Annual Departmental Open House - 2024

March 03, 2024

Department of Mathematics & Statistics
Indian Institute of Technology Kanpur
Kanpur - 208016

Coordinator: Prof. Debasis Kundu

Annual Departmental Open House - 2024

Timing

9:30 AM - 6:30 PM

Venue

L-16 & L-17, Lecture Hall Complex, IIT Kanpur

Organized By

Department of Mathematics & Statistics
Indian Institute of Technology Kanpur
Kanpur - 208016

Contact

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Dr. Minerva Mukhopadhyay
Dr. Saurabh Kumar Singh
Dr. Indranil Chowdhury
Dr. Suprio Bhar
Dr. Pooja Singla
Dr. Arnab Hazra

Volunteers

Sanjay Kumar
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Soumadeb Pain
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Swati Shukla
Arghya Mukherjee
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Arka Banerjee
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Tuhin Subhra Mahato

Technical Team

Mr. Saurabh Bajpai & Mr. Sarvesh Kumar

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Mrs. Sarita Nigam & Mr. Subhash & Mr. Mukesh

Programme Overview

Inauguration — Venue: L16 — *Time: 9:30 AM - 9:35 AM*

Prof. Mohua Banerjee, HoD

Title of Talks

Session - 01 — Venue: L16 — *Time: 9:35 AM - 11:15 AM*

Chair : Dr. Indranil Chowdhury

S01:01 Central limit theorems for lattice point counting on tessellated domains.

Speaker: Sourav Das

Timing: 9:35 AM - 10:00 AM

S01:02 Efficient Multivariate Initial Sequence Estimators in MCMC.

Speaker : Arka Banerjee

Timing: 10:00 AM - 10:25 AM

S01:03 Fine Boundary Regularity For The Fractional (p, q) Laplacian.

Speaker : Dr. Uttam Kumar

Timing: 10:25 AM - 10:50 AM

S01:04 Fine Selmer Group of Hida Family and Coleman Family.

Speaker : Abhishek

Timing: 10:50 AM - 11:15 AM

Tea and coffee break — *Time: 11:15 AM - 11:30 AM*

Session - 02 Venue: L16 *Time: 11:30 AM - 1:10 PM*

Chair : Dr. Saurabh Kumar Singh

S02:01 Reversibility in Special Linear Groups.
Spaeker : Dr. Tejbir
Timing: 11:30 AM - 11:55 AM

S02:02 Complexity in the Bolza Surface.
Speaker : Bhola Nath Saha
Timing: 11:55 AM - 12:20 AM

S02:03 CMaps between Relatively Hyperbolic Boundaries.
Speaker : Rana Sardar
Timing: 12:20 AM - 12:45 PM

S02:04 Tate Cohomology and Base Change Lift of Generic Representations of GL_n.
Speaker : Sabyasachi Dhar
Timing: 12:45 PM - 1:10 PM

Session - 03 Venue: L17 *Time: 11:30 AM - 1:10 PM*

Chair : Dr. Minerva Mukhopadhyay

S03:01 A novel characterization of structures in smooth regression curves.
Spaeker : Satish Kumar
Timing: 11:30 AM - 11:55 AM

S03:02 Bivariate Distribution with Singular Component and its real-life Application.
Speaker : Sanjay Kumar
Timing: 11:55 AM - 12:20 AM

S03:03 On power optimal designs for comparing a set of controls to a set of treatments.
Speaker : Arpan Singh
Timing: 12:20 AM - 12:45 PM

S03:04 Estimation of the Worth of the Selected Subset of Treatments under Two Stage Drop-The-Losers Design.
Speaker : Yogesh Katariya
Timing: 12:45 PM - 1:10 PM

Session - 04 Venue: L16 *Time: 2:15 PM - 3:55 PM*

Chair : Dr. Pooja Singla

S04:01 A spectral dichotomy for commuting m-isometries with negative core operator.
Speaker : Santu Bera
Timing: 2:15 PM - 2:40 PM

S04:02 Fractional Caffarelli-Kohn-Nirenberg type inequalities on the Heisenberg group.
Speaker : Haripada Roy
Timing: 2:40 PM - 3:05 PM

