Ruda Zhang

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Positions

Sep 2022–	Assistant Professor. Department of Civil and Environmental Engineering. University of Houston. Houston, TX.
Aug 2021–Jul 2022	Phillip Griffiths Assistant Research Professor. Department of Mathematics. Duke University. Durham, NC.
Aug 2019–Jul 2021	Postdoctoral fellow. Statistical & Applied Mathematical Sciences Institute (SAMSI). Durham, NC.
Jun 2018–Jul 2019	Postdoctoral research associate. University of Southern California. Los Angeles, CA.

Education

May 2018	Ph.D., Civil Engineering. **University of Southern California**. Los Angeles, CA.
May 2018	M.A., Economics. **University of Southern California**. Los Angeles, CA.
Jun 2012	B.E., Engineering Structure Analysis. **Peking University**. Beijing, China.

Research Interests

Uncertainty Quantification • Data-driven Engineering • Computational Mechanics

I am interested in developing **fast, reliable, and interpretable** methods for data-driven engineering and uncertainty quantification, with applications in structural digital twins, energy infrastructure, and quantitative sustainability and resilience.

Articles in Review

(Underline denotes current or past PhD students or post-docs.)

- **Calibrating Scientific Foundation Models with Inference-Time Stochastic Attention.**
  Akash Yadav, Taiwo Adebiyi, and **Ruda Zhang**.
  In Review. (**link**)

Peer-Reviewed Articles

- **Achieving high-performance polarization-independent nonreciprocal thermal radiation with pattern-free heterostructures.**
  Bach Do, Bardia Nabavi, Sina Jafari Ghalekohneh, Taiwo Adebiyi, Bo Zhao, and **Ruda Zhang**.
  International Journal of Heat and Mass Transfer. Accepted, 2026. (**link**)

- **Nonparametric Stochastic Subspaces via the Bootstrap for Characterizing Model Error.**
  Akash Yadav and **Ruda Zhang**.
  ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering. Accepted, 2026. (**link**, **DOI**)

- **Bayesian Optimization under Uncertainty for Training a Scale Parameter in Stochastic Models.**
  Akash Yadav and **Ruda Zhang**.
  ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering. Accepted, 2026. (**link**, **DOI**)

- **Sampling from Gaussian Processes: A Tutorial and Applications in Global Sensitivity Analysis and Optimization**.
  Bach Do, Nafeezat A. Ajenifuja , Taiwo Adebiyi, and **Ruda Zhang**.
  Structural and Multidisciplinary Optimization. 2026. (**link**)

- **Stochastic Subspace via Probabilistic Principal Component Analysis for Characterizing Model Error.**
  Akash Yadav and **Ruda Zhang**.
  Computational Mechanics. 2025. (**link**)
  – **Finalist**, WCCM 2024 UQ-TTA Student Paper Competition in Uncertainty Quantification.

- **Optimizing Posterior Samples for Bayesian Optimization via Rootfinding**.
  Taiwo Adebiyi, Bach Do, and **Ruda Zhang**.
  International Conference on Learning Representations. 2025. (**link**)

– Top 8% of submitted papers.

- **Multifidelity Bayesian Optimization: A Review.**
  Bach Do and **Ruda Zhang**.
  AIAA Journal. 2025. (**link**)

- **Automated Design of Nonreciprocal Thermal Emitters via Bayesian Optimization.**
  Bach Do, Sina Jafari Ghalekohneh, Taiwo Adebiyi, Bo Zhao, and **Ruda Zhang**.
  Journal of Quantitative Spectroscopy and Radiative Transfer. 2024. (**link**)

- **Gaussian Process Thompson Sampling via Rootfinding.**
  Taiwo A. Adebiyi and Bach Do and **Ruda Zhang**.
  NeurIPS 2024 Workshop on Bayesian Decision-making and Uncertainty, 2024. (**link**)
  – **Oral presentation** (1 of 6; top 5% of accepted papers).

