

Dhruv Patel

Curriculum Vitae

Stanford University, CA
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Research Interests

Scientific machine learning, Bayesian inference, Probabilistic deep learning, Deep generative modeling, Computational mechanics, PDE-constrained optimization, Active learning, Computer vision, Medical imaging.

Academic History

- May 2021 – **Postdoctoral Fellow**,
Present *Stanford University*, Stanford, USA.
Mechanics and Computation Group
- Aug 2016 – **PhD, Computational Mechanics**,
Feb 2021 *University of Southern California (USC)*, Los Angeles, USA.
Thesis: Physics-based data-driven inference.
Advisor: Prof. Assad Oberai
- July 2014 – **MTech, Applied Mechanics**,
June 2016 : *Indian Institute of Technology - Delhi*, New Delhi, India.
Thesis: Modeling of a supercoiled DNA using elastic rod model employing self-contact phenomena.
- July 2009 – **BE, Mechanical Engineering**,
June 2013 : *L. D. College of Engineering (LDCE)*, Ahmedabad, India.

Selected Honours & Awards

- 2021 **Stephen Timoshenko Distinguished Postdoctoral Fellowship**, Stanford University
- 2020 Featured articles in **Techxplore** and **USC News** on AI-based automatic detection, classification, and localization of semiconductor defects.
- 2019 Featured articles in 50+ national and international news media outlets including **Forbes**, **Science Daily**, **Eureka Alert**, **Medical Xpress**, and **Oncology Times** on deep learning driven elastography for efficient breast cancer diagnosis.
- 2019 The Honourable Mention of **2019 Karel Urbanek Award** for Best Student Paper, SPIE Advanced Lithography, San Jose, CA (2nd place).
- 2018 Finalist of the best student poster competition, 13th World Congress on Computational Mechanics, New York City, NY.
- 2018 9th Gene Golub SIAM summer school on inverse problems and uncertainty quantification scholarship, Breckenridge, CO.
- 2016 **Prof. Karunes Memorial Award** for **Best Master's Thesis** - Applied Mechanics department, IIT Delhi.
- 2016 Ministry of Human Resource and Development, Government of India fellowship for M.Tech., IIT Delhi.
- 2009 – Ministry of Human Resource and Development, Government of India, national merit scholarship,
2013 B.E., LDCE.

Publications

Journal Articles

- [1] **D. Patel**, R. Tibrewala, A. Vega, L. Dong, N. Hugenberg, A. Oberai "Circumventing the solution of inverse problems in mechanics through deep learning: Application to elasticity imaging", *Journal of Computer Methods in Applied Mechanics and Engineering (CMAME)*. [[Link](#)]
 - Selected media highlights: [1](#), [2](#), [3](#), [4](#), [5](#)
- [2] **D. Patel**, R. Bonam, A. Oberai "Deep learning-based detection, classification, and localization of defects in semiconductor processes", *Journal of Micro/nanolithography, MEMS, and MOEMS*. [[Link](#)]
 - Selected media highlights: [1](#), [2](#)
- [3] **D. Patel**, V. Kher, B. Desai, L. Xiaomeng, S. Cen, N. Nanda, A. Gholamrezanezhad, V. Duddalwar, B. Varghese, A. Oberai "Machine learning-based predictors for COVID-19 disease severity", *Scientific Reports*. [[Link](#)]
- [4] **D. Patel**, A. Oberai "GAN-based priors for quantifying uncertainty in supervised learning" *SIAM/ASA Journal of Uncertainty Quantification*. [[Link](#)]
- [5] **D. Patel**, D. Ray, A. Oberai, "Solution of Bayesian inverse problems and model order reduction using deep generative modeling", *Journal of Computer Methods in Applied Mechanics and Engineering (CMAME)*. (in review)[[Link](#)]
- [6] R. Raad, **D. Patel**, C. Hsu, D. Ray, B. Varghese, S. Cen, D. Hwang, I. Gill, V. Duddalwar, A. Oberai "Probabilistic recovery of missing phase images in contrast-enhanced CT", *IEEE Transactions on Medical Imaging* (in review)

Peer-reviewed Conference and Workshop Articles

- [1] **D. Patel**, J. Lee, M. Forghani, M. Farthing, T. Hesser, P. Kitanidis, E. Darve "Multi-Fidelity Hamiltonian Monte Carlo Method with Deep Learning-based Surrogate", *Second symposium on science-guided AI, AAAI Fall Symposium Series (FSS), virtual*, 2021. [[Link](#)]
- [2] **D. Patel**, C. Hsu, B. Varghese, S. Cen, D. Hwang, I. Gill, V. Duddalwar, A. Oberai "Probabilistic recovery of missing phase images in contrast-enhanced CT", *Medical imaging workshop, 34th conference on Neural Information Processing System (NeurIPS), virtual*, 2020. [[Link](#)]
- [3] **D. Patel**, D. Ray, H. Ramaswamy, A. Oberai "Bayesian inference in physics-driven problems with adversarial priors", *Deep inverse workshop, 34th conference on Neural Information Processing System (NeurIPS), virtual*, 2020. [[Link](#)]
- [4] **D. Patel**, A. Oberai "Generative Adversarial Network priors for Bayesian inference", *Deep inverse workshop, 33rd conference on Neural Information Processing System (NeurIPS), Vancouver, BC*, 2019. [[Link](#)]
- [5] **D. Patel**, R. Bonam, A. Oberai "Engineering neural networks for improved defect detection and classification", *Proc. SPIE 10959, Metrology, Inspection, and Process Control for Microlithography XXXIII, SPIE Advanced Lithography, San Jose, CA*, 2020. [[Link](#)]