S04:03 Sampling and Reconstruction Problems: An Overview.
Speaker : Dr. Ankush Kumar Garg
Timing: 3:05 PM - 3:30 PM

S04:04 Best approximations in metric spaces with property strongly UC.
Speaker : Dr. Abhik Digar
Timing: 3:30 PM - 3:55 PM

Tea and coffee break *Time: 3:55 PM - 4:15 PM*

Session - 05 Venue: L17 *Time: 2:15 PM - 3:55 PM*

Chair : Dr. Arnab Hazra

S05:01 M-Estimation in a Censored Regression Model Using Instrumental Variables Under Endogeneity.
Speaker : Swati Shukla
Timing: 2:15 PM - 2:40 PM

S05:02 Proximal importance sampling for non-differentiable posteriors.
Speaker : Apratim Shukla
Timing: 2:40 PM - 3:05 PM

S05:03 On efficient parameter estimation of elementary chirp model.
Speaker : Anjali Mittal
Timing: 3:05 PM - 3:30 PM

S05:04 Existence and Uniqueness of Stochastic PDE's Associated with the Forward Equations: An Approach using Norms.
Speaker : Arvind Kumar Nath
Timing: 3:30 PM - 3:55 PM

Tea and coffee break *Time: 3:55 PM - 4:15 PM*

Session - 06

Venue: L16 *Time: 4:15 PM - 5:55 PM*

Chair : Dr. Suprio Bhar

S06:01 The continuous extension of Kobayashi isometries.
Speaker : Dr. Anwoy Maitra
Timing: 4:15 PM - 4:40 PM

S06:02 Definability of sets and K-theory.
Speaker : Dr. Sourayan Banerjee
Timing: 4:40 PM - 5:05 PM

S06:03 Some new 3-valued Paraconsistent Logics.
Speaker : Bidhan Saha
Timing: 5:05 PM - 5:30 PM

S06:04 Characterisation of band bricks for certain string algebras.
Speaker : Annoy Sengupta
Timing: 5:30 PM - 5:55 PM

Session - 07

Venue: L17 *Time: 4:15 PM - 5:55 PM*

Chair : Prof. Malay Banerjee

S07:01 Controllability of the Linearized Compressible Navier-Stokes System with Maxell's Law.
Speaker : Dr. Sakil Ahamed
Timing: 4:15 PM - 4:40 PM

S07:02 Local Exact Controllability to the Trajectories of a Gray-Scott System.
Speaker : Mohmedmunavvar Mubarak Bapu
Timing: 4:40 PM - 5:05 PM

S07:03 Sturctural sensitivity of basin boundary collision.
Speaker : Indrajyoti Gaine
Timing: 5:05 PM - 5:30 PM

Certificate Ceremony Venue: L16 *Time: 6:00 PM - 6:15 PM*

Title and Abstract of Talks

Session - 01 Venue: L16 *Time: 9:35 AM - 11:15 AM*

Chair : Dr. Indranil Chowdhury

S01:01 **Speaker** : Sourav Das

Title: Central limit theorems for lattice point counting on tessellated domains.

Abstract: One of the central problems in the geometry of numbers is the lattice point counting problem in various domains of Euclidean spaces. We will consider the discrepancy functions for lattice point counting on domains that can be nicely tessellated by the action of a diagonal subgroup. Following the approach of Bjorklund and Gorodnik, We will show that suitably normalized discrepancy functions for lattice point counting on certain tessellated domains satisfy central limit theorems. Furthermore, we will also address the same problem for affine and congruence lattice point counting, proving analogous central limit theorems for them.

S01:02 **Speaker** : Arka Banerjee

Title: Efficient Multivariate Initial Sequence Estimators in MCMC.

Abstract: Monte Carlo error estimation is essential for measuring the sample quality of samples generated from a population under study in the Bayesian paradigm. Error variance estimation is one of the standard practices for both univariate and multivariate Markov chains. Multivariate batch means estimator, being one of the fastest and less volatile among the widely used estimators, does not perform well for highly correlated Markov chains resulting in a biased confidence region for the concerned estimates of the population parameters. Here we modify the multivariate batch means estimators with a clever use of covariance-correlation transformation to get a fast and unbiased estimator even for highly correlated cases and compare its performance with other estimators.

