Shanyin Tong

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APPOINTMENT

Assistant Professor (non-tenure track), Department of Applied Physics and Applied Mathematics
Columbia University, New York, NY   July 2022 – present

EDUCATION

Ph.D. in Applied Mathematics, Courant Institute, New York University, New York, NY   August 2017 – May 2022
- Advisor: Prof. Georg Stadler and Prof. Eric Vanden-Eijnden
- Outstanding dissertation prize for [10] at Courant

B.S. in Computational Mathematics, Peking University, Beijing, China   September 2013 – June 2017

RESEARCH INTERESTS

Applied and computational mathematics; Inverse problems in physics, engineering and data science; Extreme event estimation and control; Uncertainty quantification; PDE-constrained optimization; Optimization under uncertainty; Applied probability and statistics; Machine learning in scientific computing; Inference and sampling; Model reduction

HONORS & AWARDS

SIAM Most Read and High Impact Article for [8], SIAM/ASA Journal on UQ, US	2024
Second Prize for Leslie Fox Prize for [8], Institute of Mathematics and its Applications (IMA), Glasgow, UK	2023
AMS-Simons Travel Grant, American Mathematical Society (AMS) & Simons Foundation, US	2023-2025
NSF-AWM Travel Grant, Association for Women in Mathematics & National Science Foundation, US	2023
SIAM Early Career Travel Award, SIAM Conferences: UQ24, ICIAM23 and OP23, US	2023-2024
Finalist for ICCOPT Best Paper [11], International Conference on Continuous Optimization, Bethlehem, PA	2022
Kurt O. Friedrichs Prize, Outstanding Dissertation in Mathematics, Courant, New York, NY	2022
Rising Star in Computational and Data Sciences, Academic Workshop for Women, Albuquerque, NM	2022
Bella Manel Prize, Excellence and Promise in Mathematics on the Graduate Level, Courant, New York, NY	2020
SIAM Student Travel Award, SIAM Conferences: UQ22, CSE21 and UQ20, US	2020-2022
Isaac Barkey and Ernesto Yhap Fellowship, Outstanding Math PhD Student, Courant, New York, NY	2019
Meritorious Winner, The Interdisciplinary Contest in Modeling (ICM), Beijing, China	2016
WeTech Qualcomm Global Scholar Award, IIE and Qualcomm, Beijing, China	2015
First Prize, 7th National Mathematics Contest for College Students, Beijing, China	2015
Third Prize, 31st National Physics Contest for College Students, Beijing, China	2014
Yizheng Alumni Scholarship, Peking University, Beijing, China	2014

PUBLICATIONS

1. S. Rakshith, A. Deo, S. Tong, K. Murthy and A. Subramanyam, *Self-structured importance sampling for chance-constrained optimization*, in preparation.

2. S. Tong, I. Papaioannou and and K. Papakonstantinou, *Importance sampling for reliability analysis in high dimensions*, in preparation.

3. A. Jin and S. Tong, *Rare event probability estimation using normalizing flows*, in preparation.

4. K. Ren, N. Soedjak and S. Tong, *A policy iteration method for inverse mean field games*, submitted to Mathematics of Computation (2024). [arXiv:2409.06184]

5. Y. Pan, K. Ren and S. Tong, *A three-stage method for reconstructing multiple coefficients in coupled photoacoustic and diffuse optical imaging*, submitted to Inverse Problems (2024). [arXiv:2408.03496]

6. A. Chowdhary, S. Tong, G. Stadler and A. Alexanderian, *Sensitivity analysis of the information gain in infinite-dimensional Bayesian linear inverse problems*, International Journal for Uncertainty Quantification 14.6:17-35 (2024). [arXiv:2310.16906 | IJUQ Link]

7. T. Schorlepp, S. Tong, T. Grafke and G. Stadler, *Scalable methods for computing sharp extreme event probabilities in infinite-dimensional stochastic systems*, Statistics and Computing 33.137 (2023). [arXiv:2303.11919 | Stat.Comput. Link]

8. S. Tong and G. Stadler, *Large deviation theory-based adaptive importance sampling for rare events in high dimensions*, SIAM/ASA Journal on Uncertainty Quantification 11.3: 788-813 (2023). Selected as the Most Read and High Impact Article by SIAM, Second Prize of IMA Leslie Fox Prize. [arXiv:2209.06278 | JUQ Link]

