Annual Departmental Open House 2025

February 09, 2025

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

Coordinator: Prof. Debasis Kundu

Annual Departmental Open House 2025

Timing

9:00 AM - 6:00 PM

Venue

L14 & L15, Lecture Hall Complex, IIT Kanpur

Organized By

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

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Prof. Dootika Vats
Prof. Somnath Jha
Prof. Satya Prakash Singh
Prof. Suprio Bhar
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Programme Overview

Inauguration — Venue: L14 — *Time: 9:00 AM - 9:10 AM*

Prof. Debasis Kundu

Title of Talks

Session - 01 — Venue: L14 — *Time: 9:10 AM - 11:15 AM*

Chair : Prof. Malay Banerjee

S01:01 Regularity results for a class of mixed local and nonlocal singular problems involving distance function

Speaker : Stuti Das

Timing: 9:10 AM - 9:35 AM

S01:02 Computationally efficient Bayesian joint modeling of mixed-type high-dimensional multivariate spatial data

Speaker : Arghya Mukherjee

Timing: 9:35 AM - 10:00 AM

S01:03 Type II intermittency route to hidden attractor in modified Lorenz system

Speaker : Indrajyoti Gaine

Timing: 10:00 AM - 10:25 AM

S01:04 K-theory over an n-exact category

Speaker : Dr. Sourayan Banerjee

Timing: 10:25 AM - 10:50 AM

S01:05 Von Neumann entropy of the angle operator between a pair of intermediate subalgebras

Speaker : Biplab Pal

Timing: 10:50 AM - 11:15 AM

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

Parallel Sessions - 02 & 03

Session - 02

Venue: L14 *Time: 11:30 AM - 1:10 PM*

Chair : Prof. Kaushik Bal

S02:01 (p, q)-fractional problems involving a sandwich-type perturbation and a critical Sobolev nonlinearity

Speaker : Dr. Shilpa

Timing: 11:30 AM - 11:55 AM

S02:02 Multiplicity of solutions to a degenerate elliptic equation in the sub-critical and critical cases

Speaker : Sanjit Biswas

Timing: 11:55 AM - 12:20 PM

S02:03 Weighted fractional Hardy inequalities with singularity on any flat submanifold

Speaker : Vivek Sahu

Timing: 12:20 PM - 12:45 PM

S02:04 Efficient and accurate numerical computation of oscillatory integrals

Speaker : Damini Dhiman

Timing: 12:45 PM - 1:10 PM

Session - 03

Venue: L15 *Time: 11:30 AM - 1:10 PM*

Chair : Prof. Dootika Vats

S03:01 A transference principle for Hardy spaces

Speaker : Santu Bera

Timing: 11:30 AM - 11:55 AM

S03:02 Compact operators: A series representation

Speaker : Dr. Shanola S Sequeira

Timing: 11:55 AM - 12:20 PM

S03:03 Tensor products and Gelfand modules of $\mathrm{GL}_2(\mathfrak{o}_\ell)$

Speaker : Archita Gupta

Timing: 12:20 PM - 12:45 PM

S03:04 Real adjoint orbits of linear Lie groups

Speaker : Dr. Tejbir Lohan

Timing: 12:45 PM - 1:10 PM

Lunch break *Time: 1:10 PM - 2:15 PM*

Parallel Sessions - 04 & 05

Session - 04

Venue: L14 *Time: 2:15 PM - 3:55 PM*

Chair : Prof. Somnath Jha

S04:01 A relationship between character values of wreath products and the symmetric group

