

Dhruv V. Patel

*PhD. candidate, Department of Aerospace and Mechanical Engineering,
University of Southern California*

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Education

- **University of Southern California** *Los Angeles, CA*
PhD. in Mechanical Engineering (Computational Mechanics) *2016-present*
 - Thesis topic: “Physics-guided data-driven modeling for efficient inference”
 - Supervisor: Prof. Assad Oberai
- **Indian Institute of Technology, Delhi** *New Delhi, India*
M.Tech. in Applied Mechanics *June 2016*
 - Thesis title: “Modeling of a supercoiled DNA using elastic rod model employing self-contact phenomena”
 - Supervisor: Prof. Ajeet Kumar
- **L.D. College of Engineering** *Ahmedabad, India*
B.Tech. Mechanical Engineering *June 2013*
 - Thesis title: “Optimal design and analysis of power screw”
 - Supervisor: Prof. Shahnawazkhan Pathan

Research Interests

Physics-guided data-driven modeling, deep generative modeling, uncertainty quantification, computer vision, medical imaging, inverse problems, interpretability in deep learning, PDE-constrained optimization, finite element analysis.

Selected Honors and Awards

- The Honorable Mention of *2019 Karel Urbanek Best Student Paper Award*, SPIE Advanced Lithography, San Jose, CA [Feb. 2019] (2nd place).
- Finalist of the best student poster competition, 13th World Congress on Computational Mechanics, New York City, NY [July 2018].
- *Prof. Karunes Memorial Award for Best Master’s Thesis* - Applied Mechanics Department, IIT Delhi [June 2016].
- Ministry of Human Resource and Development, Government of India fellowship for M.Tech. degree, IIT Delhi [2014 – 2016].
- Merit-based scholarship from Ministry of Human Resource and Development, Government of India for undergraduate studies [2009 – 2013].

Research Experience

- **Graduate Research Assistant**

June 2018 – Present

Computational and Data-driven Discovery (CD³) group, USC

Los Angeles, CA

- **Bayesian Inference using Generative Adversarial Network Priors:**

- Proposed a novel algorithm and developed a general-purpose framework for solving Bayesian inference problem using Generative Adversarial Network (GAN) priors.
- Demonstrated the effectiveness of proposed algorithm in diverse uncertainty quantification and active learning tasks arising in physics and computer vision applications and developed a new software framework for solving hybrid problems involving PDE and learning-based models.

- **Improved defect detection, classification, and localization using deep learning:**

(in collaboration with IBM AI Research Center, Albany, NY)

- Developed and implemented a deep learning-based workflow to automatically detect, classify, and locate defects in manufactured semi-conductor chips in a *weakly supervised* fashion.
- Developing pattern invariant models for defect classification in limited data regime.

- **Probabilistic recovery of missing phase in contrast-enhanced CT:**

(in collaboration with Keck school of medicine - USC, LA, CA)

Leading a team of masters' students for developing probabilistic deep learning models for recovery of missing phase in contrast-enhanced CT data using GAN-based priors.

- **Graduate Research Assistant**

June 2017 – May 2018

Scientific Computation Research Center (SCOREC), RPI

Troy, NY

- **Mechanical classification of breast tumors using deep learning:**

- Developed and implemented a deep learning-based elasticity imaging workflow in TensorFlow for breast tumor classification based on mechanical properties of tissue.
- First demonstration of domain randomization in bio-mechanical imaging.

- **Adjoint-based solution of PDE-constrained optimization problems:** Derived and implemented adjoint based algorithms for inference of visco-elastic properties of tissue from interior time-harmonic data (MRI), by posing the inverse problem as a PDE-constrained optimization problem.

- **Non-overlapping domain decomposition methods for parallel solution of large-scale optimization problems:** Derived and implemented a novel non-overlapping domain decomposition method for parallel solution of large-scale PDE-constrained optimization problems using Coupled Adjoint State Equation (CASE) method.

Journal Publications[J], Peer-Reviewed Conference Publications[C], and Invited Talks[T]

