Harshdeep Sharma PhD Candidate in Computational Mechanics

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Research Interests

Computational Mechanics, Fracture and Fatigue of Composites, Phase-Field Modeling, Cohesive Zone Models, Deep Learning for Mechanics, Physics-Informed Neural Networks (PINNs), Computer Vision, Transformer-based Models, High Performance Computing, Parallel Computing, Quantum Computing (beginner).

Education

PhD in Computational Mechanics (Expected Aug 2025)

Indian Institute of Technology Patna, India
Thesis: *Numerical Modeling of Fracture and Fatigue in Composites*

- Multiscale modeling of fracture and fatigue in composites from micro to macroscale.
- Developed several phase-field and cohesive zone models; Abaqus subroutines (UEL/UMAT) for fracture and fatigue.

M.Tech in Mechanical System Design (2020)

Indian Institute of Technology Indore, India
CGPA: 8.82/10
Thesis: *Numerical Implementation of Crystal Plasticity in FCC Crystals*

- Developed CPFEM model using UMAT in Abaqus for Aluminum alloys across wide strain rates.
- Open-sourced code (14 stars, 7 forks on GitHub).

B.Tech in Mechanical Engineering (2017)

UIET KUK, India
Percentage: 67.94
Thesis: *HCF and LCF Life Simulations of Aluminum Alloy*

- Simulated fatigue life using built-in S-N and ϵ-N models.

Publications

- H. Sharma, A. Singh, *Combined phase-field and cohesive zone modeling for mixed-mode fracture in polymer composites*, Engineering with Computers (2025). DOI: 10.1007/s00366-025-02134-y
- H. Sharma, A. Singh, *Numerical implementation of a modified cohesive zone model for HCF behavior of adhesively bonded composite laminates under mixed mode loading*, International Journal of Fatigue (2024). DOI: 10.1016/j.ijfatigue.2023.108128
- H. Sharma, A. Singh, *An efficient phase field solver for modelling of elastic–plastic fracture in bimaterials*, International Journal of Mechanics and Materials in Design (2024). DOI: 10.1007/s10999-023-09665-6

Manuscripts Under Review / In Preparation

- H. Sharma, A. Singh, *A degradation-informed load accumulation framework for phase-field modeling of high-cycle fatigue in composites*, submitted to *Composites Science and Technology*, under review.
- H. Sharma, S. Ahmad, S. Singh, A. Singh, *Physics-Informed Neural Networks with Fourth-Order Phase-Field Modeling for Fracture of Functionally Graded Materials*, manuscript in preparation, to be submitted to *Structures*.

Research Experience

PhD Research Highlights

- Developed accelerated phase-field models for fracture in bimaterials (speed-up of 2.33x).
- Designed UEL/UMAT subroutines in Abaqus 6.14 for High-Cycle Fatigue in adhesively bonded joints.
- Proposed new combined damage model for microscale mixed-mode fracture in composites.
- Open-sourced scalable UEL code for matrix splitting simulations under HCF.

Project Supervision

Master's Thesis:

- Jayprakash Verma (2024-25): Phase-field model for fatigue fracture in composites using FEniCS + Gmsh + Paraview.

Bachelor's Thesis:

- Syed Ibrahim Ahmad (2023-24): PINN for fracture analysis of FGMs using Python + TensorFlow.

Teaching Experience

Indian Institute of Technology Indore (2018-2020)

- TA for Fracture Mechanics, Vibrations and Noise Control, FEM, and Engineering Graphics.

Indian Institute of Technology Patna (2021-Present)

- TA for SolidWorks Lab, ANSYS APDL Labs, Fracture & Fatigue, Finite Element Methods.

Scientific Tech Stack

Software: Abaqus (UEL, UMAT), ANSYS APDL, COMSOL, MATLAB, FEniCS, Gmsh, Paraview
Programming: Python (NumPy, SciPy, Matplotlib, TensorFlow), Fortran, C++, HPC
Others: PINN, Phase-Field Modeling, Cohesive Zone Models, Finite Element Methods, DSA
Languages: English (Proficient), Hindi (Fluent), Punjabi (Native)

Awards and Exams

- GATE ME: 2016 (97.05 percentile), 2017 (98.97 percentile)
- MHRD Institute Fellowship (Masters, 2018-20; PhD, 2021-Present)

References

- Dr. Akhilendra Singh, Associate Professor, IIT Patna
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- Dr. Indrasen Singh, Associate Professor, IIT Indore
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