Binan Gu

Personal Information

Affiliation	Worcester Polytechnic Institute (WPI), Department of Mathematical Sciences
Status	Postdoctoral Scholar
Address	100 Institute Rd, Worcester, MA 01609
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Research Interests

- Mathematical Modelling
- Fluid Dynamics
- Partial Differential Equations
- Stochastic Processes and Applications

Current work: pore dynamics through carbonate-reaction kinetics in high-temperature aquifer storage applications, simultaneous adsorption and sieving fouling mechanism on membrane pore networks, persistence homology in membrane pore networks with varying radii, exclusion processes in statistical mechanics.

Education

Sep 2016–Aug 2022
New Jersey Institute of Technology (NJIT). Ph.D. Candidate, Mathematical Sciences.
Ph.D. thesis: *Stochastic Modeling of Flow through Complex Geometries.*
Advisors: Prof. Linda J. Cummings, Prof. Lou Kondic.

Aug 2014–May 2016
New York University (NYU). Master of Science, Mathematics.
Master thesis: *Branching Markov Chains and Random Walks in Random Environments.*
Advisor: Prof. Chiranjib Mukherjee.

Aug 2009–Dec 2013
University of Southern California (USC).
Bachelor of Science, Mathematics.
Bachelor of Arts, Economics.

Publications and Work in Progress

[1]   On the Influence of Pore Connectivity on Performance of Membrane Filters.
B. Gu, D.R. Renaud, P. Sanaei, L. Kondic, L.J. Cummings, Journal of Fluid Mechanics, **902**, A5 (2020).

[2]   A Graphical Representation of Membrane Filtration with Adsorption.
B. Gu, L. Kondic, L.J. Cummings, SIAM Journal of Applied Mathematics, **82**, 3, (2022).

[3]   Network-based membrane filters: Influence of network and pore size variability on filtration performance.
B. Gu, L. Kondic, L.J. Cummings, Journal of Membrane Science, **657**, 120668 (2022).

[4]   Flow through Pore-Size Graded Membrane Networks.
B. Gu, L. Kondic, L.J. Cummings (submitted).

[5]   Modeling and Simulating Shear-Thinning Viscous Flow in a Hele-Shaw Cell.
B. Gu, J. Adriazola, L. Kondic, L.J. Cummings (final stage of manuscript preparation).

[6]   Stochastic Modeling of Sieving in Membrane Pore Networks.
B. Gu, P. Sanaei, L. Kondic, L.J. Cummings (In progress).

Technical Reports

[1]   On Temperature Effects in Reacting Porous Media Applications.
R.H. Allaire, A.G. Odu, **B. Gu**, W. Lu, A. Newell, P.J. Paranamana, T. Phan, H. Ruzayqat, DOI: 10.13140/RG.2.2.32155.62246 (2017).

[2]   Finding the Limits of Machine Learning in Optimization
D.A. Edwards, **B. Gu**, K. Johnson, M. Wichman, M. Zyskin, Mathematics in Industry Reports, DOI: 10.33774/miir-2022-q537t (2022).

Presentations, Talks and Workshops

Conference Abstracts

Mar 2023   American Physical Society March Meeting
Stochastic Modeling of Sieving in Membrane Filters.
Las Vegas, Nevada, USA.

Nov 2022   American Physical Society Division of Fluid Dynamics
On Pore-size Graded Membrane Networks.
Indianapolis, Indiana, USA.

Jan 2022   16th Northeast Complex Fluids and Soft Matter Workshop (NCS16)
A Graphical Representation of Membrane Filtration.
Princeton University, Princeton, New Jersey, USA.

Nov 2021   American Physical Society Division of Fluid Dynamics
A Graphical Representation of Membrane Filtration.
Phoenix, Arizona, USA.

May 2021   InterPore 2021-13th International Conference on Porous Media & Annual Meeting (virtual)
A Graphical Representation of Membrane Filtration with Adsorption.

Aug 2020	InterPore 2020-12th International Conference on Porous Media & Annual Meeting (virtual) *Stochastic Modelling of Adsorption and Sieving in a Pore Network.*
Nov 2019	American Physical Society Division of Fluid Dynamics. *Stochastic Modelling of Sieving in Membrane Filters with Complex Pore Morphology.* Seattle, Washington, USA.
July 2019	Fluid Mechanics of Cleaning and Decontamination, Special Interest Group *Stochastic Modelling of Sieving.* Mathematical Institute, Oxford University, Oxford, United Kingdom.
Jan 2019	10th Northeast Complex Fluids and Soft Matter Workshop (NCS10) *Modeling Connectivity and Asymmetry in Membrane Filters.* Rutgers University, New Brunswick, New Jersey, USA.
Jan 2019	Transport in Disordered Systems. *Modeling Connectivity and Asymmetry in Membrane Filters.* Princeton University, Princeton, New Jersey, USA.
Nov 2018	American Physical Society Division of Fluid Dynamics. *Modeling Connectivity and Asymmetry in Membrane Filters.* Georgia Institute of Technology, Atlanta, Georgia, USA.
May 2018	9th Northeast Complex Fluids and Soft Matter Workshop (NCS9) *Modeling Asymmetry of Membrane Filters with Complex Morphology.* University of Pennsylvania, Philadelphia, Pennsylvania, USA.