- **Epsilon-Greedy Thompson Sampling to Bayesian Optimization.**
  Bach Do and Taiwo A. Adebiyi and **Ruda Zhang**.
  Journal of Computing and Information Science in Engineering. 2024. (**link**)
  – **Editor's Pick** (1 of 5; top 4% of published papers).

- **Multi-fidelity Machine Learning for Uncertainty Quantification and Optimization.**
  Ruda Zhang and Negin Alemazkoor.
  Journal of Machine Learning for Modeling and Computing, 2024. (**link**)

- **Digital Twins and Civil Engineering Phases: Reorienting Adoption Strategies.**
  Taiwo A. Adebiyi and Nafeezat A. Ajenifuja and **Ruda Zhang**.
  Journal of Computing and Information Science in Engineering, 2024. (**link**)

- **Gaussian Process Subspace Prediction for Model Reduction**.
  Ruda Zhang, Simon Mak, and David Dunson.
  SIAM Journal on Scientific Computing. 2022. (**link**)
  – **Winner**, INFORMS 2021 Quality, Statistics & Reliability (QSR) Best Paper Award.

- **Drivers Learn City-scale Intra-daily Dynamic Equilibrium**.
  Ruda Zhang and Roger Ghanem.
  IEEE Transactions on Intelligent Transportation Systems. 2022. (**link**)

- **Normal-bundle Bootstrap**.
  Ruda Zhang and Roger Ghanem.
  SIAM Journal on Mathematics of Data Science. 2021. (**link**)

- **Demand, Supply and Performance of Street-hail Taxi**.
  Ruda Zhang and Roger Ghanem.
  IEEE Transactions on Intelligent Transportation Systems. 2020. (**link**)

Book Chapters

- **Environmental Economics and Uncertainty: Review and a Machine Learning Outlook**. **Ruda Zhang**, Patrick Wingo, Rodrigo Duran, Kelly Rose, Jennifer Bauer, Roger Ghanem. Oxford Research Encyclopedia of Environmental Science. 2020. (**link**)

Manuscripts & Preprints

- **Newton Retraction as Approximate Geodesics on Submanifolds**.
  Ruda Zhang.
  arXiv. 2020. (**link**)

- **Multi-market Oligopoly of Equal Capacity**.
  Ruda Zhang and Roger Ghanem.
  arXiv. 2020. (**link**)

Software & Data

- **`TSRoots`: Gaussian process Thompson sampling in Python**.
  A Python package for efficient Gaussian process Thompson sampling in Bayesian optimization via rootfinding. (**link**)
- **`GPyS`: Gaussian Process Subspace Regression in Python**.
  A Python package implementing the Gaussian process subspace (GPS) model. (**link**)
- **`gpsr`: Gaussian Process Subspace Regression in R**.
  An R package implementing the Gaussian process subspace (GPS) model. (**link**)
- **`plmr`: Probabilistic Learning on Manifolds in R**.
  An R package implementing methods for probabilistic learning on manifolds. (**link**)
- **New York City Taxi Trip Records, 2009–2013.**
  Ruda Zhang. Open Science Framework. (Total size: ~200 GB) (**link**)

Research Grants

- **Automated Design and Discovery of Optical Energy Devices via Bayesian Optimization: Breaking the Nonreciprocity Barrier in Thermal Photonics**. Agency: University of Houston Division of Research. Program: High Priority Area Research Seed Grants. PI: Ruda Zhang. Award: $60,308. Period: 2024/05–2025/11.

Fellowships & Awards

2023	University of Cambridge, Isaac Newton Institute Travel Fund.
2022	USACM UQ-MLIP Travel Award.
2022	SIAM Early Career Travel Award.
2021	INFORMS Quality, Statistics & Reliability (QSR) Best Paper Award. (First out of 27 paper submissions.)
2019–2021	Postdoctoral Fellow. NSF Grant DMS-1638521, Division of Mathematical Sciences.
2012–2016	Provost Fellow, University of Southern California.
2009–2010	Peking University Academic Excellence Award.
2009–2010	Wusi Scholarship.
2009 Fall	HKUST Dean's List (as an exchange student).
2008–2009	Peking University Three-Good Student (Highest Honor).
2008–2009	First Prize, Starlight International Media Scholarship.

