group algebra $L1(G)$ of a locally compact group G. For a semi topological semigroup S, the amenability is defined as an existence of a left invariant positive linear functional on some function spaces associated to S. This concept then is used in studying the existence of fixed points for an action, $S \times K \to K$ defined by $(s, x) \to T_S x$, of S on a convex set K of a Banach space. To guarantee a common fixed point, that is, a point $x_0 \in K$ such that $= T_S x_0 = x_0, \forall s \in S$, the maps T_S need to satisfy some nonexpansiness and continuity conditions.

We present in this talk some of our recent results. Let LUC(S) be the space of left uniformly continuous functions on S. Assume that S is right reversible and LUC(S) has a left invariant mean. Then there always exists a common fixed point for any jointly weakly continuous and super asymptotically nonexpansive representation of S on a weakly compact convex subset K of a Banach space. Several variances involving weak* compactness of K and other function spaces on S a real so provided in [6]. The results are extended and generalized to the Fréchét and locally convex space setting in [4], and applied to Bregman type nonexpansive mappings in [5].

References

B. E. Johnson, *Cohomology in Banach algebras*, Mem. Amer. Math. Soc., 127 (1972).

A. T.-M. Lau, Invariant means on almost periodic functions and fixed point properties, Rocky Mountain J. Math., 3 (1973), 69–76.

T. Mitchell, Function algebras, means and fixed points, Trans. Amer. Math. Soc., (1968) 117–126.

B. N. Muoi and N.-C. Wong, Super asymptotically nonexpansive actions of semitopological semigroups on Fréchet and locally convex spaces, in the Proceedings of the International Conference on Nonlinear Analysis and convex Analysis & International Conference on Optimization: Techniques and Applications-II (Hakodate Japan 2019), 53-71.

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Qamrul Hasan Ansari
Department of Mathematics, Aligarh Muslim University, Aligarh

Variational Inclusions on Hadamard Manifolds

In this talk, we shall give a survey on variational inclusions in the setting of Hadamard manifolds. First, we shall give the motivation to study the variational inclusions on manifolds, and then we shall consider different kinds of variational inclusions on Hadamard manifolds. We shall also provide the relation among variational inclusions, variational inequalities and optimization problems in the setting of Hadamard manifolds. We shall discuss several solution methods to compute the approximate solutions of the variational inclusions. The convergence analysis of these methods will also be presented in the setting of Hadamard manifolds. Some appropriate examples will also be presented at the suitable places.

Debabrata Datta
Department of Information Technology Heritage institute of Technology, Kolkata, West Bengal

Optimization Methods using Music Inspired Algorithm and its Comparison with Nature Inspired Algorithm

Optimization problems of various categories either static or dynamic in one direction and single objective and multiobjective in another route always occurred in the industry. Risk informed decision making based management of any industry depends on the optimal solution of problems faced by the industry. Classical optimization methods for handling the industrial optimization problems fail and hence society looks for an efficient and simple technique. In this context, an emerging metaheuristic optimization algorithm named as Harmony Search (HS) plays a major role in the field of engineering and medical science. The HS optimization method works on the basis of metaheuristics and is based on harmony of music and categorized as music inspired optimization algorithm. We can apply HS for function optimization, pipe network optimization and data optimization for its classifications. The paper will explore the fundamentals of HS algorithm and its applications for two case studies: (a) to optimize piping for water network system and (b) to optimize effective radiation dose delivered to affected cancerous target organ. Outcome of HS algorithm is further compared with that using nature inspired algorithm BAT and Bee Colony Optimization (BCO). The present paper will also explore the variation of HS algorithm for designing harmony filter system in the field of signal processing in an optimized manner.

Mantu Saha
Department of Mathematics, The University of Burdwan, Purba-Bardhaman, West Beangal

A Study on Fixed Points for a Class of Mappings over a Locally Convex Space

Here the concepts of contraction mapping and contractive mapping over a locally convex topological vector space have been introduced. The main objective is to present the study of fixed points for a class of mappings either contraction or contractive type in nature over a locally convex topological vector space together with its application. A suitable local base plays an important role for the existence of fixed points of such mappings on it.

Saurabh Kumar Singh
IIT Kanpur

Delta symbol and its applications

The circle method is a method employed by Hardy, Ramanujan, and Littlewood to solve many asymptotic problems in additive number theory, particularly in deriving an asymptotic formula for the partition function $p(n)$. In this talk we shall first recall the formula developed by Kloosterman and Duke-Friedlander-Iwaniec and then discuss some applications of the delta symbol.

Ramesh Kumar Vats
Department of Mathematics and Scientific Computing, National Institute of Technology Hamirpur, Hamirpur(H.P.)

Controllability of Fractional Order Systems

Control Theory has great importance now a days due to its immense applications in science and engineering, viz. satellite control and control of aircraft, defence-missiles and anti- missiles problems, Economy-regulating inflation rate. In this regard, a fundamental concept of mathematical Control Theory is known as controll ability introduced by Kalman in 1960. Control- lability means checking the existence of a control function, which steers the solution of the system from its initial state to final states, where initial and final states may vary over the entire space. On the other hand, fractional calculus is an active and growing area of research now a days. Some anomalous processes have complicated dynamics that classical derivative models cannot adequately describe. In these cases, fractional order derivatives and integrals lead to a better understanding of such models. So the study of controllability problems of fractional order systems leads to some better results in this direction. The aim of this talk on "Controllability of Fractional Order Systems" presents a brief over view of Fractional-order controllability problems in both finite and infinite-dimensional space.

L K Dey
Department of Mathematics National Institute of Technology Durgapur

Discontinuity at fixed points of contractive type mappings

In this talk, we first discuss the origin of the metric fixed point theory. This theory comes into light by the introduction of the Banach contraction principle. This principle is an important tool for solving many problems in mathematics and other fields such as biology, economics, engineering etc. Then we talk about contractive type maps and the existence of their fixed points. We highlight the importance of continuity in the existence of fixed points of such mappings. Then we concentrate on the discontinuity at fixed points of different types of contractive mappings in this talk.

A. Sankaranarayanan
School of Mathematics & Statistics, University of Hyderabad

Some results of Srinivasa Ramanujan

We discuss a few interesting results of the Mathematical Legend Srinivasa Ramanujan.

Radu Ioan Ƀot
University of Vienna

Continuous-time approaches for structured convex minimization problems

In this talk, we first propose a primal-dual continuous-time approach for the minimization of a structured convex function consisting of a smooth term, a nonsmooth term, and the composition of another nonsmooth term with a linear continuous operator. To this end we introduce a dynamical system for which we prove that its trajectories asymptotically converge to a saddle point of the Lagrangian of the underlying convex minimization problem as time tends to infinity. In addition, we provide rates for both the violation of the feasibility condition by the ergodic trajectories and the convergence of the objective function along these ergodic trajectories to its minimal value. Explicit time discretization of the dynamical system results in a numerical algorithm which is a combination of the linearized proximal method of multipliers and the proximal ADMM algorithm.
In the second part of the talk we give an outlook on a second order primal- dual continuous-time system with asymptotic vanishing term and on its fast convergence properties. The talk relies on the papers (Ƀot, Csetnek, László, JDE, 2020) and (Ƀot, Nguyen, JDE, 2021).

Joydeep Dutta
IIT Kanpur

Playing with Optimality Conditions

The title may seem strange but over the years I have developed an eerie sense that I do enjoy playing with optimality conditions. One might wonder what it might be since at the end in optimisation we will reach an optimality condition which under its skin is an KKT condition. However it is not always about the condition that intrigues me but the paths to reach the goal that does. While taking different paths one gets new insight into the very problem one is handling. For example in order to develop the KKT conditions for minimizing a differentiable function under linear/affine constraints we in general use the Farkas lemma. What if I ask myself not to use the Farkas lemma and see if the KKT condition can be reached through other means. In this particular case we will see that elegant tools of variational analysis can be invoked to prove the result and at the same time opening the path to develop KKT conditions for more general setting when the objective is not differentiable. The Farkas lemma approach provides no such insight. My pursuit here is mostly mathematical and not focused on ay practical aspect of optimization. I will attempt to show some very elegant and geometric approaches to deduce optimality conditions as we keep on adding more structures to optimality conditions. We also take a look at the story of constraint qualifications where in we will show that it is variational geometric structure that provides the necessary regularity for an optimality condition to hold. Thus we will play around by taking a simple problem first and then making it a bit harder twisting it in this way or that and see how we can reach the optimality conditions. At the end I believe you will also take your note book and also try to play and find new routes to optimality.

B S Choudhury
Department of Mathematics IIEST, Shibpur, Howrah

CYCLIC CONTRACTIONS AND APPLICATIONS TO OPTIMIZATION AND FRACTALS

Cyclic contractions are defined between two subsets of a metric space. Various types of these contractions are studied in recent literatures. There are important applications of these contractions. We describe two types of

applications of these mappings. One is to a global optimization problem and the other is in the construction of fractals.