S01:03 **Speaker** : Dr. Uttam Kumar

Title: Fine Boundary Regularity For The Fractional (p, q) Laplacian.

Abstract: In this article, we deal with the fine boundary regularity, a weighted Holder regularity of weak solutions up to the boundary, to the problem involving the fractional (p, q)-Laplacian denoted by $(-\Delta)^s_p u + (-\Delta)^s_q u = f$ in Ω; and $u = 0$ in $\mathbb{R}^N \backslash \Omega$ where Ω is a $C^{1,1}$ domain, $f \in L^\infty(\Omega)$, $0 < s < 1$ and $2 \leq p \leq q < \infty$. A novel barrier construction allows us to analyse the regularity theory even in the absence of the scaling or the homogeneity properties of the operator. We

use the nonlocal analogue of the Krylov boundary Harnack method to prove that $u/ \in C^{\alpha}(\Omega)$ for some $\alpha \in (0,1)$ and is the distance from the boundary.

S01:04 **Speaker** : Abhishek

Title: Fine Selmer Group of Hida Family and Coleman Family.

Abstract : Fix an odd prime p and let K be any number field. For each $n \geq 1$, let ζ_{p^n} be a primitive p^n-th root of unity in $\overline{\mathbb{Q}}$. Now, consider the (cyclotomic) tower of field extensions K_n/K such that $K_n \subset \bigcup_{n\geq 1} K(\zeta_{p^n})$ and $\mathrm{Gal}(K_n/K) \cong \mathbb{Z}/p^n\mathbb{Z}$. Let $Cl(K_n)(p)$ denote the p-primary part of the ideal class group $Cl(K_n)$ of K_n. Then it is well known that there exist constants $\lambda, \mu, \nu \in \mathbb{N} \cup \{0\}$, depending on p and independent of n, such that

$$\#Cl(K_n)(p) = p^{\lambda n + \mu p^n + \nu} \quad (1)$$

for $n \gg 0$. Iwasawa conjectured that $\mu = 0$ in Equation (1).

Inspired by this, Coates-Sujatha made predictions regarding the structure of fine Selmer groups of elliptic curves over p-adic Lie-extension of number fields. In this talk, we will discuss suitable analogues of these conjectures for the 'big' Galois representation associated to a Hida family and a Coleman family.

Tea and coffee break *Time: 11:15 AM - 11:30 AM*

Session - 02 Venue: L16 *Time: 11:30 AM - 1:10 PM*

Chair : Dr. Saurabh Kumar Singh

S02:01 **Speaker** : Dr. Tejbir

Title: Reversibility in Special Linear Groups.

Abstract: Reversible or real elements in a group are those elements that are conjugate to their own inverses. They are closely related to strongly reversible or strongly real elements, which can be expressed as a product of two involutions. Classifying reversible and strongly reversible elements in a group has been a problem of broad interest. The reversibility problem is well-studied for finite groups, whereas the problem is widely open for infinite groups. In this talk, we will investigate the reversibility problem in the context of special linear groups over the field of complex numbers and the division ring of real quaternions. This is joint work with Krishnendu Gongopadhyay and Chandan Maity.

S02:02 **Speaker** : Bhola Nath Saha

Title: Complexity in the Bolza Surface.

Abstract: A surface in the Teichm¨uller space, where the systole function attains its maximum, is called a maximal surface. For genus two there exists a unique maximal surface which is called the Bolza surface. In this talk, we study the complexity of the set of systolic geodesics on the Bolza surface. We show that any non-systolic geodesic intersects the systolic geodesics in 2n points, where $n \geq 5$. For each non-negative integer n, we show the existence of curves on the Bolza surface which intersect the set of systolic geodesics at $(10 + 6n)$ and $(12 + 6n)$ points by construction. Furthermore, we show that there are exactly 12 second systolic geodesics on the Bolza surface and they form a triangulation of the surface. This is joint work with Dr. Bidyut Sanki.