Spaeker : Dr. Papi Ray

Timing: 2:15 PM - 2:40 PM

S04:02 On tensor product of representations of Lie superalgebras

Speaker : Abhishek Das

Timing: 2:40 PM - 3:05 PM

S04:03 A system of Diophantine equations

Speaker : Dr. Shamik Das

Timing: 3:05 PM - 3:30 PM

S04:04 2-Selmer companion modular forms

Speaker : Abhishek Shukla

Timing: 3:30 PM - 3:55 PM

Session - 05

Venue: L15 *Time: 2:15 PM - 3:55 PM*

Chair : Prof. Satya Prakash Singh

S05:01 Weyl modules for twisted toroidal Lie algebras

Speaker : Ritesh Pandey

Timing: 2:15 PM - 2:40 PM

S05:02 Braces and classification struggles

Speaker : Dr. Snehashis Mukherjee

Timing: 2:40 PM - 3:05 PM

S05:03 Length of filling pairs on punctured surfaces

Speaker : Bhola Nath Saha

Timing: 3:05 PM - 3:30 PM

S05:04 Embedding of graphs on translation surfaces

Speaker : Achintya Dey

Timing: 3:30 PM - 3:55 PM

Tea and coffee *Time: 3:55 PM - 4:10 PM*

Parallel Sessions - 06 & 07

Session - 06

Venue: L14 *Time: 4:10 PM - 5:25 PM*

Chair : Prof. Suprio Bhar

S06:01 Geometry of horospheres and extension of biholomorphic map

Speaker : Nishith Mandal

Timing: 4:10 PM - 4:35 PM

S06:02 Finite element approximation of stochastic linear Schrödinger equation

Speaker : Mangala Prasad

Timing: 4:35 PM - 5:00 PM

S06:03 Invariant measure for linear stochastic PDEs in the space of tempered distributions

Spaeker : Arvind Kumar Nath

Timing: 5:00 PM - 5:25 PM

Session - 07

Venue: L15 *Time: 4:10 PM - 5:25 PM*

Chair : Prof. Arnab Hazra

S07:01 Divergence-based robust inference for the Marshall-Olkin bivariate exponential distribution

Speaker : Sanjay Kumar

Timing: 4:10 PM - 4:35 PM

S07:02 On weighted least squares estimation of elementary chirp model

Speaker : Anjali Mittal

Timing: 4:35 PM - 5:00 PM

S07:03 Discriminating between Weibull and log-normal distributions in the presence of hybrid censoring

Speaker : Ojasvi Rajput

Timing: 5:00 PM - 5:25 PM

Tea and coffee *Time: 5:25 PM - 5:40 PM*

Valedictory Session

Venue: L14 *Time: 5:40 PM - 6:00 PM*

Title and Abstract of Talks

Session - 01 Venue: L14 *Time: 9:10 AM - 11:15 AM*

Chair : Prof. Malay Banerjee

S01:01 **Speaker** : Stuti Das

Title: Regularity results for a class of mixed local and nonlocal singular problems involving distance function

Abstract: We consider a quasilinear non-homogeneous elliptic equation involving mixed local and nonlocal operators with doubly singular nonlinearity and prove several Hölder regularity (up to the boundary) results regarding it. For the usual Laplace operator, Hölder regularity results for both singular and non-singular cases have been well understood since a very long time. Recently, nonlocal operators are also being studied on a large scale. Motivated by the Hölder and gradient Hölder regularity of such equations, we consider the operator $-\Delta_p u + (-\Delta)^s_q u = f(x)u^{-\delta}$ in Ω (a C^2-regular bounded domain in $\mathbb{R}^n$), where $1 < q \leq p < \infty$, $\delta > 0$ and $f \in L^\infty_{\text{loc}}(\Omega)$ is a non-negative function which behaves like $\mathbf{dist}(\mathbf{x}, \partial\mathbf{\Omega})^{-\beta}$, $\beta \geq 0$ near $\partial\Omega$.

A suitable notion of weak solutions has been defined for such mixed operators, and several Hölder and gradient Hölder regularity results for a more general class of quasilinear operators (with $\delta = 0$) have been proved. Using these, we deduce existence, uniqueness and Hölder regularity of a weak solution of the singular problem in $W^{1,p}_{\text{loc}}(\Omega)$ and its behavior near $\partial\Omega$ albeit with different exponents depending on $\beta + \delta$. Boundedness and Hölder regularity results for the singular equation with critical exponent perturbation were also discussed. This is a joint work with Dr. Kaushik Bal.

