Debabrata Auddya, PhD

✆ +1 608.335.7427 • ✉ debabrata.auddya.nitd@gmail.com • auddya.github.io

Education

University of Wisconsin-Madison, USA • GPA: 3.79/4.0 — May 2024
Doctor of Philosophy • *Major: Mechanical Engineering* • *Minor: Mathematics*

University of Wisconsin-Madison, USA • GPA: 3.68/4.0 — May 2020
Master of Science • *Mechanical Engineering*

National Institute of Technology, Durgapur, India • GPA: 3.77/4.0 — June 2017
Bachelor of Technology • *Mechanical Engineering*

Research Experience

Postdoctoral Research Associate – University of Delaware, Newark, USA — May 2024 – Present
Multi-Scale Fiber-Reinforced Tissue Biomechanics Laboratory
Advisor: Dawn Elliott

- Developed finite element models of fiber reinforced composite soft materials (intervertebral disc), focusing on quantifying structural and functional changes associated with its natural degeneration (coding using FEBio).
- Performed finite element analysis on several disc geometries and optimized mesh design for achieving experimentally validated results.
- Performed comprehensive parametric sensitivity analyses on nonlinear rate-dependent constitutive models to identify most sensitive parameters under various physiological boundary conditions.

Graduate Research Assistant – University of Wisconsin, Madison, USA — January 2018 – May 2024
Computational Multiphysics and Mechanics Group (CMMG)
Advisor: Shiva Rudraraju
Thesis Title: *Multiphysics Modeling of Deformation in Biomembranes and the Neuronal Microenvironment, With Application to Traumatic Brain Injury*

- Developed a three dimensional mechano-chemical model for capturing mechanical deformation induced necrotic chemical signaling pathways leading to neurodegenerative processes during mild traumatic brain injury (TBI). The model quantifies and validates cell-death inducing biomarkers (Coding using deal.II library) (*collaborative work with ONR-PANTHER, UW Madison*).
- Developed a multiscale three dimensional continuum viscoelastic computational model of neurons and neuron clusters for replicating an experimentally-validated phase space of injury metrics during TBI (Coding using deal.II library) (*collaborative work with ONR-PANTHER, UW Madison*).
- Developed a three dimensional computational framework using differential geometry, Kirchhoff-Love kinematics and Helfrich energy formulations for demonstrating biomembrane asymmetric deformations. The model captures thermodynamically consistent lower energy deformation modes in shell-like structures (Coding using PetIGA (Portable Extensible Toolkit for Isogeometric Analysis), C++) (*collaborative work with Padmini Rangamani, UCSD and Krishna Garikipati, USC*).
- Implemented a phase field formulation for capturing embryo-genesis as a classical soft packing problem (Coding using deal.II library). (*collaborative work with Krishna Garikipati, USC*).
- Developed a coupled eulerian lagrangian (CEL) framework and implemented a fluid structure interaction scheme for modeling non-Newtonian fluid dynamics with mechanical deformation in aortic aneurysm (Abaqus and SolidWorks).

Project Assistant – Oakland University, USA (Telecommuting) — November 2015 – June 2017
Advisor: Bradley J. Roth

- Developed a computational and analytical extension of the mechanical bidomain model in cylindrical coordinates to predict mechanics induced cell signaling.
- The model quantifies cell differentiation of a growing cell colony along the edge and also gives an analytical expression for a length constant previously estimated in literature.

Summer Intern – University of Liege, Belgium — May 2016 – June 2016
Advisor: Liesbet Geris

- Developed a structural and constitutive model of a bioprinter and bioprinting ink (hydrogel). The goal was to identify and model relevant mechanical metrics of the hydrogel-bioprinter interaction optimized for organ printing (COMSOL).
- Implemented and compared various hyperelastic constitutive models for bioprinting ink modeling used in organ printing.

Senior Year Project Assistant – National Institute of Technology, Durgapur, India — July 2016 – May 2017
Advisor: Manik Majumder

- Implemented analytical and numerical studies of externally pressurized gas lubricated journal bearings using MATLAB.

Teaching Experience

Department(s) of Mechanical Engineering, Engineering Mechanics and Aeronautics - UW Madison, USA
- **Principal Instructor**, Mechanics of Materials Lab (Summer 2021)
- **Teaching Assistant**, Mechanics of Materials Lab (Spring 2021, Fall 2020)

Publications

- **Debabrata Auddya**, Shiva Rudraraju. Mechano-chemical modeling of glia initiated secondary injury of neurons under mechanical load (submitted, PRSB).
- **Debabrata Auddya**, Xiaoxuan Zhang, Rahul Gulati, Ritvik Vasan, Krishna Garikipati, Padmini Rangamani, Shiva Rudraraju, 2021. Biomembranes undergo complex, non-axisymmetric deformations governed by Kirchhoff-Love kinematics and revealed by a three dimensional computational framework, *Proceedings of the Royal Society A* 477.2255 (2021): 20210246
- **Debabrata Auddya**, Bradley J Roth, 2017. A mathematical description of a growing cell colony based on the mechanical bidomain model, *Journal of Physics D: Applied Physics*, Volume 50, 105401