S02:03 **Speaker** : Rana Sardar

Title: Maps between Relatively Hyperbolic Boundaries.

Abstract: In 1987, M. Gromov introduced the notion of hyperbolic metric spaces. A geodesic metric space is said to be hyperbolic if there exists a $\delta \geq 0$ such that for any geodesic triangle $\triangle$, each side of $\triangle$ is contained in a closed δ-neighborhood of the union of the other two sides. The Gromov boundary ∂X of a proper geodesic hyperbolic metric space X is the set of equivalent classes of geodesic rays starting from a fixed basepoint $x_0 \in X$, where two such rays are equivalent if their Hausdorff distance is finite. A quasi-isometry is a coarsely bi-Lipschitz map between two metric spaces. Quasi-isometry between two hyperbolic metric spaces induces a homeomorphism between their Gromov boundaries. However, the converse is not true. There exist two hyperbolic groups, due to Bourdon, with homeomorphic Gromov boundaries, but they are not quasi-isometric.

In 1996, F. Paulin proved that if Gromov boundaries of two hyperbolic groups are homeomorphic and quasi-Möbius equivalent, then they are quasi-isometric to each other. A quasi-Möbius map is defined in terms of cross ratios. Corresponding to a triangle $\triangle(a, b, c)$ in $X \cup \partial X$, there exists a point $p_{abc} \in X$ (called a quasiprojection) such that distance of p_{abc} to each side of the $\triangle(a, b, c)$ is bounded in terms of the hyperbolicity constant of X. Given any four distinct points $a, b, c, d \in \partial X$, a cross-ratio $[a, b, c, d]$ roughly estimates the distance between barycenters of the triangles $\triangle(a, b, c)$ and $\triangle(a, c, d)$. A quasi-Möbius map $f : \partial X \to \partial Y$ roughly compares the cross ratios $[a, b, c, d]$ and $[f(a), f(b), f(c), f(d)]$.

Relatively hyperbolic groups were first introduced by M. Gromov, and it is a generalisation of hyperbolic groups. Let G be a finitely generated group and H be a subgroup of G. We say G is hyperbolic relative to H if the space G^h obtained by attaching 'combinatorial horoballs' to each of the left cosets of H in a

Cayley graph of G is a hyperbolic metric space. The boundary ∂G^h is called the relative hyperbolic boundary of G. Our goal is to extend Paulin's results to relatively hyperbolic groups. Given two relatively hyperbolic groups, we have proved that if their relative hyperbolic boundaries satisfy some conditions similar to quasi-Möbius equivalence, then the groups are quasi-isometric to each other. In this talk, after introducing basic notions, we will give a brief sketch of our result.

S02:04 **Speaker** : Sabyasachi Dhar

Title: Tate Cohomology and Base Change Lift of Generic Representations of GL_n.

Abstract: Let l and p be distinct odd primes, and let F be a finite extension of $\mathbb{Q}_p$. Let π be a generic smooth integral representation of $GL_n(F)$ over an $\mathbb{Q}_l$-vector space. Let E be a finite Galois extension of F with $[E : F] = l$. Let Π be the base change lift of π to the group $GL_n(E)$. Under this set up, we discuss a conjecture of A.Venkatesh-D. Treumann–which in general states that "Tate cohomology realizes mod-l functoriality". Then, we talk about the Tate cohomology group of a "particular" $GL_n(E)$-stable lattice in the representation space of Π, and its relation with the mod-l reduction of π–which proves a part of the conjecture. This is based on the joint work with Santosh Nadimpalli.

Session - 03 Venue: L17 *Time: 11:30 AM - 1:10 PM*

Chair : Dr. Minerva Mukhopadhyay

S03:01 **Speaker** : Satish Kumar

Title: A novel characterization of structures in smooth regression curves: from a viewpoint of persistent homology.

Abstract: In this talk, I shall talk about a novel characterization of structures such as monotonicity, convexity, and modality in smooth regression curves using persistent homology. Persistent homology is a key tool in topological data analysis that detects higher dimensional topological features such as connected components and holes (cycles or loops) in the data. In particular, we explore structures in regression curves via the persistent homology of super-level sets of a function, where the function of interest is - the first derivative of the regression function.

