

The Analysis Seminar

Fourier

The seminar meets Wednesdays in WH-100E at 4:00-5:00 p.m. There are refreshments and snacks in WH-102 at 3:15.

Organizers:

Faculty: Paul Loya, David Renfrew, Minghao Rostami, Emmett Wyman, Xiangjin Xu, Ziyao Xu and Gang Zhou

Post-Docs: Rohan Sarkar

Previous talks

- [Fall 2014 to Spring 2025](#)

Fall 2025

* **August 20th, Wednesday** (4:00-5:00pm)

Speaker :

Topic: organizational meeting

* **September 10th, Wednesday** (4:00-5:00pm)

Speaker : Rohan Sarkar(Binghamton)

Topic: Spectrum of Lévy-Ornstein-Uhlenbeck semigroups on \mathbb{R}^d

Abstract: We investigate spectral properties of Markov semigroups associated with Ornstein-Uhlenbeck (OU) processes driven by Lévy processes. These semigroups are generated by non-local, non-self-adjoint operators. In the special case where the driving Lévy process is Brownian motion, one recovers the classical diffusion OU semigroup, whose spectral properties have been extensively studied over past few decades. Our main results show that, under suitable conditions on the Lévy process, the spectrum of the Lévy-OU semigroup in the L^p -space weighted with the invariant distribution coincides with that of the diffusion OU semigroup. Furthermore, when the drift matrix B is diagonalizable with real eigenvalues, we derive explicit formulas for eigenfunctions and co-eigenfunctions. A key ingredient in our approach is intertwining relationship: we prove that every Lévy-OU semigroup is intertwined with a diffusion OU semigroup, thereby preserving the spectral properties.

* **September 17th, Wednesday** (4:00-5:00pm)

Speaker : Ziyao Xu (Binghamton)

Topic: A Conservative and Positivity-Preserving Discontinuous Galerkin Method for the Population Balance Equation

Abstract: We develop a conservative, positivity-preserving discontinuous Galerkin (DG) method for the population balance equation (PBE), which models the distribution of particle numbers across particle sizes due to growth, nucleation, aggregation, and breakage. To ensure number conservation in growth and mass conservation in aggregation and breakage, we design a DG scheme that applies standard treatment for growth and nucleation, and introduces a novel discretization for aggregation and breakage. The birth and death terms are discretized in a symmetric double-integral form, evaluated using a common refinement of the integration domain and carefully selected quadrature rules. Beyond conservation, we focus on preserving the positivity of the number density in aggregation-breakage. Since local mass corresponds to the first moment, the classical Zhang-Shu limiter, which preserves the zeroth moment (cell average), is not directly applicable. We address this by proving the positivity of the first moment on each cell and constructing a moment-conserving limiter that enforces nonnegativity across the domain. To our knowledge, this is the first work to develop a positivity-preserving algorithm that conserves a prescribed moment. Numerical results verify the accuracy, conservation, and robustness of the proposed method.

* **September 24th, Wednesday** (4:00-5:00pm)(Rosh Hashanah)

Speaker : Rosh Hashanah break

Topic:

* **October 1st, Wednesday** (4:00-5:00pm) (Yom Kippur)

Speaker: Yom Kippur break

Topic:

* **October 8th, Wednesday** (4:00-5:00pm)

Speaker: Prof. Lixin Shen (Syracuse University)

Topic: Explicit Characterization of the $\|\cdot\|_p$ Proximity Operator for $0 < p < 1$

Abstract: The nonconvex $\|\cdot\|_p$ quasi-norm with $0 < p < 1$ is a powerful surrogate for sparsity but complicates the evaluation of proximal maps that underpin modern algorithms. In this talk we give an explicit characterization of the scalar proximal operator of $|\cdot|^p$ for all $0 < p < 1$, including the structure and admissible ranges of global minimizers and

conditions ensuring strict, isolated solutions. By applying the Lagrange-Bürmann inversion formula to the stationarity equation, we derive a uniformly convergent series for the larger positive root, yielding an exact and numerically stable formula for the $\|\cdot\|_p$ proximal map above the classical threshold. We further provide a Mellin-Barnes integral representation and identify the series as a Fox-Wright function, which determines its radius of convergence. Specializations recover the known closed forms for $p=\frac{1}{2}$ and $p=\frac{2}{3}$, and we supply compact hypergeometric expressions for additional rational cases (e.g., $p=\frac{1}{3}$). These results unify scattered formulas into a single framework and enable high-accuracy evaluation of $\|\cdot\|_p$ proximity operators across the full range $0 < p < 1$.