Presentations

Invited seminar talks:

- Multi-Scale Modeling and Simulation Lab, Gustave Eiffel University, France. Jun 19, 2023.
- Sandia National Lab. Virtual. May 23, 2023.
- Department of Engineering Systems and Environment, University of Virginia. Apr 18, 2023.
- GE Research. Mar 31, 2023.
- School of Mathematics, University of Birmingham, United Kingdom. Dec 12, 2022.
- Department of Statistical Science, University College London, United Kingdom. Dec 1, 2022.
- Smart Informatix Lab, Lyles School of Civil Engineering, Perdue University. Oct 17, 2022.
- Zachry Department of Civil & Environmental Engineering, Texas A&M University. Sep 2, 2022.
- Department of Civil and Environmental Engineering, University of Houston. Mar 14, 2022.
- Department of Industrial Engineering, University of Arkansas. Feb 17, 2022.
- Department of Industrial and Manufacturing Engineering, Florida A&M University–Florida State University College of Engineering. Feb 15, 2022.
- Department of Energy Resources Engineering, Stanford University. Oct 11, 2021.

Invited conference talks:

- SIAM Conference on Uncertainty Quantification (UQ26). Minneapolis, MN, US. March 22–25, 2026. Title: Characterizing Errors in Fine-tuned Scientific Foundation Models via Stochastic Attention.
- 18th U.S. National Congress on Computational Mechanics (US NCCM 2025). Chicago, Illinois. July 20–24, 2025. Title: Stochastic reduced-order modeling for model error characterization and correction.

- USACM Thematic Conference on Uncertainty Quantification for Machine Learning Integrated Physics Modeling (UQ-MLIP 2024). Arlington, VA. Aug 12–14, 2024. Title: Stochastic Subspace via Probabilistic PCA to Characterize and Correct Model Error.
- 5th International Conference on Uncertainty Quantification in Computational Sciences and Engineering (UNCECOMP). Athens, Greece. June 12–14, 2023. Title: Probabilistic Operator Learning via Stochastic Processes with Implicit Kernels.

- SIAM-TXLA 2022. Houston, TX. Nov 4–6, 2022. Title: Smoothness and Sensitivity of Principal Subspace-valued Map.
- 5th Annual Meeting of the SIAM Texas–Louisiana Section (SIAM-TXLA 2022) Houston, TX. Nov 4–6, 2022. Title: Gaussian Process Subspace Prediction for Model Reduction.
- INFORMS 2022 Annual Meeting. Indianapolis, IN. Oct 16–19, 2022. Title: GPΣ: Gaussian Process Prediction of Covariances and Distributions.
- IMS/ASA Spring Research Conference (SRC) 2022. Virtual. May 19-20, 2022. Title: Gaussian Process Subspace Prediction for Dimension Reduction of Computational Models.
- SIAM Conference on Uncertainty Quantification (UQ22). Atlanta, GA. Apr 12–15, 2022. Title: Gaussian Process for Dimension Reduction of Computational Models.
- INFORMS 2021 Annual Meeting. Anaheim, CA. Oct 24-27, 2021. Quality, Statistics & Reliability (QSR) Best Paper Competition.
- International Chinese Statistical Association (ICSA) 2021 Applied Statistics Symposium. Virtual. Sep 12–15, 2021. Title: Gaussian process subspace regression: How to do PCA without a data sample?
- Data Science, Statistics & Visualization (DSSV) Conference 2020. Virtual. July 29–31, 2020. Organized by International Association for Statistical Computing (IASC) International Statistical Institute (ISI). Title: Normal-bundle Bootstrap.
- SAMSI Games, Decisions, Risk and Reliability (GDRR) Program Transportation Workshop. Durham, NC. March 9–11, 2020. Title: Driver Strategy and Multimarket Oligopoly: Evidence from New York City.
- Institute for Operations Research and the Management Sciences (INFORMS) 2019 Annual Meeting. Seattle, WA. Oct 20–23 2019. Title: Driver Strategy and Multimarket Oligopoly: Evidence from New York City.

