

Subhayan De

Mechanical Engineering
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OVERVIEW

Assistant Professor, Former Viterbi Ph.D. Fellow.

EDUCATION

Ph.D. in Civil Engineering <i>University of Southern California, Los Angeles</i>	May 2018
M.S. in Electrical Engineering <i>University of Southern California, Los Angeles</i>	May 2016
M.Eng. in Civil Engineering (Structural Engineering) <i>Indian Institute of Science (IISc), Bangalore</i>	2011-2013
B.Eng. in Civil Engineering with Honours <i>Jadavpur University, Kolkata</i>	2007-2011

EXPERIENCE

Northern Arizona University

<i>Assistant Professor</i>	August 2022 - present
Department of Mechanical Engineering	
<i>Instructor for ME 252: Applied Mechanics Dynamics</i>	Fall 2022, Fall 2023
<i>Instructor for ME 454,554: Finite Element Analysis</i>	Spring 2023

University of Colorado, Boulder

<i>Postdoctoral Associate</i>	June 2018 - August 2022
Ann and H.J. Smead Department of Aerospace Engineering Sciences	
<i>Collaborators:</i> Prof. Alireza Doostan and Prof. Kurt Maute	
<i>Projects:</i> (i) Adaptive Multi-Resolution Design Optimization Framework; (ii) Physics-Informed Deep Learning with Scientific Perceptual Loss Networks and Multifidelity Uncertainty Quantification	
<i>Lecturer for Random Vibrations</i>	Spring 2019

University of Southern California

<i>Viterbi Ph.D. Fellow and Graduate Research Assistant</i>	2013-2018
Sonny Astani Department of Civil and Environmental Engineering	
<i>Supervisor:</i> Prof. Erik A. Johnson.	
<i>Teaching Assistant for CE 205: Statics, CE 225: Mechanics of Deformable Bodies, CE 408: Risk Analysis in Civil Engineering, CE 529a: Finite Element Analysis</i>	2016-2018

Indian Institute of Science

<i>Graduate Research Assistant</i>	2012-2013
Department of Civil and Environmental Engineering	
<i>Supervisors:</i> Prof. C. S. Manohar and Prof. Debraj Ghosh	

JOURNAL PUBLICATIONS

Preprint

15. **S. De** and P.T. Brewick, “A Bi-fidelity DeepONet Approach for Modeling Uncertain and Degrading Hysteretic Systems,” *Journal TBD*, (arxiv Preprint).

Published

14. **S. De**, H. Malik, M. Reynolds, R. King, and A. Doostan, “Bi-fidelity Modeling of Uncertain and Partially Unknown Systems using DeepONets,” *Computational Mechanics*, (2023).
13. **S. De**, K. Maute, and A. Doostan, “Topology Optimization under Microscale Uncertainty using Stochastic Gradients,” *Structural and Multidisciplinary Optimization*, (2023).
12. K. Maute and **S. De**, “Shape and Material Optimization of Problems with Dynamically Evolving Interfaces Applied to Solid Rocket Motors,” *Structural and Multidisciplinary Optimization*, (2022).
11. **S. De**, and A. Doostan, “Neural Network Training for Uncertainty Propagation Using ℓ_1 Regularization and Bi-fidelity Data,” *Journal of Computational Physics*, (2022).
10. **S. De**, B.S.M. Ebna Hai, A. Doostan, and M. Bause, “Prediction of Ultrasonic Guided Wave Propagation in Solid-fluid and their Interface under Uncertainty using Machine Learning,” *Journal of Engineering Mechanics*, (2022).
9. **S. De**, K. Maute, and A. Doostan, “Reliability-based Topology Optimization under Uncertainty using Stochastic Gradients,” *Structural and Multidisciplinary Optimization*, (2021).
8. **S. De**, “Uncertainty Quantification of Locally Nonlinear Dynamical Systems using Neural Networks,” *Journal of Computing in Civil Engineering*, (2021).
7. **S. De**, J. Britton, M. Reynolds, R. Skinner, K. Jansen, and A. Doostan, “Transfer Learning of Neural Networks using Bi-fidelity Data for Uncertainty Propagation,” *International Journal for Uncertainty Quantification*, (2020).
6. **S. De**, K. Maute, and A. Doostan, “Bi-fidelity Stochastic Gradient Descent for Structural Optimization under Uncertainty,” *Computational Mechanics*, (2020).
5. **S. De**, J. Hampton, K. Maute, and A. Doostan, “Topology Optimization under Uncertainty using a Stochastic Gradient-based Approach,” *Structural and Multidisciplinary Optimization*, (2020).
4. **S. De**, P. T. Brewick, E. A. Johnson, and S. F. Wojtkiewicz, “A Probabilistic Hybrid Framework for Model Validation with Application to Structural Dynamics Modeling,” *Mechanical Systems and Signal Processing*, (2019).
3. **S. De**, P. T. Brewick, E. A. Johnson, and S. F. Wojtkiewicz, “Investigation of Model Falsification using Error and Likelihood Bounds with Application to a Structural System,” *Journal of Engineering Mechanics* (**Editor’s choice**), (2018).
2. **S. De**, E. A. Johnson, S. F. Wojtkiewicz, and P. T. Brewick, “Computationally-Efficient Bayesian Model Selection for Locally Nonlinear Structural Dynamic Systems,” *Journal of Engineering Mechanics* (**Editor’s choice**), (2018).
1. **S. De**, S. F. Wojtkiewicz, and E. A. Johnson, “Computationally Efficient Optimal Design of Passive Control Devices for a Benchmark Cable-Stayed Bridge,” *Structural Control and Health Monitoring*, (2017).