S03:02 **Speaker** : Sanjay Kumar

Title: Bivariate Distribution with Singular Component and its real-life Application.

Abstract: Real-life data sets with ties arise quite commonly in reliability and survival analysis. We attempt to model such types of data sets using bivariate distributions with singular components. For this purpose, we consider mainly two types of approaches, namely the "Minimization approach" and the "Maximization approach". Using the minimization approach the bivariate modified Weibull (BMW) distribution is derived. The BMW is more general distribution and it reduces to the Marshall-Olkin bivariate exponential (MOBE) and Marshall-Olkin bivariate Weibull (MOBW) distributions under certain parameter restrictions. Some distributional, modal and aging properties of BMW will be discussed. The copula associated with BMW distribution is given. Finally we will discuss about the maximum likelihood estimation of parameters of BMW distribution via EM algorithm. We will give some numerical results and comparisons. This talk is based on joint work with Prof. Debasis Kundu and Prof. Sharmishtha Mitra.

S03:03 **Speaker** : Arpan Singh

Title: On power optimal designs for comparing a set of controls to a set of treatments.

Abstract: In various experiments the researchers are interested in the pairwise comparison of a set of already existing treatments (controls) with a set of newly developed treatments. Usually, experimenters pair every control with several new treatment and then simultaneously compare these pairs. In such experiments, the following two hypotheses are generally of interest: (1) Is there a significant difference in at least one of the selected pairs? (2) Is there a significant difference in all selected pairs? These type of simultaneous comparisons can be seen as a bi-partite graph with one set of vertices as the controls and the other as the treatments. In this article, we propose max–min designs for the hypothesis testing problems of the type (1) and (2) for these bi-partite graphs based on an elegant game theoretic approach. Some of the max-min designs obtained are well known with respect to different optimality criteria, and other max–min designs are novel. Theoretical findings are supplemented with numerical studies based on real data examples.

S03:04 **Speaker** : Yogesh Katariya

Title: Estimation of the Worth of the Selected Subset of Treatments under Two Stage Drop-The-Losers Design.

Abstract: The Drop-The-Losers design emerges as a pivotal methodology in enhancing treatment efficacy assessment. The two-stage Drop-The-Losers design involves a two-stage process where the first stage selects a nonempty subset of effective

treatment(s) among the given treatments. Subsequently, the selected subset of treatments is further analyzed and evaluated to estimate its worth of the selected subset of treatments. This estimation helps determine the selected treatment(s) effectiveness and potential impact of the selected treatment(s) within the subset.

In this study, we focus on the scenario encompassing general k treatments, where their effects are described by independent Gaussian distributions having different unknown means and a common known variance. Building upon Gupta's(1956, 1965) subset selection rule, which guarantees to select the most effective treatment(s) in the subset with a predefined minimum probability, we undertake a comprehensive investigation. In the initial stage, the k treatments are independently administered to n1 subjects each, facilitating the selection of a subset demonstrating superior efficacy based on observed sample means. Subsequently, in the second stage, additional sample sizes n2 are drawn from the treatment(s) selected in the preceding stage, refining the assessment process. Our primary objective revolves around deriving the Uniformly Minimum Variance Conditionally Unbiased Estimator (UMVCUE) to estimate the worth of the selected subset of treatments. This estimation is crucial in determining the effectiveness and potential impact of the selected treatments within the subset. Such estimations are key in guiding informed decision-making within clinical trial research settings.

Tea and Coffee *Time: 3:35 PM - 3:55 PM*

Session - 04

Venue: L16 *Time: 2:15 PM - 3:55 PM*

Chair : Dr. Pooja Singla

S04:01 **Speaker** : Santu Bera

Title: A spectral dichotomy for commuting m-isometries with negative core operator.

Abstract: We show that the Taylor spectrum of any pair of commuting m-isometries with negative core operator is either contained in the boundary of the unit bidisc or equal to the closed unit bidisc. Our method of proof relies on a strictly 2-variable fact about the topological boundary of the Taylor spectrum. This is a joint work with Sameer Chavan and Soumitra Ghara.

