

Mingkai Yu, Ph.D.

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Education

University of Maryland, Baltimore County

Ph.D. in Applied Mathematics

Baltimore, MD

Aug 2016 – Aug 2023

Shandong University

Bachelor of Science in Mathematics

Jinan, China

Aug 2012 – Jun 2016

Skills

Programming skills: MATLAB, Python, C/C++, R, Linux, GitHub, LaTeX.

Math skills: Numerical analysis, applied probability, mathematical modeling, optimization, differential equations.

Data science skills: Machine learning, statistical modeling and simulation, Bayesian methods, data visualization.

Leadership skills: Teaching, communication and collaboration, project management, grant writing.

Research Experience

University of Maryland, Baltimore County, advisor Dr. Muruhan Rathinam

State and parameter estimation in stochastic reaction networks

Baltimore, MD

Jan 2019 – Aug 2023

- Mathematically formulated the filtering equation that describes the conditional distribution of hidden molecular species in continuous-time stochastic reaction networks. Formulated and proved a novel filter (Targeting Algorithm) in discrete-time reaction networks.
- Developed weighted Monte Carlo particle filters with resampling to estimate hidden states and unknown parameters.
- Implemented the algorithms in a MATLAB package and applied them to biological systems (genetic circuits, genetic toggle switches, and the SEIR model) to evaluate accuracy.

Analysis and Simulation of Fluorescence Correlation Spectroscopy

Jan 2019 – Dec 2019

- Analyzed the physical mechanisms of fluorescently labeled molecules undergoing reflected Brownian motion in a confocal volume to infer diffusivity and molecular concentration.
- Derived a closed-form upper bound for the variance of time-averaged autocorrelation estimators to quantify uncertainty.
- Evaluated multiple nonlinear least-squares fitting options via Monte Carlo simulations and conducted sensitivity analysis.

Publications

1. Muruhan Rathinam and Mingkai Yu, “State and parameter estimation from exact partial state observation in stochastic reaction networks.” *The Journal of Chemical Physics*, **154.3**, 2021, p. 034103.
2. Muruhan Rathinam and Mingkai Yu, “Stochastic Filtering of Reaction Networks Partially Observed in Time Snapshots.” *Journal of Computational Physics*, 2024, p. 113265.

Presentations

1. ICM@ICM 2026 Satellite Conference, Morgan State University (June 2, 2026), *Estimating Hidden Dynamics in Stochastic Reaction Networks from Partial Observations*. (slides)
2. CIMBRE Symposium Poster (April 24, 2026), *Estimating Hidden Dynamics in Stochastic Reaction Networks from Partial Observations*.

3. Mid-Atlantic Numerical Analysis Day (October 28, 2022), *State and parameter estimation from exact partial state observation in stochastic reaction networks*.
4. Sayas Numerics Day 2022 (Sept. 17, 2022), *State and parameter estimation from exact partial state observation in stochastic reaction networks*.
5. SIAM Conference on Applications of Dynamical Systems (May 23, 2021), *State and parameter estimation from exact partial state observation in stochastic reaction networks*.
6. Graduate Student Seminar (Nov 11, 2020), *State and parameter estimation from exact partial state observation in stochastic reaction networks*.
7. Differential Equations Seminar (Nov 2019), *Analysis and Simulation of Fluorescence Correlation Spectroscopy*.
8. Graduate Student Seminar (Oct 2019), *Analysis and Simulation of Fluorescence Correlation Spectroscopy*.
9. Graduate Student Seminar (Oct 2018), *Homogenization of a Random Walk on a Graph to predict Diffusivity in Obstructed Media*.
10. Graduate Student Seminar (Nov 2017), *The random time change representation of stochastic chemical systems*.
11. Graduate Student Seminar (Mar 2017), *Stability Analysis of Swarms*.

Awards

- Outstanding Graduate Research in Mathematics, College of Natural and Mathematical Sciences, UMBC, Apr 2021.

Work Experience

Melchizedek Education and Research Institute

Program Manager and Researcher

Rockville, MD

Sept 2024 – present

- Lead a STEM mentorship program for Title I middle school students in Montgomery County developing their science fair projects. Conduct pedagogical research and program evaluation.
- Develop grant proposals and strategic content to expand organizational reach and funding capacity.
- Cultivate partnerships with community organizations, universities, and corporate sponsors.