V. Sankar Raj
Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu India

An Elementary Best Proximity Point Theorem in Metric Spaces

Let us consider two nonempty subsets A and B of a metric space X and a continuous mapping $f : A \cup B \to A \cup B$ satisfying the cyclic condition $f(A) \subseteq B$, $f(B) \subseteq A$. If $A \cap B = \emptyset$, then there is no $x \in A \cup B$ such that $f(x) = x$. Let $\text{dist}(A, B) = \inf\{d(a, b) : a \in A, b \in B\}$. Since $\text{dist}(A, B) \leq d(x, f(x))$, for all $x \in A \cup B$, the optimum solution to the minimization problem $\min_{x \in A \cup B} d(x, f(x))$ is the one which attains $\text{dist}(A, B)$. An optimal solution to the above minimization problem, i.e., $d(x_0, f(x_0)) = \text{dist}(A, B)$ is known as *best proximity point of* f. Note that if $A = B$, then the best proximity points are nothing but the fixed points of f.

In this discussion, we provide sufficient conditions for the existence of a best proximity point for a continuous cyclic function $f : A \cup B \to A \cup B$. Our main result generalizes the well-known elementary fixed point theorem given in [1]

References

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M K Roychowdhury
The University of Texas Rio Grande Valley USA

Quantization for probability distributions

Quantization for probability distributions refers to the idea of estimating a given probability by a discrete probability supported by a set with no more than n points. It has broad application in signal processing and data compression. Quantization dimension gives the speed how fast the specified measure of the error goes to zero as n approaches to infinity. Quantization dimension is also connected with other dimensions of dynamical systems such as Hausdorff, packing and box counting dimensions. It is also connected with the temperature function that arises in the thermodynamic formalism in multifractal analysis. In the discretization process it is much more difficult to find the optimal sets of n-means than to calculate the quantization dimension. I will talk about it.

R P Pant
DSB Campus, Kumaun University, Nainital India

Discrete Dynamical Systems

The basic goal of the theory of dynamical systems is to understand the eventual or asymptotic behaviour of an iterative process. This process may be a differential equation whose independent variable is time, in which case the theory attempts to predict the ultimate behaviour of solutions of the equation in either distant future ($t \to \infty$) or distant past ($t \to -\infty$). If the process is a discrete process such as the iteration of a function, then the theory studies the eventual behaviour of the points $x, fx, f^2x, f^3x, \ldots, ; f^nx$ as n becomes large. In the present talk we discuss some aspects of Discrete Dynamical Systems.

R Pant
University of Johannesburg, South Africa

On fixed points of nonexpansive type mappings in Banach spaces

In this talk, we present a brief development of fixed point theory for nonexpansive type mappings in Banach spaces. We shall present some existence and convergence results for generalized nonexpansive mappings. Moreover, we shall discuss some long standing open problems in this area

Dhananjay Gopal
Department of Mathematics, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chattisgarh

On Topology of non-triangular metric spaces and related fixed point results

Non-triangular metric spaces have been introduced by Khojasteh and Khandani ([13]) in 2020. The concept of non-triangular metric spaces is fresh and therefore, requires quite some analysis on its topology. In this talk, we discuss about the study of topology of non-triangular metric spaces by giving a natural definition of open sets in this context. The introduction of non-triangular metric spaces has shown that there is no inherent need for the triangle inequality to prove various fixed point results. Keeping this in mind, we present a fixed point result for Suzuki type Z-contractions in the context of non-triangular metric spaces by introducing a new property of maps. We also the scope of further work on this topic.

R. Munshi
Statistics and Mathematics Unit Indian Statistical Institute, Kolkata India

The Circle Method

The circle method was conceived by Hardy and Ramanujan. They applied this method to find asymptotic for the partition function. Later Hardy together with Littlewood, developed the method further and applied it to the Waring problem. In the last one hundred years or so, the circle method has been applied to several different problems in number theory. This talk will be a survey of the circle method, and its modern versions.

G. V. RAVINDRANADH BABU
Andhra University, Andhra Pradesh India

CONVERGENCE OF CERTAIN ITERATION PROCEDURES IN CONVEX METRIC SPACES

We discuss the strong convergence of Ishikawa iteration scheme for a nonlinear quasi-contractive selfmap of a nonempty closed convex subset of a complete convex metric space and show that this iteration procedure converges strongly to the unique fixed point. We extend it to a pair of selfmaps.

Further, we discuss the strong convergence of CR-iteration procedure for a nonlinear quasi-contractive map in convex metric spaces. Also, we define Noor iteration procedure and, Abbas and Nazir iteration procedure associated with three selfmaps in the setting of convex metric spaces and prove that these iterations converge strongly to a unique common fixed point of three nonlinear quasi-contractive self maps in convex metric spaces.

Akhtar A. Khan
Rochester Institute of Technology, USA

On the Stochastic Inverse Problem of Identifying Random Parameters in Stochastic Partial Differential Equations

This talk will focus on the inverse problem of identifying a stochastic parameter in partial differential equations with random data. In the framework of stochastic Sobolev spaces, we will discuss the Lipschitz continuity and the differentiability of the parameter-to-solution map. We will discuss a new energy-norm-based output least-squares (ELS) objective functional and prove its smoothness and convexity. For stable inversion, we will discuss a regularization framework. We will also discuss using the stochastic approximation approach for solving the considered inverse problem via a variational inequality formulation. We will give detailed computational results to illustrate the feasibility and efficacy of the developed inversion framework.

P Marechal
Professor of Mathematics at Université Paul Sabatier, Toulouse France

Regularizing a Cauchy problem for the inhomogeneous Helmholtz equation

We consider the Cauchy problem for the inhomogeneous Helmholtz equation with non-uniform refraction index. This is an ill-posed problem, and we propose to regularize it by means of the variational form of mollification. This approach turns out to be consistent: the mollified solution converges to least square solution as the mollification parameter goes to zero. Moreover, we provide some numerical simulations that are quite promising.

D. K. Ganguly
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The Structure of Omega-Limit Sets of Discrete Dynamical Systems

In mathematics, especially in the dynamical systems, Omega-limit, written as ω-limit, sets are intersecting and important phenomenon because they can be used to understand the long term behaviour of a dynamical systems. There have been many treatments of the structure of ω- limit sets in recent literature developed by several authors. We consider a discrete dynamical system generated by a continuous map defined on a compact metric space. In this note, we will begin study by reviewing some of the central notions in discrete dynamical systems and also we will introduce some specific definitions and terminology related to ω-limit sets for presenting some important results in this area. Our main objective here is to highlight certain specific topological and the dynamical properties of ω-limit sets in discrete dynamical systems.

Samarjit Kar
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On Uncertain Multi-objective Minimum Spanning Tree Problem

Many real-world problems involve the simultaneous optimization of several competing objectives and constraints that are difficult, if not impossible, to solve without the aid of powerful optimization algorithms. What makes multi-objective optimization so challenging is that, in the presence of conflicting specifications, a single solution cannot be optimal to all objectives. Therefore optimization algorithms must be capable of finding a number of alternative solutions representing the trade-offs. However, multi-objectivity is just one facet of real-world applications. Most optimization problems are also characterized by various forms of uncertainties stemming from factors such as data incompleteness, fluctuating nature of parameter values, noise in data, bad statistical analysis, uncertainty in judgment, etc. Evolutionary algorithms are a class of stochastic search methods that are very efficient and effective in solving complex multi-objective problems where conventional optimization tools fail to work well. Evolutionary algorithms' advantage can be attributed to their capability of sampling multiple candidate solutions simultaneously, a task that most classical multi-objective optimization techniques are found

to be wanting. Much work has been done to the development of these algorithms in the past decade and it is finding increasingly applied to the fields of bioinformatics, logical circuit design, control engineering and resource allocation. Interestingly, many researchers in the field of evolutionary multiobjective optimization assume that the optimization problems are deterministic, and uncertainties are rarely examined. While multi-objective evolutionary algorithms draw their inspiration from nature where uncertainty is a common phenomenon, it cannot be taken for granted that these algorithms will hence be inherently robust to uncertainties without any further investigation. Modelling such real-world applications involves the incorporation of indeterminate phenomena based on their subjective estimations. Such phenomena can be represented rationally using uncertainty theory (Liu 2007). Considering the above-mentioned fact, in our study, we have investigated a multi-objective minimum spanning tree problem (MMSTP) with indeterminate problem parameters based on the principles of the uncertainty theory. Here, the objective is to simultaneously minimize uncertain cost and uncertain time associated with every edge of the network. Subsequently, two uncertain programming models of the proposed uncertain multi-objective minimum spanning tree problem (UMMSTP) are developed and their corresponding crisp equivalence models are investigated, and eventually solved using a classical multi-objective solution technique, the epsilon-constraint method (Haimes et al. 1971). Additionally, two multi-objective evolutionary algorithms (MOEAs), non-dominated sorting genetic algorithm II (NSGAII) (Deb et al. 2002) and duplicate elimination non-dominated sorting evolutionary algorithm (DENSEA) (Greiner et al. 2007) are also employed as solution methodologies. An appropriate numerical example is demonstrated for the proposed UMMSTP.