9. S. Tong, E. Vanden-Eijnden and G. Stadler, *Estimating earthquake-induced tsunami height probabilities without sampling*, Pure and Applied Geophysics 180.5:1587-1597 (2023). Included in the special issue "Sixty Years of Modern Tsunami Science, Volume 2: Challenges". [arXiv:2111.14325 | PAG Link]

10. S. Tong, *Extreme event probability estimation and control using large deviation theory and PDE-constrained optimization*, Doctoral dissertation (2022). Awarded Kurt O. Friedrichs Prize (Outstanding Dissertation). [ProQuest Link]

11. S. Tong, A. Subramanyam and V. Rao, *Optimization under rare chance constraints*, SIAM Journal on Optimization 32.2:930-958 (2022). Finalist of Best Paper for ICCOPT. [arXiv:2011.06052 | SIOPT Link]

12. S. Tong, E. Vanden-Eijnden and G. Stadler, *Extreme event probability estimation using PDE-constrained optimization and large deviation theory, with application to tsunamis*, Communications in Applied Mathematics and Computational Science 16.2:181–225 (2021). [arXiv:2007.13930 | CAMCoS Link]

13. S. Tong, *Extreme event probability estimation with application to tsunamis*, SIAM News (2021). Featured on the homepage of SIAM News. [SIAM News link]

Grant Proposals

Principal Investigator (Co-PI: Xuan (Sharon) Di), 2025-2028, submitted to NSF 24-559: Mathematical Foundations of Digital Twins, Project Title: *MATH-DT: RareDT: Rare event evaluation and control in digital twins*

Principal Investigator (Single PI), 2024-2027, submitted to NSF PD 16-1271: Computational Mathematics, Project Title: *Large-deviation-based algorithms for estimation and mitigation of rare and extreme events in complex and high-dimensional systems*

Presentations & Talks

NSF Workshop on Data-driven Modeling and Prediction of Rare and Extreme Events, IMSI, Chicago, IL	November 2024
CCAM seminar, Department of Mathematics, Purdue University, West Lafayette, IN	November 2024
SIAM Conference on Mathematics of Data Science (MDS24), Atlanta, GA	October 2024
SIAM Texas-Louisiana Section Annual Meeting, Baylor University, Waco, TX	October 2024
Engineering Speaks to K-12 students, Columbia University, New York, NY	August 2024
Empowering a Diverse Computational Mathematics Research Community Workshop, Providence, RI	July 2024
New England Numerical Analysis Day (NENAD), Dartmouth College, Hanover, NH	June 2024
Sayas Numerics Day, Workshop on Computational Mathematics, George Mason University, Arlington, VA	May 2024
2024 INFORMS Optimization Society Conference (IOS 2024), Houston, TX	March 2024

SIAM Conference on Uncertainty Quantification (UQ24), Trieste, Italy	February 2024
Mathematical Opportunities in Digital Twins Workshop, George Mason University, Arlington, VA	December 2023
Mid-Atlantic Numerical Analysis Day, Temple University, Philadelphia, PA	November 2023
SIAM New York-New Jersey-Pennsylvania Annual Meeting, New Jersey Institute of Technology, NJ	October 2023
2023 INFORMS Annual Meeting, Phoenix, AZ	October 2023
10th International Congress on Industrial and Applied Mathematics (ICIAM 2023), Tokyo, Japan	August 2023
Seminar Series on Young Scholars in Optimization and Data Science, Department of Applied Mathematics, The Hong Kong Polytechnic University, Hong Kong, China	July 2023
IMA Leslie Fox Prize meeting, Glasgow, UK	June 2023
SIAM Conference on Optimization (OP23), Seattle, WA	May 2023
Joint Mathematics Meetings (JMM2023), Boston, MA	January 2023
Seminar in Applied Mathematics, Columbia University, New York, NY	September 2022
APAM Research Conference, Columbia University, New York, NY	September 2022
Best Paper Session at International Conference on Continuous Optimization (ICCOPT), Bethlehem, PA	July 2022
Rising Stars in Computational and Data Sciences, Albuquerque, NM	April 2022
SIAM Conference on Uncertainty Quantification (UQ22), Atlanta, GA	April 2022
Scientific Computing and Numerics (SCAN) Seminar, Cornell University, Ithaca, NY (virtual)	March 2022
CCB Seminar at Center for Computational Biology, Simons Foundation, New York, NY	January 2022
Applied Mathematics Colloquium, Columbia University, New York, NY (virtual)	January 2022
SIAM Conference on Computational Science and Engineering (CSE21), Fort Worth, Texas (virtual)	March 2021
2020 INFORMS Annual Meeting, National Harbor, MD (virtual)	November 2020
Summer Argonne Students Symposium (SASSy), Argonne National Lab, Lemont, IL (virtual)	August 2020
NSF Research Training Group (RTG) in Modeling & Simulation, CIMS, NYU, , New York, NY	February 2020
ICERM Workshop: Mathematical Optimization of Systems Impacted by Rare Events, Providence, RI	June 2019
Gene Golub SIAM Summer School: Inverse Problems, Models under Uncertainty, Breckenridge, CO	June 2018