S04:02 **Speaker** : Haripada Roy

Title: Fractional Caffarelli-Kohn-Nirenberg type inequalities on the Heisenberg group.

Abstract: In 1984, L. Caffarelli and his coauthors established a family of interpolation inequalities, now known as Caffarelli-Kohn-Nirenberg (CKN) inequalities, which includes the well known Sobolev inequality and Hardy's inequality as particular cases. In this talk first we will briefly discuss the classical and fractional Sobolev, Hardy's and CKN inequalities for Euclidean spaces. Then we will discuss our recent results concerning fractional CKN type inequalities on the Heisenberg group, which includes the fractional Sobolev and Hardy type inequalities established by Adimurthi and Arka Mallick. Our inequalities also give an improvement on the range of indices for the Hardy type inequality established by them.

S04:03 **Speaker** : Dr. Ankush Kumar Garg

Title: Sampling and Reconstruction Problems: An Overview.

Abstract: In this talk, we will discuss sampling and reconstruction problems in specific spaces. The well known Shannon sampling theorem which was proved in 1949, turned out to be a milestone result in information theory and set the foundation for this field. We will discuss the several generalizations of this theorem have been studied in various contexts over these years.

S04:04 **Speaker** : Dr. Abhik Digar

Title: Best approximations in metric spaces with property strongly UC.

Abstract: Fixed point theory is a fundamental tool extensively investigated for addressing solutions to the operator equation $fx = x$, where f denotes a self-map on a non-empty subset of a metric space. In 2005, P. Veeramani et al. initiated the concept of best proximity theory that studies the existence results of best proximity points as a generalization of fixed point theorems. In 2009, Suzuki et al. introduced the notion of property UC and extended the results of [1] to a metric space setting. In 2017, Shunumugaraj et al. characterized uniform rotundity in terms of property UC. Recently in 2021, S. Basha established the best approximation results for almost cyclic contractions in a uniformly rotund Banach space setting. In this talk, we discuss a geometrical notion, called property strongly UC which is stronger than property UC and prove the existence of best approximations for a new class of almost cyclic ψ-contraction maps defined on a pair of subsets of a metric space. As a particular case of this existence theorem, we obtain the main results of [1] and [2]. Moreover, we study the existence of a best approximation and continuity properties of almost cyclic contractions in the context of a reflexive Banach space and a metric space.

References

1 Eldred, A. Anthony and Veeramani, P., Existence and convergence of best proximity points, J. Math. Anal. Appl., vol 323(2), (2006) 1001–1006.

2 Basha, S.,Best approximation theorems for almost cyclic contractions, J. Fixed Point Theory Appl., vol 23(2), (2021) Paper No. 32, 12.

3 Shunmugaraj, P. and Thota, V., Uniform convexity, strong convexity and property UC, J. Math. Anal. Appl., vol 446(2), (2017) 1769–1775.

4 Suzuki, Tomonari, Kikkawa, Misako, Vetro, Calogero, The existence of best proximity points in metric spaces with the property UC, Nonlinear Anal., vol 71(7-8), (2009) 2918– 2926.

Tea and coffee break *Time: 3:55 PM - 4:15 PM*

Session - 05 Venue: L17 *Time: 2:15 PM - 3:55 PM*

Chair : Dr. Arnab Hazra

S05:01 **Speaker** : Swati Shukla

Title: M-Estimation in a Censored Regression Model Using Instrumental Variables Under Endogeneity.

Abstract: In this talk, I will talk about M-estimation in a censored regression model in the presence of endogenous variables We use the instrumental variable approach to remove endogeneity from the model. The model parameter estimation procedure consists of two steps: In the first step, we use a control function approach to remove the endogeneity from the model. Then, in the second step, we employed M-estimation to estimate the parameters of the censored regression model. I will briefly summarize the estimation procedures and main results of the paper titled as "M-Estimation in a Censored Regression Model Using Instrumental Variables Under Endogeneity."

S05:02 **Speaker** : Apratim Shukla

Title: Proximal importance sampling for non-differentiable posteriors.