Oscar Castillo

Institute of Technology Tijuana, Mexico

Type-2 Fuzzy Systems and Perspectives for Type-3: Theory and Applications

Type-2 fuzzy systems are powerful intelligent models based on the theory of fuzzy sets, originally proposed by Prof. Zadeh. Most real-world applications up to now are based on type-1 fuzzy systems, which are built based on the original (type-1) fuzzy sets that extend the concept of classical sets. Type-2 fuzzy sets extend type-1 fuzzy sets by allowing the membership to be fuzzy, in this way allowing a higher level of uncertainty management. Even with the current successful applications of type-1 fuzzy systems, now several papers have shown that type-2 is able to outperform type-1 in control, pattern recognition, manufacturing and other areas. The key challenge in dealing with type-2 fuzzy models is that their design has a higher level of complexity, and in this regard the use of bio-inspired optimization techniques is of great help in finding the optimal structure and parameters of the type-2 fuzzy systems for particular applications, like in control, robotics, manufacturing and others. Methodologies for designing type-2 fuzzy systems using bio- inspired optimization in different areas of application are presented as illustration. In particular, we will cover Bee Colony Optimization, Particle Swarm Optimization, Gravitational Search and similar approaches to the optimization of fuzzy systems in control applications, robotics and pattern recognition. We will also consider using fuzzy logic for enhancing the performance of metaheuristics, where also good results have been achieved. Finally, the prospects for the future applications of type-3 fuzzy logic will be discussed.

A.K. Misra

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Modeling the role of healthcare facilities and vaccination on the dynamics of an emerged infectious disease

Worldwide, many infectious diseases spread in human population and hinder the country's social and economic development. Several mathematical models have been proposed to study the transmission, control, and prevention of these diseases. But these studies do not explicitly include the role of healthcare facilities in controlling diseases and competition between infected individuals for healthcare facilities. In this talk, some compartmental models will be introduced to explore the role of hospital beds on the disease dynamics. First, a three-dimensional mathematical model will be introduced by considering three compartments of human population (i.e., susceptible, infected, and hospitalized). As the allocation of beds in the hospitals depends on demand, and this demand for hospital beds may increase during an epidemic outbreak. Thus, the arrangement of temporary hospital beds becomes crucial to fulfil this demand and so the first proposed model will be extended by incorporating temporary hospital beds. Also, vaccination plays a vital role in reducing the prevalence of an infectious disease and

therefore the collective impact of healthcare facilities and vaccination will be shown on the disease dynamics. The analysis of proposed mathematics models produces rich dynamics, which includes transcritical (backward and forward), Bogdanov- Takens, and Hopf (supercritical and subcritical) bifurcations. The generalized Hopf (or Bautin) bifurcation at which the first Lyapunov coefficient vanishes is also discussed. All these dynamical properties are well supported through numerical simulatons.

S. Verma

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Dimension of fractal graphs

One of the most fascinating aspects of fractal geometry is fractal dimension. There are several distinct fractal dimensions available in the literature and they provide different information about the geometry of a given fractal set. In this talk, we will discuss some of them with examples. We will also present some recent results on fractal dimension of the graphs of fractal functions constructed through an Iterated Function System.

Dipak Kumar Jana

School of Applied Science & Humanities, Haldia Institute of Technology, Haldia, West Bengal

Game Theoretical Perspectives on Manufacturer and Retailer Stackelberg

In this investigation, we have developed two models: (i) two-period green supply chain (GSC) a novel model with a single retailer and single manufacturer where four Stackelberg games have been introduced as Manufacturer Stackelberg (MS), Retailer Stackelberg (RS), Nash, and Cost-sharing (CS) games. The purpose of this investigation is to create a new decision to working structure in point of views of the choice and successful replacement towards eco-friendly products where the gain of each and every member, greening level, a quantity discount, and environmental impact. A total of eight analytical models have been derived on the basis of strategic inventory (S.I) and explored by the effect of four-game structures for the two-period on the sustainability goals of the green supply chain model. (ii) three-stage interconnected forward and reverse supply chains, in which new as well as remanufactured green products are shipped to the green market. The manufacturer and the remanufacturer both invest and decide their greening levels in green manufacturing processes. Each supply chain member tries to maximize their own profit in the decentralized model and lower greening levels are decided by both the manufacturer and the remanufacturer than the optimum solution, i.e., the centralized solution. Finally some solutions with 3D views.

Abstracts of Participants

A generalized rational type fixed point theorems in I-generalized metric spaces

Jayanta Biswas

A new fixed point theorem under more general rational type contraction conditions has been established in generalized metric spaces (g.m.s.) and then establish an analogous version of this theorem in the frame of I-generalized metric spaces (I- g.m.s.).

Fixed point theorems under rational contraction in b_2-metric space

Himanshu Kumar Pandey

Badshah *et al.* established a fixed point theorem for a new type of rational contractive mappings. In this paper, we have extended the Badshah-type contractive mapping into b_2-metric space in more general form.

Soft Almost s-Regular and Soft Almost s-Normal Spaces

Archana Yadav

In this paper, we prove common fixed point theorems for faintly compatible and subsequently continuous mappings satisfying general contractive condition in cone metric spaces. Our result extend and generalize results of Badshah et.al. [1]

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Badshah V.H., S.Namita and P.Akhilesh, Common Fixed Point Theorems for Occasionally Weakly Compatible mappings in Cone metric Space, Int. J. of Theo. and App. Sc. 7(2); 25-27 (2015).

Gornicki-Proinov type contractions in S-Metric Spaces

Watanjeet Singh

In this paper, we introduce Gornicki - Proinov type contractions in the framework of complete S-metric spaces and establish some fixed point results. Examples are also provided to validate our results.

Linear angle preservers of Hilbert bundles

Yao-Te Huang

Let x, y be two vectors in a (real or complex) Hilbert C^* module $\mathcal{H}$ over a C^*-algebra $\mathcal{A}$. The angle $\angle(x, y)$ between x and y can be defined in several way. When $\mathcal{A} = C_0(X)$ is a commutative C^*-algebra,in other words, $\mathcal{H}$ is a continuous field of Hilbert spaces over a locally compact space X, we define the cosine of the angle, $u = \cos\angle(x, y) \in C(X)$, by the equation

$$|\langle x, y\rangle| = |x||y|u$$

We show that if $T : \mathcal{H} \to \mathcal{K}$ is a linear module map between two Hilbert $C_0(X)$-modules preserving (cosines of) non-flat angles, then $T = \alpha J$ for abounded,strictly positive and continuous scalar function α on X and a module into isometry $J : \mathcal{H} \to \mathcal{K}$.

Application of Fixed Point Theorem in Digital Metric Space

Rita Pal

suppose of the paper is to present another generalization of the well known Banach contraction principle for digital images. The basic concepts about the digital images and an application of fixed point theorem to compression of digital images and fractal image compression are mentioned. Digital contractive Type mappings in Digital Metric Space are introduced and prove the uniqueness of fixed point in digital metric space .

Solvability of the system of implicit generalized order complementarity problems

K. Mahalik

We introduce the notion of exceptional family for the system of implicit generalized order complementarity problems in vector lattice. We present some alternative existence results of the solutions for the system of implicit generalized order complementarity problems via topological degree. The new developments in this paper are generalize and improve of some known results in the literature.

Strong Convergence Algorithm for the Split Problem of Variational Inclusions, Split Generalized Equilibrium Problem and Fixed Point Problem

Mohd Asad

The purpose of this paper is to recommend an iterative scheme to approximate a common element of the solution sets of the split problem of variational inclusions, split generalized equilibrium problem and fixed point problem for nonexpansive mappings. We prove that the sequences generated by the recommended iterative scheme strongly converge to a common element of solution sets of stated split problems. In the end, we provide a numerical example to support and justify our main result. The result studied in this paper generalizes and extends some widely recognized results in this direction.

On Nonsmooth Univex Functions and Vector Variational-like inequality problems

Tirth Ram

In this paper, we proposed the nonsmooth univex function by generalizing the invex function and establish relationships between vector variational-like inequality problems and nonsmooth vector optimization problems under nonsmooth univexity. We also identify the vector critical points, the weakly efficient points and the

solutions of the nonsmooth weak vector variational-like inequality problems, under nonsmooth pseudo-univexity assumptions. These conditions are more general than those existing in the literature.

Splitting algorithms for solving inclusion problems on Hadamard manifolds with applications

Shikher Sharma

Composite minimization problem and variational inequalities problem on Hadamard manifolds have many useful applications. These problems can be solved by means of sum of a single-valued vector field and a set-valued vector field defined on a Hadamard manifold. A Mann type algorithm for finding the solution of variational inclusion problem defined on a Hadamard manifolds has been proposed in [1]. We propose S-iteration type and normal S-iteration type algorithms for finding the solution of variational inclusion problem defined on a Hadamard manifolds. We study the convergence behavior of proposed algorithms under mild assumptions in the frame work of Hadamard manifolds.To demonstrate the applicability of our result and algorithms, we derive the solution methods and their convergence results for the composite minimization problems and variational inequality problem.

