Ruda Zhang

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Pronouns: they/them/their

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. Dissertation: "Taxicab Transportation: Operations, Equilibrium, and Efficiency". Committee: *Roger G. Ghanem* (Chair), Sami F. Masri, Ketan Savla, Juan D. Carrillo.
May 2018	M.A., Economics. **University of Southern California**. Los Angeles, CA. Thesis: "Taxi Driver Learns Dynamic Multi-Market Equilibrium". Committee: *Matthew E. Kahn* (Chair), M. Hashem Pesaran, Geert Ridder.
Jun 2012	B.E., Engineering Structure Analysis. **Peking University**. Beijing, China. Advisor: *Dongxiao* (*Don*) *Zhang*.

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.

Publications

- **Demand, Supply and Performance of Street-hail Taxi**.
  Ruda Zhang and Roger Ghanem.
  IEEE Transactions on Intelligent Transportation Systems. 2019. (**link**)

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

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

- **Gaussian Process Subspace Regression 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.

- **Multi-market Oligopoly of Equal Capacity**.
  Ruda Zhang and Roger Ghanem.
  In peer review. Mathematical Social Sciences. (**link**)

- **Newton Retraction as Approximate Geodesics on Submanifolds**.
  Ruda Zhang.
  In revision. Statistics and Computing. (**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**)

Working Papers

- **Gaussian Process Covariance Prediction for Stochastic Simulation**.

Ruda Zhang, Simon Mak, Jean-François Paquet, and David Dunson.
- **System-theorectic Model Reduction for Structural Dynamics**.
  Ruda Zhang and Taiwo Adebiyi.
- **Probabilistic Operator Learning via Stochastic Processes with Implicit Kernels**.
  Ruda Zhang.
- **Smoothness and Sensitivity of Principal Subspace-valued Maps**.
  Ruda Zhang.

Software & Data

- **`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**)

Fellowships & Awards

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.

Teaching

2023 Spring	CIVE 3337: Structural Analysis.
	Instructor. Undergraduate core course at UH.
2020 Fall	ST 515: Experimental Statistics for Engineers I.
	Instructor. Shared with Dr. Dan Harris at NCSU.
	Probability and statistics for engineering departments. 87 graduate students.
2017 Spring	CE 402: Computer Methods in Engineering.
	Teaching Assistant for Prof. Sami F. Masri at USC.
	Numerical methods and numerical analysis. 25 undergraduate students.
2016 Fall	CE 408: Risk Analysis in Civil Engineering.
	Teaching Assistant for Prof. Roger G. Ghanem at USC.
	Probability and statistics. 44 undergraduate students.
2014 Fall	CE 408: Risk Analysis in Civil Engineering.

Presentations

Invited seminar talks:

- School of Mathematics, University of Birmingham. Dec 12, 2022.
- Department of Statistical Science, University College London. 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:

- 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.
- IMS/ASA Spring Research Conference (SRC) 2023. Banff, Canada. May 24–26, 2023. Title: Gaussian Process Prediction of Covariance Matrices and Gaussian Distributions

- 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:

- 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

Postdoctoral researcher:

- Bach Do (June 2023 – May 2025)

PhD students:

- Taiwo A. Adebiyi (Fall 2022 – Spring 2027)
- Akash Yadav (Fall 2023 – Spring 2027)
- Nafeezat Adetoro Ajenifuja (Fall 2023 – Spring 2028)

Undergraduate students:

- Matthew Robbins (DOmath 2022)
- Noah Harris (DOmath 2022)
- Marie-Hélène Tomé (DOmath 2022)

Academic Service

Journal Review

- Journal of Engineering Mechanics.
- Technometrics.
- Journal of Statistical Theory and Practice. (2)
- Data-Centric Engineering.
- Transportation Research Part B: Methodological.
- Transportation Research Record. (4)
- IJERPH. SI: Traffic and Road Safety.
- Mathematics.
- Applied Sciences.

Grant Review

- Sigma Xi. Grants in Aid of Research (GIAR). Hybrid. Apr 28–29, 2023.
- Sigma Xi. Grants in Aid of Research (GIAR). Hybrid. Dec 2–3, 2022.
- Sigma Xi. Grants in Aid of Research (GIAR). Chapel Hill, NC. Apr 29–30, 2022.
- Sigma Xi. Grants in Aid of Research (GIAR). Hybrid. Dec 3–4, 2021.

- National Science Foundation (NSF). Broadening Participation: 2021 MPS Workshop for Young Investigators. Virtual. Oct 7–8, 2021.
- Sigma Xi. Grants in Aid of Research (GIAR). Virtual. Apr 26–May 3, 2021.
- Sigma Xi. Grants in Aid of Research (GIAR). Virtual. Dec 7–12, 2020.
- Sigma Xi. Grants in Aid of Research (GIAR). Virtual. May 1–2, 2020.
- Sigma Xi. Grants in Aid of Research (GIAR). Raleigh, NC. Dec 13–14, 2019.

Conference & Workshop Organization

- 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.

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

- American Society of Civil Engineers (ASCE). Associate Member (A.M.ASCE).
  - ASCE Engineering Mechanics Institute (EMI). Member.
- United States Association for Computational Mechanics (USACM). Member.
  - Technical Thrust Area in Uncertainty Quantification and Probabilistic Modeling (UQ-TTA).
- Society for Industrial and Applied Mathematics (SIAM). Member.
- Institute for Operations Research and the Management Sciences (INFORMS). Member.
- Sigma Xi, The Scientific Research Honor Society. Elected Member.

Updated: March 2023