- **[J] D. Patel**, A. Oberai, R. Bonam “Deep learning-based detection, classification, and localization of defects in semiconductor processes”, *Journal of Micro-nanolithography, MEMS and MOEMS* [[Link](#)].
- **D. Patel**, A. Oberai “GAN-based priors for quantifying uncertainty”. [[Link](#)].
- **[J] D. Patel**, R. Tibrewala, A. Vega, N. Hugenberg, L. Dong, A. Oberai "Circumventing the solution of inverse problems in mechanics through deep learning: an application to elasticity imaging", *Computer Methods in Applied Mechanics and Engineering*. [[Link](#)]
 - Selected media highlights: [1](#) , [2](#) , [3](#) , [4](#) , [5](#)
- **D. Patel**, A. Oberai “Generative Adversarial Network Priors for Bayesian Inference”, Deep-inverse workshop, NeurIPS 2019, Vancouver, BC [[Link](#)].
- **[C] D. Patel**, A. Oberai, R. Bonan “Engineering neural networks for improved defect detection, classification, and localization”, *Metrology, Inspection, and Process Control for Microlithography XXXIII* Feb 2019 [[Link](#)].
- **[T] D. Patel**, E. Gupta, A. Oberai “Bayesian Inference using Generative Adversarial Network Priors (BI-GANP)”, 15th U.S. National Congress on Computational Mechanics (USNCCM), Austin, TX [2019].
- **[T] D. Patel**, A. Oberai, R. Bonan “Engineering neural networks for improved defect detection, classification, and localization”, SPIE Advanced Lithography, San Jose, CA [2019].
- **[T] D. Patel**, E. Gupta, A. Oberai “Regularization of inverse problems with data-based priors”, Research challenges and opportunities at the intersection of Machine Learning and Uncertainty Quantification, USC, Los Angeles, CA [2019].
- **[T] D. Patel**, E. Gupta, A. Oberai “Regularizing via Adversarial Learning”, Applied inverse problems conference, Grenoble, FR [2019].
- **[T] D. Patel**, A. Boquet, C. Bi, H.A. Arguedas “Efficient solution of inverse elasticity imaging problem using Hessian-free inexact Newton conjugate gradient method”, 9th Gene Golub SIAM summer school on inverse problems and uncertainty quantification, Breckenridge, CO. [2018].
- **[T] D. Patel**, R. Tibrewala, A. Vega, N. Hugenberg, L. Dong, A. Oberai "Circumventing the solution of inverse problems in mechanics through deep learning", 13th World Congress on Computational Mechanics (WCCM), NYC, NY [2018].
- **[T] L. Dong**, N. Hugenberg, **D. Patel**, T. Seidl, P. Barbone and A. Oberai “Adaptive mesh refinement and domain decomposition techniques in elasticity imaging”, 14th U.S. National Congress on Computational Mechanics (USNCCM), Montreal, QC [2017].

- **[T] D. Patel**, R. Tibrewala, A. Vega, L. Dong, N. Hugenberg, A. Oberai “Mechanical classification of tumors using deep learning”, Computational Science & Engineering seminar series, SCOREC, RPI, Troy, NY [2017].
- **[T] D. Patel**, R. Tibrewala, A. Vega, L. Dong, N. Hugenberg, A. Oberai “Mechanical classification of tumors using deep learning”, Graduate Research Symposium, RPI, Troy, NY [2017].
- **[T] D. Patel**, A. Kumar “Modeling of a supercoiled DNA using elastic rod model employing self-contact phenomena”, Applied Mechanics seminar, IIT Delhi, New Delhi [2016].

Teaching Experience

- **Teaching Assistant [Department of Mechanical, Aerospace and Nuclear Engineering, RPI]**
 - *Engineering graphics and CAD (ENGR 1200):* *Fall 2016*
 - Conducted lab sessions and office hours as a lead TA for this undergraduate course with around 150 students.
 - Graded assignments and final projects of around 100 students.
 - *Introduction to Engineering Design (ENGR 2050):* *Spring 2017*
 - Conducted studio session and assisted students in conceptual and detail design of the project.

Research Mentorship

- **PhD. research supervision, USC (Ragheb Raad)** *August 2019 – Present*
 - Developing probabilistic deep predictive model for cancer survival (in collaboration with Amgen and USC center for convergent bioscience).
- **M.S. research supervision, USC (Vijay Kothapalli, Chiao-Chih Hsu)** *August 2018 – Present*
 - Developing learning-based probabilistic model to infer and classify renal lesions from Contrast-enhanced ultrasound (CEUS) data.
 - A conference and journal paper in preparation.
- **Undergraduate research supervision, RPI**
 - Vikram Kher *Summer 2020*
 - Developing ML-based tools for prediction of clinical prognosis and disease severity in COVID-19 patients.
 - Eeshan Gupta *Summer 2019*
 - Developed software tools for solving physics-driven Bayesian inverse problems using GAN priors.
 - Adriana Vega and Raaghav Tibrewala *Summer 2017*
 - Developed deep learning-based elasticity imaging workflow to classify breast tumors based on its mechanical properties while circumventing the need of solving expensive inverse problems.
 - Resulted in one journal publication.
- **High-school summer research supervision, USC (Jacqueline Wang)** *Summer 2018*
 - Developed data processing and visualization pipelines for tumor classification project.

Computer Skills

- **Programming languages and OS:**
 - Python, C, C++, Fortran, Linux, Windows.
- **Scientific tools and libraries:**
 - TensorFlow, PyTorch, FEnics, Non-Linear Adjoint based Coefficient Estimator (NLACE) (an adjoint-based optimization library - developer), MATLAB, Ansys, NX, Catia.

Proposal Experience (assisting my PhD. advisor)

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| • Army Research Lab | 1 proposal, 2019 |
| • DOE: scientific Machine Learning and Artificial Intelligence for UQ | 1 proposal, 2019 |
| • DARPA: Physics of AI | 1 proposal, 2018 |
| • NIH: Artificial Intelligence, Machine Learning, and Deep Learning | 1 proposal, 2017 |