Qualytics (a data quality startup)

Intern (Data Scientist)

Baltimore, MD

June – July 2021

- Applied machine learning methods for anomaly detection in seasonal time-series data.

CAS – MPG Partner Institute for Computational Biology

Intern (REU Student Researcher)

Shanghai, China

Jan 2016 – Jun 2016

- Built a pipeline connecting bioinformatics software for plant RNA-seq data on a lab server.

Teaching Experience

University of Maryland, Baltimore County

Baltimore, MD

2024 Spring: Instructor, Math 152 Calculus II; Math 151 Calculus I

2023 Fall: Instructor, Math 151 Calculus I

2023 Summer: TA, Math 290 Special Topics (with Dr. Animikh Biswas)

2022 Fall: Instructor, Math 150 Precalculus; Math 152 Calculus II

2022 Summer: TA, Math 290 Special Topics (with Dr. Animikh Biswas)

2022 Spring: TA, Math 301 Mathematical Analysis (with Dr. Manil Suri); Grader, Math 452 Intro Stochastic Processes (with Dr. Muruhan Rathinam)

2021 Fall: TA, Math 251 Multivariate Calculus (with Dr. Michael Galbraith)

2021 Summer: Instructor, Math 152 Calculus II

2020 Fall: TA, Math 251 Multivariate Calculus (with Dr. Michael Galbraith)

2020 Summer: TA, Math 150 Precalculus (with Mrs. Raji Baradwaj and Dr. Mark Ramos)

2020 Spring: TA, Math 150 Precalculus (with Dr. Brian Dean)

2019 Fall: TA, Math 150 Precalculus (with Dr. Brian Dean)
2019 Summer: TA, Math 152 Calculus II (with Dr. Michael Galbraith)
2019 Spring: TA, Math 151 Calculus I (with Mrs. Bonny Tighe)
2018 Fall: TA, Math 151 Calculus I (with Dr. Kalman Nanes)
2018 Spring: TA, Math 152 Calculus II (with Dr. Sean Colbert-Kelly)
2017 Fall: TA, Math 251 Multivariate Calculus (with Dr. Michael Galbraith)
2017 Summer: TA, Math 150 Precalculus (with Dr. Zois Boukouvalas)
2017 Spring: TA, Math 151 Calculus I (with Dr. Kalman Nanes)
2016 Fall: TA, Math 150 Precalculus (with Dr. Brian Dean); Grader, Math 385 Mathematical Modeling (with Dr. Michael Galbraith)

Workshops/Hackathons

Graduate Student Mathematical Modeling Camp

Group Project: *Flow and Fouling in Elastic Membrane Filters (Report)*

Newark, DE

Jun 12 – 15, 2019

Mathematical Problems in Industry Workshop

Group Project: *Using Image Analysis to Characterize Fibril Porous Media (Report)*

Newark, NJ

Jun 17 – 21, 2019

Certificate

- An Introduction to Evidence-Based Undergraduate STEM Teaching (CIRTL Network), *Nov 2021*.
- Machine Learning (Stanford University, Coursera), *Sept 2018*.

Service

- Volunteer in AI Circles (peer-led AI learning community), *Apr 2026 – present*.
- Judge at DC STEM Fair, *Mar 2026*.
- Judge at Montgomery County Science Fair, *Mar 2026, Apr 2025, Apr 2024*.
- Volunteer in Division C Science Olympiad at UMBC, *Jan 13, 2024*.
- Mentoring undergraduate students in the weekly CALC session (Calculus Active Learning Clinics), *Aug 2023 – Dec 2023*.
- Mentoring undergraduate Teaching Assistants, *Aug 2022 – Dec 2022, Aug 2023 – June 2024*.
- Composed recommendation letters for UMBC students, *2022 – 2025*.
- Student panelist in departmental graduate student orientation on Ph.D. experience, *Aug 25, 2022*.
- Graduate student representative on Dr. Justin Webster's promotion and tenure committee, *Nov 2021*.
- Student panelist in special graduate student seminar on TAing, *Oct 6, 2021*.
- Student panelist in graduate student seminar on Ph.D. experience, *Sept 23, 2020*.
- Volunteer in Probability and Statistics Day at UMBC, *Apr 21–22, 2017*.
- Volunteer in Celebrate Science at UMBC's 50th Anniversary, *Sept 17, 2016*.

Professional Membership

- American Mathematical Society (AMS).
- Society for Industrial and Applied Mathematics (SIAM).
- Toastmasters International (public speaking clubs).