Contributed Conference Presentations

July 2019	27th Congress on Statistical Physics *Stochastic Modeling of Flow Through Complex Geometries.* Buenos Aires, Argentina.
May 2018	Interpore 2018-10th International Conference on Porous Media & Annual Meeting. *Mathematical Modeling of Microstructured Membrane Filters: A Stochastic Approach.* New Orleans, Louisiana, USA.
Jan 2018	8th Northeast Complex Fluids and Soft Matter Workshop *Stochastic Approach to Model Fouling in Membrane Filters.* New York, New York, USA.
Nov 2017	American Physical Society Division of Fluid Dynamics. *Stochastic Approach to Model Fouling in Membrane Filters with Complex Pore Morphology.* Denver, Colorado, USA.

Invited Talks

Feb 2023	Applied Math Group Lunch Meeting *Graphical Representation of Membrane Filtration.* Georgia State University, Atlanta, Georgia, USA.
Sep 2022	Mathematical Sciences Department, Colloquium *Graphical Representation of Membrane Filtration.* Worcester Polytechnic Institute, Worcester, Massachussetts, USA.

Dec 2021	Applied Mathematics and Mathematical Medicine and Biology Seminar *Graphical Representation of Membrane Filtration.* University of Delaware, Newark, Delaware, USA.
Sep 2021	NJIT Optimization and Machine Learning Talks *PageRank, its related centrality measures and diffusion on large graphs..* New Jersey Institute of Technology, Newark, New Jersey, USA.
Oct 2021	Complex Fluids and Soft Matter Group *Graphical Representations of Membrane Networks.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Sep 2021	NJIT Optimization and Machine Learning Talks *Stochastic Temporal Networks.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Apr 2021	NJIT Optimization and Machine Learning Talks *On Diffusion Approximations of Stochastic Gradient Descent.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Feb 2021	NJIT Optimization and Machine Learning Talks *On the Energy Landscape of Deep Networks.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Oct 2020	NJIT Optimization and Machine Learning Talks *Graph-Based Models & Model Selection.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Nov 2020	NJIT Optimization and Machine Learning Talks *Graph-Based Learning.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Feb 2020	Complex Fluids and Soft Matter Group *Continuous-Time Random Walk on a Weighted Dynamic Graph.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Aug 2019	Complex Fluids and Soft Matter Group *A Graph Theory Approach to Study Network-Based Membrane Filter Models.* New Jersey Institute of Technology, Newark, New Jersey, USA.
Aug 2019	Applied Math Group *Graphical Representation of Membrane Filters.* New York Institute of Technology, New York, USA.
Apr 2019	Dana Knox Student Research Showcase *Stochastic Modeling of Membrane Filtration.* New Jersey Institute of Technology, Newark, New Jersey, USA.

Workshops

Nov 2021	Mean-Field Models for Interacting Agents (Meeting attendance) Distributed Solutions to Complex Societal Problems series Institute for Mathematical and Statistical Innovation, Chicago, Illinois.
Jul 2021	Analytic and Geometric Approaches to Machine Learning Symposium (Meeting attendance) University of Bath, United Kingdom.
Jun 2021	CMS 75th Anniversary Summer Meeting (Meeting attendance)

Apr 2021	East Coast Optimization Meeting (Meeting attendance) George Mason University Fairfax, Virginia, USA
Mar 2021	Tensor Methods and Emerging Applications to the Physical and Data Sciences (Workshop attendance) Workshop I: Tensor Methods and their Applications in the Physical and Data Sciences Institute for Pure & Applied Mathematics, UCLA, Los Angeles, California, USA.
Jun 2020	Mathematical Problems in Industry *Dynamics on the Ternary Diagram Represetation of Mixtures in a Membrane Filter.* University of Vermont, Burlington, Vermont, USA.
May 2018	Intensive Program on Fluid and Waves (Workshop attendance) Gran Sasso Science Institute, L'Aquila, Italy.
Jun 2017	Mathematical Problems in Industry *On Characterizing and Simulating Porous Media* New Jersey Institute of Technology, Newark, New Jersey, USA.
Jun 2017	Graduate Student Mathematical Modelling Camp *On Temperature Effects in Reacting Porous Media Applications.* Rensselaer Polytechnic Institute, Troy, New York, USA.

Short-Term Visiting Position

Jun 2019–Jul 2019	Academic Visitor. Hosts: Prof. Ian M. Griffiths, Dr. Mohit Dalwadi Mathematical Institute, Oxford University.

