Divya Adil
PhD Student, Stanford University

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Education

- **Stanford University** — Stanford, CA, USA
  Doctor of Philosophy — Sep 2023 - Present
  Advisor: Prof. Alison Marsden, Co-advisor: Prof. Ellen Kuhl
  Department of Mechanical Engineering — GPA: 4.0

- **Indian Institute of Technology (IIT) Kanpur** — Kanpur, UP, India
  B.Tech-M.Tech Dual Degree — Aug 2018 - Jul 2023
  Master of Technology — CPI: 9.1/10
  Department of Mechanical Engineering Advisor: Prof. Sumit Basu
  Bachelor of Technology
  Department of Biological Sciences and Bioengineering

Research Experience

- **Constitutive model discovery for coronary artery bypass grafts (CABG)** *(Ongoing)*
  Advisor: Prof. Alison Marsden and Prof. Ellen Kuhl, Stanford University, Prof. Jay Humphrey, Yale University — June 2025 - Present
  - The CABG procedure generally involves grafting the saphenous vein into the arterial circulation to bypass blocked coronary arteries. However, these grafts often fail under the new environment. We are investigating methods to prevent vein graft failure andsimulate growth and remodelling of these grafts.
  - Our collaborators have collected inflation-biaxial testing data for vein grafts in rabbits. Constitutive models for veins and vein grafts are scarce in the literature.
  - We aim to use data driven methods to discover constitutive models for veins and grafts and model the evolution of these tissues and their components using constrained mixtures models.

- **Integrating newly discovered constitutive models in fluid-structure interaction simulations for the cardiovascular system** *(Manuscript in preparation)*
  Advisor: Prof. Alison Marsden and Prof. Ellen Kuhl, Stanford University — Apr 2024 - Sep 2025
  - Fluid-structure interaction (FSI) models of the cardiovascular system can help with treatment planning and clinical decisions. Biological tissues have highly variable non-linear response that has motivated research in data-driven constitutive model discovery using methods like constitutive artificial neural networks (CANN).
  - We extended a flexible framework proposed for structural simulations to FSI to incorporate new constitutive models into FEA solvers. We also investigated the effect of constitutive model choice and the use of prestress in simulating abdominal aortic aneurysms.
  - We found that for applications interested in wall mechanics, the choice of material mdoel and the use of prestress are equally important, while if interested in only the fluid quantities, the use of prestress is more important than material model choice.

- **Mechanical Testing of Real and Artificial Meat** *(Research Rotation Project)*
  Advisor: Prof. Ellen Kuhl, Stanford University — Oct 2023 - Dec 2023
  - Artificial meats are marketed as plant-based replacements for meat. We sought to understand the fundamental mechanical properties that characterize real and plant-based based meat products, as they would affect the sensory experience.
  - We tested real and artificial hotdogs, tofu and turkey under uniaxial tension, compression and shear and found that real and fake hotdogs behave similarly under tension and compression.
  - We found that plant-based sausage and hotdog successfully mimic their animal counterparts in stiffness, while tofurky is twice as stiff, and tofu is twice as soft.

- **Growth-Driven Deformation of Ultra-Soft Tissues** *(M. Tech Thesis)*
  Advisor: Prof Sumit Basu, IIT Kanpur — May 2022 - Jun 2023
  - **Aim:** To model morphogenesis in vertebrates in three dimensions using continuum mechanics.
  - Constructed a mechanical model of morphogenesis, specifically the problem of buckling due to restricted growth of ultra soft tissue.
  - The tissue is modelled as a continuous material and assumed to deform according to non linear hyperelastic theory. The deformation is modelled through an intermediate configuration which results purely from growth, which then deforms non linearly due to constraints on growth to give the current configuration. We implemented the model on ABAQUS by writing a UMAT.

- We implemented the model on 3D geometries like circular discs that occur in biological systems and modelled their deformation into a hat and saddle shape due to different types of growth.

- **Role of Metabolically Related Genes in Chick Hindbrain Development** *(UG Project)*
  Advisor: Prof Jonaki Sen, IIT Kanpur Jan 2022 - Apr 2022
  - **Aim:** To study the role of metabollically related genes in chick hindbrain development. We chose a particular gene which is known to be expressed in the rhombic lip at a particular stage.
  - Carried out a *Temporal Expression Analysis* at HH18, 22 and 24 by *Whole Mount RNA in-situ Hybridisation* to see how the expression changed with time.
  - **Results:** Imaging results showed expression at all three stages indicating a possible role in the formation of further structures by the rhombic lip.

- **Spatiotemporal mapping of tumor heterogeneity during cancer invasion & its implications** *(Summer Project)*
  Advisor: Prof Shamik Sen, IIT Bombay Jan 2021 - Aug 2021
  - **Aim:** To study the spatio-temporal location of cancer stem cell populations in tumours, and the factors affecting tumour composition through computational modeling of tumour growth.
  - Calculated the interconversion rates between Epithelial, Hybrid, and Mesenchymal states of Breast cancer (MDA-MB-231) cells (in-vitro) using Markov model. Modelled the growth of a spheroid of cells in 2D on MATLAB and observed the tumour composition and growth pattern.
  - **Results:** Identified Extracellular Matrix (ECM) density and ECM degradation rates as parameters for, and found ECM degradation to be regulating tumour heterogeneity.

Teaching Experience

- Teaching Assistant for the course Heat Transfer Lab *(ME341A)*. Demonstrated experiments and graded lab reports. Jan - Apr 2023
- Grader for the course Mechanics of Solids *(ESO202)*. Aug - Nov 2022
- Academic Mentor under Counselling Services (IITK) for students who needed extra help with the first year undergraduate course Introduction to Biology *(LIF101)*. Taught classes and tutored students one-on-one. 2019

Awards and Scholarships

- The Charles M. Pigott Fellowship for the year 2023-24, Stanford University.
- Academic Excellence Award, IIT Kanpur, for the year 2020-2021 (3rd year of Bachelors).
- *Mona and Paramjit Singh Scholarship* for the year 2020-21 and 2021-2022 for exemplary academic performance in the department of BSBE, IIT Kanpur.

Publications

1. St. Pierre, S.R., Darwin, E.C., **Adil, D.** et al. The mechanical and sensory signature of plant-based and animal meat. *npj Sci Food* **8**, 94 (2024).

Talks and Posters

1. Flexible framework to integrate new hyperelastic material models in cardiovascular fluid-structure interaction simulations. Poster at 11th Summer School on Physics-Informed Modeling, Simulation and Experiments with Emphasis on the Cardiovascular System, Graz (AT), 2025
2. Integrating material models discovered by constitutive artificial neural networks in cardiovascular simulations. Talk at USNCCM, Chicago 2025

References

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