TEACHING EXPERIENCE

2024 Fall	Instructor, APMA-E2000-001: Multivariable Calculus	Columbia University
2024 Spring	Instructor, APMA-E4306: Applied Stochastic Analysis	Columbia University
2023 Fall	Instructor, APMA-E2000-001: Multivariable Calculus	Columbia University
2023 Spring	Instructor, APMA-E4306: Applied Stochastic Analysis	Columbia University
2022 Fall	Instructor, APMA-E2000-001: Multivariable Calculus	Columbia University
2021 Fall	Recitation & lab instructor, MATH-UA.0253-002: Linear and Nonlinear Optimization	NYU
2021 Spring	Recitation & lab instructor, MATH-UA.0253-002: Linear and Nonlinear Optimization	NYU (virtual)
2021 Spring	Recitation instructor, MATH-UA.0263-002: Partial Differential Equations	NYU (virtual)
2021 Spring	Instructor, Graduate written exam workshop: Linear Algebra	CIMS, NYU (virtual)
2020 Fall	Teaching assistant & grader, MATH-GA.2010-001: Numerical Methods I	CIMS, NYU (virtual)
2019 Fall	Recitation instructor, MATH-UA.0121-032 & -034: Calculus I	NYU
2019 Fall	Instructor, Graduate written exam workshop: Complex Variables	CIMS, NYU
2019 Fall	Instructor, Graduate written exam workshop: Linear Algebra	CIMS, NYU
2018 Fall	Instructor, Graduate written exam workshop: Linear Algebra	CIMS, NYU
2018 Fall	Teaching assistant & grader, MATH-GA.2043-001: Scientific Computing	CIMS, NYU

PROFESSIONAL SERVICE

Journal Referee International Journal for Uncertainty Quantification (IJUQ)
Journal of Computational Science (JOCSCI)
Journal of Optimization Theory and Applications (JOTA)
Machine Learning: Science and Technology (MLST)
Psychometrika (PMET)
SIAM Journal on Scientific Computing (SISC)

Grant Referee Dutch Research Council (NWO)

Committee Member APAM PhD Student Thesis Proposal, Columbia University, New York, NY, 2023-present
APAM PhD Student Oral Exams, Columbia University, New York, NY, 2023-present
APAM PhD Student Written Exams, Columbia University, New York, NY, 2023-present

STUDENT ADVISING

Research Advise the following undergrad and graduate students for different research projects:
Zhinan Han (former master at Columbia, co-advised by Kui Ren, now PhD student at Duke math)
Andrew Jin (former undergrad at Columbia, now PhD student at Northwestern IEMS)
Joonsoo Lee (former undergrad at Columbia, Bonomi Scholar, now PhD student at MIT math)
Yitian Liang (master at Columbia)
Yifan Wang (master at Columbia)

Career Development Besides the above students, also provide career development advice for the following students:
Anna Mazhar (former undergrad at Columbia, now PhD student at Princeton math)
Panagiotis Tsimpo (former undergrad at Columbia, now PhD student at MIT OR)
Serena Yihe Yang (undergrad at Columbia)
Max Zhao (former undergrad at Columbia, now PhD student at UT Austin Oden Institute)