CONFERENCES

31. **M. Maghazeh**[†], A. U. Pillai, M. M. Rahaman, and **S. De**, “Thermodynamically Consistent Topology Optimization Under Uncertainty for Brittle Fracture Resistance,” *17th U.S. National Congress on Computational Mechanics, Albuquerque, NM, USA*, (2023).
[†] Student advised.
30. **S. De** and P. T. Brewick, “Modeling Degrading Hysteretic Systems under Uncertainty with a Bi-fidelity DeepONet,” *ASCE Engineering Mechanics Institute Conference, Georgia Institute of Technology, Atlanta, GA, USA*, (2023).
29. M. Hassanaly, P. Weddle, K. Smith, **S. De**, A. Doostan, and R. N. King, “Physics-Informed Neural Network Modeling of Li-Ion Batteries,” *242nd Electrochemical Society Meeting Atlanta, GA, USA*, (2022).
28. **S. De** and A. Doostan, “Bi-fidelity Training of Neural Networks and Neural Operators,” *SIAM Conference on the Mathematics of Data Science (MDS22), San Diego, CA, USA*, (2022).
27. **S. De**, H. Malik, M. Reynolds, R. King, and A. Doostan, “Bi-fidelity Neural Network Operators for Uncertain Systems,” *ASCE Engineering Mechanics Institute Conference, Johns Hopkins University, Baltimore, MD, USA*, (2022).
26. **S. De**, A. Doostan, “Bi-fidelity Training of Neural Networks Using ℓ_1 -Regularization,” *SIAM Conference on Uncertainty Quantification (UQ22), Atlanta, GA, USA*, (2022).
25. **S. De**, K. Maute, and A. Doostan, “Microscale Uncertainty in Macroscale Topology Optimization,” *14th World Congress of Structural and Multidisciplinary Optimization (WCSMO-14), Boulder, CO, USA*, (2021).
24. K. Maute, **S. De**, and A. Doostan, “Shape and Material Optimization of Problems with Dynamically Evolving Interfaces,” *14th World Congress of Structural and Multidisciplinary Optimization (WCSMO-14), Boulder, CO, USA*, (2021).
23. **S. De**, K. Maute, and A. Doostan, “Use of Stochastic Gradient Descent for Topology Optimization under Reliability Constraints,” *16th U.S. National Congress on Computational Mechanics, Chicago, IL, USA*, (2021).
22. **S. De**, K. Maute, and A. Doostan, “Topology Optimization in the Presence of Microscale Uncertainty,” *ASCE Engineering Mechanics Institute Conference, Columbia University, New York, NY, USA*, (2021).
21. **S. De**, A. Doostan, “Multi-fidelity Methods for Deep Neural Network Surrogates,” *SIAM Conference on Computational Science and Engineering (CSE21), Fort Worth Convention Center, Fort Worth, TX, USA*, (2021).
20. **S. De** and B.S.M. Ebna Hai, “Ultrasonic Guided Wave-based Structural Health Monitoring System in Fluid-solid and their Interface: Physics-informed Deep Learning,” *10th European Workshop on Structural Health Monitoring (EWSHM 2020), Palermo, Italy*, (postponed due to COVID-19 outbreak).
19. **S. De**, J. Britton, M. Reynolds, and A. Doostan, “Neural Network Training using Bi-fidelity Data for Uncertainty Quantification,” *SIAM Conference on Uncertainty Quantification (UQ20), Munich, Germany*, (canceled due to COVID-19 outbreak).

