Agnimitra Dasgupta

Curriculum Vitae

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Research Interests

Uncertainty quantification (UQ), scientific machine learning, inverse problems, reliability and rare-events estimation, multifidelity methods, generative modeling

Education

2017 - 2023   **Ph.D., Civil Engineering**, *University of Southern California*, Los Angeles, USA.
Sonny Astani Department of Civil & Environmental Engineering
Advisor: Prof. Erik A Johnson, Vice Dean for Academic Programs, USC
Thesis: *Model falsification: new insights, methods and applications*
Awarded: May 2023
GPA: 4.0/4.0

2017 – 2020   **Master of Science, Electrical Engineering**, *University of Southern California*, Los Angels, USA.
Ming Hsieh Department of Electrical and Computer Engineering
GPA: 4.0/4.0

2015 – 2017   **Master of Engineering, Civil Engineering**, *Indian Institute of Science*, Bangalore, India.
Major in Structural Engineering
Advisor: Prof. Debraj Ghosh
Master's Thesis: Reduced order modeling in uncertainty quantification of dynamical systems
GPA: 8.0/8.0

2011 – 2015   **Bachelor of Engineering, Civil Engineering**, *Jadavpur University*, Kolkata, India.
GPA: 9.26/10

Professional Experience

Research

May 2023 – present   **Postdoctoral Scholar – Research Associate**, *Computational & Data-driven Discovery Group.*
Aerospace and Mechanical Engineering Department, University of Southern California, Los Angeles
- Primary research in the interface of machine learning (ML) and physics-based computing.
- Conditional generative models for solving inverse problems.
- ML methods fo cancer diagnosis and rare cell detection.
- **Advisor:** Dr. Assad A. Oberai, Hughes Professor and Professor of Aerospace and Mechanical Engineering, USC

Summer 2022, 2021,2020   **Givens Associate**, *Laboratory for Applied Mathematics, Numerical Software, and Statistics.*
Argonne National Laboratory, Lemont, Illinois, USA
- Gaussian processes for tomography, Deep learning for ptychography
- **Mentor:** Dr. Zichao 'Wendy' Di, Computational Mathematician, ANL

Fall 2017 – Present   **Graduate Research Assistant**, *Sonny Astani Department of Civil & Environmental Engineering.*
University of Southern California, Los Angeles, USA
- CSD&E: Collaborative Research: A New Framework for Computational Model Validation, **National Science Foundation** (CMMI 16-63667/16-62992)

July 2016 – June 2017   **Research Assistant**, *Department of Civil Engineering.*
Indian Institute of Science, Bangalore, India
- Reduced order modeling of linear time-varying dynamical systems for efficient reliability estimation.

May 2014 – June 2014   **Summer Intern**, *Reactor Safety Division.*
Bhabha Atomic Research Centre, Mumbai, India
- Modelling the behavior of 'bonds' between concrete and rebar subject to elevated temperatures.

Teaching

Fall 2023   **Guest Lecturer**, *Aerospace & Mechanical Engineering Department*, USC.
- AME508 Machine Learning and Computational Physics – Held office hours and held tutorial on PyTorch autograd.

Fall 2017 –   **Graduate Teaching Assistant**, *Sonny Astani Department of Civil & Environmental Engineering*, USC.
Spring 2022
- CE529a Finite Element Analysis – Lead lab sessions introducing ABAQUS and helped students with their final project which involved FE analysis using Matlab and ABAQUS.
- CE402 Numerical Methods in Engineering – Lead discussion sessions to help students with coding numerical techniques on Matlab and Python.
- CE458 Theory of Structures- II – Lead lab sessions introducing SAP2000 and helped students with their final project which involved the modelling and analysis of a multistorey building.

Mentoring

Summer 2020   **Graduate Research Mentor**, *Viterbi Summer Research Program*, USC.
- Mentored 2 students on research about the statistical nature of model falsification.

Summer 2018   **Graduate Research Mentor**, *Viterbi Summer Institute Program*, USC.
- Mentored 4 incoming undergraduate students, providing them insight into on-going research in the Department.