References

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Inertial type Krasnoselski-Mann iterative method for finding a common solution of split monotone variational inclusion problem and hierarchical fixed point problem

M. U. Khairoowala

The primary goal of this paper is to present and study a modified Krasnoselski-Mann type inertial iterative method to approximate a common solution of a split monotone variational inclusion problem and hierarchical fixed point problem of a finite collection of k-strictly pseudo contractive non self mappings.Furthermore, we show that these quences generated by the proposed iterative method weakly converges to a common solution of these problems. The method and results presented in this paper extend and unify certain recent known results in this field.Finally, a numerical example isused to demonstrate the convergence analysis of the sequences generated by the iterative method.

Algorithm for Higher Order Variational Inequalities in Hadamard Manifold

Uqba Rafat

We begin by introducing the concept of higher order variational inequalities in the context of the Hadamard manifold. Then, under certain assumptions, we propose and analyse a method for solving higher order variational inequality. Finally, we clarify the convergence analysis of the proposed method by some computational numerical experiments in the Hadamard manifold.

On Proximal Uniform Normal Structure

Abhik Digar

For $x \in A \cup B$, define $d_n = d\left(T^n x, T^{n-1} x\right), n \geq 1$ where A and B are subsets of a metric space and T is a cyclic map on $A \cup B$. In this talk we discuss a new class of mappings called cyclic uniform Lipschitzian mappings for which $\{d_n\}$ is not necessarily a non-increasing sequence. We prove the existence of a best proximity pair in the setting of a uniformly convex Banach space. We also introduce a notion called proximal uniform normal structure which is stronger than proximal normal structure and prove the best proximity pair results in a general Banach space setting.

A Comprehensive Study on Image Feature Extraction Techniques

Prabu S

Feature extraction plays a key role in the fields of image processing, machine learning and pattern recognition. Binarization, resizing, thresholding, normalization etc., are the initial steps applied before extraction of related feature from an image. Feature extraction methods are applied to the images to extract feature that helps in the recognition and classification of images. Feature extraction techniques are used in different image processing applications such as object recognition, character recognition, pattern recognition, etc. In this paper, we provide a comprehensive study on image feature extraction algorithm and techniques, including Independent Component Analysis, Local binary patterns, SURF, BRISK, Principal component analysis, Scale-invariant feature transform (SIFT) etc., to improve the classification accuracy, in particular, it starts by sketching fundamental concepts. We not only classify current feature extraction methods but also provide detailed descriptions of typical approaches within each category to provide a detailed study. We are going to discuss different types of features, feature extraction methods, and explain which feature extraction technique is best in which scenario. The paper also discusses the pros and cons of each method and its various forms and applications. We found that various feature extraction methods provide significant outcomes for various image processing applications after doing extensive research on these techniques.

A New Type of Pythagorean Fuzzy Relations

Puna Ram Sahu

In this chapter, we have extended the intuitionistic fuzzy relation defined on an intuitionistic fuzzy set to a Pythagorean fuzzy relation defined on a Pythagorean fuzzy set and studied properties like symmetry, reflexivity, transitivity.

A Bootstrap Control Chart for Beta Percentiles

Bidhan Modok

As an alternative to the standard p and np charts along with their various modifications, beta control charts are used in the literature for monitoring proportion data. These charts in general use average proportion to set up the control limits assuming the in-control parameters known. Here we propose a control chart for detecting shift(s) in the percentiles of a beta distributed process monitoring scheme when the in-control parameters are unknown. Such situations arise when specific percentile of proportion of conforming or non-conforming units is the quality parameter of interest.The parametric bootstrap method is used to develop the control chart for monitoring percentiles of a beta distributed process when in-control parameters are unknown. Extensive Monte Carlo simulations are conducted with various combinations of the percentiles, false-alarm rates and sample

sizes to evaluate the in-control performance of the proposed bootstrap control charts in terms of the average run lengths. The out-of-control behavior and performance of the proposed bootstrap percentile charts are thoroughly investigated for several choices of shifts in the parameters of beta distribution. The proposed chart is finally applied to two skewed data sets for illustration. Here the programming language R (*version* 4.0.0) is use to find all the result.

Hybrid and Automated Segmentation Algorithm for Malignant Melanoma using Chain Codes and Active Contours

Nirmala Veeramanni

The paper presents a hybrid and automated segmentation algorithm to precisely separate the affected region from melanoma skin lesion. Melanoma is one of the types of skin cancer which cannot be diagnosed at the early stage. Many computer aided diagnosis systems are developed in the literature and it comprises of many phases like: i) Image acquisition, ii) Preprocessing, iii) segmentation, iv) Feature extraction, v) Classification and vi) Prediction. This paper focuses on the segmentation phase which will help to acquire the affected region and if the exact region is segmented, from the region significant features can be extracted for classification and prediction. Major issue that impacts the accurate segmentation is the irregular and disconnected borders of the skin lesion. To overcome this problem, a hybrid and automated segmentation algorithm is proposed in this paper. Initially, the algorithm acquires the enhanced melanoma skin lesion and the image is represented using chain codes to trace the border of the image. Then, Euclidean distance-based region selection is done to remove the negligible regions from the image. After region selection, active contours are deployed, and the affected region is extracted precisely.The algorithm is evaluated by estimating dice similarity coefficient between the segmented image and the ground truth images. Promising results are acquired when the algorithm is compared with the other existing segmentation algorithms.

A Similarity measure of Picture Fuzzy Soft Sets and its application

Salsabeela V

Picture Fuzzy Soft Sets ($\mathrm{PFS}_f\mathrm{S}$) is an extension of Intuitionistic Fuzzy Soft Sets and has wide range of applications. In this work, we propose a similarity measure and a corresponding weighted similarity measure between two $\mathrm{PFS}_f\mathrm{S}$. A numerical example is presented to demonstrate that proposed method can be effectively applied to problems in the field of medical diagnosis.

Divergence measures of Pythagorean Fuzzy Soft Sets

Athira T M

This work initiates the study of divergence measure of Pythagorean fuzzy soft sets (PFSS). A couple of expressions to find PFSS divergence measureare obtained, and thus we can quantify the deviation between any two PFSSs. Also, certain theorems based on the properties of proposed expressions are proved.

Algebraic Properties of Spherical Fuzzy Sets

Fathima Perveen P. A.

The spherical fuzzy set (SFS) is an advanced version of fuzzy set, intutionistic fuzzy set, Pythagorean fuzzy set, and picture fuzzy set. This generalized three dimensional fuzzy set model is more realistic and accurate. In this paper, we discuss the algebraic operations on SFSs such as union, intersection, complement, algebraic sum, algebraic product, exponentiation operation, and scalar multiplication operation. Also, we prove some fundamental algebraic properties of these operations.

A note on connectedness in soft L-topological spaces

Sandhya S. Pai

Soft set theory is a generalized method for solving problems with uncertainty. The authors have introduced the concept of soft L-topological space defined over an initial universe X with the fixed set of parameter P. In this paper, we introduce the concept of connectedness on soft L-topological spaces. We also investigate how soft L-connected spaces respond to soft L-continuous mappings, soft L-boundaries, and soft L-closure.

Fermate an fuzzy interaction aggregation operators and their application to decision making

Aparna Sivadas

In this work, we develop some Fermatean fuzzy interaction aggregation operators using arithmetic and geometric operations. We study the main features of these operators.Then,using these operators, devise an approach to decision making with Fermatean fuzzy information.

Water Quality Analysis Using Fuzzy Logic Based Optimisation Techniques

Sangeeta Mishra

Surface water is an important natural resource for drinking water. But the quality of water is a significant issue of concern. In this context, human uses their thumb rules to solve complex problem such as evaluation of water quality index (WQI). Many researchers have attempted to emulate human reasoning by mathematical or statistical approaches. It is necessary to have a an approximate reasoning model that is competent enough to predict the status of water quality in linguistic terms such as poor, moderately good, good and high and to show the type of water treatment that would be used to meet different demands. Linguistic variables in fuzzy logic represent natural language variables which humans commonly used to specify semantic rules from several processes. On the other hand, optimal solution for prediction of water quality index metaheuristics are proposed as alternative search mechanisms for complex optimization problems like prediction of WQI, where classical mathematical methodologies fails. In addition, there are different statistical methods to find out water quality index (WQI). The computation of WQI on the basis of fuzzy logic can be simplified and speed up by using a Fuzzy Inference System (FIS) with the right now existing norms for calculation of WQI. The present paper proposes an innovative optimisation method known as fuzzy logic based optimization (FLOA) to predict WQI. The system developed for this purposes operates in a fuzzy logic mode that consists of a fuzzification engine which receives a set of input fuzzy variables representing the concentration of water quality parameters in fuzzified form. Water quality parameters taken into consideration are namely dissolved oxygen (DO), total dissolved solids (TDS), turbidity, nitrate and pH. The system has a defuzzification unit which operates to translate the inference results into a discrete crisp value of water quality index. The developed system is

implemented to predict water quality of various districts of Karnataka state. The FLOA uses a Takagi-Sugeno inference model in which the output is estimated as a weighted sum of four fuzzy rules, viz., (a) attraction, (b) repulsion, (c) perturbation and (d) randomness. The performance of the system is validated by assessing the WQ using a statistical model.

