Sourabh Shende

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Professional Experience

Apr 2018 – Present **PhD Researcher,** Computational Mechanics, University of Cincinnati

- Developed Bayesian optimization (BO) technique using Gaussian process (GP) surrogate for efficiently discovering origami-inspired folding structures. Demonstrated its superiority over gradient-based and genetic algorithms with an order of magnitude fewer function evaluations.
- Enhanced vanilla BO with gradient and anisotropy information. These enrichments showcased a threefold increase in speed for uncovering optimal designs.
- Applied anisotropy enriched Bayesian optimization (BO) for material calibration of hyperelastic Yeoh model for porcine meniscus.
- Developed energy-based machine learning framework, Deep energy minimization (DEM), using neural network surrogate to solve deformations of hyperelastic multistable structures. Demonstrated advantages and shortcomings of DEM over well-established finite element approaches.
- Developed DEM to solve phase-field plasticity problems. Working on using the DEM framework to solve inverse problems to determine plasticity material parameters.

Jan 2019 – Present **Graduate Research Assistant,** P&G Digital Accelerator @ University of Cincinnati.

- Developed detailed Finite element model of paper at the fiber scale level using connectors representing glue.
- Developed performance tests: Tensile, Compression, and Bending to determine the strength of paper.
- Developed automation scripts to speed up the setup and launch time of the simulations.
- Developed detailed finite element model for corrugated cases used for packaging.
- Automated detailed finite element pre-processing of corrugated case using *tcl* script in Altair Hypermesh.
- Performed top load simulations on different designs of plastic tubs used for storing liquid pods.

May 2018 – Aug 2018 **Software Integrity Intern,** Altair Engineering, Troy, MI, US.

- Designed and developed 201 *tcl* automation scripts to test the functionality and performance of Altair HyperMesh's newly developed tools.
- Analyzed and validated the scripts by comparing the script's output to the intended output of the HyperMesh's tool.

Jul 2015 – Jun 2017 **Senior CAE Engineer, R&D department,** Bajaj Auto Ltd, Pune, India.

- Developed and validated Finite Element (FE) modeling methodology for welded components.
- Performed durability simulations and suggested design changes for exhaust system (silencer), cylinder head, crankcase, connecting rod and crankshaft for improving fatigue life.
- Improved modal assurance criteria (MAC) correlation methodology used for Finite Element model validation.
- Established welding standard to decide pass/fail criteria for exhaust system (silencers). Standard was developed by measuring parameters like weld leg lengths, weld penetration, root gap, grain size, extend of HAZ and hardness of the road endurance passed silencers.
- Developed automation scripts in Excel VBA and *tcl* to drastically reduce Finite Element model setup time.

Education

2020 – Present
Doctor of Philosophy, Mechanical Engineering, $4.0/4.0$, University of Cincinnati, US.
Advisor: Dr. Kumar Vemaganti.
Thesis title: *Scientific machine learning approaches for nonlinear computational mechanics.*

2017 – 2020
Master of Science, Mechanical Engineering, $4.0/4.0$, University of Cincinnati, US.
Advisor: Dr. Kumar Vemaganti.
Thesis title: *Bayesian topology optimization for efficient design of origami folding structures..*

2011 – 2015
Bachelor of Technology, Mechanical Engineering, $9.03/10.0$, Visvesvaraya National Institute of Technology (VNIT), India.

Publications & Conferences

1. **S. Shende** and K. Vemaganti, "Application of energy-based physics informed machine learning for multistable beam structure," *European Journal of Mechanics - A/Solids (in preparation)*,
2. **S. Shende** and K. Vemaganti, "Application of physics informed machine learning for buckling of bi-stable beam structure," in 17*th U.S National Congress on Computational Mechanics*, Albuquerque, New Mexico, 2023. URL: https://17.usnccm.org/.
3. T. Long, **S. Shende**, C.-Y. Lin, and K. Vemaganti, "Experiments and hyperelastic modeling of porcine meniscus show heterogeneity at high strains," *Biomechanics and Modeling in Mechanobiology*, vol. 21, 6 2022, ISSN: 1617-7940. DOI: 10.1007/s10237-022-01611-3.
4. **S. Shende**, A. Gillman, P. Buskohl, and K. Vemaganti, "Systematic cost analysis of gradient- and anisotropy-enhanced bayesian design optimization," *Structural and Multidisciplinary Optimization*, vol. 65, 8 2022, ISSN: 1615-1488. DOI: 10.1007/s00158-022-03324-8.
5. **S. Shende**, A. Gillman, D. Yoo, P. Buskohl, and K. Vemaganti, "Bayesian topology optimization for efficient design of origami folding structures," *Structural and Multidisciplinary Optimization*, vol. 63, pp. 1907–1926, 4 2021, ISSN: 1615-1488. DOI: 10.1007/s00158-020-02787-x.
6. **S. Shende** and K. Vemaganti, "Bayesian topology optimization for efficient design of origami folding structures," in 16*th U.S National Congress on Computational Mechanics*, 2021. URL: http://16.usnccm.org/.
7. A. Inamdar, N. Adhe, **S. Shende**, R. Uddanwadiker, and S. Lulay, "Design and development of low cost silicone implant used in augmentation rhinoplasty suitable for the indian sub-continental population," *International Journal of Pharma Medicine and Biological Sciences*, vol. 5, no. 1, 2016. URL: https://www.ijpmbs.com/index.php?m=content&c=index&a=show&catid=135&id=196.

Software Skills

Finite Element Suite	Altair, Abaqus, Ansys.
Machine Learning Framework	pytorch, Tensorflow.
High Performance Computing	MPI, OpenMP.
Programming	MATLAB, Python, Tcl, VBA, Fortran, C++, LaTeX.
Version Control	Git.

Selected Projects

- **Non-linear Hyper-elastic response:** MATLAB script to find nonlinear force response of hyper-elastic materials with Ogden and Gent strain energy potentials when subjected to uni-axial, bi-axial, and pure shear deformation modes. The Newton-Raphson method was implemented to perform the necessary iterations for solving the nonlinear equations.
- **Parallelization of Linear iterative solver:** Developed a code in Fortran to solve 2D Poissons problem using conjugate gradient linear iterative solver. Parallelization of the solver was done using Message Passing Interface (MPI) with 1D and 2D decomposition of the domain.