# Xinran Yu

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# Education

University of Illinois Urbana-Champaign (UIUC), Champaign, IL

Ph.D in Mathematics: Expected May 2026
Research Focus: Conformal geometry, Modifying Einstein's Theory of General Relativity.

University of Liverpool, Liverpool, UK

BSc in Mathematics with Honors
Thesis: Analytic Continuation and Riemann Surfaces. Supervisor: Dr. Jon Woolf.

Xi'an Jiaotong-Liverpool University, Suzhou, China

2019–2026

2015–2017

BSc in Applied Mathematics

# **Preprints**

#### Properties of Conformally Compact Lovelock Metrics

2025

This paper explores the properties of conformally compact Lovelock metrics, confirming through elliptic regularity that a formal polyhomogeneity expansion is achieved for metrics close to the hyperbolic ball. It also examines obstructions to polyhomogeneity, the singular Yamabe-2q problem, and the metric filling problem for spin manifolds.

Witten Instanton Complex and Morse-Bott Inequalities on Stratified Pseudomanifolds with Gayana Jayasinghe and Hadrian Quan, arxiv 2412.12003

2024

# Projects

Analysis of US Mortality Data, Internship network in the mathematical sciences, UIUC

Feb 2025

- Performed data cleaning, exploratory analysis, and visualization to highlight mortality trends using Python.
- Built predictive models (decision trees, random forests, KMeans, neural networks) to explore causes of death.

Bird-Aircraft Collision, Internship network in the mathematical sciences, UIUC

Nov 2024

- Conducted statistical analysis, including multi-linear regression, log regression, and hypothesis testing.
- Modeled damage cost versus altitude and number of strikes using Python.

# Safety Analysis of Autonomous Vehicles, ECE471 mini project, UIUC

Sep 2024

- Analyzed AV safety using simulated data from Carla and real-world data from the California DMV.
- Used statistical analysis, Bayesian inference, and data visualization to assess and improve AV reliability.

# Goodreads Data Analysis, PI4 Bootcamp, UIUC

June 2020

- Analyzed reading patterns and book rating trends in **Python**.
- Revealed insights into user behavior and preferences.

# Technical Skills

Programming Languages: Python (NumPy, Pandas, Matplotlib, Scikit-learn, PyTorch, Statsmodels, Seaborn),
Mathematica

Data Analysis & Modeling: statistical analysis, Partial Differential Equations, machine learning

Languages: English (fluent), German (translation project experience),

Japanese (intermediate), Chinese (native)

# Honors & Awards

Susan C. Morisato IML Scholarship, UIUC

Summer 2025

Ruth V Shaff & Genevie I. Andrews Fellowship, UIUC

Spring 2024

Teachers Ranked as Excellent by their Students, UIUC

Spring and Fall 2021

Wills Prize in Mathematics, University of Liverpool

Jul 2017

IMA Prize, University of Liverpool

Jul 2017

# Teaching & Mentoring

#### Instructor, Calculus II, UIUC

Spring 2025 & 2022

- Delivered three weekly lectures, covering integral calculus, sequences, and series.
- Designed and managed course materials, including syllabus, assignments, quizzes, and exams.
- Provided student support through office hours, in-class discussions, and supplementary resources.

#### Translation Project, Mathematics Library, UIUC

2024

- Revised and edited translations of the early 20th-century M. Schilling catalog from German to English.
- Collaborated with library staff to validate the documentation of mathematical models in Altgeld Hall.

#### Graduate Team Leader, Illinois Math Lab, UIUC

2024-2025

Project: Historical Mathematical Models

Recipient of the Nancy D. Anderson Undergraduate Research Award

- Collaborated with the University Library to catalog one of the worlds largest mathematical model collections.
- Created detailed descriptions for the math librarys digital catalog using **Mathematica** to support public online exhibits and long-term accessibility.
- Developed educational materials and 3D print files for an outreach initiative aimed at promoting mathematical visualization.

#### Graduate Team Leader, Illinois Geometry Lab, UIUC

Fall 2019

Project: Simulating Multi-Soliton Solutions to NLS and KdV and Studying Interactions

- Simulated multi-soliton solutions to the nonlinear Schrdinger (NLS) equation with nonzero boundary conditions
- Used **Python** for data visualization and model creation.
- Supervised mid-semester presentation and open house event and led final report.

#### Teaching Assistant, UIUC

2019-present

- Led discussion sections for introductory and advanced Calculus courses.
- Offered individualized support to students and tutored Differential Equations with a focus on problem-solving.

### **Talks**

Dirichlet-to-Neumann map for conformally compact Einstein metrics Graduate Student Geometry and Topology Seminar at UIUC	Oct 2024
Conformal geometry in Lovelock gravity theories AWM Graduate Student Colloquium at UIUC	Apr 2024
The fractional Laplacian through Dirichlet problem formulation Graduate Geometry and Analysis Seminar at UIUC	Feb 2024
The ambient obstruction tensor Graduate Geometry and Analysis Seminar at UIUC	Feb 2023
Introduction to Einstein-Maxwell equations Graduate Geometric Analysis Seminar at UIUC	Oct 2022
The renormalized volume of conformally compact Einstein manifolds Graduate Geometric Analysis Seminar at UIUC	Oct 2022
Einstein filling on hyperbolic ball Graduate Analysis Seminar at UIUC	Feb 2022
The Yamabe problem Graduate Geometry and Topology Seminar at UIUC	Apr 2021

# Services & Enrichment

### Microlocal Analysis and Quantum Dynamics 2024

Summer 2024

Northwestern summer school

# International TA Panel Panelist, UIUC

Aug 2022

- Shared strategies for overcoming language barriers and improving communication as an international TA.
- Compared teaching practices between the U.S. and other countries, emphasizing adaptability.
- Offered advice on navigating cultural differences in academic expectations and classroom management.