Saurav Dutta

Contact Information

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Portfolio
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Educational Qualifications

National Institute of Technology, Silchar, India *(June '19 - June'23)*
Bachelor of Technology (B.Tech.) Civil Engineering
Thesis : Static and Dynamic Analysis of Laminated Composite Plates using Finite Element Analysis
CGPA : **9.03/10** (**Top 10%**)

Publications/ Book Chapters/ Conferences

1. **S. Dutta**, V. Anand, *"Framework for Ground Motion Characterization,"* **Seismic Hazard Analyses, Wave Propagation & Site Characterization, Springer Nature** (2024)
2. A. Joshi, **S. Dutta**, S. Kumar, *"Hetero–EUCLID : Simultaneously segmenting and discovering hyperelastic constitutive models of all components of a heterogeneous hyperelastic material using EUCLID,"* **European Solid Mechanics Conference 2025, Lyon, France.**
3. K. L. Chaurasiya, **S. Dutta**, S. Kumar, A. Joshi, *"Hetero-EUCLID : Interpretable model discovery for heterogeneous hyperelastic materials using stress-unsupervised learning,"* **Computer Methods in Applied Mechanics & Engineering** (2025) (Accepted).
4. H. K. Sandhu, **S. Dutta**, R. Chaunsali, *"Wave propagation in an elastic lattice with non-reciprocal stiffness and engineered damping,"* **Journal of the Acoustical Society of America** (2025) (Accepted).
5. S. Singh, M. Kumar, **S. Dutta**, V. Anand, *"Identification of critical ground motion features for seismic fragility studies considering soil-structure interaction,"* **Journal of Vibration Engineering & Technologies** (2025) (submitted).

International Collaboration

Inverse Design of Granular Solids using generative models *(July '25 - Present)*
Advisor : Prof. Konstantinos Karapiperis, **École Polytechnique Fédérale de Lausanne**

- Synthesized insights from recent studies on architected granular lattices to identify gaps in mechanical modeling, motivating a data-driven framework for inverse lattice design.
- Developed a Python-based automated pipeline to generate and catalog over **10,000**+ 3D lattice datasets having periodicity and fully-dense structure.
- Established a comprehensive dataset forming the foundation for training a generative model, such as a diffusion model, toward inverse mapping of architected granular lattices.

Professional Experience

Indian Institute of Technology BHU, Varanasi *(May '22 - July '22)*
Summer Research Intern, Dept. of Civil Engineering, Advisor : Prof. Vishwajit Anand

- Developed a MATLAB-based framework to characterize seismic records and identify seismic parameters most sensitive to structural response under earthquake loading.
- Processed 195 seismic records from the PEER Database, extracting and computing over **30**+ intensity measures, including PGA, PGV, PGD, Arias intensity.
- Utilised the OpenSeismoMatlab framework to automate Fourier and elastic response spectral analyses, determining predominant periods ($T_p = 0.1 - 2.4$ s) and pseudo-accelerations ($2.9 - 13.3$ m/s^2), providing a basis for fragility assessment and parameter sensitivity evaluation.

Indian Institute of Science, Bengaluru *(June '23 - July '25)*
Research Associate, Dept. of Mechanical Engineering, Advisor : Prof. Akshay Joshi

- Investigated automated model discovery for heterogeneous hyperelastic materials by extending the EUCLID framework, originally developed for homogeneous systems.
- Developed a Python-based probabilistic growth algorithm with interpretable priors to detect and track heterogeneous material interfaces, achieving **98–99%** segmentation accuracy.
- Implemented Bayesian-EUCLID with **2–10%** MCMC sub-sampling over 10,000–21,000 C3D6 nodes, predicting local material parameters with **1–3%** mean error.
- Validated the resulting Hetero-EUCLID method on 3D non-equi-biaxial tension tests ($\lambda_x = 1.6, \lambda_y = 2.2$), demonstrating noise robustness and interpretable constitutive model recovery.

Research Assistant, Dept. of Aerospace Engineering, Advisor : Prof. Rajesh Chaunsali

- Investigated the design of non-reciprocal elastic lattices to realize unidirectional wave propagation through non-reciprocal stiffness and non-reciprocal damper.
- Developed a MATLAB-based framework to derive complex dispersion relations for an infinite lattice with asymmetric springs ($\alpha = 0.1$) and dampers ($\beta = \pm 0.2$), and validated these predictions using finite-chain simulations of 200 oscillators with $<$**2%** deviation.
- Demonstrated unidirectional wave amplification with a growth rate of **0.71** $\mathbf{s^{-1}}$, confirming non-reciprocal energy transport and validating the theoretical model.

Vizuara AI Labs, Pune, India *(Sept '25 – Present)*
Research Scientist, Principal Investigator : Dr. Sreedath Panat

- Engaged in research on Scientific Machine Learning (SciML) and Physics-informed AI, with a focus on developing interpretable and data-efficient learning frameworks for scientific systems.
- Working on a Universal Differential Equation (UDE) framework to infer micro-scale material properties, such as alloy behavior, by combining mechanistic models with neural components.
- Exploring extensions of these methods toward foundation models for physical systems and the integration of LLMs, reinforcement learning (RL).