Conference Presentations

- **Debabrata Auddya**, Harrah R. Newman, John M. Peloquin, Edward J. Vresilovic, Dawn M. Elliott. Material property sensitivity of disc mechanics under physiological loading: A nonlinear finite element approach, *ORS-PSRS 2025*, Newark, DE
- Pratyusa Kar, **Debabrata Auddya**, Shiva Rudraraju. Multiphysics of neuronal injury - Modeling mechanical deformation induced by electromagnetic waves, *SES 2025*, Atlanta, GA
- **Debabrata Auddya**, Harrah R. Newman, John M. Peloquin, Dawn M. Elliott. Parametric sensitivity analysis of disc mechanics using a nonlinear biphasic and fiber-reinforced finite element analysis, *DCMR/CBER Symposium 2025*, University of Delaware, Newark, DE
- **Debabrata Auddya**, Shiva Rudraraju. A Mechano-Chemical Continuum Framework For Modeling Axonal Deformation and Neuronal-ECM Molecular Pathways underlying Traumatic Brain Injury, *SES 2023*, Minneapolis, MN
- *Session Chair*, Cell Mechanics and Mechanobiology, *USNCCM17 2023*, Albuquerque, NM
- **Debabrata Auddya**, Shiva Rudraraju. A Continuum Framework for Modeling Mechano-Chemical Interactions Underlying Neuronal Deformation and Injury, *USNCCM17 2023*, Albuquerque, NM
- *Session Chair*, Modeling of Complex Fluids and Applications, *SES 2022*, College Station, TX
- **Debabrata Auddya**, Rahul Gulati, Shiva Rudraraju. Mechanics and Microstructure underlying Axonal Deformation of Neurons and Neuronal Injury, **Invited Talk**, *SES 2022*, College Station, TX
- **Debabrata Auddya**, Rahul Gulati, Shiva Rudraraju. Mechanics and Microstructure underlying Axonal Deformation of Neurons and Neuronal Injury *USNCTAM19*, Austin, TX
- **Debabrata Auddya**, Xiaoxuan Zhang, Rahul Gulati, Ritvik Vasan, Krishna Garikipati, Padmini Rangamani, and Shiva Rudraraju. Biomembranes undergo complex, non-axisymmetric deformations governed by Kirchhoff-Love kinematics and revealed by a three dimensional computational framework. *USNCCM16 2021*, Chicago, IL
- **Debabrata Auddya**, Jiahao Jiang, Krishna Garikipati, Shiva Rudraraju. A Diffuse Interface Framework for Modelling the Evolution of Multi-cell Aggregates as a Soft Packing Problem Driven by the Growth and Division of Cells *USNCCM15 2019*, Austin, TX
- Bradley J Roth, **Debabrata Auddya**, 2018. A mathematical model of mechanotransduction for morphogenesis *Mechanics in Morphogenesis 2018* Princeton Center for Theoretical Science, Princeton University, Princeton, NJ

Awards

- 2nd Prize Winner, Poster Presentation, Office of Naval Research (ONR) and PANTHER, University of Wisconsin-Madison, (September 2023)
- 2nd Prize Winner, Poster Presentation, Office of Naval Research (ONR) and PANTHER, University of Wisconsin-Madison, (September 2022)
- 16th U S National Congress on Computational Mechanics Conference Award ,*Virtual Conference* (July 2021)
- Chester E. & Flora Jane LeRoy Fellowship Award, Department of Mechanical Engineering, UW Madison (2018-2019)

Professional Activities

- **Peer Reviewer** PLOS One (**ORCID ID**: https://orcid.org/0000-0002-4813-5516)

Industrial Experience

- **Mathematical Problems in Industry (MPI), Society of Industrial and Applied Mathematics**, *June 9 - 13, Claremont Graduate University, Claremont, CA*. Travel award for a five day industrial problem solving workshop with Kwaai AI. (2025)
- **Mathematical Problems in Industry (MPI), Society of Industrial and Applied Mathematics**, *June 25 - 29, University of Vermont, Burlington, VT*. Selected for a five day industrial problem solving workshop with Vironix AI. (2024)

- **Graduate Student Mathematical Modeling Camp (GSMMC)**, *June 20 - 23, University of Delaware, Newark, DE*. Selected for a four day mathematical modeling training camp. (2024)
- **Morgridge Entrepreneurial Bootcamp (MEB)**, *June 6 - 10, Wisconsin School of Business, UW Madison*. Selected for a competitive one-week intensive training bootcamp in technology and business entrepreneurship. (2022)

TECHNICAL SKILLS

- Programming languages: C++, Python
- Softwares: deal.II, PetSc, FEBio, MATLAB, ABAQUS, COMSOL, Solidworks, GMSH
- Technical Subjects: Continuum Mechanics, Finite Elements Analysis, Mechanics of Materials