

Graduate Research Forum (2025-2026)

Department of Mathematics

University of Connecticut

Sponsored by Mathematical Science Research Collaboratory and the Graduate Program

All Students' talks are for 20 minutes plus 5 minutes for questions

May 2, 2026, Monteith 104

| Schedule | |
|-----------------|--|
| 8:40-9:00am | Coffee and Social |
| 9:00-9:10am | Opening remarks by Ambar Sengupta |
| 9:10-9:35am | Dion Mann |
| 9:40-10:05am | Yukta Lodha |
| 10:10-10:35am | Alec Wendland |
| 10:35-11:05pm | Coffee break and Social |
| 11:10-11:35pm | Benjamin Grant |
| 11:40-12:05pm | Andrey Russanov |
| 12:10-12:35pm | Jacob Brown |
| 12:35-1:25pm | Working Lunch Break |
| 1:30-1:55pm | Xiaohang Ma |
| 2:00-2:25pm | Chinmay Dharmendra |
| 2:30-2:55pm | Yihao Sheng |
| 2:55-3:25pm | Coffee break and Social |
| 3:30-3:55pm | Caylee Spivey |
| 4:00-4:25pm | Yuxiao Fu |
| 4:30-5:15pm | Krystnya Serhiyenko |
| 5:15-5:20pm | Concluding Remarks |
| 5:20pm- | Discussions, Social and Working Dinner |

Speaker: Jacob Brown

Title: Rigorous, High-Order Dimension Estimates for Continued Fraction Fractals via B-Splines

Abstract: We develop a method for the rigorous estimation of Hausdorff dimensions of limit sets produced by continued fraction iterated function systems in \mathbb{R}^d . Our method is based on the approximation of a Perron-Frobenius operator using the finite element method with B-splines as our choice of basis functions. We discuss key numerical advantages of this choice, including higher-order convergence and increased computational flexibility compared to previous methods. We provide numerical results to verify both

the rigor and high-order convergence of our method using quadratic B-spline interpolants for various examples in one and two dimensions.

Speaker: Chinmay Dharmendra

Title: Combinatorics of Okada arc diagrams

Abstract: In 1988 Stanley described the Young-Fibonacci lattice, a lattice that shares many properties with the Young's lattice. The Young's lattice appears as the Bratteli diagram of the symmetric group algebra, Okada in 1993 described a family algebra whose dimension is $n!$, and has the Young-Fibonacci Lattice as its Bratteli diagram. In 2024 Hivert and Scott realized the Okada algebra as a diagram algebra; the basis elements of the algebra are represented via decorated non-crossing arc diagrams. They construct a natural bijection between permutations and these arc diagrams using Fomin's variation of the Robinson-Schensted algorithm. Many results are known in the Robinson-Schensted algorithm where small variations in the permutation preserve certain properties of the resultant tableaux. In this talk we will present similar results in the context of this bijection from permutations to Okada arc diagrams. We will define equivalence classes of permutation that preserve the shape of the arc diagram, and describe certain moves on permutations that act on the arc diagrams in predictable ways via this bijection.

Speaker: Yuxiao Fu

Title: The Weihrauch Classification of Embeddability

Abstract: This talk presents an ongoing project on the classification of Weihrauch problems associated with embeddability for countable structures. I will discuss recent results for several natural classes of relational structures and highlight two general techniques that arise in establishing these classifications.

Speaker: Benjamin Grant

Title: Topologizing infinite quivers and their mutations

Abstract: A quiver is a directed multigraph with no loops or oriented 2-cycles. Quivers are the basic combinatorial objects needed to define cluster algebras; the dynamics of cluster algebras are governed by certain locally-defined transformations between quivers called mutations. While most instances of cluster algebras involve finite quivers and finite sequences of mutations, it is natural

to inquire about infinite quivers and (finite or infinite) sequences of mutations performed on them. Using tools and techniques from mathematical logic, we develop a topological approach to countably infinite quivers and their mutations. We use this topological framework to establish a number of basic structural results concerning infinite mutation sequences and mutation-invariant properties of quivers. We also prove some seemingly paradoxical results about a certain highly-symmetric infinite quiver which we call the Fraïssé quiver.

Speaker: Yukta Lodha

Title: Heisenberg Uncertainty Principle and its stability on orthant

Abstract: We establish sharp Heisenberg Uncertainty Principles on orthants by explicitly computing the optimal constants and characterizing all extremal functions. We also prove stability estimates on half-spaces and orthants, quantifying deviations from extremality.