▬▬▬ Journal publications

Published
- *A. Dasgupta*, D. V. Patel, D. Ray, E. A. Johnson and A. A. Oberai, **A hybrid dimension-reduced and variational framework for solving high-dimensional inverse problems**, *Computer Methods in Applied Mechanics & Engineering*, accepted. [arXiv]
- *A. Dasgupta* and E. A. Johnson **REIN: Reliability estimation via importance sampling with normalizing flows**, *Reliability Engineering & System Safety*, 2023. DOI: 10.1016/j.ress.2023.109729
- D. Ray, J. Murgoitio-Esandi, *A. Dasgupta* and A. A. Oberai, **Solution of physics-based inverse problems using conditional generative adversarial networks with full gradient penalty**, *Computer Methods in Applied Mechanics and Engineering*, 2023 DOI: 10.1016/j.cma.2023.116338
- *A. Dasgupta* and E. A. Johnson, **Model falsification from a Bayesian viewpoint with applications to parameter inference and model selection of dynamical systems**, *ASCE Journal of Engineering Mechanics*, 2023. DOI: 10.1061/JENMDT/EMENG-7204
- *A. Dasgupta* and D. Ghosh, **Failure Probability Estimation of Linear Time Varying Systems by Progressive Refinement of Reduced Order Models**, *SIAM/ASA Journal on Uncertainty Quantification, Volume 7, Issue 3, Pages 1007–1028, 2019.* DOI: 10.1137/18M1165840

Under preparation
- *A. Dasgupta*, J. Murgoitio-Esandi, H. Ramaswamy, D. Ray and A. A. Oberai, **Conditional score-based diffusion generative models for inverse problems in mechanics**
- *A. Dasgupta*, E. A. Johnson and S. F. Wojtkiewicz, **A new perspective on model falsification as a binary classifier**
- *A. Dasgupta*, E. A. Johnson and S. F. Wojtkiewicz, **Hybrid Bayesian approach for the inference of spatially varying constitutive parameters of linear isotropic materials from noisy response data**

# ▬▬▬ Conferences   (Keys : † mentees, * equal contribution)

with refereed papers
- *A. Dasgupta*, J. Murgoitio-Esandi, H. Ramaswamy, D. Ray and A. A. Oberai, **Conditional score-based generative models for solving physics-based inverse problems**, *Workshop on Deep Learning and Inverse Problems, 37th Annual Conference on Neural Information Processing Systems (NeuRIPS)*, New Orleans, December 2023.
- *A. Dasgupta* and E. A. Johnson, **REIN: Rare event simulation via importance sampling with normalizing flows**, *ASCE Engineering Mechanics Institute Conference*, Atlanta, GA, June 2023, *Awarded **Best Student Competition Paper** by the EMI Probabilistic Methods Committee*.
- E. A. Johnson and *A. Dasgupta*, **Learning Importance Sampling Distributions via Normalizing Flows for Estimating Rare-Event Failure Probabilities**, *2023 New Zealand Society for Earthquake Engineering Conference*, University of Auckland, April 2023. [link]
- *A. Dasgupta*, C. Graziani and Z. W. Di, **Simultaneous reconstruction and uncertainty quantification for tomography**, 2023 IEEE International Conference on Acoustics, Speech and Signal Processing, Greece, June 2023. [link, arXiv]
- *A. Dasgupta*, D. V. Patel, D. Ray, E. A. Johnson and A. A. Oberai, **GAN-Flow: A dimension-reduced variation framework for physics-based inverse problems**, *Workshop on Machine Learning and the Physical Sciences, 36th Annual Conference on Neural Information Processing Systems (NeuRIPS)*, virtual event, December 2022. [arXiv]
- *A. Dasgupta* and E. A. Johnson, **Model falsification from a Bayesian viewpoint with applications to system identification**

and model selection, *8th World Conference on Structural Control and Monitoring*, Orlando, FL, USA, June 2022. [to appear in proceedings]

- *A. Dasgupta* and Z.W. Di, **Uncertainty quantification for ptychography using normalizing flows**, *Workshop on Machine Learning and the Physical Sciences, 35th Annual Conference on Neural Information Processing Systems (NeuRIPS)*, virtual event, December 2021. [arXiv]

