Sourabh Shende

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Skills

Finite Element Analysis Abaqus, FEniCS, Altair, Ansys
Machine Learning Frameworks PyTorch, TensorFlow
High Performance Computing SLURM, LSF, MPI, OpenMP
Programming Python, MATLAB, Tcl, VBA, Fortran, C++, LaTeX
Version Control Git

Work Experience

University of Cincinnati
Cincinnati, Ohio, USA

GRADUATE RESEARCHER - SCIENTIFIC MACHINE LEARNING
Aug. 2018 - Present

- Developed Bayesian optimization (BO) with Gaussian processes (GP) surrogates, reducing finite element (FE) function evaluations by **10x** to discover optimal actuating designs for origami-inspired folding structures.
- Enhanced BO with gradient and anisotropy data, achieving a **3x** speedup in optimal design discovery.
- Applied anisotropy-enriched BO for material calibration of hyperelastic Yeoh models for porcine meniscus.
- Developed a physics-informed machine learning (PIML) framework using system energy minimization to evaluate buckling deformation in hyperelastic multistable structures, eliminating the need for eigenvalue solutions required in finite element methods.
- Developed a physics-informed machine learning (PIML) based approach for phase-field plasticity at the mesoscale, improving plasticity parameter characterization by **6x**.

Innovative Numerics LLC
Cincinnati, Ohio, USA

SIMULATION AND MACHINE LEARNING INTERN
Jan. 2025 - April 2025

- Conducted advanced finite element (FE) simulations for nontrivial projects across feminine, fabric, and family care consumer products.
- Developed Abaqus subroutines (DLOAD and UEXTERNALDB) with MPI parallelization for efficient distributed memory computations.
- Designed a graph neural network (GNN)-based machine learning framework to accelerate FE solution predictions.

P&G Digital Accelerator
Cincinnati, Ohio, USA

GRADUATE RESEARCH ASSISTANT - MODELING & SIMULATION
Jan. 2019 - Jan. 2025

- Built a microscale finite element (FE) model for non-woven paper, incorporating adhesive interactions using connector elements.
- Developed tensile, compression, and bending performance test protocols to assess material strength.
- Automated FE pre-processing in Abaqus and HyperMesh, using Python and Tcl scripts, reducing setup time and enhancing productivity.
- Created Python scripts to automate end-to-end workflows in Simulia Process Composer (Model First), streamlining the simulation process.
- Improved buckling mode failure prediction with a detailed finite element (FE) model for corrugated cases.
- Conducted top-load simulations for plastic tub designs to optimize structural integrity.

Altair Engineering
Troy, Michigan, USA

SOFTWARE INTEGRITY INTERN
May 2018 - Aug. 2018

- Automated testing of new HyperMesh features using Tcl scripts, ensuring quality and performance.
- Validated script outputs against benchmarks, improving software reliability.

Bajaj Auto Limited
Pune, Maharashtra, India

SENIOR CAE ENGINEER
Jul. 2015 - Jun. 2017

- Developed and validated finite element (FE) modeling methodologies for welded components, improving simulation accuracy.
- Conducted durability simulations for exhaust systems, cylinder heads, crankcases, and crankshafts, optimizing fatigue life.
- Enhanced modal assurance criteria (MAC) correlation to improve FE model validation and structural reliability.
- Standardized welding parameters (weld leg lengths, penetration, root gap, grain size, HAZ extent, hardness) to refine pass/fail criteria based on endurance tests.
- Automated finite element (FE) modeling workflows using Excel VBA and Tcl scripts, reducing setup time.

Education

University of Cincinnati
Cincinnati, US

Doctor of Philosophy, Mechanical Engineering, $4.0/4.0$
2020 - Present

- Dissertation: *Scientific machine learning approaches for nonlinear computational mechanics*
  Advisor: Dr. Kumar Vemaganti

University of Cincinnati
Cincinnati, US

Master of Science, Mechanical Engineering, $4.0/4.0$
2017 - 2020

- Thesis: *Bayesian topology optimization for efficient design of origami folding structures*
  Advisor: Dr. Kumar Vemaganti

Visvesvaraya National Institute of Technology *Nagpur, India*

Bachelor of Technology, Mechanical Engineering, $9.03/10.0$ *2011 - 2015*

- Thesis: *Design and development of low-cost silicone implant used in augmentation rhinoplasty suitable for the Indian sub-continental population*
  Advisor: Dr. Rashmi Uddanwadiker

Publications & Conferences

- **Shende, S.**, and Vemaganti K. "*Calibration of an Elastic-Perfectly Plastic Phase Field Model using Physic-informed Machine Learning,*" (in preparation).
- **Shende, S.**, and Vemaganti K. "*Application of energy-based physics informed machine learning for multistable beam structure,*", Mechanics of Advanced Materials and Structures (in review).
- **Shende, S.**, and Vemaganti K."*Application of physics informed machine learning for buckling of bi-stable beam structure,*", 17th U.S. National Congress on Computational Mechanics, Albuquerque, New Mexico, July 23-27, 2023.
- Long, T., **Shende, S.**, Lin C., and Vemaganti K. "*Experiments and hyperelastic modeling of porcine meniscus show heterogeneity at high strains*", Biomechanics and Modeling in Mechanobiology, (2022).
- **Shende, S.**, Gillman A., Buskohl P., and Vemaganti K. "*Systematic cost analysis of gradient- and anisotropy-enhanced Bayesian design optimization*", Structural and Multidisciplinary Optimization, Vol. 65, Issue. 8 (2022): 235-262.
- **Shende, S.**, and Vemaganti K."*Bayesian topology optimization for efficient design of origami folding structures*", 16th U.S. National Congress on Computational Mechanics July 25-29, 2021.
- **Shende, S.**, Gillman A., Yoo D., Buskohl P., and Vemaganti K. "*Bayesian Topology Optimization for Efficient Design of Origami Folding Structures*", Structural and Multidisciplinary Optimization, Vol. 63, Issue. 4 (2021): 1907-1926.
- Inamdar, A., Adhe, N., **Shende, S.**, et al., "*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, Issue. 1 (2016): 81-85.

Selected Projects

- **Non-linear Hyper-elastic Response:**
  - Developed MATLAB script to determine 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.
  - Implemented the *Newton-Raphson* method to solve the nonlinear equations iteratively.
- **Parallelization of Linear iterative solver:**
  - Developed a Fortran code to solve 2D Poissons problem using conjugate gradient linear iterative solver.
  - Used Message Passing Interface (MPI) to parallelize the solver with 1D and 2D domain decomposition.
- **Non-linear Bending of Thin Beam:**
  - Developed a MATLAB script to solve the nonlinear bending of the thin beam when subjected to an extreme moment of force.
  - Implemented the modified Newton-Raphson method with the total Lagrangian configuration scheme under plane strain conditions for convergence between each load step.
- **Multi-Layer Feed-Forward Neural Network:**
  - Developed Python script for the multi-layer feed-forward neural network from scratch to classify the digit images from the MNIST dataset.
  - Implemented the backpropagation algorithm for the training of the neural networks.
- **Finite Element Formulation:**
  - Developed MATLAB code to formulate 2D *tria3* and *quad4* elements to solve linear static problems.
  - Validated the accuracy of the developed scripts by comparing the solution with those generated by a commercial Finite Element software package.
- **Modal Parameter Estimation (MPE) and Finite Element Validation:**
  - Extracted modal parameters of Circular (aluminum) and Rectangular (steel) plates using X-modal III software from captured Frequency Response Functions (FRFs).
  - Correlated modal frequencies and mode shapes with corresponding finite element models.