Global Exponential Stability of Takagi-Sugeno Fuzzy Cohen-Grossberg Neural Network with Time-varying Delays

Ankit Kumar

In this article, the global exponential stability of Takagi Sugeno fuzzy Cohen-Grossberg Neural Network(CGNN) with time-varying delay factor has been investigated based on the criteria of non-singular M-matrix and the Lyapunov stability technique. The stability inequality is derived with the help of the Lipschitz condition for the nonlinear activation functions and a sufficient condition is shown to verify the criterion of the exponential stability condition for the CGNN with time-varying delay terms, which is described in the presence of delay terms of T-S Fuzzy model. Thus, the global exponential stability for T-S fuzzy CGNN in the presence of time-varying delay terms is derived in an easy way. The article contains quite a new result for delayed CGNN for the T-S Fuzzy model. Finally, a numerical example is taken to validate the efficiency and unwavering quality and to exhibit the superiority of the considered method as compared to the existing method for particular cases.

A Pneumonia Detection Approach using Multiple Deep Neural Network

Sneha

Recently pneumonia has become as one of the world's deadliest child killer. In that last year, it was the cause of around 800,000 deaths of children below the age of five. In order to diagnose this disease, chest X-rays are primarily used by the trained radiologist, which often lead to incorrect result. Hence, there is a need to improve the diagnosis accuracy. In this study, a model trained on digital chest X-ray images for the detection of pneumonia is proposed, which could help the radiologists in the decision-making process. To increase the performance accuracy, a weighted average ensemble model is proposed to combine the predictions of the Long Short-Term Memory-convolutional neural network (LSTM-CNN) and DenseNet121. GAN model is employed for data augmentation to increase the training dataset in a balanced way. It solves the problem of scarcity of medical data by synthesizing the dataset. The experiment shows that the ensemble of the two models increases the accuracy than that of the two individual models. Hence, it extends the help to doctors and radiologists to make the prediction more efficiently.

Zipper Rational Trigonometric Fractal Interpolation

Sneha Garg

The aim of this paper is to introduce the zipper rational cubic trigonometric fractal interpolation function (ZRCTFIF) which gives more flexibility than the trigonometric fractal interpolation function (TFIF) because of the presence of signature and scaling factors. Further, the sufficient positivity conditions on the shape parameters and scaling factor to construct a positive zipper trigonometric fractal interpolation function (ZRCTFIF) are also carried out and the results are proved by the simple numerical examples.

Iterative learning control for a class of Switched Discrete-Time Systems with Model Uncertainties, External Noises and Time-Delay

N. K. Singh

The PD-type ILC is studied for a class of linear discrete-time switched systems with model uncertainties, external noises and time-delay for tracking reference trajectory by taking advantage of super-vector representation. This study is based on the assumption that the systems operates under finite interval. A sufficient condition for monotone convergence of the algorithms are deduced, when the model uncertainties and external noises are absent. Then the robust monotone convergence is analyzed, when the model uncertainties is present but the external noises are absent and the robustness against the bounded external noises is discussed.The analysis manifests that the PD-type ILC algorithm is feasible and effective when it is imposed on the linear switched systems specified by the arbitrarily present switching rules when they are imposed on the system. Supported by stimulation example.

A posteriori error estimation for quasilinear singularly perturbed problems with integral boundary condition

Shashikant Kumar

The present paper is concerned with the numerical analysis of the quasilinear singularly perturbed parameterized problem with integral boundary condition. The discretization of the problem comprises an implicit Euler scheme for the quasi linear problem and a composite right rectangle rule for the integral boundary condition. We establish a posteriori error estimate for the discrete problem that holds uniformly in the small perturbation parameter. Further,we also show the posteriori estimate of the same problem without the control parameter λ. Numerical results validates the theoretical eooro estimate on the various a priori meshes as well.

On the Solution of Generalized Proportional Hadamard Fractional Integral Equations

Nihar Kumar Mahato

In this article, we have considered a fractional integral equation, namely, Generalized Proportional Hadamard fractional integral equations. Then as an application of fixed point theory, we established the existence of solution of above mentioned Generalized Proportional Hadamard fractional equations using measure of noncompactness. At the end, we have provided a suitable example to verify our obtained results.

Pythagorean Fuzzy Relation Equations and New Composition For Pythagorean Fuzzy Relations

Akash Pradhan

The notion of fuzzy relation equations is associated with the concept of composition of binary relations. The composition of two binary fuzzy relations $P(X, Y)$ and $Q(Y, Z)$ on finite universe can be defined, in general, in terms of an operation on the membership matrices of P and Q that resembles matrix multiplication. In the min-max composition, for example, the multiplications and additions are replaced with the min and max operations, respectively. Inspired by this idea, we define composition of *Pythagorean fuzzy relations* ($PFRs$), when membership values are considered, we take max-min composition and when non-membership values are considered, we take min-max composition. There are other possible compositions for non-membership values like max-min, max-max and min-min. However max-min and max-max composition are not closed (that is, if

we take max-min composition for membership values and max-max or max-min for non-membership values then composition of two $PFRs$ is not necessarily a PFR). Like matrix representation for binary fuzzy relation, we have defined matrix representation for Binary *Pythagorean fuzzy relation* and we have also defined *Pythagorean fuzzy relation* equations and discuss their solutions for different cases. As a particular case we discuss min-max composition for fuzzy relation equation and give criteria for solutions. A new composition for $PFRs$ is also discussed.

On Unique Positive solution of Hadamard fractional Differential Equation involving p-Laplacian

Ankit Kumar Nain

In this work, we have considered the Hadamard fractional differential equation involving p-Laplacian operator along with three-point integral boundary condition. The sufficient condition for the existence and uniqueness of solution is also developed using a new fixed point theorem [1] of $\varphi-(h,\boldsymbol{e})$-concave operators. We can construct an iterative method for approximating the unique solution for any initial value given in a special set.

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Qualitative and Quantative Assessment of Hostel and Mess Facilities

Ankita Panwar

Performance measurement of a unit or an organization is a concrete step for maintaining quality services. The present study aims to assess the performance of hostel and mess facilities through multi-criteria decision-making methods (MCDM). The two MCDM techniques, data envelopment analysis (DEA) and analytic hierarchy process (AHP), are used for data analysis based on which the results are obtained and analyzed. The DEA is used for the quantitative analysis and AHP is used for the qualitative analysis of the present study. For this purpose, a hypothetical case base numerical example is included to justify the reliability of the models. In this study, we also identified the best performance factors of the hostel and mess. AHP, and sensitivity analysis-DEA (SA-DEA) techniques are used to determine the best performance factors.

A Collocation Method for Solving Proportional Delay Riccati Differential Equations of Fractional Order

Basharat Hussain

A numerical technique is presented to find an approximate solution of proportional delay Riccati differential equations of fractional order. This technique utilizes delay Haar basis, integration of Haar basis and collocation points. The proposed technique converts the given equation into set of algebraic equations. After solving the set of algebraic equations using Newton-Raphson method approximate solution of the problem can be obtained. Several considered examples depict that the proposed method is valid, accurate, and computationally efficient. A detailed comparison of exact and obtained solution is demonstrated in the form of graphs and Tables.

Multi-objective Environment Friendly and Economically Feasible Electric Power Distribution Problem with Primal-Dual Interior-Point Method

Jauny

This paper introduces a primal-dual interior-point algorithm to obtain a Pareto optimal solution for a multiobjective environmentally friendly and economically feasible distribution (MEED) problem. A Pascoletti-Serafini scalarization technique is utilized to convert the MEED problem into a parametric scalar optimization problem. We derive KKT conditions corresponding to the transformed parametric scalar optimization problem and solve them with the help of Newton's method. A merit function is also utilized to take the suitable steplength towards the descent direction. Successful numerical results of the MEED problem demonstrate the efficiency of the proposed method.

Implicit Hilfer Fractional Differential Equations with Non-local Boundary Conditions

Kanika Dhawan

In this paper, the authors study the implicit Hilfer fractional differential equations of order $1 < \rho \leq 2$ with non-local boundary conditions. By imposing the growth conditions on non-linear function the existence of solution for boundary value problem (BVP) is given by using Schaefer's fixed point theorem and using Lipschitz condition, existence and uniqueness of solution is established due to Banach contraction principle. Following this, Ulam-Hyers, Generalized Ulam-Hyers, Ulam-Hyers-Rassies and Generalized Ulam-Hyers-Rassies analysis of the BVP is also presented. Further, to validate the results some examples are also given.

Fractional Operator Associated with The Fractional Integral of A-Fractal Function

T.M.C. Priyanka

An advanced calculus, called the fractal calculus is formulated as a generalization of ordinary calculus and it is being applied to functions with fractal support, where the standard calculus can not be applied. In this paper, the concepts of fractal functions and fractal calculus have been interconnected by exploring the fractal integral of A-fractal function with predefined initial conditions. In addition, a fractional operator is presented, which takes each vector valued continuous functionon $I \subset \mathbb{R}$ to its fractal integral.

On the box dimension of mixed Riemann-Liouville fractional integral

Subhash Chandra

The main purpose of this talk to discuss the box dimension of the graph of the mixed Riemann-Liouville fractional integral for various choice of continuous functions on a rectangular region. We compute the upper bound of the box dimension of the graph of the mixed Riemann-Liouville fractional integral of Hölder continuous functions. We also estimate the box dimension of the graph of the mixed Riemann-Liouville fractional integral of a continuous function having box dimension two. Furthermore, we show that the box dimension of the graph of the mixed Riemann-Liouville fractional integral of unbounded variational continuous functions is two.

