

Ruda Zhang

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Positions

- Aug 2021– Phillip Griffiths Assistant Research Professor.
Department of Mathematics, Duke University. Durham, NC.
- Aug 2019–Jul 2021 Postdoctoral fellow.
The 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, California.
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, California.
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 • Machine Learning • Engineering Systems • Risk and Resilience

I currently focus on manifold-based methods for **dimension reduction of computational models**, which includes learning manifold-valued mappings and probabilistic learning on manifolds.

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.
Accepted. 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 via Separable Transformation.**
Ruda Zhang, Simon Mak, Jean-François Paquet, and David Dunson.
- **Parametric Principal Component Analysis with Gaussian Process.**
Ruda Zhang, Xingjian Wang, Simon Mak.
- **Probabilistic Learning on Manifolds via Normal Bundle.**
Ruda Zhang and Roger Ghanem.

Software & Data

- **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

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| 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

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| 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:

- 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:

- IMS/ASA Spring Research Conference (SRC) 2022. Banff, Canada. May 18–20, 2022. (postponed to 2023)
- 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:

- 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:

- Siyu Ding (joint with Xingjian Wang)

Undergraduate students:

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

Academic Service

Journal Review

- 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). 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. 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. DMath 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.
- 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 2022