Allamaprabhu S Ani

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scholar.google.com/citations?user=dX3xKGsAAAAJ

Research Statement

Doctoral researcher developing GPU native, autograd-driven phase field fracture solvers with neural operator constitutive laws. Research bridges computational mechanics and machine learning: differentiable physics for inverse problems, learned closures for multiscale fracture, and benchmark methodology for the field. Lead author of the 2026 *Engineering Fracture Mechanics* review (Vol. 332, Art. 111778) on machine learning for fracture mechanics with collaborators at EPFL, University of Florida, and City St George's.

Education

PhD, Mechanical Engineering Jul 2023 – Jun 2026 (expected)
City, St George's, University of London – School of Sciences and Technology
Thesis: *GPU native differentiable phase field fracture: autograd enabled inverse problems in heterogeneous materials*.
Supervisor: Dr Sathiskumar A. Ponnusami FRAeS.

MTech, Design and Manufacturing Sep 2021 – May 2023
National Institute of Technology, Silchar – CGPA 9.88/10. Best Student Award.
Thesis: Machine learning for fatigue life prediction in aluminium alloys. Advisor: Dr A.B. Deoghare.

BE, Mechanical Engineering Aug 2016 – Jul 2020
GM Institute of Technology, Davangere (Visvesvaraya Technological University) – CGPA 8.47/10.

Awards and Honours

- **Yeoman and Travelling Scholarship, Worshipful Company of Tin Plate Workers** (Mar 2026). One of three Travelling Scholarship recipients across the City of London, for "AI-accelerated modelling for fracture prediction." Nominated by Prof. Kenneth Grattan.
- **Dean's Award for Outstanding Teaching Support**, School of Sciences and Technology, City St George's, University of London (Apr 2026). Nominated by students.
- **Associate Fellow of the Higher Education Academy (AFHEA)**, Advance HE (Oct 2024). Credential PR301728.
- **Funded PhD Studentship** "Modelling for Failure Analysis," City St George's, University of London (2023).
- **Best Student Award**, MTech Design and Manufacturing, NIT Silchar (2023).
- **Inspiring Student Award for Mechanical Engineering**, Visvesvaraya Technological University (Dec 2020).

Publications

Journal articles

J1. **Ani, A.S.**, Nakka, R., Subhash, G., Molinari, J.-F., Ponnusami, S.A. (2026). Machine learning for computational fracture and damage mechanics: Status and perspectives. *Engineering Fracture Mechanics*, 332, 111778. doi:10.1016/j.engfracmech.2025.111778. *Open access; field-level review paper.*

J2. Srinivasa, C.V., **Ani, A.S.** (2020). Protective Coatings for Bio-Composites: A Review. *IOP Conference Series: Materials Science and Engineering*, 925, 012048. doi:10.1088/1757-899X/925/1/012048.

Book chapters and conference papers

C1. **Ani, A.S.**, Deoghare, A.B. (2024). Leveraging Machine Learning for Enhanced Fatigue Life Prediction in Aluminium Alloys. In: *Lecture Notes in Mechanical Engineering*, Springer. doi:10.1007/978-981-97-7535-4_61.

In preparation

- Two-part submission to *Computer Methods in Applied Mechanics and Engineering* (CMAME) on differentiable phase field fracture and autograd-based inverse problems. Drafts in revision; submission target Q3 2026.

Research Experience

Doctoral Researcher, Computational Mechanics and Machine Learning Jul 2023 – present
City, St George's, University of London & Queen Mary University of London

- Designed and built `torch_pf_solver`: a PyTorch native, GPU-accelerated, autograd-differentiable phase field fracture solver with neural operator hooks for learned constitutive laws.
- Demonstrated inverse problems via gradient based optimisation: scalar fracture toughness recovery, spatial Gc-field reconstruction, and stiff inclusion localisation, all driven by autograd through a staggered solver.
- Cross-validated against Akantu (C++), FEniCSx, COMSOL, PhaseFieldX and PhaFiDyn on quasi static and dynamic benchmarks (Borden, Bourdin, Miehe, Kalthoff, SENT, Brazilian disc).
- Maintained reproducible HPC workflow on Hyperion2 (Slurm) with local Mac CPU and WSL CUDA development environments.