Abstract: Bayesian models with non-differentiable posterior distributions have become increasingly prevalent in modern machine learning and statistics. Traditional gradient-based Markov chain Monte Carlo (MCMC) techniques are not viable sampling strategies for such posteriors. Using tools from the optimization literature,such as proximal operators and Moreau – Yosida envelopes, a smooth appro-

ximation of the posterior density is constructed, leading to proximal MCMC algorithms. Such proximal MCMC algorithms are either inexact and/or suffer from slow mixing when the smoothing approximations are inaccurate. We propose a proximal importance sampling (IS) estimator, that replaces the regular Monte Carlo estimator of the proximal MCMC with an importance sampling estimator. Leveraging specific properties of proximal operators, we demonstrate the finiteness of the asymptotic variance of the proximal IS estimator, and provide a method of estimation for this variance. We demonstrate the effectiveness of the proposed methods in a wide variety of problems including trendfiltering, imaging deconvolution, and signal processing.

S05:03 **Speaker** : Anjali Mittal

Title: On efficient parameter estimation of elementary chirp model.

Abstract: Elementary chirp signals can be found in various fields of science and engineering. We propose two computationally efficient algorithms based on the choice of two different initial estimators to estimate the parameters of the elementary chirp model. It is observed that the proposed efficient estimators are consistent; they have the identical asymptotic distribution as that of the least squares estimators and they are also less computationally intensive. We also propose sequential efficient procedures to estimate the parameters of the multi-component elementary chirp model. The asymptotic properties of the sequential efficient estimators coincide with the least squares estimators. The important point about the efficient and sequential efficient algorithms is that these algorithms produce efficient frequency rate estimators in a fixed number of iterations. On an EEG dataset, we demonstrate the performance of the proposed algorithm.

S05:04 **Speaker** : Arvind Kumar Nath

Title: Existence and Uniqueness of Stochastic PDE's Associated with the Forward Equations: An Approach using Norms.

Abstract: We consider stochastic PDEs

$$dY_t = L(Y_t)dt + A(Y_t)dBt, \qquad t \geq 0$$

and associated PDEs

$$du_t = Lu_t dt, \qquad t \geq 0$$

with regular initial conditions. Here, L and A are certain partial differential operators involving multiplication by smooth functions and are of the order two and one respectively, and in special cases are associated with finite dimensional diffusion processes. This PDE also includes Kolmogorov's Forward Equation (Fokker-

Planck Equation) as a special case. We first discuss the Monotonicity inequality for the pair (L, A) and using this inequality, we obtain the existence and uniqueness of strong solutions to the Stochastic PDE and the PDE. In addition, a stochastic representation for the solution to the PDE is also established.

Tea and coffee break *Time: 3:55 PM - 4:15 PM*

Session - 06 Venue: L16 *Time: 4:15 PM - 5:55 PM*

Chair : Dr. Suprio Bhar

S06:01 **Speaker** : Dr. Anwoy Maitra

Title: The continuous extension of Kobayashi isometries.

Abstract: In this talk, we will first see a very quick introduction to the Kobayashi distance on (bounded) domains in complex Euclidean space, and go over some basic facts about this distance that are going to be important for us. Then we will have a very quick introduction to Gromov hyperbolic distance spaces, learn about a natural compactification of these spaces, and also about some important properties that it possesses. Then we will adapt these concepts from the realm of metric geometry to the concrete situation of interest to us, namely that of a bounded domain in complex Euclidean space endowed with its Kobayashi distance and its Euclidean compactification (which is unrelated to the Kobayashi distance!). In particular, we will learn about Gromov model domains, domains that are locally Gromov model domains, and visibility domains. After this we will state our main theorem, which says, roughly: any Kobayashi isometric embedding from a domain that is locally a Gromov model domain to a visibility domain extends to a continuous map between their closures. We will discuss a few applications of this theorem and conclude by briefly examining the proof. This is part of joint work with V.S. Chandel, S. Gorai and A.D. Sarkar.

S06:02 **Speaker** : Dr. Sourayan Banerjee

Title: Definability of sets and K-theory.