Speaker: Xiaohang Ma

Title: Bayesian Inverse Problem with Diffusion Based Prior and Applications in Power System Calibration

Abstract: Accurate dynamic models for Inverter-Based Resources (IBRs) are critical for modern grid reliability, but parameter calibration remains a challenging computational task. Due to highly nonlinearity and the ill-posed inverse problem. Existing methods typically suffer from prohibitive computational costs or get trapped in metastable states. To overcome this, we introduce a novel Diffusion Score Matching Variational Inference (DSM-VI) framework that formulates the sampling process as a stochastic optimization problem. Our approach characterizes the smoothed split Gibbs prior via a diffusion process and utilizes the estimated diffusion score function to compute the Kullback-Leibler divergence. This framework allows efficient iterative solvers to capture robust parameter solutions, bypassing the heavy sampling burden of traditional gradient-based methods. Numerical experiments on a high-fidelity solar PV model demonstrate the enhanced accuracy and computational efficiency of our method in identifying critical control parameters. This work is based on collaborative research conducted with the Interdisciplinary Science Department at Brookhaven National Laboratory.

Speaker: Dion Mann

Title: Holonomic Gauge Theory, Path Spaces, and the Universal Connection in Diffeology

Abstract: Motivated by holonomy-based approaches to gauge theory and the need for smooth structures on path spaces, we develop a universal construction for principal bundles with connection in the category of diffeological spaces. For a pointed, path-connected diffeological space (X, \bullet) and a smooth homomorphism $H : \Omega X \rightarrow G$ from a certain group of loops based at \bullet , we construct a diffeological principal G -bundle with a diffeological connection whose holonomy realizes H . The construction is an adaptation of Singer's path spaces and its universal connection, reinterpreted in the diffeological setting where path spaces naturally carry smooth structures. We prove a reconstruction theorem asserting that diffeological principal G -bundles with the same holonomy are isomorphic, extending classical results of S. Kobayashi and J. Barrett beyond manifolds. These results provide a rigorous foundation for holonomic gauge theory on generalized smooth spaces, naturally including path spaces relevant to higher gauge theory.

Speaker: Andrey Russanov

Title: Functional Inequalities under Curvature Dimension Condition

Abstract: We will use Bakry-Emery Gamma calculus methods to establish various functional inequalities such as Poincaré, Logarithmic Sobolev, and others with weighted Gaussian measure. We will discuss the advantages of this method compared to the classical techniques for Gaussian measure. Finally we will look at several applications such as stability of Poincaré Inequality and a Euclidean Log Sobolev inequality with homogeneous measure.

Speaker: Yihao Sheng

Title: Systems of Singularly Perturbed Forward-Backward Stochastic Differential Equations and Control Problems

Abstract: "This paper focuses on systems of singularly perturbed forward-backward stochastic differential equations (FBSDEs) and control problems. Assuming Lipschitz continuity on the coefficients and allowing degeneracy in the diffusion terms, the solution of a two-time-scale FBSDE is shown to converge to the solution of an averaged FBSDE as a small parameter tending to zero. Moreover, it is shown that the value function of the singularly perturbed systems converges to the solution of a nonlinear partial differential equation

(PDE). Furthermore, under additional conditions, it is demonstrated that the solution of the limit PDE is in fact the limit value function. These results provide insights into the convergence rate and extend existing results on the averaging principles for such stochastic control problems.

Speaker: Caylee Spivey

Title: The 2-power divisibility of $2 + \frac{2^2}{2} + \dots + \frac{2^n}{n}$

Abstract: It is a classic exercise in p -adic analysis to show the rational number $S(n) = 2 + \frac{2^2}{2} + \dots + \frac{2^n}{n}$ is highly divisible by powers of 2 as $n \rightarrow \infty$, meaning the power of 2 in its numerator grows with n . For example, $S(10) = \frac{2^{10} \cdot 73}{315}$. The “standard” way of proving this result uses properties of the 2-adic logarithm, but since each term in the sum is in \mathbb{Q} , it is natural to ask for a proof of the increasing 2-power divisibility of $S(n)$ as $n \rightarrow \infty$ that does not rely on 2-adic logarithms. There is such a proof that shows the 2-power divisibility of $S(n)$ is bounded below by $\log_2(n)$ (a real base 2 logarithm), however data suggest this lower bound is far ideal.

We will see there is a much higher lower bound on the 2-power divisibility of $S(n)$ that grows like n rather than $\log_2(n)$, and this improved lower bound equals the 2-power divisibility infinitely often. Time permitting, we will see how this result generalizes with the role of 2 replaced by an arbitrary prime power.

Speaker: Alec Wendland

Title: Polar director structures in ferroelectric bent-core liquid crystals under an electric bias field

Abstract: We study a continuum free-energy model for a thin planar cell of bent-core liquid crystals in the ferroelectric smectic-A (SmAP_F) phase. *Minimization of the energy yields a Lagrange boundary value problem governing the polarization direction. We establish an existence and*