CONFERENCE & SEMINAR ORGANIZING

Co-organizer, Minisymposium at SIAM CSE25 Conference, Fort Worth, TX	March 2025
Co-organizer, Minisymposium at SIAM Texas-Louisiana Section Annual Meeting, Waco, TX	October 2024
Co-organizer, Minisymposium at Engineering Mechanics Institute Conference and Probabilistic Mechanics & Reliability Conference (EMI/PMC 2024), Chicago, IL	May 2024
Co-organizer, Applied Mathematics Colloquium, Columbia University, New York, NY	2023 -present
Co-organizer, Minisymposium at SIAM-NNP Section Annual Meeting, Newark, NJ	June 2023
Co-organizer, Minisymposium at SIAM Conference on Optimization, Seattle, WA	June 2023
Proposer & Co-organizer, APAM Research Symposium, Columbia University, New York, NY	2023-present
Co-organizer, APAM Research Conference, Columbia University, New York, NY	2022-present

OUTREACH & INCLUSION ACTIVITIES

Selected Participant, ICERM Workshop: Empowering a Diverse Computational Mathematics Research Community, Providence, RI	July 2024
Member, APS-IDEA Team, Columbia University, New York, NY	2024-present
Founder, Women and Diversity Association in APAM (WDAPAM), Columbia University, New York, NY	2022-present
Organizer, Discussion Panel for Women and Diversity in APAM, Columbia University, New York, NY	2022-present
Member, SEAS Faculty DEI Working Group, Columbia University, New York, NY	2022-present

Secretary, APAM Faculty Meeting, Columbia University, New York, NY   2022-present

Member, Association for Women in Mathematics, US   2022-present

Selected Participant, Rising Stars: Academic and Research Career Workshop for Women in Computational and Data Sciences, Albuquerque, NM   April 2022

Member, Association for Women in Mathematics at Courant, New York, NY   2021

Selected Participant, Morgan Stanley Women's PhD Mentorship Program, New York, NY   2021

Mentor, Student mentor for new incoming PhD students at Courant, New York, NY   2018

Member, Society for Industrial and Applied Mathematics, US   2017-present

Selected Participant, Women Enhancing Technology (WeTech) Program, Beijing, China   2015-2016

Member, School basketball team, Beijing, China   2013-2017

Leader, Mathematics modeling contest team, Beijing, China   2016

Selected Participant, Social research examined the volunteerism in Guangdong Province, China   2014

Guide, Campus tour of Peking University, Beijing, China   2014

Mentor, Free tutoring for middle school students from low-income families, Guangdong, China   2011

INDUSTRIAL & INTERNSHIP EXPERIENCES

Research Scientist, Amazon, Seattle, WA (virtual)	May 2021 - August 2021
Givens Associate, Argonne National Lab, Lemont, IL (virtual)	June 2020 – August 2020
Summer Research Intern, UCLA, Los Angeles, CA	June 2016 – September 2016

ADDITIONAL TRAININGS

IMSI Workshop: Mathematical and Statistical Foundations of Digital Twins, Chicago, IL	July 2024
MATH-DT Workshop: Mathematical Opportunities in Digital Twins, George Mason University, Arlington, VA	December 2023
Measure Transport, Diffusion Processes and Sampling Workshop, Flatiron Institute, New York, NY	December 2023
PIMS-IFDS-NSF Summer School on Optimal Transport, University of Washington, Seattle, WA	June 2022
Challenges and Prospects of ML for the Physical Sciences Workshop, Flatiron Institute, New York, NY	June 2022
DFG-SPP 1962 Summer School on Optimization under Uncertainty, Germany (virtual)	September 2021
East Coast Optimization Meeting, George Mason University, Fairfax, VA (virtual)	April 2021
ICERM Workshop: Computational Statistics and Data-Driven Models, Providence, RI (virtual)	April 2020
ICERM Workshop: Mathematical Optimization of Systems Impacted by Rare, High-Impact Random Events, Providence, RI	June 2019
Gene Golub SIAM Summer School: Inverse Problems: Systematic Integration of Data with Models under Uncertainty, Breckenridge, CO	June 2018

COMPUTING & SOFTWARE

Coding Languages	Python, Matlab, Julia, C, C++, Java, SQL, HTML, Shell, TeX
Tools & Software	PyTorch, Tensorflow, Pandas, Scikit-learn, Jupyter Notebook, Conda, Git, NumPy, SciPy, CUDA, OpenMP, MPI, FEniCS, hIPPYlib, MUQ, ParaView, Gurobi, Xpress, Matplotlib, TikZ
Implementations	Online adaptive model reduction for shallow water equations [Git Repo Link]
	Fast multipole method for computing electrostatic interactions in 2D [Git Repo Link]
	High performance computing for the Biot-Savart law in 3D [Git Repo Link]
	Self-supervised learning for image classifications [Git Repo Link]