S01:02 **Speaker** : Arghya Mukherjee

Title: Computationally efficient Bayesian joint modeling of mixed-type high-dimensional multivariate spatial data

Abstract: Multivariate spatial data, comprising multiple responses recorded across geographically indexed observational units, is regularly collected in many disciplines. Recent research emphasizes the advantages of jointly modeling mixed-type responses, leading to more robust inference and improved prediction. Joint spatial modeling techniques bring two primary benefits: they make it possible to estimate association between variables that univariate models overlook, and they enhance prediction accuracy by incorporating dependencies among variables. This approach allows joint models to better account for random variation in the residuals by levera-

ging multiple layers of dependence. Despite extensive research in spatial statistics, most spatial generalized linear mixed-effect models have been confined to marginal modeling of univariate responses within the exponential family of distributions. Although joint modeling offers significant benefits, the development of methods for large-scale multivariate spatial data has been limited due to the computational demands of fitting latent multivariate Gaussian process (GP) models, which require substantial floating-point operations and memory. We propose a novel, computationally efficient methodology grounded in the Vecchia approximation for jointly modeling mixed-type responses using a latent multivariate GP framework within a Bayesian paradigm. Our approach employs a Markov chain Monte Carlo (MCMC) based inference method that utilizes a Metropolis-within-Gibbs sampling strategy with blocking, which enhances mixing and overall model performance. The proposed method offers substantial computational and inferential advantages over fitting separate models for each type of response. We illustrate the efficacy of the proposed method through numerical examples and application to real datasets.

S01:03 **Speaker** : Indrajyoti Gaine

Title: Type II intermittency route to hidden attractor in modified Lorenz system

Abstract: The location and basins of attraction of attractors involved in nonlinear smooth dynamical systems play a crucial role in understanding the dynamics of these systems across a wide range of parameter values. Nonlinear dynamical systems, described by autonomous nonlinear coupled ordinary differential equations with three or more variables, often exhibit chaotic dynamics within specific parameter ranges. In the literature, three distinct routes to chaos are well known: period doubling, crisis, and intermittency. However, traditional methods often fail to trace the emergence of attractors whose basins of attraction do not intersect with any open neighborhood of the equilibrium points. These attractors are known as the **Hidden attractors**. Interestingly, this kind of attractors also can exist in systems with no equilibrium point. Recent research in the field of nonlinear dynamical systems focuses on the characterization and identification of hidden attractors. In this talk, I will present an investigation into the dynamics of a modified Lorenz system (MLS), exhibiting a chaotic hidden attractor, with particular emphasis on the successive local and global bifurcations leading to the chaotic behavior.

S01:04 **Speaker** : Dr. Sourayan Banerjee

Title: K-theory over an n-exact category

Abstract : Quillen's definition of an exact category has played an instrumental role in the development of the higher K-theory. Later Waldhausen further generalized it, and through his $S_\cdot$-construction he defined that for a Waldhausen category $\mathcal{C}$,

$K_n(\mathcal{C}) \cong \pi_{n+1}|wS.\mathcal{C}|$. Since every exact category could be given a trivial Waldhausen category structure both Quillen's and Waldhausen's definitions are equivalent for any given exact category. Grayson, in one of his seminal articles in 2012 [**?**], described higher K-theory in terms of a quotient of an interesting Grothendieck group. To be specific he defined that for an exact category $\mathcal{N}$, that supports a long exact sequence, $K_n(\mathcal{N}) \cong K_0(B^{q^n}\mathcal{N})/T^n_{\mathcal{N}}$, for all $n \geq 1$, where $B^{q^n}\mathcal{N}$ was defined as the category of binary (multi) complexes over $\mathcal{N}$. Thus making it abundantly clear that for higher K-theory over an exact category $\mathcal{N}$, it was both necessary and sufficient to understand the group $K_0(B^{q^n}\mathcal{N})$. His proof heavily used the homotopy equivalence of loop spectra devised by Waldhausen, and the fact that any exact category is trivially Waldhausen. Thus in 2016, when G.Jasso [**?**] introduced the notion of n-abelian and n-exact categories which do not differ much from the classical definition of abelian and exact categories, there was always a natural question, i.e. "Can Grayson's technique be generalized for an n-exact category?"