- METRANS Emerging Scholars Transportation Research (ESTR) Symposium 2019. Los Angeles, CA. Mar 29, 2019. Title: Taxicab Transportation: Operations, Equilibrium, and Efficiency.
- National Travel Monitoring Exposition and Conference 2018 (NaTMEC 2018). Irvine, CA. June 10–13, 2018. Title: Estimating Taxi Traffic from GPS Records.

Contributed talks:

- 20th U.S. National Congress on Theoretical and Applied Mechanics (USNC-TAM). Pasadena, CA. Jun 21–25, 2026. Title: Characterizing Errors in Fine-tuned Scientific Foundation Models via Stochastic Attention.
- 38th Annual Conference on Neural Information Processing Systems (NeurIPS) Workshop on Bayesian Decision-making and Uncertainty. Vancouver, Canada. Dec 14, 2024. Title: Gaussian Process Thompson Sampling via Rootfinding.
- Oden Institute Workshop on Scientific Machine Learning (SciML) 2024. Austin, TX. Oct 02–04, 2024. Title: Stochastic Subspace via Probabilistic PCA to Characterize and Correct Model Error.
- Engineering Mechanics Institute and Probabilistic Mechanics & Reliability Conference 2024 (EMI/PMC 2024). Chicago, IL. May 28–31, 2024. Title: Multi-fidelity Bayesian Optimization in Engineering Design.
- 17th U.S. National Congress on Computational Mechanics (US NCCM 2023). Albuquerque, New Mexico. July 23–27, 2023. Title: Gaussian Process Subspace Prediction for Parametric Studies of Structural Systems.
- Engineering Mechanics Institute Conference 2023 (EMI 2023). Atlanta, GA. June 6–9, 2023. Title: Probabilistic Operator Learning via Stochastic Processes with Implicit Kernels.
- USACM Thematic Conference on Uncertainty Quantification for Machine Learning Integrated Physics Modeling (UQ-MLIP). Arlington, VA. Aug 18–19, 2022. Title: Gaussian Process Subspace Regression for Parametric Studies of Structural Systems.
- Engineering Mechanics Institute Conference 2022 (EMI 2022). Baltimore, MD. May 31–Jun 3, 2022. Title: Gaussian Process Subspace Prediction for Parametric Studies of Structural Systems.
- Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology (MMLDT-CSET 2021): An IACM Conference. San Diego, CA. Sep 26–29, 2021. Title: Gaussian Process Subspace Regression for Parametric Reduced-Order Modeling.
- Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology (MMLDT-CSET 2021): An IACM Conference. San Diego, CA. Sep 26–29, 2021. Title: A Digital Twin for Oil Spills Including Socio-economic Impact Assessment.
- Graduate-Faculty Seminar, Department of Mathematics, Duke University. Sep 20, 2021. Title: Learning Manifold-valued Mappings for Dimension Reduction of Computational Models.
- Engineering Mechanics Institute Conference 2021 and Probabilistic Mechanics & Reliability Conference 2021 (EMI 2021/PMC 2021). Virtual. May 25–28, 2021. Title: Manifold-constrained Uncertainty Quantification of Computer Models.
- Engineering Mechanics Institute Conference 2021 and Probabilistic Mechanics & Reliability Conference 2021 (EMI 2021/PMC 2021). Virtual. May 25–28, 2021. Title: Sampling on Manifolds via Mean Shift.