with refereed abstracts

- *A. Dasgupta*, **Solving large-scale physics-based inverse problems using coupled generative adversarial networks and normalizing flows** , *SoCal Solids Conference*, Los Angeles, CA, August 2023.
- *A. Dasgupta* and E. A. Johnson, **Rare-events simulation using normalizing flows**, *ASCE Engineering Mechanics Institute Conference*, Atlanta, GA, June 2023.
- *A. Dasgupta* and E. A. Johnson, **Normalizing flows based importance sampling for estimating rare event probabilities**, *SIAM Conference on Mathematics of Data Science*, San Diego, CA, September 2022.
- *A. Dasgupta* and E. A. Johnson, **Model falsification from a Bayesian viewpoint with applications to system identification and model selection**, *ASCE Engineering Mechanics Institute Conference*, Baltimore, MD, June 2022.
- *A. Dasgupta* and Z.W. Di, **Ptychographic Inversion and Uncertainty Quantification Using Invertible Neural Networks**, *SIAM Conference on Uncertainty Quantification*, Atlanta, GA, April 2022.
- A. Kannan[†], *A. Dasgupta*, E. A. Johnson and S. F. Wojtkiewicz, **Investigation of bounds on sample size for reliable model falsification**, *SIAM Conference on Computational Science and Engineering*, virtual event, March 2021.
- *A. Dasgupta*, E. A. Johnson and S. F. Wojtkiewicz, **Deep learning of surrogate models from un-falsified physics**, *SIAM Conference on Computational Science and Engineering*, virtual event, March 2021.
- *A. Dasgupta*, E. A. Johnson and S. F. Wojtkiewicz, **Characterization of spatial heterogeneity in material properties using a probabilistic hybrid approach**, *ASCE Engineering Mechanics Institute Conference*, Pasadena, CA, June 2019.
- *A. Dasgupta*, S. De, K. Teferra, E. A. Johnson, S. F. Wojtkiewicz and L. Graham-Brady, **Probabilistic validation of material models**, *ASCE Engineering Mechanics Institute Conference*, Cambridge, MA, May 2018.
- S. De, T. Yu, *A. Dasgupta*, E. A. Johnson and S. F. Wojtkiewicz, **Probabilistic model validation of a full-scale four-story base-isolated building**, *ASCE Engineering Mechanics Institute Conference*, Cambridge, MA, May 2018.
- *A. Dasgupta**, S. De*, E. A. Johnson and S. F. Wojtkiewicz, **Probabilistic model validation of large-scale systems using reduced order models**, *SIAM Conference on Uncertainty Quantification*, Orange County, CA, April 2018.
- *A. Dasgupta* and D. Ghosh, **Progressively refining reduced order models for estimating failure probabilities of dynamical systems**, *SIAM Conference on Uncertainty Quantification*, Orange County, CA, April 2018.

Selected Honors & Awards

- 2023: **Winner** of the **ASCE EMI Probabilistic Methods Committee Student Paper Competition**.
- 2022-2023: **Outstanding Research Assistant Award**, USC Viterbi School of Engineering.
- 2022: **Outstanding Research Assistant Award**, Sonny Astani Department of Civil and Environmental Engineering, USC.
- 2022: **Das Family Travel Award** of $1000 to attend EMI, 2022.
- 2022: **SIAM Student Travel Award** of $650 to attend SIAM UQ 2022, courtesy of NSF.
- 2020 : **Provost Fellow Travel Award** of $1500 to attend SIAM UQ 20 (award unused due to COVID-19).
- 2017–2021: **Provost PhD Fellowship**, University of Southern California, Los Angeles
- 2018 : **Prof. N S Lakshmana Rao Medal** for best M. E. student in Civil Engineering, IISc Bangalore.
- 2015-2017: **2-year scholarship** for graduate study, Ministry of Human Resource & Development, India.
- 2015 : **University Medal** (and 4 other medals) for standing First at the Bachelor of Civil Engineering, Jadavpur University.

Invited Talks

- *A. Dasgupta*, **Forward and inverse uncertainty quantification using generative models**, Virtual Seminar, Johns Hopkins University, July, 2022.
- *A. Dasgupta*, **A hybrid probabilistic approach to characterizing material heterogeneity**, USC WiSE STEM Bytes Seminar, June, 2021. [link]

Skillsets

Programming Languages: Python, MATLAB
Frameworks: PyTorch, Keras, Tensorflow, Scikit-Learn
Finite Element packages: ABAQUS, SAP2000, FEAP, FENICs.

Service

Reviewer

- *Conferences:* Machine Learning and the Physical Sciences Workshop, Neural Information Processing Systems (NeurIPS),

2022, 2023; The Synergy of Scientific and Machine Learning Modelling Workshop, International Conference on Machine Learning (ICML), 2023.

- *Journal:* Engineering Structures, Composites: Part B

Tutorials

- Score-based diffusion generative models: Implementation and results, *Uncertainty Quantification Summer School*, University of Southern California, August, 2023.

References

1. **Professor Erik A. Johnson**
   Professor, Sonny Astani Department of Civil & Environmental Engineering,
   Vice Dean for Academic Programs, USC Viterbi School of Engineering,
   University of Southern California.
   Email: johnsone@usc.edu

2. **Professor Assad A. Oberai**
   Hughes Professor and Professor, Aerospace and Mechanical Engineering,
   University of Southern California.
   Email: aoberai@usc.edu

3. **Professor Roger G. Ghanem**
   Gordon S. Marshall Professor of Engineering Technology and Professor,
   Sonny Astani Department of Civil & Environmental Engineering,
   University of Southern California.
   Email: ghanem@usc.edu