In this talk first, we will go through the basics of higher dimensional analogs of the classical categories and then we will define an n-Waldhausen category in a way such that any n-exact category can be given a trivial n-Waldhausen category structure. Then we will provide a brief description of Grayson's technique for an exact category along with a few results derived using it and finally, we will show our progress regarding the $S.$-construction of an n-Waldhausen category which is a pivotal step in finding a satisfactory answer to our main question.

References

1 Daniel R. Grayson. "Algebraic K-theory via binary complexes". In: J. Amer. Math. Soc. 25.4 (2012), pp. 1149–1167. ISSN: 0894-0347,1088-6834. DOI: 10.1090/S0894-0347-2012- 00743-7.

2 Gustavo Jasso. "n-abelian and n-exact categories". In: Math. Z. 283.3-4 (2016), pp. 703– 759. ISSN: 0025-5874,1432-1823. DOI: 10.1007/s00209-016-1619-8.

S01:05 **Speaker** : Biplab Pal

Title: Von Neumann entropy of the angle operator between a pair of intermediate subalgebras

Abstract: Given a pair of intermediate C^*-subalgebras of a unital inclusion of simple C^*-algebras equipped with a conditional expectation of finite Watatani index, we will discuss the corresponding angle operator and its Fourier transform. Furthermore, we will see a calculable formula for the von Neumann entropy of the (Fourier) dual angle operator for a large class of quadruples of simple C^*-algebras. This is a joint work with K. C. Bakshi and S. Guin.

Session - 02 Venue: L14 *Time: 11:30 AM - 1:10 PM*

Chair : Prof. Kaushik Bal

S02:01 **Speaker** : Dr. Shilpa

Title: (p, q)**-fractional problems involving a sandwich-type perturbation and a critical Sobolev nonlinearity**

Abstract: In this talk, we deal with elliptic problems set on a general open domain Ω, driven by a (p, q)-fractional operator, involving a critical Sobolev nonlinearity and a nonlinear perturbation of sandwich type. More precisely, the subcritical term is intrinsically linked to the double (p, q)-growth of the main operator. Under different settings of involved parameters, we prove the existence and multiplicity results for our problems. For this, we combine topological tools and variational methods.

S02:02 **Speaker** : Sanjit Biswas

Title: Multiplicity of solutions to a degenerate elliptic equation in the sub-critical and critical cases

Abstract: In this talk, we discuss about the existence of multiple non-negative solutions of a degenerate elliptic equation with convex-concave nonlinearities in the sub-critical and critical cases. More specifically, for a given smooth bounded domain $\Omega \subset \mathbb{R}^N$, we deal with the following semilinear degenerate elliptic equation:

$$\left.\begin{aligned} -\Delta_\lambda u = \mu g(z)|u|^{r-1}u + h(z)|u|^{s-1}u \text{ in } \Omega, \\ u \in H_0^{1,\lambda}(\Omega), \end{aligned}\right\}$$

where $\Delta_\lambda = \Delta_x + |x|^{2\lambda}\Delta_y$ is the Grushin Laplacian operator, $z = (x, y) \in \Omega \subset \mathbb{R}^N$, $N = n + m$; $n, m \geq 1$, $\lambda > 0$, $0 \leq r < 1 < s < 2^*_\lambda - 1$; the functions g, h are of indefinite sign and $2^*_\lambda = \frac{2Q}{Q-2}$ is the critical Sobolev exponent, where $Q = n + (1 + \lambda)m$ is the homogeneous dimension associated to the operator Δ_λ. As for the critical case $s = 2^*_\lambda - 1$, we prove the existence of at least two non-negative solutions provided $g \geq 0$ and $h \equiv 1$.