- SAMSI Postdoctoral Fellow Seminars. Virtual. Mar 17, 2021. Title: Gaussian Process Subspace Regression.
- SAMSI Postdoctoral Fellow Seminars. Virtual. Oct 28, 2020. Title: Probabilistic Learning on Manifolds.
- SAMSI Postdoctoral Fellow Seminars. Virtual. Apr 1, 2020. Title: Normal-bundle Bootstrap.
- SAMSI Postdoctoral Fellow Seminars. Durham, NC. Oct 16, 2019. Title: Probability Approximation on Manifolds.
- Engineering Mechanics Institute Conference 2019 (EMI 2019) joint with Geo-Institute. Pasadena, CA. June 18–21, 2019. Title: Probability Approximation on Manifolds.
- 65th Annual North American Meetings of the Regional Science Association International (NARSC 2018). San Antonio, TX. Nov 7–10, 2018. Title: Taxi driver learns dynamic spatial equilibrium.
- GIS-Pro 2018 & CalGIS 2018. Palm Springs, CA. Oct 9–12, 2018. Title: Pick your poison: point, line, or polygon as your spatial unit?
- Engineering Mechanics Institute Conference 2018 (EMI 2018). Massachusetts Institute of Technology. May 29—Jun 1, 2018. Title: Taxi driver learns dynamic spatial equilibrium.
- Probabilistic Mechanics & Reliability Conference 2016 (PMC 2016). Vanderbilt University, May 22–25, 2016. Title: Sociodynamic Modeling of Urban Transportation System: Case Study of Taxi Commute in New York City.
- Engineering Mechanics Institute Conference 2016 (EMI 2016). Vanderbilt University, May 22–25, 2016. Title: Sustainability Score for Urban Systems.
- Engineering Mechanics Institute Conference 2015 (EMI 2015). Stanford University, June 16–19, 2015. Title: Quantifying Transit Accessibility in Urban Systems: Case Study in Portland Metropolitan Area.
- The National Workshop on Resilience Research (NWRR) for Critical Infrastructure: Current Status and Challenges. National Science Foundation, Arlington, VA. October 22–23, 2015. Title: Performance Metrics for Urban Infrastructure Systems: Transit Accessibility in Portland and Its Resilience.

Students & Advising

PhD students:

- Taiwo A. Adebiyi (Fall 2022 – Spring 2027, expected)
- Akash Yadav (Fall 2023 – Spring 2027, expected)

Doctoral theses as a secondary reader:

- Zheren Baizhikova (Summer 2025)
- Kripa Adhikari (Spring 2025)
- Heng ZHAO (Spring 2024, Mathematics)

Masters students:

- Nafeezat Adetoro Ajenifuja (Fall 2023 – Summer 2025)

Undergraduate students:

- Mingyu Li
- Sahran E. Ashoor
- Matthew Robbins (2022)
- Noah Harris (2022)
- Marie-Hélène Tomé (2022)

Postdoctoral scholars:

- Bach Do (June 2023 – May 2026)

Teaching

Courses taught since 2022:

- CIVE 3337: Structural Analysis. (2025 Fa/Sp, 2023 Fa/Sp)
  - Instructor. Undergraduate core course. ~40 students.
- CIVE 6355: Introduction to Dynamics of Structures (2024 Fall)
  - Instructor. Graduate core course. 23 graduate students.
- CIVE 7397: Mathematics of Artificial Intelligence. (2026 Spring)
  - Instructor. Graduate topics course. 24 graduate students.
- CIVE 7397: Data-driven Engineering. (2024 Spring)
  - Instructor. Graduate topics course. 10 graduate students.

Courses taught prior to 2022:

- ST 515: Experimental Statistics for Engineers I. (2020 Fall)
  - Instructor. Shared with Dr. Dan Harris at NCSU.
  - Probability and statistics for engineering departments. 87 graduate students.
- CE 402: Computer Methods in Engineering. (2017 Spring)
  - Teaching Assistant for Prof. Sami F. Masri at USC.
  - Numerical methods and numerical analysis. 25 undergraduate students.
- CE 408: Risk Analysis in Civil Engineering. (2016 Fall, 2014 Fall)
  - Teaching Assistant for Prof. Roger G. Ghanem at USC.
  - Probability and statistics. 44 undergraduate students.

Academic Service

Editorship

2024 Guest editor for the Journal of Machine Learning for Modeling and Computing (JMLMC), special issue on "Advancements and Applications of Multifidelity Machine Learning in Engineering".

