Subhayan De

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OVERVIEW

Postdoctoral Associate, Former Viterbi Ph.D. Fellow, **Nationality:** Indian.

EDUCATION

Ph.D. in Civil Engineering May 2018
University of Southern California, Los Angeles
GPA: **4.0 out of 4.0**.
Thesis title: "A Novel Hybrid Probabilistic Framework for Model Validation" (awarded **best dissertation**).
Thesis advisor: Prof. Erik A. Johnson. Co-advisor: Prof. Steven F. Wojtkiewicz.

M.S. in Electrical Engineering May 2016
University of Southern California, Los Angeles
GPA: **4.0 out of 4.0**.
Projects: *Structural system identification, model selection, and damage detection using wavelet approaches*, *Machine Learning for Musical Year Prediction.*

M.Eng. in Structural Engineering 2011-2013
Indian Institute of Science (IISc), Bangalore
GPA: **7.5 out of 8** (Rank: 1st).
Thesis title: *"Bayesian model selection in structural engineering".*
Project: *Application of Multigrid Methods in Structural Mechanics Problems.*

B.Eng. in Civil Engineering with Honours 2007-2011
Jadavpur University, Kolkata
GPA: **9.28 out of 10** (Rank: 3rd).
Project: *Genetic Algorithm in Civil Engineering Applications.*

EXPERIENCE

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

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

Indian Institute of Science
Graduate Research Assistant 2012-2013
Department of Civil and Environmental Engineering
Supervisors: Prof. C. S. Manohar and Prof. Debraj Ghosh

JOURNAL PUBLICATIONS

Submitted

11. **S. De**, and A. Doostan, "Neural Network Training for Uncertainty Propagation Using ℓ_1 Regularization and Bi-fidelity Data", *Journal of Computational Physics*, (submitted).

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*, (submitted).

9. **S. De**, K. Maute, and A. Doostan, "Reliability-based Topology Optimization under Uncertainty using Stochastic Gradients", *Structural and Multidisciplinary Optimization*, (submitted).

Published/Accepted

8. **S. De**, "Uncertainty Quantification of Locally Nonlinear Dynamical Systems using Neural Networks", *Journal of Computing in Civil Engineering*, (in press).

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).

In preparation

12. **S. De**, K. Maute, and A. Doostan, "Topology Optimization under Microscale Uncertainty using Stochastic Gradients", *Journal TBD*, (in preparation).

CONFERENCE

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*, (scheduled for 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*, (scheduled for 2021).

23. **S. De**, K. Maute, and A. Doostan, "Use of Stochastic Gradient Descent for Topology Optimization under Reliability Constraints", *16th U.S. Congress on Computational Mechanics, Chicago, IL, USA*, (scheduled for 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, USA*, (postponed to 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, Texas, USA*, (scheduled for 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. 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 *Scalable and Multi-disciplinary Design Optimization of Hypersonic Systems* (submitted to the United States Air Force Office of Scientific Research for funding).
- Assisted authoring *Physics-Informed Deep Learning with Scientific Perceptual Loss Networks and Multifidelity Uncertainty Quantification*, accepted for funding by the United States Department of Energy, starts 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

- 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.

SYNERGISTIC ACTIVITIES

- **Organizing** a minisymposium on "Recent Advances in Design Optimization under Uncertainty" at the 16th U.S. Congress on Computational Mechanics, July, 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, ASCE Journal of Bridge Engineering, Computational Geosciences, AIAA journal, and International Journal for Uncertainty Quantification.

ACADEMIC BACKGROUND

Control Theory: Linear Feedback Control, Linear System Theory, Robust and Multivariable Control.
Dynamics: Structural Dynamics, Finite Element Method in Dynamics, Random Vibrations and Structural Reliability.
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

HONOURS & AWARDS

- Recipient of SIAM Early Career Travel Award to attend the SIAM Conference on Computational Science and Engineering, 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 Human Resource Development, 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 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.
- 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 Civil Engineers (ASCE).
- The Society for Industrial and Applied Mathematics (SIAM).
- The United States Association for Computational Mechanics (USACM).

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.