18. A. Glaws, R. King, M. Reynolds, A. Doostan, and **S. De**, “Physics-informed Deep Learning for Multi-fidelity Uncertainty Quantification,” *Workshop on Research Challenges and Opportunities at the interface of Machine Learning and Uncertainty Quantification, Los Angeles, CA, USA*, (2019).
17. **S. De**, E. A. Johnson, and S. F. Wojtkiewicz, “Efficient Evidence Estimation for Bayesian Model Selection,” *ASCE Engineering Mechanics Institute Conference, California Institute of Technology, Pasadena, CA, USA*, (2019).
16. **S. De**, K. Maute, and A. Doostan, “Optimization under Uncertainty Using Stochastic Gradients,” *15th U.S. National Congress on Computational Mechanics, Austin, TX, USA*, (2019).
15. **S. De**, K. Maute, and A. Doostan, “Topology Optimization under Uncertainty using Stochastic Gradients,” *Topology Optimization Roundtable, Albuquerque Marriot, Albuquerque, NM, USA*, (2019).
14. A. Dasgupta, **S. De**, A. Dasgupta, E. A. Johnson, and S. F. Wojtkiewicz, “Probabilistic validation of material models,” *ASCE Engineering Mechanics Institute Conference, Massachusetts Institute of Technology, Cambridge, MA, USA*, (2018).
13. **S. De**, T. Yu, A. Dasgupta, E. A. Johnson, and S. F. Wojtkiewicz, “Probabilistic Model Validation of the Isolation layer of a Full-Scale Four-Story Base-Isolated Building,” *ASCE Engineering Mechanics Institute Conference, Massachusetts Institute of Technology, Cambridge, MA, USA*, (2018).
12. **S. De**, A. Dasgupta, E. A. Johnson, and S. F. Wojtkiewicz, “Probabilistic Model Validation of Large-Scale Systems using Reduced Order Models,” *SIAM Conference on Uncertainty Quantification (UQ18), Hyatt Regency Orange County, Garden Grove, California, USA*, (2018).
11. **S. De**, E. A. Johnson, and S. F. Wojtkiewicz, “Uncertainty Quantification of Locally Nonlinear Dynamical Systems using Polynomial Chaos Expansion,” *SIAM Conference on Uncertainty Quantification (UQ18), Hyatt Regency Orange County, Garden Grove, CA, USA*, (2018).
10. **S. De**, T. Yu, E. A. Johnson, and S. F. Wojtkiewicz, “Model Validation of a 4 Story Base Isolated Building using Seismic Shake-Table Experiments,” *11th U.S. National Conference on Earthquake Engineering, Los Angeles, CA, USA*, (2018).
9. **S. De**, P. T. Brewick, E. A. Johnson, and S. F. Wojtkiewicz, “Model Falsification in a Bayesian Framework,” *ASCE Engineering Mechanics Institute Conference, University of California, San Diego, CA, USA*, (2017).
8. **S. De**, E. A. Johnson, and S. F. Wojtkiewicz, “Efficient Uncertainty Quantification for Locally Nonlinear Dynamical Systems,” *ASCE Engineering Mechanics Institute Conference, University of California, San Diego, CA, USA*, (Student Paper Competition Finalist) (2017).
7. **S. De**, P. T. Brewick, E. A. Johnson, S. F. Wojtkiewicz, and I. Bermejo-Moreno, “Error and Likelihood Bounds for Falsification of Dynamical Models,” *IMAC XXXV Conference, Hyatt Regency Orange County, CA, USA*, (2017).
6. **S. De**, P. T. Brewick, E. A. Johnson, and S. F. Wojtkiewicz, “Exploration of Error Rate Criteria to Decide Bounds for Model Falsification,” *ASCE Engineering Mechanics Institute Conference, Vanderbilt University, Nashville, TN, USA*, (2016).