S02:03 **Speaker** : Vivek Sahu

Title: Weighted fractional Hardy inequalities with singularity on any flat submanifold

Abstract: We derive weighted fractional Hardy inequalities with singularities on flat submanifolds of codimension k, where $1 < k < d$. Additionally, we investigate the critical case $sp = k + \alpha + \beta$ and establish a corresponding weighted fractional Hardy inequality incorporating an appropriate logarithmic weight function.

S02:04 **Speaker** : Damini Dhiman

Title: Efficient and accurate numerical computation of oscillatory integrals

Abstract: In many branches of applied mathematics, the evaluation of highly oscillating integrals plays a significant role. When the oscillation frequency is much more than the number of quadrature points, the numerical approximation suffers greatly in accuracy. A classic way of approximating these integrals is using Filon-type quadrature [1] which requires explicit moment calculation, which is not necessarily easy. To solve this underlying moment problem rapidly, in this paper, we propose a Filon-type quadrature for oscillatory integrals that effectively handles a variety of weak and strong singularities in the integrand. The method depends on the interpolating trigonometric polynomial approximation of the smooth non-oscillatory part of the integrand. However, if the function being approximated has a discontinuous periodic extension, such an approximation is inflicted with Gibb's oscillations. To overcome this difficulty, a periodic extension of the function is constructed, which is then approximated by the interpolating trigonometric polynomial [2], [3]. In fact, for several special singular weights, the proposed approach yields moment problems that can be solved analytically. Additionally, our method requires only discrete functional data on a uniform grid and no explicit knowledge of the derivatives is required to approximate the integral. Various numerical experiments, including oscillatory integrals with algebraic, logarithmic, and Cauchy singularities, have been presented to illustrate the effectiveness of the proposed quadrature.

References

1 Louis Napoleon George Filon, On a quadrature formula for trigonometric integrals, Proceedings of the Royal Society of Edinburgh 49 (1930), 38–47.

2 M. Garbey and D. Tromeur-Dervout, A new parallel solver for the nonperiodic incompressible Navier–Stokes equations with a Fourier method: Application to frontal polymerization, Journal of Computational Physics, 145 (1998), 316–331.

3 Akash Anand and Awanish K Tiwari, Fourier extension based numerical integration scheme for fast and high-order approximation of convolutions with weakly singular kernels, SIAM Journal on Scientific Computing 41.5 (2019), A2772–A2794.

Session - 03 Venue: L15 *Time: 11:30 AM - 1:10 PM*

Chair : Prof. Dootika Vats

S03:01 **Speaker** : Santu Bera

Title: A transference principle for Hardy spaces

Abstract: In this talk, we address the problem of constructing a Hardy space of a given domain in the d-dimesional Euclidean space. In particular, we provide an alternate approach to this problem based on the theory of reproducing kernel Hilbert spaces. In simple words, the main result allows us to construct a Hardy space $H^2(\Omega_2)$ from a known Hardy space $H^2(\Omega_1)$ of a domain Ω_1 in various situations in which Ω_2 is a 2-proper image of Ω_1. Another important aspect of this principle is that it gives a transformation formula relating to the reproducing kernels in question. This is a joint work with Sameer Chavan and Shubham Jain.

S03:02 **Speaker** : Dr. Shanola S Sequeira

Title: Compact operators: A series representation

Abstract: The spectral theorem for compact operators between Hilbert spaces is a classical result of great importance. In this talk, we generalize this result and discuss the representation of compact operators between reflexive Banach spaces.

S03:03 **Speaker** : Archita Gupta

Title: Tensor products and Gelfand modules of $\mathrm{GL}_2(\mathfrak{o}_\ell)$

Abstract: Let F be a non-Archimedean local field with ring of integers $\mathfrak{o}$, maximal ideal $\mathfrak{p}$, and finite residual field $\mathbb{F}_q$, where q is a power of an odd prime p. Let $l \geq 2$ be an integer. Define $\mathfrak{o}_\ell = \mathfrak{o}/\mathfrak{p}^l$ as the finite local principal ideal ring. Let $G = \mathrm{GL}_2(\mathfrak{o}_\ell)$ be the group of invertible 2×2 matrices over $\mathfrak{o}_\ell$, and let B be the standard Borel subgroup of G, consisting of upper triangular matrices.