Visiting Researcher, LSMS Lab, EPFL 2025
Host: *Prof. Jean-François Molinari* (École Polytechnique Fédérale de Lausanne).

- Collaborated on the *Engineering Fracture Mechanics* 2026 review of machine learning for computational fracture and damage mechanics.
- Engaged with the LSMS group on differentiable methods for solid mechanics; visit informed the autograd-through-staggered-solver framework in the PhD code base.

MTech Researcher, NIT Silchar 2021 – 2023
Advisor: *Dr A.B. Deoghare*.

- Machine-learning surrogate models for fatigue life prediction across multiple aluminium alloy compositions (scikit-learn, MATLAB). Best Student Award.

Founder and Tool Developer, Aeroknacks India Ltd 2020 – 2021

- Built a library of validated structural-analysis tools: BJSFM (Lekhnitskii anisotropic stress field with de Jong correction), Cozzone f_0 plastic-bending extraction, lug strength (Bruhn/Niu/ESDU), fastener lap-joint load transfer, column buckling (Euler/Johnson + AFFDL coefficients), modal analysis (Roark validation), ABD calculator, Neuber non-linear stress, and a NASTRAN `.f06` parser. Tools shipped to an aerospace engineering firm.

Research Intern, NMCAD Lab, Indian Institute of Science Bengaluru
Research Intern, CGPL Lab, Indian Institute of Science Bengaluru (Feb 2018) – Pressure Swing Adsorption for 99.997%-purity hydrogen from biomass gasifier.

Teaching and Outreach

Teaching, City St George's (2023 – present)

- Co-pilot, Learning Enhancement and Development (LEaD) educational technology team (Sep 2024 – Feb 2025).
- Graduate Teaching Assistant, EG1004 tutorials and laboratory (Nov 2023 – Mar 2024).
- Head Invigilator, School of Sciences and Technology (Dec 2023 – Apr 2024); Regular Invigilator, Examinations Office (Apr 2023 – Jan 2025).
- "Engineering 2050 for Good" Hackathon (Oct 2023).

Teaching, NIT Silchar (2021 – 2023)

- Teaching Assistant: ME-316 Machine Design Laboratory (SolidWorks, ANSYS, FEA); ME-202 Theory of Machines.
- Faculty Engineer: designed and delivered a Python-for-Mechanical-Engineers curriculum, replacing legacy Excel-VBA hand-calculation workflows.

Workshop co-organisation

- Co-organiser, M2L (Mechanics and Machine Learning) Workshop, City St George's, July 2024 and July 2025. EPSRC-supported. Speakers: M. Khodaei (Imperial), G. Subhash (Florida), J.-F. Molinari (EPFL), S. Kumar (TU Delft), S. Chakraborty (IIT Delhi), S.A. Ponnusami (City).

Open-Source Software and Online Presence

- **`torch_pf_solver`** – PyTorch native differentiable phase field fracture solver (research code; selective release planned alongside publications).
- **`bjsfm`** – github.com/allamaprabhuani/bjsfm – anisotropic stress field around a hole in a composite plate (Lekhnitskii, de Jong). Public release with attribution to upstream MIT-licensed source.
- **`geometric-transformations`** – github.com/allamaprabhuani/geometric-transformations – 2D/3D affine transforms with MATLAB Live Scripts.
- **Personal site** – allamaprabhuani.github.io – research notes, technical tutorials, blog.

Technical Skills

Scientific computing and ML. PyTorch (autograd, CUDA), JAX (familiar), NumPy/SciPy, scikit-learn, pandas. Differentiable physics, neural operators (DeepONet, FNO), physics-informed neural networks.
Finite element analysis. Akantu (C++), FEniCSx, COMSOL Multiphysics, MSC Nastran/Patran (SOL-101/103/105/106), Altair Hypermesh/Optistruct, Abaqus, ANSYS, SolidWorks.
HPC and infrastructure. Slurm, Linux clusters, Git, Sphinx, latexmk, reproducible Python packaging (pyproject, editable installs).
Programming. Python, MATLAB, C++ (read), Excel-VBA, LaTeX, Bash.
Reference texts mastered. Bruhn (Flight Vehicle Structures), Niu (Airframe Stress Analysis), Timoshenko (Plates and Shells), Lekhnitskii (Anisotropic Plates), Roark (Stress and Strain), ESDU.

Referees

Available on request.