Scholastic Achievements

- Maintained **9.58/10 Cumulative GPA** considering all core courses from 3^{rd} - 8^{th} semester
- **AA** grade in Bachelor's Thesis I and II, 2023
- **AA** grade in **17** out of **27** departmental courses, 2023
- Selected for Undergraduate Research Council Funded Project (UGRC), NIT Silchar, 2022
- Achieved **2nd** rank institute-wide and in the department in **4th** semester with **9.93/10** GPA

Thesis Projects

Static and Dynamic Analysis of Laminated Composite Plates under Thermal Effects using Finite Element Simulation *(Jan '23 - May '23)*
Advisor : Prof. Atanu Sahu, Dept. of Civil Engineering, **NIT Silchar**

- Developed FEA models of 10-layer, 5 mm laminated graphite composite plates in ABAQUS to study their static and vibrational behavior under thermal loading.
- Performed static simulations across multiple lamination sequences and boundary conditions over 300-400 K, computing deflection (**1.42 mm**) and von Mises stress (**82 MPa**).
- Conducted dynamic analysis to determine natural frequencies and mode shapes, capturing temperature-dependent shifts in the vibrational response.
- Identified significant thermo-mechanical coupling effects, including up to **12%** frequency reduction and **15%** stiffness degradation, demonstrating the influence of fiber orientation and temperature on structural stability.

Design and Analysis of G+4 Residential Structure *(Aug '22 - Dec '22)*
Advisor : Prof. Subhrajit Dutta, Dept. of Civil Engineering, **NIT Silchar**

- Performed structural design and analysis of a G+4 reinforced concrete building (15 m × 25 m × 20 m) situated in Seismic Zone V, incorporating dead, live, wind (33 m/s) and seismic loads in accordance with Indian Standard (IS) codes.
- Developed frame models with 300×300 mm columns, 300×350 mm beams, and 140 mm slabs, and analyzed the structure using the Substitute Frame Method, obtaining base reactions up to 46.7 kN and bending moments up to 22.2 kNm/m.
- Designed slabs, beams, columns, footings, and staircases (200 mm waist slab, 10 mm bars @ 220 mm c/c), ensuring l/d $<$ 33.8, FOS $>$ 2.5, and full compliance with IS serviceability and ductility criteria, thereby confirming the building's safety and stability under seismic loading.

Teaching Experience & Talks

Course Instructor : *Artificial Intelligence for Materials*, Vizuara AI Labs *(Jan '26 – Present)*

- Designed and currently delivering a specialized curriculum focused on the intersection of Scientific Machine Learning (SciML) and Elastic Materials.
- Developing technical modules to train researchers on integrating Generative AI (Diffusion Models, Transformers) with traditional physics-based simulations.

Guest Lecture : *Wave Propagation AE 351A*, Indian Institute of Science, Bengaluru *(Nov '23)*

- Delivered an invited research lecture in the Department of Aerospace Engineering, introducing non-reciprocity and demonstrating the mechanical skin effect to a graduate cohort.

Extracurricular Key Projects

Experimental Realisation of Non-linear Pendulums in 1-DOF *(June '23 - July '24)*
Advisor : Prof. Rajesh Chaunsali, **Indian Institute of Science, Bengaluru**

- Developed an experimental framework to realize non-linear pendulums in a 1-DOF mechanical oscillator for studying non-stationary dynamic behavior.
- Designed and fabricated custom motor hubs and magnet-embedded discs, enabling tunable magnetic interactions between the 3 pendulums.
- Implemented a custom Python control framework to synchronize 3 Dynamixel motors with **<1% error** in speed and position and generate controlled stiffness modulation.
- Observed tunable stiffness modulation from the data captured using high resolution DIC (240 fps) and LDV, developing a foundation for non-linear dynamical system.

Stress Analysis in a Truss System using Finite Element Method *(Jan '23 – Apr '23)*
Course : Finite Element Method, **National Institute of Technology, Silchar**

- Performed stress analysis of a 2D plane truss using the FEM, with a 25-element, 16-node model developed in MATLAB to evaluate structural response under a 100 kN load.
- Implemented element-level stiffness formulation to compute nodal displacements and axial stresses across all members, validating the stress distribution.
- Conducted mesh-convergence analysis for an aluminum truss ($E = 70$ GPa, $A = 900$ mm^2), determining a maximum axial stress of **115 MPa** and tip deflection of **2.4 mm**.

Technical Skills

Programming Languages	: C, C++, Python, Julia, HTML, CSS
Scientific Softwares	: MATLAB, ABAQUS, AutoCAD, COMSOL, Mathematica, CATIA
Libraries & Frameworks	: PyTorch, NumPy, SciPy, scikit-learn, Matplotlib, PyVista, OpenCV, Pandas, SymPy, Abaqus Python (scripting), Seaborn
Hardwares	: Motor Control, Arduino, Sensors, U2D2, LDV, 3D Printing

Relevant Course Work

Mechanics, Structures & Design :- Engineering Mechanics • Mechanics of Materials • Structural Analysis I, II & III • Deesign of Concrete Structures I & II • Design of Steel Structures • Advanced Structural Analysis • Numerical Methods in Engineering • Finite Element Method • Earthquake Resistant Design of Structures • Concrete Technology

Fluids & Hydraulics :- Fluid Mechanics • Hydraulics • Surface and Ground Water Hydrology • Water Supply Engineering • Environmental Engineering

Audited Miscellaneous :- Plates & Shells[1] • Vibrations[2] • Wave Propagation in Designed Materials[3] • Quantum Mechanics-I[3] • Condensed Matter Physics-I[3]

Workshop and Labs

CISM-IISc Workshop :- Served as a volunteer, contributing to the smooth execution of the workshop through coordination, technical support, and participant engagement on July 2025.
NITS Workshop and labs :- Mechanical Engineering Workshop, Structural Engineering Lab, Fluid Mechanics Lab, Computer Aided Design & Lab.

Leadership Activities

Social

- Head, **Razzmatazz – Incandescence**, NIT Silchar, 2023
- Head, **School Genius – Tecnoesis**, NIT Silchar, 2022

[1] CDEEP IIT Bombay [2] Master's course NIT Silchar [3] IISc Bengaluru