Journal Review

- Computer Methods in Applied Mechanics and Engineering.
- Journal of Computational Physics.
- International Journal for Uncertainty Quantification.
- Structural and Multidisciplinary Optimization.
- Journal of Engineering Mechanics.
- Journal of Computing and Information Science in Engineering.
- Journal of Machine Learning for Modeling and Computing.
- Technometrics.
- Scientific Reports.
- Data-Centric Engineering.
- Journal of Statistical Theory and Practice.
- Transportation Research Part B: Methodological.
- Transportation Research Record.
- IJERPH. SI: Traffic and Road Safety.
- Mathematics.
- Applied Sciences.

Conference & Workshop Organization

- Minisymposium organizer. ICOSSAR 2025.
  Risk, Reliability and Uncertainty Quantification in Structural Digital Twins.
- Minisymposium organizer. EMI 2024.
  MS 1004: Multi-fidelity Methods and Machine Learning for Uncertainty Propagation, Inference, and Optimization.
- Minisymposium organizer. UNCECOMP 2023.
  MS16: Stochastic Finite Element Methods: Improvements and New Approaches.
- Minisymposium organizer. EMI 2023.
  MS: Data-driven Methods for Uncertainty Quantification: Improvements and New Approaches.

- Minisymposium organizer. SIAM CSE 2023. Amsterdam, Netherlands.
  MS395 Data-Driven Dynamics and Model Reduction for Nonlinear Systems in Engineering.
- Minisymposium organizer. EMI 2022.
  MS316: Dimension and Model Reduction in Computational Mechanics and Engineering System.
- Session chair, Data Science 1. DSSV 2020.
- Session host, Statistical Learning 4. DSSV 2020.
- Workshop organizer, SAMSI GDRR Opening Workshop. Raleigh, NC. Aug 5–9, 2019.
- Session chair, Urban Economics. NARSC 2018.

Other Professional Activities

- Reviewer & Judge. EMI/PMC 2024 Probabilistic Methods Student Paper Competition.
  - Review student papers and evaluate finalists' presentations.
- Reviewer. INFORMS Data Mining Best Paper Competition.
  - Student track and general track: 2023–2025.
- Reviewer. ASA Physical and Engineering Sciences (SPES) and Quality and Productivity (Q&P) student paper competition, 2026.
- Reviewer. Institute of Industrial and Systems Engineer (IISE) Data Analytics & Information Systems (DAIS) Best Student Paper Competition, 2026.
- Reader / Judge. Sigma Xi Grants in Aid of Research (GIAR).
  - In person and online: 2019 Dec, 2020–2024 Apr/Dec, 2025 Apr.

Mentoring & Outreach

- Faculty mentor. DOmath 2022. Duke University & North Carolina Central University. (**link**)
  - Lead a group of undergraduate students on an 8-week summer research project.
- Student presentation judge. 2021 Sigma Xi Annual Meeting and Student Research Conference.
  - Provide feedback to research projects by undergraduate students/teams in the US.
- Student presentation judge. 2020 Sigma Xi Annual Meeting and Student Research Conference.
- R tutorial. SAMSI GDRR Undergraduate Workshop. Durham, NC. Feb 24–25, 2020. (**link**)

Press Coverage

- American Statistical Association (ASA) interview series on "Advancing Statistical Science & Machine Learning". With Glen Wright Colopy. Jan 2022.

Academic and Professional Affiliations

- United States Association for Computational Mechanics (USACM). Member.

  - Technical Thrust Area in Uncertainty Quantification and Probabilistic Modeling (TTA-UQ&PM). Committee Member-at-Large (Elected; 1 of 2).
- American Society of Civil Engineers (ASCE). Member (M.ASCE).
  - Engineering Mechanics Institute (EMI). Member.
    - Probabilistic Methods Committee (PMC). Committee Member (Elected).
- Society for Industrial and Applied Mathematics (SIAM). Member.
  - SIAM Activity Group on Uncertainty Quantification (SIAG UQ).
- Sigma Xi, The Scientific Research Honor Society. Elected Member.

Updated: Apr 2026