Selected talks

- [1] **D. Patel** "Efficient Bayesian Inference using Deep Generative Priors and Multi-fidelity Modeling", *Energy Resources Engineering (ERE) graduate seminar series, Stanford, CA*, 2021 - virtual (**Invited talk**). [[Link](#)]
- [2] **D. Patel**, A. Oberai "Efficient Bayesian inference using deep generative modeling", *Mechanics and Computation group, Stanford, CA*, 2020 - virtual (**Invited talk**).
- [3] **D. Patel**, A. Oberai "Solution of Bayesian inverse problems and uncertainty quantification in deep learning using deep generative modeling", *Combustion Research Facility, Sandia National Lab, Livermore, CA*, 2020 - virtual (**Invited talk**).

- [4] **D. Patel**, A. Oberai "Solution of Bayesian inverse problems and uncertainty quantification in deep learning using deep generative modeling", *Mechanics of materials department, Sandia National Lab, Livermore, CA*, 2020 - virtual (**Invited talk**).
- [5] **D. Patel**, A. Oberai "Physics-based data-driven deep generative models for efficient Bayesian inference", *Climate Modeling Alliance (CliMA), Caltech, Pasadena, CA*, 2020 (**Invited talk**).
- [6] **D. Patel**, A. Oberai "To know what we don't know: quantifying uncertainty using sample-based priors", *Mechanics seminar series, Department of Aerospace and Mechanical Engineering, USC, Los Angeles, CA*, 2020.
- [7] **D. Patel**, R. Bonam, A. Oberai "Engineering neural networks for improved defect detection, classification, and localization", *SPIE Advanced Lithography, San Jose, CA*, 2019.
- [8] **D. Patel**, R. Tibrewala, A. Vega, L. Dong, N. Hugenberg, A. Oberai "Circumventing the solution of inverse problems in mechanics through deep learning", *13th World Congress on Computational Mechanics (WCCM), NYC, NY*, 2018.
- [9] **D. Patel**, A. Boquet, C. Bi, H.A. Arguedas "Hessian-free inexact Newton conjugate gradient method for efficient solution of inverse elasticity problems", *9th Gene Golub SIAM summer school on inverse problems and uncertainty quantification, Breckenridge, CO*, 2018.
- [10] **D. Patel**, R. Tibrewala, A. Vega, L. Dong, N. Hugenberg, A. Oberai "Effectiveness of domain randomization and transfer learning in bio-mechanical imaging", *Computational Science and Engineering seminar series, SCOREC, RPI, Troy, NY*, 2017.

Research Advising

MS candidates

- Fall 2019 – *Chiao-Chih Hsu*
 present Implementing learning-based models to infer missing phase image of renal lesions from partially visible Contrast-Enhanced Computed Tomography (CECT) data.
- Fall 2018 – *Vijay Kothapalli*
- Summer 2019 Designed and developed deep learning-based models for time series data with application to Contrast-Enhanced Ultrasound (CEUS) imaging.

Undergraduate candidates

- Summer 2020 *Vikram Kher*
 – present Developing ML-based tools for prediction of clinical prognosis and disease severity in COVID-19 patients – **winner**: Best USC Viterbi summer undergraduate research project.
- Summer 2019 *Eeshan Gupta*
 Developed software tools for solving physics-driven Bayesian inverse problems using GAN priors.
- Summer 2017 *Adriana Vega, Raghav Tibrewala*
 Developed deep learning-based elasticity imaging workflow to classify breast tumors based on its mechanical properties.

High-school student

- Summer 2018 *Jacqueline Wang*
 Developed data processing and visualization pipeline for the tumor classification project.

Teaching Experience

- Fall 2020 **AME 599: Machine Learning and Computational Physics**, USC.
 - Assisted my advisor in preparing course material for the first offering of this graduate level course.
 - Conducted office hours and grading assignments.
- Spring 2017 **ENGR 2050: Introduction to Engineering Design**, RPI.
 - Conducted studio sessions and assisted students in conceptual and detailed design of the project for the project-based undergraduate course.

Fall 2016 **ENGR 1200: Engineering graphics and CAD**, RPI.

- o Conducted lab sessions as a lead TA for the undergraduate course with 250+ students.
- o Conducted office hours, graded assignments, and assisted 50+ students with final CAD project.

Spring 2016 **Advanced Solid Mechanics**, IIT-D.

- o Conducted office hours and tutorials and graded assignments.

Professional Membership and Service

- o Reviewer, *Journal of Computational Physics (JCP)*, *Journal of Geosciences*, *AAAI*, *ICLR*.
- o Student member, Society of Industrial and Applied Mathematics, Computational Science and Engineering (CSE) group.
- o Student member, Society of Industrial and Applied Mathematics, Uncertainty Quantification (UQ) group.
- o Central team placement coordinator, *IIT Delhi*.

Computer Skills

Programming Languages Python, C, C++, MATLAB, Fortran, Bash scripting

Scientific tools and libraries TensorFlow, PyTorch, TensorFlow Probability, FEniCS, MPI, OpenMP, data analysis packages in python (Scikit-learn, pandas, Scipy), ParaView, Ansys, NX, Creo, \LaTeX , version control with GitHub