Service work

Mar 2022	Session Chair American Physical Society March Meeting 2023 Las Vegas, Nevada, USA
Sep 2022–Present	Reviewer Journal of Fluid Mechanics
Sep 2020–Present	Organizer of NJIT Optimization and Machine Learning Talks Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, New Jersey, USA.
Sep 2018–Present	Department Student Representative, Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, New Jersey, USA.

Mentorship

Sep 2017–May 2018	Dylan Renaud. Undergraduates. New Jersey Institute of Technology, Newark, New Jersey, USA. Now PhD candidate at Harvard University, Applied Physics.

June 2021–Sep 2021
        Justin Lee, Siddarth Kunisetty, Heer Patel. High School Students.
        Middlesex County Academy for Science, Mathematics & Engineering Technologies, Edison, New Jersey, USA.

June 2021–Sep 2021
        Anay Badlani. High School Student.
        West Orange High School, West Orange, New Jersey, USA.

Awards

- Best Oral Presenter Award.
  Graduate Student Association Research Day, Fall 2021.
  New Jersey Institute of Technology.

- SIAM Student Chapter Certificate of Recognition, awarded Spring 2021.
  Society for Industrial and Applied Mathematics.

- College of Science & Liberal Arts, Outstanding Graduate Student Award, awarded Spring 2021.
  Department of Mathematical Sciences, New Jersey Institute of Technology.

- Provost Doctoral Assistantship, awarded Spring 2017, Fall 2017.
  Department of Mathematical Sciences, New Jersey Institute of Technology.

- Graduate Student Travel Award.
  New Jersey Institute of Technology, Graduate Student Association.

Selected Graduate Courses

NJIT   Real Analysis, Numerical Methods, Asymptotics, Convex Optimization, Probability Theory, Partial Differential Equations Theory, Fluid Dynamics, Stochastic Processes, Calculus of Variations.

NYU   Limit Theorems, Stochastic Calculus, Numerical Methods.

USC   Analysis, Ordinary Differential Equations, Stochastic Calculus and Mathematical Finance.

Teaching

Oct 2022–May 2023
        Lecturer. Numerical Methods for Linear and Nonlinear Systems.
        Department of Mathematical Sciences, Worcester Polytechnic Institute.

Oct 2022–May 2023
        Lecturer. Calculus IV.
        Department of Mathematical Sciences, Worcester Polytechnic Institute.

Sep 2021–Dec 2021
        Lecturer. Calculus I.
        Department of Mathematical Sciences, New Jersey Institute of Technology.

Jan 2020–May 2020
        Lecturer. Calculus II.
        Department of Mathematical Sciences, New Jersey Institute of Technology.

Aug 2017–May 2018
> Lab Assistant. Methods of Applied Mathematics I and II, Honors.
> Department of Mathematical Sciences, New Jersey Institute of Technology.

Aug 2019–Dec 2019
> Teaching Assistant. Calculus I, Honors.
> Department of Mathematical Sciences, New Jersey Institute of Technology.

Aug 2016–May 2019
> Teaching Assistant. Precalculus, Calculus I, Calculus II.
> Department of Mathematical Sciences, New Jersey Institute of Technology.

July 2016–Aug 2016
> Lecturer. Mathematical Modelling and Applied Statistics.
> Duke Talent Identification Program, Wake Forest University.

Aug 2015–May 2015
> Teaching Assistant. Calculus I; Probability and Statistics.
> Courant Institute of Mathematical Sciences, New York University.

References

Prof. Linda J. Cummings
> Advisor,
> Department of Mathematical Sciences, New Jersey Institute of Technology,
> linda.cummings@njit.edu

Prof. Lou Kondic
> Advisor,
> Department of Mathematical Sciences, New Jersey Institute of Technology,
> kondic@njit.edu

Prof. Anand Oza
> PhD Thesis Committee Member,
> Department of Mathematical Sciences, New Jersey Institute of Technology,
> anand.u.oza@njit.edu

Prof. James Maclaurin
> PhD Thesis Committee Member,
> Department of Mathematical Sciences, New Jersey Institute of Technology,
> james.n.maclaurin@njit.edu

Prof. Ian M. Griffiths
> PhD Thesis Committee Member,
> Mathematical Institute, Oxford University,
> ian.griffiths@maths.ox.ac.uk

Coding skills

- MATLAB, LaTeX, Fortran, Python.

Miscellaneous

- Languages: Mandarin Chinese and Shanghainese (Native), English (Fluent), German (Beginning).

- Royal Conservatory of Music, Technical Certificate for Keyboard, Level 10.

- Play the piano and tenor saxophone, arrange for acapella groups and wind and brass ensembles, compose recreationally.

- Amateur golfer, handicap 5.

- "By Accidental" podcast – reviews for classical music concerts and competitions; guides listening experience.