In this talk, we demonstrate that the pair (G, B) forms a strong Gelfand pair. Additionally, we explore the structure and properties of the degenerate Gelfand-Graev modules for G. Next we discuss the tensor product problem for G and give some results on multiplicities of regular constituents of the tensor products of regular representations of G.

S03:04 **Speaker** : Dr. Tejbir Lohan

Title: Real adjoint orbits of linear Lie groups

Abstract: Let G be a Lie group with Lie algebra $\mathfrak{g}$, and consider the adjoint orbit $\{\mathrm{Ad}(g)X \mid g \in G\}$ of an element $X \in \mathfrak{g}$ under the adjoint representation $\mathrm{Ad} : G \mapsto \mathrm{GL}(\mathfrak{g})$. An element $X \in \mathfrak{g}$ is called Ad_G-real if there exists $g \in G$ such that $\mathrm{Ad}(g)X = -X$, and strongly Ad_G-real if this condition holds for an

involution $g \in G$. Classifying Ad_G-real and strongly Ad_G-real elements in a Lie algebra $\mathfrak{g}$ is a problem of broad interest. In this talk, we will provide a classification of these elements in the special linear Lie algebra $\mathfrak{sl}(n, \mathbb{C})$ and the symplectic Lie algebra $\mathfrak{sp}(2n, \mathbb{C})$. This is a joint work with Krishnendu Gongopadhyay and Chandan Maity.

Session - 04 Venue: L14 *Time: 2:15 PM - 3:55 PM*

Chair : Prof. Somnath Jha

S04:01 **Speaker** : Dr. Papi Ray

Title: A relationship between character values of wreath products and the symmetric group

Abstract: A relation between certain irreducible character values of the hyperoctahedral group B_n ($\mathbb{Z}/2\mathbb{Z} \wr S_n$) and the symmetric group S_{2n} was proved by F. Lübeck and D. Prasad in 2021, using Lie theory. In 2022, R. Adin and Y. Roichman proved a similar relation between certain character values of $G \wr S_n$ and S_{rn}, where G is an abelian group of order r (generalizing the result of Lübeck-Prasad) using combinatorial methods. We prove yet another relation between certain irreducible character values of $G \wr S_n$ and S_{rn}, where G is an abelian group of order r.

S04:02 **Speaker** : Abhishek Das

Title: On tensor product of representations of Lie superalgebras

Abstract: This talk will discuss about the unique decomposition of finite dimensional tensor product of representations of a basic classical simple Lie superalgebra. The problem asks that if we are given an isomorphism of representations, say, $V_1 \otimes \cdots \otimes V_k \cong W_1 \otimes \cdots \otimes W_k$, whether this information is sufficient for any conclusion about isomorphisms of the individual representations involved. It has a definitive answer for Lie algebras and Kac-Moody algebras. In case of a Lie superalgebra of the type mentioned above, we show that under a certain condition unique decomposition of tensor product holds, and for some particular class of representations, it is automatic.

S04:03 **Speaker** : Dr. Shamik Das

Title: A system of Diophantine equations

Abstract: In this talk, we will discuss two well-known problems related to systems of Diophantine equations. The first is the Congruent Number Problem, which concerns identifying natural numbers that appear as the area of a right triangle with rational sides. Specifically, we will focus on congruent numbers with at most two prime factors.

The second problem is the Cube Sum Problem. I will provide a brief introduction to this problem and present some results that establish connections between the cube sum problem and the class number of certain cubic number fields.