5. **S. De**, E. A. Johnson, S. F. Wojtkiewicz, and P. T. Brewick, “Efficient Bayesian Model Selection for Locally Nonlinear Systems incorporating Dynamic Measurements,” *10th International Workshop on Structural Health Monitoring (IWSHM)*, (2015).
4. **S. De**, E. A. Johnson, and S. F. Wojtkiewicz, “Fast Bayesian Model Selection with Application to Large Locally-Nonlinear Dynamic Systems,” *6th International Conference on Advances in Experimental Structural Engineering, 11th International Workshop on Advanced Smart Materials and Smart Structures Technology, University of Illinois, Urbana-Champaign, IL, USA*, (2015).
3. **S. De**, S. F. Wojtkiewicz, and E. A. Johnson, “Efficient Optimal Design-Under-Uncertainty of Passive Structural Control Devices,” *Proceedings of the 12th International Conference on Applications of Statistics and Probability in Civil Engineering (ICASP12), Vancouver, BC, Canada, T. Haukaas (Ed.)*, (2015).
2. **S. De**, M. Kamalzare, E. A. Johnson, and S. F. Wojtkiewicz, “Computationally Efficient Bayesian Model Selection for Structural Systems with Local Nonlinearities,” *ASCE Engineering Mechanics Institute Conference, McMaster University, Hamilton, ON, Canada*, (Student Paper Competition Finalist) (2014).
1. **S. De**, M. Kamalzare, E. A. Johnson, and S. F. Wojtkiewicz, “Efficient Optimal Design of Passive Structural Control Devices for Complex Structures,” *ASCE Engineering Mechanics Institute Conference, McMaster University, Hamilton, ON, Canada*, (2014).

RESEARCH PROPOSALS

- Assisted authoring *Physics-Informed Deep Learning with Scientific Perceptual Loss Networks and Multifidelity Uncertainty Quantification*, funded by the United States Department of Energy, started on January 2021, **\$249,907**.
- Assisted authoring CSD&E: *Collaborative Research: A New Framework for Computational Model Validation*, United States National Science Foundation, collaborative grants 16-63667 & 16-62992, September 2017 to August 2020, **\$615,914** total (based on Ph.D. dissertation).

INVITED TALKS

- USACM Large-Scale TTA Early-Career Colloquium, *Design Optimization Under Uncertainty Using Stochastic Gradients*, March 2023
- 22nd TOP Webinar, *Reliability-based Topology Optimization Using Stochastic Gradients*, November 2022
- Department of Mechanical Engineering, Northern Arizona University, *Design Optimization under Uncertainty using Stochastic Gradients*, March 2022.
- Department of Aerospace Engineering Sciences, University of Colorado Boulder, *Machine Learning Techniques for Modeling and Design under Uncertainty*, November 2021.
- Sandia National Laboratory, *Multi-fidelity Methods for Deep Neural Network Surrogates*, May, 2021. (Webinar)
- Palo Alto Research Center, *Design under Uncertainty using Stochastic Gradients*, April, 2021. (Webinar)
- Faculty of Architecture, Civil Engineering and Environmental Sciences, Technische Universität Braunschweig, *Data-driven Modeling, Validation, and Design under Uncertainty*, July, 2020. (Webinar)

- Faculty of Mechanical Engineering, Helmut Schmidt University, *Dealing with Uncertainty in Modeling of Structures: Applications to Model Validation and Design Optimization*, April, 2020. (canceled due to COVID-19 outbreak)
- Department of Civil and Environmental Engineering, University of Southern California, *Design Optimization under Uncertainty using a Stochastic Gradient Approach*, February, 2020.
- Department of Aerospace Engineering Sciences, University of Colorado, Boulder, *“Incorporating Uncertainty into Modeling: Applications to Model Validation and Design Optimization”*, November, 2019.
- Department of Civil Engineering, Indian Institute of Technology, Kanpur, *“Applications of Probabilistic Hybrid Model Validation Framework to Structural Problems”*, January, 2018.
- Department of Civil Engineering, Indian Institute of Science, Bangalore, *Probabilistic Hybrid Model Validation Framework*, December, 2017.
- Department of Civil and Environmental Engineering, University of Southern California, *Efficient Bayesian Model Selection for Locally Nonlinear Systems incorporating Dynamic Measurements*, March, 2015.

PH.D. COMMITTEE SERVICE

- Maryam Aliakbari (Ph.D. Advisor: Peter Vadasz), Qualifying Exam and Final Defense Committee, Northern Arizona University, 2022-2023.
- Karl Harshe (Ph.D. Advisor: Zachary Lerner), Qualifying Exam Committee, Northern Arizona University, 2023.