Parametric Prospective for a nondifferentiable class consisting a vector of quotients of functionals of curvilinear integral type with cone constraints

Vivek Dhingra

This article is tendered to discussing the non differentiable class of multiobjective variational problems of minimizing a vector of quotients of functionals of curvilinear integral type with cone constraints and duality theorems are proved under assumptions of higher-order (F, α, ρ, d)-pseudoconvexity. The value of the objective function of primal can not exceed the value of dual is shown by giving the weak duality theorem. Moreover, we study the connection between the values of the primal problem and dual problem in strong and converse duality theorems. Also, we have obtained the examples of functionals which are higher- order (F, α, ρ, d)-pseudo convex but not higher-order F-pseudo convex and not (F, α, ρ, d)-pseudoconvex.

Price penalty factor-based approach for the solution of combined economic emission dispatch problem by hybrid moth flame optimization algorithm

Saroj Kumar Sahoo

The combined economic and emission dispatch (CEED) problem is a highly non-linear multi-objective problem with equality and inequality constraints and is considered as crucial task in operation and planning of power systems problem. Due to the conflicting nature of the objectives of CEED, it is popular among the resarchers. On the other hand, the moth flame optimization (MFO) algorithm shows descent performance results compared to other metaheuristic algorithms for tackling nonlinear constrained global optimization problems. However, it still suffers from a good quality solution and slow convergence speed. Also, the sine cosine algorithm (SCA) has recently gained much popularity due to its simplicity, but it also suffers from poor exploitation ability. In this study, a novel hybrid algorithm, h-MFSCA, is introduced, which integrated MFO with SCA algorithm to overcome the shortcomings of MFO and SCA and inherit their advantages. To measure the effectiveness of the proposed h-MFSCA algorithm, it is applied to solve CEED problem for ten-unit thermal generating systems. The results achieve superior performance among other optimization algorithms in terms of both solution quality and convergence rate.

A New approach towards solution of generalized KdV Burgers Kuramoto Equation using Bernstein Polynomials

Supriya Mukherjee

The present communication is aimed at formulating a numerical solution of the generalised KdV Burgers Kuramoto Equation in a Berstein (B)-Polynomial basis. Galerkin method is used to construct the expansion coefficients of the desired solution. Runge Kutta (4th order) method is employed in determining the solution to the system of equations in the time variable. A recursive definition of the B-Polynomials and its derivatives is also presented.

Hopf bifurcation analysis of a tumor-immune interaction delay differential model

Kaushik Dehingia

The tool of mathematical modeling is widely used by researchers in the field of cancer modeling.The present study discussed a tumor-immune interaction model consists of discrete time-delay in tumor-immune interaction and stimulation processes. Existence of Hopf bifurcation of the considered model around the co-axial equilibrium is investigated. Theoretically, it was observed that the system undergoes different states if we vary the system's

parameters. Our bifurcation analysis and numericals imulations revealed that a "careful" selection of the model's parameters must be obtained so that the stable steady-state loses its stability. We showed that the delay term was not necessary to generate oscillations because our model can generate these oscillations even without the delay term.

Dimensions of the attractors corresponding to the product iterated function systems

Alamgir Hossain

In this paper, the product of the Hausdorff metric on the product space is defined and the equivalency between the product Hausdorff metric and the Hausdorff metric on the product space is established. The finite product of the iterated function systems (IFSs) on the product space is defined and the relation between the attract or of the product IFS and attractors of the co-ordinate IFSs is investigated. Also,various dimensions of the homogeneous and in homogeneous attractors on the product space are investigated.

Fixed-time stability of dynamical systems with impulsive effect

MD Arzoo Jamal

The paper is concerned with the fixed-time stability analysis of nonlinear dynamical system with impulsive effect. The novel criteria have been derived to achieve stability of nonautonomous dynamical system in fixed-time under the effects of stabilizing and destabilizing impulses. Two theorems are constructed to estimate the fixed-time convergence precisely by using the concept of Lyapunov functional and average impulsive interval. The theoretical derivation shows that the estimated fixed-time in this study is less conservative and more accurate as compared to the existing fixed-time stability theorem. Further, the theoretical results are applied to the impulsive control of general neural network systems. Finally, simulated results for two numerical examples are provided to validate the effectiveness of the theoretical results.

Interaction of three collinear cracks ina composite medium subjected to time-harmonic wave disturbance

Neha Trivedi

The article deals with the three collinear Griffith cracks under the time-harmonic waves, situated in an orthotropic strip sandwiched between two identical half-planes. The outer cracks are considered to be situated on either side of the central crack. The mathematical model is solved by applying the Fourier transform, and then the unknown functions have been determined using the Schmidt method.

The approximate analytical expressions of the stress Magnification Factors (SMFs) have been obtained at the tips of the cracks. The interaction of cracks for the considered composite with Graphite epoxy material as the strip and E-glass epoxy as the half-plane are computed numerically for different crack lengths and wave numbers. The obtained results are displayed graphically.

On mathematical programs with equilibrium constraints under data uncertainty

Vivek Laha

Mathematical program with equilibrium constraints is a special case of mathematical program where the decision variables satisfy a finite number of constraints together with an equilibrium condition. Optimization problem with equilibrium constraints appear in many practical applications are difficult to solve as they do not satisfy the standard regularity conditions. Moreover, in real life problems the input data associated with the objective function and the constraints are uncertain or incomplete due to prediction or measurement errors. In this paper, we consider a mathematical program with equilibrium constraints in the phase of data uncertainty of the feasible region with in the frame work of robust optimization. We derive necessary and sufficient optimality conditions for a stationary point to be a global or local optimal solution of the problem under consideration.

Quasi projective synchronization of time varying delayed complex valued Cohen-Grossberg neural networks with mismatched parameters

Sapna Baluni

In this article the quasi-projective synchronization of time-varying delayed complex-valued Cohen Grossberg Neural Networks (CGNNs) has been studied. As complete projective synchronization is impossible due to parameters ismatches and projective coefficient, a drive has been taken to achieve quasi-projective synchronization of distinct complex-valued CGNNs. The purpose of this study is to find a criterion for quasi-projective synchronization of two non-identical CGNNs by constructing a suitable controller and by using direct method. The important contribution is to estimate the bound on the synchronization error. Some sufficient criteria for synchronization between master and response systems are also established. The efficiency of the proposed method is justified through numerical simulation applied to a specific example.

A Note On Complex-Valued Fractal Functions on The Sierpiński Gasket

Vishal Agrawal

Traditional non-recursive approximation methods are less versatile than fractal interpolation and approximation approaches. The concept of fractal interpolation functions (FIFs) has been found to be an effective technique for generating interpolants and approximants for a vast area of scenarios. Using an iterated function system (IFS), Barnsley discovered the FIFs, which is the most prominent approach for constructing fractals. In this article, we establish the notion of constrained approximation by the square integrable complex valued fractal approximants on the Sierpiński gasket. We define fractal function in square integrable complex-valued function spaces on the Sierpiński gasket. Furthermore, we study some properties of the associated fractal operator.

Optimal extension of the Fourier Transform and Convolution Operator on Compact Groups

Manoj Kumar

The determination of the optimal domain and the continuous extension for the operators arising from analysis is one of the classical problems of functional analysis. We describe the optimal domain and the continuous extension of two central operators arising in the harmonic analysis. Concretely, we consider the Fourier transform and the convolution operator acting in the Orlicz spaces on a compact group (not necessarily abelian). We also discuss some characterizations of the compactness of the extended operator in terms of the associated vector measure.

An Efficient finite difference method for coupled systems of singularity perturbed parabolic convection diffusion problems

Kuldeep

We construct an efficient finite difference method for coupled systems of singularly perturbed parabolic problems of convection-diffusion type. We consider two splitting schemes on a uniform mesh to discretize in time and an up wind scheme on layer-adapted Shishkin and Bakhvalov meshes to discretize in space. The numerical method is proved to be convergent independent of the perturbation parameters. The splitting schemes are very efficient, as a teach time level the components of the vector approximate solution are decoupled, which resulted in a reduced computational cost. Numerical results for two test examples are presented that validate the theoretically proved results and also illustrate the efficiency of the proposed finite difference method.

Soft Almost s-Regular and Soft Almost s-Normal Spaces

Archana K. Prasad

The present paper introduce two new soft separation axioms called soft almost s-regularity and soft almost s-normality using soft regular semi open sets. Some of the properties and characterizations of soft almost s-regular and soft almost s-normal spaces have been studied.

Existence of Best Proximity Point with an Application to Nonlinear Integral Equations

Shagun Sharma

In this paper, using the idea of modified α-proximal admissible mappings, we derive some new best proximity point results for $\alpha - \lambda$-contraction mappings in metric spaces. We also provide some illustrations to back up our work. As a result of our findings, several fixed point results for such mappings are also found. We obtain the existence of a solution for nonlinear integral equations as an application.