S04:04 **Speaker** : Abhishek Shukla

Title: 2**-Selmer companion modular forms**

Abstract: Given a prime p and two elliptic curves $\mathsf{E}_1, \mathsf{E}_2$ over a number field K, Mazur-Rubin have defined them to be p-Selmer companion curves if the p-Selmer groups of E_1^χ and E_2^χ over K are isomorphic for every quadratic character χ of K. For $p = 2$, they have given a set of sufficient conditions for E_1 and E_2 to be 2-Selmer companion over K in terms of the mod-4 congruence between E_1 and E_2 over K. In this talk, we discuss an analogue of this for modular forms at $p = 2$. Following a conjecture of Mazur-Rubin, it was shown by M. Yu that if E_1 and E_2 are Selmer *near*-companion over K at 2, then $\mathsf{E}_1[2]$ is isomorphic to $\mathsf{E}_2[2]$ as a G_K-module. Under certain hypotheses, we also discuss an analogue of this for modular forms at the prime $p = 2$.

Session - 05 Venue: L15 *Time: 2:15 PM - 3:55 PM*

Chair : Prof. Satya Prakash Singh

S05:01 **Speaker** : Ritesh Pandey

Title: Weyl modules for twisted toroidal Lie algebras

Abstract: In this talk, we extend the notion of Weyl modules for twisted toroidal Lie algebra $\mathcal{T}(\mu)$. We prove that the level one global Weyl modules of $\mathcal{T}(\mu)$ are isomorphic to the tensor product of the level one representation of twisted affine Lie algebras and certain lattice vertex algebras. As a byproduct, we calculate the graded character of the level one local Weyl modules of $\mathcal{T}(\mu)$.

S05:02 **Speaker** : Dr. Snehashis Mukherjee

Title: Braces and classification struggles

Abstract: Braces are algebraic structures introduced by W. Rump in relation to his work on set-theoretic solutions of the quantum Yang-Baxter equation. In this talk, we will address the problem of classifying braces of prime-power order, reviewing previously obtained results and exploring potential future directions.

S05:03 **Speaker** : Bhola Nath Saha

Title: Length of filling pairs on punctured surfaces

Abstract: A pair (α, β) of simple closed curves on an oriented surface $S_{g,n}$ of genus g and with n punctures is called a filling pair if the complement of the union of the curves is a disjoint union of topological disks with at most one puncture. In this

talk, we study the lengths of filling pairs on once-punctured hyperbolic surfaces. In particular, we find a lower bound of the lengths of filling pairs. Furthermore, we show that this lower bound is the best one which depends only on the topology of the surface. This is a joint work with Dr. Bidyut Sanki.

S05:04 **Speaker** : Achintya Dey

Title: Embedding of graphs on translation surfaces

Abstract: Embedding of a graph G on a translation surface is celluar if each complementary region is a topological disk and essential if all the regions are not topological disks. Here we are more focused on systolic embedding means each edge of the graph is associated with the shortest saddle connection of the translation surface. It has been shown that any graph can be essentially and systolically embedded on a translation surface and after that we show an upper bound for the genus of such kind of embedding surfaces for a given graph. Next we have developed the existence of cellular and systolic embedding for a specific class of graphs, a bouquet of n circles $\sum_n$, $n \geq 2$ on a translation surface and also compute the minimum and maximum genus $g_{\min}$ and $g_{\max}$ for this respectively. Finally, we have shown for every integer g such that $g_{\min} \leq g \leq g_{\max}$, $\sum_n$ can also be cellularly and systolically embedded on a translation surface of genus g

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Session - 06 Venue: L14 *Time: 4:10 PM - 5:25 PM*

Chair : Prof. Suprio Bhar

S06:01 **Speaker** : Nishith Mandal

Title: Geometry of horospheres and extension of biholomorphic map

Abstract: For a Kobayashi hyperbolic domain, Abate introduced the notion of small and big horospheres of a given radius at a boundary point with a pole. In my presentation, I shall present which domains have the property that closure of big horospheres and closure of small horospheres centered at a given point and of a given radius intersect the boundary only at that point? In this direction, I shall present three classes of domains that have the above propery. Finally, using the geometry of the horospheres, I present a result about the homeomorphic extension of biholomorphisms.

S06:02 **Speaker** : Mangala Prasad

Title: Finite element approximation of stochastic linear Schrödinger equation

Abstract: In this talk, we analyze semi-discrete finite element approximations of the Stochastic linear Schrödinger equation in a bounded convex polygonal domain

driven by additive Wiener noise. We use the finite element method for spatial discretization and derive an error estimate with respect to the discretization parameter of the finite element approximation. Finally, we validate and illustrate the theoretical error estimates through a concrete example.