MENTORING

- Maryam Maghazeh (Spring 2023 – present) – pursuing her Ph.D. in Mechanical Engineering
- Shaojie Wang, Grace Morris – undergraduate researchers
- Madison Gallardo - S-STEM scholar

SYNERGISTIC ACTIVITIES

- **Organized** a minisymposium on “Data-driven Methods for Uncertainty Quantification: Improvements and New Approaches” at the Engineering Mechanics Institute Conference (EMI 2023), June, 2023.
- **Moderated** a discussion on “Artificial Intelligence and Machine Learning” at the 14th World Congress of Structural and Multidisciplinary Optimization, June, 2021.
- **Organized** and **chaired** a session on “Robust design and reliability-based design optimization” at the 14th World Congress of Structural and Multidisciplinary Optimization, June, 2021.
- **Organized** and **chaired** a minisymposium on “Advances in Design Optimization under Uncertainty” at the 15th U.S. Congress on Computational Mechanics, July-August, 2019.
- **Chaired** a session on “Polynomial Chaos and Polynomial Approximation” at the SIAM Conference on Uncertainty Quantification (UQ18), Hyatt Regency Orange County, Garden Grove, California, USA, April, 2018.

- **Reviewer** for Structural Control and Health Monitoring, Computer Methods in Applied Mechanics and Engineering, Journal of Bridge Engineering, Computational Geosciences, AIAA Journal, International Journal for Uncertainty Quantification, Journal of Engineering Mechanics, Journal of Computing in Civil Engineering, International Journal for Numerical Methods in Engineering, Entropy, Ultrasonics, Scientific Reports, Journal of Intelligent Material Systems and Structures, Engineering with Computers, Structural Health Monitoring, Science Advances, and SN Applied Sciences.

ACADEMIC BACKGROUND

Dynamics: Structural Dynamics, Finite Element Method in Dynamics, Random Vibrations and Structural Reliability.

Control Theory: Linear Feedback Control, Linear System Theory, Robust and Multivariable Control.

Mathematics: Probability, Uncertainty Quantification, Ordinary Differential Equations, Optimization.

Signal Processing: Digital Signal Processing, Machine Learning, Wavelets.

PROGRAMMING SKILL

Python, MATLAB, C, PyTorch, TensorFlow, FEniCS, and OpenFOAM

HONORS & AWARDS

- Recipient of **SIAM Early Career Travel Award** to attend the SIAM Conference on Computational Science and Engineering, 2021.
- Recipient of Postdoctoral Association of Colorado Boulder Travel Award to attend the Engineering Mechanics Institute Conference, 2021.
- Recipient of **best dissertation** award in Civil Engineering at the University of Southern California, 2018.
- Recipient of **Viterbi Graduate School Ph.D. Fellowship** (2013-2017) and Gammel scholarship (Spring 2017) from the University of Southern California.
- Recipient of monthly scholarships from **Ministry of Education, Govt. of India**, for graduate studies (August, 2011-July, 2013).
- Recipient of travel grants from USC Graduate Student Government to attend *ASCE Engineering Mechanics Institute Conferences*, 2014 & 2017, and *IMAC XXXV Conference*, 2017.
- *ASCE Engineering Mechanics Institute Conference* Probabilistic Methods student paper competition finalist in 2014, 2017.
- Recipient of a scholarship from the National Science Foundation to attend the Asia-Pacific Summer School on Smart Structures Technology, 2015.
- Selected as *Research Assistant of the month* in March 2015 at the University of Southern California.
- GATE (Graduate Aptitude Test in Engineering) All India Rank: 5th in the year 2011 (Civil Engineering).
- Recipient of the University Medal from Jadavpur University, 2011.

ASSOCIATION MEMBERSHIPS

- The American Society of Mechanical Engineers (ASME).
- The Society for Industrial and Applied Mathematics (SIAM).
- The American Society of Civil Engineers (ASCE).

EXTRACURRICULAR ACTIVITIES

- Senior Diploma in Fine Arts with Distinction.
- Junior Diploma in Acoustic Hawaiian guitar with Distinction.
- Treasurer of Balaka: Bengali Association of USC in 2017.
- Organized a Bengali festival in campus for 2014-2016.