Effect of Nonlinear Prey Refuge on Predator-Prey Dynamics

Shilpa Samaddar

A mathematical model on predator-prey dynamics is analyzed in this study. In traditional models, prey refuge is usually taken constant which is nearly impossible in real life scenario. We have considered nonlinear prey refuge which depends on both prey and predator. We have performed various dynamical studies incorporating Holling type II functional response. The system can perceive at most two equilibria. The boundedness of all the solutions, stability-instability conditions and bifurcation analysis are demonstrated in this work. All the analytical finding are verified with numerical simulations. Additionally, a model comparison is performed which helps to understand the dynamical changes due to nonlinear refuge.

Pricing Policy with the effects of fairness concern, imprecise greenness and prices in a imprecise market for a dual channel

Sanchari Ganguly

Fairness concern behaviour, a well-known cognitive bias, refers to a person's attitude of dissatisfaction for unequal pay-os in someone's favour. Rapidextinction of natural resources in the name of modernization and extreme degradation of environmental system, particularly green house gases, causes serious threats to ecological balance. Many firms are focused on resolving these environmental issues by switch ingover to green manufacturing and decision-making problems to maintain sustainable development. With the progress of technology, on line shopping and its quick acceptance among consumers throughout the world changed the dynamic of competition in the retail supply chain. Considering the above facts, theeectoffairness concern on optimal pricing strategy as well as on profits of channel members of a two-echelon supply chain is investigated in this study. Here, we consider a supply chain comprising of a green manufacture randa fairness-sensitive retailer where the manufacturer produce and sell the green products through both theone and online channel to consumers. Due to uncertainty in the real world, the fuzziness is associated with market demand, price elasticity, and the co-efficient of greenness. Both centralized and decentralized model (with and with out the cognitive bias) is formulated and solved by Stackel berg game for the optimal prices and product greenness level. The optimal solutions of the models are analyzed and compared with the deterministic models numerically. The eect of fairness concern coefficient on the optimal prices and product greenness level for the channels are investigated. Moreover, the sensitivity analyses are presented to study the fuzzy degree of customer's sensitivity towards greenness on channel members' profits as well on optimal solutions of SC. Finally, some interesting managerial insights are presented.

Fuzzy-Rough Optimization Technique for Breast Cancer Classification

K.Anitha

Breast cancer is one of the deadly diseases among women. The rate of survival can be increased through early detection. The classification model with high level of predictive performance will help the medical experts to early identification of this disease. To develop such types of robust and optimal classification model, Machine learning algorithms are widely used. In this paper we introduce hybrid intelligent Fuzzy-Rough classification method based on Rule Induction. At initial stage irrelevant features are removed through weak gamma evaluator. Performance of this classification model is examined for Wisconsin Breast Cancer Database (WBCD) and classification accuracy evaluated through F-Measure. Performance measure of fuzzy-rough set optimization technique is taken into account by measuring sensitivity, specificity and accuracy of the applied technique. Verification and validation exercise of the applied technique are carried out on the basis of results obtained in the similar direction by various realistic breast cancer images captured by thermography.

Effects of magnetic field and thermal conductivity variance on thermal excitation developed by laser pulses and thermal shock

Rakhi Tiwari

The present study investigates the influences of magnetic field on the transient responses inside a half-space medium in the frame of dual phase lag thermoelasticity. Additionally, variable properties of the material have been taken into account. Boundary of the medium is exposed to a sudden heat input (thermal shock). Further, the bounding surface is assumed to be affected by a non-Gaussian laser beam type heat source. Closed form solutions are evaluated by adopting the concept of Kirchhoff transformation and Laplace transform technique. Impact of magnetic field as well as variable thermal conductivity has been exhibited on significant field quantities such as dimensionless conductive temperature, dimensionless displacement as well as dimensionless stress through the quantitative results. Auspicious outcomes have been achieved and prominent role of magnetic field and changing thermal conductivity are observed on the field components. Author believes that the current theoretical study will be helpful in designing the various structures affected by non-Gaussian laser beam.

Study of interactions among three embedded cracks in an orthotropic material

Anshika Tanwar

The article deals with the problem of thermal stresses produced due to the presence of three thermally insulated cracks embedded in an orthotropic strip of depth h. The infinite orthotropic plane is under the influence of steady-state thermo-mechanical loadings. The present mathematical model contains a central crack at the lower interface and two collinear cracks at the upper interface, which are symmetric about the central one. Using the Fourier integral transform technique, the governing equations are converted into two systems of singular integral equations. These Cauchy type Fredholm integral equations of the second kind are solved by using the Chebyshev polynomial method. Numerical values of the Mode-I thermal stress intensity factors (TSIFs) at the vicinity of crack tips are found for different particular cases of the considered model. The novelty of the article is the graphical study of interactions among the cracks through TSIFs.

Some New Integral Inequalities for Higher Order Strongly Exponentially Convex Functions

Jaya Bisht

In this paper, we study the concept of higher order strongly exponentially convex functions and establish new Hermite-Hadamard inequality for the class of strongly exponentially convex functions of higher order. We derive some new integral inequalities for Riemann-Liouville fractional integrals via higher order strongly exponentially convex functions. Further, several new and known results in particular cases are briefly discussed.

A Study of Geometric Properties of Normed Linear Space

Sunny Kumar

In this paper we have discussed various type geometric properties of normed linear space and tried to construct relation between them. Here we proved a theorem (Let A be a densely defined closed linear operator from X to Y suppose B in B(Y, Z) with) $\alpha(B) < \infty$ and $BA \in \Phi(X, Z)$ then, $A \in (X, Y)$ and also discuss operator with closed range. Here we introduce few concept "If U be a convex subset of a normed vector space x then 0 is an interior point of U. we construct a non-complete norm X so that X is rotund but completion $\overrightarrow{X}$ is non rotund. We can see here quasi complementation and CS complementation are not in general equivalent concept.

Time Series analysis of earthquake signals using Multifractal Detrended Fluctuation Analysis

Madhubrata Bhattacharya

Earthquake is a seismic event which can be identified by a precursor that triggered sufficiently prior to its incidence. Signal possessing earthquake is categorized as nonlinear and nonstationary time series. Hence, forecasting of earthquake needs to understand the statistical properties of the corresponding time series, which can be based on the observation of precursory phenomena. In fact, researches evidenced that there exist many precursors phenomenon among them ground deformation, sea level changes and that in earth tidal strain, changes in seismic wave velocities in geomagnetic field, changes in radon level in groundwater and soil are worth to mention and these precursor phenomena are instrumental from the point of implementation. Nonlinear and nonstationary property of earthquake time series can be modeled as power law relation between the magnitude of the event and its occurrence time. However, as physics of earthquake time series is not well understood, it invites always innovations to characterize the signals pertaining to this specific time series. Kissin and Grinevsky (1990)

has shown that variation of water level occurs between 4.5 m and 8.0 m before the occurrence of earthquake event. Researchers also have attempted to measure the precursor phenomenon of radon anomaly in soil and in water by passive track detector. Radon anomalies present in soil and water have been detected by passive track detector LR-115. Hauksson and Goddard (1981) has established an empirical relationship on the basis of radon diffusion, which is written as $\mu \geq 2.4log_{10}\gamma - 0.43$, where μ signifies the minimum magnitude of earthquake in Richter scale occurred for a radon anomaly at a distance of γ (km). The empirical relationship between μ and the time precursor - was formulated empirically by Rikitake (1976) and is written as $\log(\eta) = 0.76\eta - 1.83$ where η is time precursor. Non stationary time series pertaining to earthquake are proven to be a fractal structure. The multifractal spectrum identifies the deviation in fractal structure within time periods with large and small fluctuation. Formally the signals $X(\eta)$ are scale invariant when $X(c\eta) = e^H X(\eta)$. In this paper we have approached fractals to estimate the power law exponent H, known as Hurst exponent. Basically, Multifractal Detrended Fluctuation Analysis (MFDFA) methodology is researched out to estimate the multifractal spectrum of power law exponents from the given time series of earthquake events and this is due to a fact that highly nonlinear and nonstationary signals always have a multifractal structure which is a typical scale invariant in nature. The objective of this present paper is to explore MFDFA based analysis of earthquake time series Paper also focusses on forecasting of earthquake time series using MFDFA. Estimation of Hurst exponent will be mapped to fractal dimension which is further mapping to the distance of earthquake epicenter at which anomaly will occur.

Fractal Dimension for a class of complex valued fractal interpolation functions.

Manuj Verma

In this paper, we study the fractal dimension of the graph of complex-valued function $g(x) + ih(x)$, compare its fractal dimension with the graph of complex-valued functions $g(x) + h(x)$ and $(g(x), h(x))$ and also obtained some bounds. We also study fractal dimension of the graph of complex-valued fractal interpolation function associated with a germ function f, base function b and a scaling functions α_j.