S06:03 **Speaker** : Arvind Kumar Nath

Title: Invariant measure for linear stochastic PDEs in the space of tempered distributions

Abstract: We first explore exponential stability by using monotonicity inequality and use this information to obtain the existence of invariant measure for linear Stochastic PDEs with potential in the space of tempered distributions. The uniqueness of invariant measure follows from monotonicity inequality.

Session - 07 Venue: L15 *Time: 4:10 PM - 5:25 PM*

Chair : Prof. Arnab Hazra

S07:01 **Speaker** : Sanjay Kumar

Title: Divergence-based robust inference for the Marshall-Olkin bivariate exponential distribution

Abstract: Statistical modeling of bivariate data sets with ties is an active research area in the literature. The most common model fitted to such data sets is the Marshall-Olkin bivariate exponential (MOBE) distribution. As bivariate data sets often contain outliers and maximum likelihood estimation (MLE) is highly sensetive to outliers, it is crucial to use robust parameter estimation procedure. We use the widely adopted minimum density power divergence estimation (MDPDE) method, for robust and efficient estimation of the MOBE parameters. We derive analytical expressions for the estimating equations and the asymptotic distributions of the MDPDE. We compare the asymptotic covariance of MDPDE with the Fisher information matrix. Besides, we study the asymptotic relative efficiency of MDPDE. The influence function of MDPDE for the MOBE model is bounded that ensure the robustness of MDPDE compared to the MLE. We discuss the data-driven procedure for the optimal tuning parameter selection. We apply the proposed technique to a real data set. The results indicate superior performance of the MDPDE compared to the MLE, specially in the presence outliers

S07:02 **Speaker** : Anjali Mittal

Title: On weighted least squares estimation of elementary chirp model

Abstract: Elementary chirp signals can be found in various fields of science and engineering. We consider the estimation of the parameters of the multiple component

elementary chirp model based on weighted least squares estimators (WLSEs). Recently, least squares estimators (LSEs) were proposed to estimate the parameters of the elementary chirp model. However, it has been observed that LSEs are quite sensitive to outliers. The least absolute deviation estimators and Huber's M-estimators are the robust estimators for estimation in the presence of outliers. However, computing these robust estimators is numerically challenging, and deriving their statistical properties is not straightforward under the same error assumption as the LSEs. We prove the strong consistency and asymptotic normality of the WLSEs under the same error assumptions as those of the LSEs. We have also considered sequential WLSEs to estimate the parameters, which are less computationally involved and have the same asymptotic properties as the WLSEs. We also discuss the choice of weight function, as the performance of the proposed estimators depends on the weight function. For illustration, we have analyzed a real data set.

S07:03 **Speaker** : Ojasvi Rajput

Title: Discriminating between Weibull and log-normal distributions in the presence of hybrid censoring

Abstract: The Weibull and log-normal distributions are two of the most commonly used distributions for analyzing lifetime data. Both distributions share several interesting properties, and for a certain range of parameters, their cumulative distribution functions can be similar. However, selecting the more appropriate distribution is crucial.

When data are observed under some censoring scheme, the problem becomes more challenging. It is assumed that the data comes either from log-normal or Weibull distributions and are hybrid censored (considering both Type-I and Type-II hybrid censoring). We use the difference between the maximized log-likelihood functions (DML) to discriminate between the two distribution functions. Additionally, we employ the Bayesian decision criterion for this problem.

We derive the asymptotic distribution of the DML statistic to determine the probability of correct selection and to calculate the minimum sample size required for this discrimination process. Simulation studies are performed to observe how the asymptotic results work for different sample sizes, degrees of censoring, and choices of censoring time. The asymptotic results work quite well even for moderate sample sizes.

Furthermore, we study the effect of model misspecification on the p-th quantile, mean residual life, and prediction for future failures.

Thank You!