Abstract: In his theory of motivic integration, Kontsevich used (a completion of a localization of) the Grothendieck ring of algebraic varieties over a field k, $K_0(Var_k)$, as the value ring for motivic measures. This motivated Krazi˘cek and Scanlon to define a model-theoretic Grothendieck ring associated with a first-order structure M. To understand the model-theoretic Grothendieck ring, we first need to understand the category of definable sets over M, whose objects are definable subsets of finite cartesian powers of the structure M and morphisms are defina-

ble injections between those definable subsets. Under the disjoint union operation, this category becomes a symmetric monoidal category, and hence it enables us to talk about its K-theory. Interestingly, when M is a finite structure then $K_n(M)$ is isomorphic to the n^{th} stable homotopy group of spheres thanks to the Barratt-Priddy-Quillen-Segal theorem. In this talk, I will introduce the model-theoretic K-theoretic terminology. Even though explicit computation of the Kgroups is in general hard, I will report on the progress towards the computation of K_1 of the abelian group $\mathbb{Z}_{\mathbb{Z}}$ of integers.

S06:03 **Speaker** : Bidhan Saha

Title: Some new 3-valued Paraconsistent Logics.

Abstract: In classical logic, a statement α is either true or false and not both. Therefore a statement and its negation $\neg\alpha$ cannot both be true. As a result, an arbitrary statement β can be concluded from a premise set containing both α and $\neg\alpha$ - this is known as the *principle of explosion*. In this presentation, we illustrate cases where the principle is violated. Corresponding logics are called *paraconsistent*. We describe a scheme for the development of certain paraconsistent logics and present some new 3-valued systems following the scheme.

S06:04 **Speaker** : Annoy Sengupta

Title: Characterisation of band bricks for certain string algebras.

Abstract: A brick is a module whose endomorphism algebra is of dimension 1. From the viewpoint of representation theory of finite-dimensional algebras, a brick is an important module owing to the classification of such algebras into brick-finite, brick-tame and brick-wild representation types. In a recent work, Dequêne et al. provided a connection between some band bricks over a particular family of gentle algebras and perfectly clustering words over a linearly ordered alphabet. Generalising this result, we characterise band bricks for string algebras whose underlying quiver is acyclic in terms of weakly perfectly clustering pairs of crowns–a variant of perfectly clustering words.

Session - 07 Venue: L17 *Time: 4:15 PM - 5:55 PM*

Chair : Prof. Malay Banerjee

S07:01 **Speaker** : Dr. Sakil Ahamed

Title: Controllability of the Linearized Compressible Navier-Stokes System with Maxell's Law.

Abstract: Here, we discuss the control properties of the linearized compressible Navier-Stokes system with Maxwell's law around a constant steady state $(\rho_s, u_s, 0), \rho_s > 0, u_s > 0$ in the interval $(0, 2\pi)$ with periodic boundary data. We explore the exact controllability of the coupled system by means of a localized interior control acting in any of the equations when time is large enough. We prove the exact controllability of the system in the space $L^2(0, 2\pi) \times L^2(0, 2\pi) \times L^2(0, 2\pi)$ by proving an observability inequality with the help of an Ingham-type inequality.

S07:02 **Speaker** : Mohmedmunavvar Mubarak Bapu

Title: Local Exact Controllability to the Trajectories of a Gray-Scott System.

Abstract: In this talk, we present the controllability of a Gray-Scott System. We discuss the null controllability of the linearized system around a trajectory using the Carleman inequality. Then, by applying the Kakutani fixed point theorem, the controllability to the trajectory of the nonlinear system is shown.

S07:03 **Speaker** : Indrajyoti Gaine

Title: Sturctural sensitivity of basin boundary collision threshold in Hastings-Powell model.

Abstract: Investigating the structural sensitivity of outcomes generated by deterministic ecological models has emerged as a recent research focus. Blasius et. al. established the possibility of sub-critical Hopf-bifurcation in classical Rosenzweig-MacArthur model. Hastings-Powell was the first to report the period doubling route to chaos in an ecological food chain. This presentation aims to discuss the shift in the basin boundary collision threshold within the classical HastingsPowell model. The discussion centers around the consideration of two quantitatively similar functional responses that describe grazing patterns in ecological systems.

Thank You!