Dimensional analysis of Mixed Riemann-Liouville Fractional integral of vector-valued functions

Megha Pandey

Because of its wide applications in many important areas, fractal dimension has become one of the most interesting parts of fractal geometry. Estimating the fractal dimension is one of the most fascinating work in fractal theory. It is not always easy to estimate the fractal dimension even for elementary real valued functions. Many theories have been developed in the context of fractal dimension of the graph of univariate real valued maps, for example, Hausdorff (and box) dimension of the graph of Lipschitz univariate real valued map is 1, Hausdorff (and box) dimension of the graph of univariate real valued function of bounded variation is also 1, and an upper bound of fractal dimension of the graph of univariate real valued Hölder continuous function is $2 - \sigma$, where σ is the Hölder exponent. Theories for bivariate real valued functions have also been introduced in the literature, for instance, Hausdorff (and box) dimension of the graph of Lipschitz bivariate real valued map is 2 and so is the graph of function of bounded variation and an upper bound of fractal dimension of the graph of bivariate real valued Hölder continuous function is $3 - \sigma$. However, in this paper, we shall make an effort to find the fractal dimension of continuous bivariate vector valued maps. Particularly, we find the fractal dimension of Riemann-Liouville fractional integral of a continuous vector valued bivariate map of bounded variation defined on a rectangular domain.

Modeling and Optimization of Multi-objective Signomial Programming Problems

Sudipta Mishra

In this paper, we have interpreted an alternative way to deal with multi-objective nonlinear signomial problems by consolidating the weighted sum method with the Geometric programming technique first time. Because of the complexity and nonlinearity nature of multi-objective programming problems, so many optimization techniques have been developed. One of the methods is the signomial type geometric programming technique. For this purpose, a suitable numerical example has been taken to prove our work.

THE AREA OF REGIONS BOUNDED BY FRACTAL CURVES

MD Nazimul Islam

This paper introduces the α fractal curves defined on a compact interval I of the real line $\mathbb{R}$. The area of the regions under α fractal curves and also of the regions whose boundary has fractal structure are estimated here. Some closed fractal curves are defined here and the area of the regions bounded by these closed fractal curves are calculated.

An Extended Car-Following Model Based on Collision Sensitivity and Backward Looking Effect

Kumari Jyoti

In this paper, an extended car- backward-looking effect based on collision sensitivity. We introduce the collision sensitivity coefficient into the car following model to explore its effect on vehicle dynamic performance and safety from a different perspective. The performance of the model is investigated analytically and numerically. The stability criteria is obtained by linear stability analysis. We conclude that collision sensitivity substantially affects car-following behavior and traffic congestion can be further reduced by sensing the information of preceding vehicles.

ANN and RSM based Modeling of Moringa Stenopetala Seed Oil Extraction Process Optimization and Oil

Bethu Srikanth

Likelihood awards us to amass from a manual for an all-inclusive community. Without a doubt, inferring is an instrument of likelihood hypothesis. This paper takes a gander at the Binomial, Poisson, and Normal scatterings. These are likelihood spreads, which are utilized extensively in deduction. You are a medical clinic administrator, and you need to sort out the staff numbers effectively for various non-weekend days. You know absolute number of patients came into a crisis station due to liquor harming in each time frame. You can break down the dissemination of patient numbers for every day of the week. No doubt you will have more such cases in the ends of the week, and you want bigger staff. This will be additionally valid for different organizations. They can utilize binomial circulations to compute changes popular and plan as needs be. Likelihood conveyances overall are utilized to foresee future occasions and frequently dependent on frightful looking numerical equations. Yet, there is additionally something excellent here. For instance, the binomial dissemination numerical capacity can be utilized to anticipate the results of any genuine occasion which has two results.

The generalized hyperstability of a function equation in a quasi-2-Banach space

Ravinder Kumar Sharma

In this paper, we study the hyperstability for the general linear equation

$$f(ax + by) = Af(x) + Bf(y)$$

in the setting of complete quasi-2- Banach spaces. We first extend the main fixed point result of Brzdęk and Ciepliński to quasi-2-Banach spaces. Then we use this result to generalize the main results on the hyperstability for the general linear equation in quasi-2- Banach spaces.

Parkinson Disease Detection from spirals and wave drawings using Sequential Model Selection

Chandramohan Bhuma

One simple approach for detecting Parkinson's Disease (PD) is using spiral and wave drawings. Role of deep and machine learning approaches is immense, as the accuracies reported are superior to human assessment. Severity of the PD is reflected in the spiral and wave drawings. Patients suffering with PD are unable to apply sufficient pressure and their writing speed also tends to slow as the diseases advances. Hence, if correctly identified at the early stage, using these spirals and wave drawings, the prognosis can be assessed accurately. In this work, a deep learning approach is proposed for accurately classifying the healthy and Parkinson disease patients drawings. Spiral drawing patterns and wave drawing patterns are analyzed using 323 pre-trained Convolution Neural Network (CNN) features trained on 'imagenet1k' dataset mostly. However, some CNNs considered in this work are pre-trained on 'imagenet21k' also. Features from four selected pre-trained CNNs, are fused by concatenating and are applied to a passive aggressive classifier. Pre-trained networks are selected sequentially. By using a bench mark dataset of spiral and drawing sketches, various performance metrics are computed. Results are compared with the existing works in the literature and superiority of the method is demonstrated with the simulations. For spiral drawings, with $70\% - 30\%$ train test split, an average accuracy of 95.8%, F1 score of 95.38%, Precision of 98.57% and a Recall of 92.62% are obtained. For wave drawings, they are $96.12\%, 95.7\%, 97.85\%$ and 94.1% respectively.

An SIS epidemic model with variable population and fear effect

Manisha Mukherjee

In this paper we have investigated the dynamics of an integer-order and fractional-order SIS epidemic model with birth in both susceptible and infected population, constant recruitment and effect of fear level due to infectious disease. We have established the existence of various equilibrium points and derived the sufficient conditions that ensure the local stability under two cases in both integer and fractional order model. The global stability has been vindicated by using Dulac's Bendixon criterion in integer order model. The forward transcritical bifurcation near the disease free equilibrium is investigated. The effect of fear level on infected density is also observed. We have done numerical simulation by MATLAB to verify the theoretical results and find the effect of fear level on dynamical behaviour of the infected population and obtained bifurcation diagram with respect to the constant recruitment and fear level. Finally we have compared the stability of the population in integer and fractional order systems.

A glimpse into the theory of multivariate fractal approximation on some function spaces with mixed norms

Kshitij Kumar Pandey

The notion of the mixed norm Lebesgue space, first systematically studied by Benedek and Panzone [Duke Math. J., 28 (1961), pp. 301–324], is a generaliza- tion of the classical Lebesgue space. In contrast to the classical case, the mixed Lebesgue space addresses problems that demand different integrability exponents for different variables of the function, for instance, in the study of partial differential equations. Stimulated by the work on mixed Lebesgue spaces, numerous other function spaces with mixed norms such as the Besov spaces, Sobolev spaces, Triebel-Lizorkin spaces, and Bessel potential spaces were introduced and investigated. On the other hand, fractal interpolation, as introduced by Barnsley [Constr. Approx., 2 (1986), pp. 303-329], is a relatively new subject that provides an alternative to the traditional interpolation techniques. Rooted in Barnsley's seminal work on univariate fractal interpolation and influenced by several attempts to its higher dimensional generalizations scattered in the literature, recently, we constructed a class of continuous multivariate fractal interpolation functions on gridded hyper-rectangular domains, with an approximation theoretic standpoint. This note continues the study of multivariate fractal functions, but does so in the context of mixed norm spaces. The intended classes of multivariate fractal approximants are obtained as the fixed points of the so-called Read-Bajraktarević operators defined on function spaces such as the mixed norm Lebesgue space and mixed norm Sobolev space, which are known to be Banach spaces. For appropriate choice of parameters, we obtain a sequence of fractal operators that are strongly convergent to the identity operator on the mixed norm function space under consideration. Overall, the current work is a modest attempt to bridge the gap between the two fields - fractal interpolation and theory of mixed norm spaces - with a strong belief that the one can provide benefits to the other.

Weak solution to the Complex Hessian equation associated to an m-positive closed current

Mohamed Zaway

The aim of this talk is to present a study about the existence of a solution to the complex Hessian equation associated to an m-positive closed current T. We give a sufficient condition on T and the measure μ so that the equation $T \wedge \beta^{n-m} \wedge (dd^c.)^{m-p} = \mu$ has a solution on the set of m-subharmonic functions. For this we establish a connection between the convergence in $cap_{m,T}$ of a sequence of m-subharmonic functions and the weak convergence of the associated Hessian measure.

Eigenvalue criteria for Existence or Non Existence of positive solution for fractional differential equation with integral condition

Souad Chentout

We purpose in this article is to establish existence and nonexistence of solutions to fractional differential equations with integral condition. We used index point fix theorem.

Optimization of the company's production program

Dmitry Ivakhnik

The paper presents an economic-mathematical model that helps to determine the risk reduction resources at the phase of selecting a variant of the company's production program. Risk reduction is conditioned by the manipulation of sales volumes and selling prices, and by searching for the solution, which allows achieving the maximum risk reduction in the model - ≪product sales income - financial safety margin". The study demonstrates the practical implementation of the developed model on the basis of a dental clinic services. The practical value of the study has been proved by the possibility of reducing the risks for the clinic by choosing the optimal parameters of sales volume and cost of services.