* **October 22nd, Wednesday** (4:00-5:00pm)

Speaker:

Topic:

* **October 30th, Thursday(Special date)** (4:00-5:00pm)

Speaker: Zengyan Zhang (Penn State)

Topic: Geometric local parameterization for solving Hele-Shaw problems with surface tension

Abstract: With broad applications in biology, physics, and material science, including tumor growth and fluid interface dynamics, the Hele-Shaw problem with surface tension provides a canonical model for studying the dynamics of evolving interfaces. Solving such problems requires precise treatment of sharp boundaries. However, constructing a global parameterization for complicated surfaces and explicitly tracking boundary motion is challenging. In this work, we present a geometric local parameterization approach for efficiently solving the two-dimensional Hele-Shaw problems, where the boundary is identified only from randomly sampled data. Through convergence and error analysis, as well as numerical experiments, we demonstrate the capability and effectiveness of our approach in resolving complex interface evolution.

November 5th, Wednesday (4:00-5:00pm)

Speaker: Yuanyuan Pan (Syracuse University)

Topic: On the Spectral Geometry and Small-Time Mass of Anderson Models on Planar Domains

Abstract: We consider the Anderson Hamiltonian (AH) and the parabolic Anderson model (PAM) with white noise and Dirichlet boundary condition on a bounded planar domain $D \subset \mathbb{R}^2$. We compute the small- t asymptotics of the AH's exponential trace up to order $O(\log t)$, and of the PAM's mass up to order $O(t \log t)$. Applications of our main result include the following:

- (i) If the boundary ∂D is sufficiently regular, then D 's area and ∂D 's length can both be recovered almost surely from a single observation of the AH's eigenvalues.
- (ii) If D is simply connected and ∂D is fractal, then ∂D 's Minkowski dimension (if it exists) can be recovered almost surely from the PAM's small- t asymptotics.
- (iii) The variance of the white noise can be recovered almost surely from a single observation of the AH's eigenvalues.

* **Room 309, November 20th, Thursday** (4:00-5:00pm) (Special room and time)

Speaker: Brian Kirby(Binghamton University)

Topic: Compactifying the Manifold given by the Schwartzchild Metric

Abstract: Consider the metric in \mathbb{R}^4 given by $ds^2 = f(r)dt^2 - 1/f(r)dr^2 - r^2 d\theta^2$, where g is the standard Riemannian metric in \mathbb{R}^2 , $f(r) = \phi(r)(r - r_0)$, where ϕ is a continuous, differentiable, positive function on \mathbb{R} . We will construct the Penrose diagram (the compactified manifold) for the given metric via coordinate changes and compactification. We will then discuss extensions to topological Penrose Diagrams and metric functions with an arbitrary number of roots, if time permits.

* **November 26th, Wednesday** (4:00-5:00pm) (Thanksgiving Break)

Speaker: Thanksgiving Break

Topic:

* **December 3rd, Wednesday** (4:00-5:00pm)

Speaker: Job interview

Topic:

Abstract:

Spring 2026

* **January 21st, Wednesday** (4-5pm)

Speaker :

Topic: organizational meeting

Abstract:

* **January 28th, Wednesday** (4-5pm)

Speaker : Chad Nelson (Binghamton University)

Topic:

Abstract:

* **February 4th, Wednesday** (4-5pm)

Speaker : TBD

Topic:

Abstract:

* **February 11th, Wednesday** (4-5pm)

Speaker :

Topic:

Abstract:

* **February 18th, Wednesday** (4-5pm)

Speaker :

Topic:

Abstract:

* **February 25th, Wednesday** (4-5pm)

Speaker :

Topic:

Abstract:

* **March 4th, Wednesday** (4-5pm)

Speaker :

Topic:

Abstract:

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* **March 11th, Wednesday** (4-5pm)

Speaker :

Topic:

Abstract:

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* **March 18th, Wednesday** (4-5pm)

Speaker:

Topic:

Abstract:

* **March 25th, Wednesday** (4-5pm)

Speaker: Yiming Zhao(Syracuse University)

Topic: TBD

Abstract:

* **April 1st, Wednesday** (4-5pm)

Speaker: Spring Break

Topic:

Abstract:

* **April 8th, Wednesday** (4-5pm)

Speaker:

Topic:

Abstract:

* **April 15th, Wednesday, 4:00-5:00pm**

Speaker:

Topic:

Abstract:

* April 22th, Wednesday **(4-5pm)**

Speaker:

Topic:

Abstract:

* April 29th, Wednesday **(4-5pm)**

Speaker:

Topic:

Abstract:

* May 6th, Wednesday **(4-5pm)**

Speaker:

Topic:

Abstract:

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