**Dhruv V. Patel**

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

Website: [dhruvpatel108.github.io](https://dhruvpatel108.github.io) | GitHub: [dhruvpatel108](https://github.com/dhruvpatel108) | E-mail: [dhruvvpa@usc.edu](mailto:dhruvvpa@usc.edu)

**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 learning, Bayesian inference, PDE-constrained optimization, computer vision, medical imaging, inverse problems, deep generative modeling, 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, 2020* [[Link](https://www.spiedigitallibrary.org/journals/Journal-of-MicroNanolithography-MEMS-and-MOEMS/volume-19/issue-2/024801/Deep-learning-based-detection-classification-and-localization-of-defects-in/10.1117/1.JMM.19.2.024801.short?SSO=1)] - Media highlight: [1](https://viterbischool.usc.edu/news/2020/06/catching-defects-before-they-multiply/).
* **D. Patel**, A. Oberai “GAN-based priors for quantifying uncertainty”. [[Link].](https://arxiv.org/abs/2003.12597)
* **[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*, 2019.. [[Link](https://www.sciencedirect.com/science/article/pii/S0045782519302579)]
  + Selected media highlights**:** [1](https://www.sciencedaily.com/releases/2019/07/190712151928.htm) , [2](https://www.forbes.com/sites/cognitiveworld/2019/10/17/recent-research-utilizing-ai-for-early-detection-of-breast-cancer-has-doctors-rethinking-the-human-role-in-diagnosis/#7eb6f6e944dc), [3](https://www.medicalnewstoday.com/articles/325750.php#1) , [4](https://health.economictimes.indiatimes.com/news/health-it/ai-can-diagnose-breast-cancer-more-quickly-accurately/70205340) , [5](https://news.usc.edu/158958/cancer-diagnosis-algorithm-early-detection/)
* **D. Patel**, A. Oberari “Generative Adversarial Network Priors for Bayesian Inference”, *Deep-inverse workshop, NeurIPS 2019*, Vancouver, BC [[Link](https://openreview.net/forum?id=HJlL2Q2qLS)].
* **[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](https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10959/1095910/Engineering-neural-networks-for-improved-defect-detection-and-classification/10.1117/12.2515065.short?SSO=1)].
* **[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]** A. Oberai, **D. Patel**, E. Gupta “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]** A. Oberai, **D. Patel,** E. Gupta “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**

* **MS 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**

*Vikram Kher (USC)*   *Summer 2020*

* Developing ML-based tools for prediction of clinical prognosis and disease severity in COVID-19 patients.

*Eeshan Gupta (USC)*   *Summer 2019*

* Developed software tools for solving physics-driven Bayesian inverse problems using GAN priors.

*Adriana Vega* and *Raghav Tibrewala (RPI)*   *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), MATLAB, Ansys, NX, Catia.