# Debabrata Auddya, PhD

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## Summary Statement

A specialist in finite element method, possessing expertise in the numerical, theoretical, and computational modeling of multiscale and multiphysics phenomena. Proficient in numerical methods, scientific computing, finite element software and biomechanics.

## Education

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

**University of Wisconsin-Madison** • 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 — May 2024 – Present
Multi-Scale Fiber-Reinforced Tissue Biomechanics Laboratory
Advisor: Dawn Elliott
- Developing finite element models to investigate degeneration of the intervertebral disc.
- Parametric analysis of biological tissue properties of the intervertebral disc to establish correlation between functional and structural degeneration.

**Graduate Research Assistant** – University of Wisconsin, Madison — January 2018 – May 2024
Computational Multiphysics and Mechanics Group (CMMG)
Advisor: Shiva Rudraraju
- Developed a three dimensional mechano-chemical code for capturing mechanical deformation induced necroptotic molecular mechanotransduction pathways leading to neurodegenerative processes during mild traumatic brain injury (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 capturing injury metrics during traumatic brain injury (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. (Coding using PetIGA (Portable Extensible Toolkit for Isogeometric Analysis), C++) (*collaborative work with Padmini Rangamani, UCSD and Krishna Garikipati, Univ of Michigan*)
- Phase field modeling and integration of mechanics for capturing multi-cell cluster evolution as a soft packing problem. (Coding using deal.II library) (*collaborative work with Krishna Garikipati, Univ of Michigan*)
- Developed a Coupled Eulerian Lagrangian (CEL) framework and implemented a Fluid Structure Interaction (FSI) analytical study for aortic aneurysm using Abaqus and SolidWorks.

**Project Assistant** – Oakland University (Telecommuting) — November 2015 – June 2017
Advisor: Bradley J. Roth
- Developed a computational and analytical extension for the mechanical bidomain model in cylindrical coordinates to predict foundational biophysical phenomena such as mechanotransduction
- The model predicts 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 numerical model of a bioprinter and bioprinting ink. The goal was to predict mechanical metrics within the three dimensional bioprinter amiable for organ printing (COMSOL)
- Implemented various hyperelastic constitutive models for bioprinting ink modeling used in organ printing

**Project Assistant** – National Institute of Technology (NIT), Durgapur — July 2016 – May 2017
Advisor: Manik Majumder
- Worked on analytical and numerical studies of externally pressurized gas lubricated journal bearings
- Developed a parametric analysis of these bearings using MATLAB

## Teaching Experience

UW Madison Department of Mechanical Engineering
- **Principal Instructor, Mechanics of Materials Lab, ME 307, EMA 307** *Summer 2021*
- **Teaching Assistant, Mechanics of Materials Lab, ME 307, EMA 307** *Spring 2021, Fall 2020*
Instructed about 70 students at undergraduate and graduate level while performing various mechanical testing methods and evaluating student projects. Performed and edited demonstration videos while teaching the course remotely and in person.

## Publications

- **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
- **Debabrata Auddya**, Shiva Rudraraju. Spatio temporal modeling of biomarker expression in neuronal clusters during traumatic brain injury (submitted).

## Conference Presentations

- **Debabrata Auddya**, Shiva Rudraraju, 2023. A Mechano-Chemical Continuum Framework For Modeling Axonal Deformation and Neuronal-ECM Molecular Pathways underlying Traumatic Brain Injury, *SES, Oct 8-11*, Minneapolis, MN
- *Session Chair*, Cell Mechanics and Mechanobiology, *USNCCM17 2023, July 23-27, 2023*, Albuquerque, NM
- **Debabrata Auddya**, Shiva Rudraraju, 2023. A Continuum Framework for Modeling Mechano-Chemical Interactions Underlying Neuronal Deformation and Injury, *USNCCM17, July 23-27*, Albuquerque, NM
- *Session Chair*, Modeling of Complex Fluids and Applications, *SES 2022, Oct 15-19, 2022*, College Station, TX
- **Debabrata Auddya**, Rahul Gulati, Shiva Rudraraju, 2022. Mechanics and Microstructure underlying Axonal Deformation of Neurons and Neuronal Injury, **Invited Talk**, *SES 2022, Oct 15 - 19*, College Station, TX
- **Debabrata Auddya**, Rahul Gulati, Shiva Rudraraju, 2022. Mechanics and Microstructure underlying Axonal Deformation of Neurons and Neuronal Injury *USNCTAM19, June 19 - 25*, Austin, TX
- **Debabrata Auddya**, Xiaoxuan Zhang, Rahul Gulati, Ritvik Vasan, Krishna Garikipati, Padmini Rangamani, and Shiva Rudraraju, 2021. Biomembranes undergo complex, non-axisymmetric deformations governed by Kirchhoff-Love kinematics and revealed by a three dimensional computational framework. *USNCCM16, July 28 - 31*, Chicago, IL
- **Debabrata Auddya**, Jiahao Jiang, Krishna Garikipati, Shiva Rudraraju, 2019. 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, July 28-31*, Austin, TX
- Bradley J Roth, **Debabrata Auddya**, 2018. A mathematical model of mechanotransduction for morphogenesis *Mechanics in Morphogenesis, February 21-23, 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)

## Workshops

- **Morgridge Entrepreneurial Bootcamp (MEB)**, *June 6 - 10, Wisconsin School of Business, UW Madison*. Selected and participated in a one-week intensive training bootcamp in technology entrepreneurship. (2022)
- **NEO Training** *CEETE, UW Madison*. Workshop for Incoming Teaching Assistants (2020)

## Technical Skills

- Programming languages: C, C++
- Software: ANSYS, ABAQUS, COMSOL, Solidworks, Hypermesh, GMSH, MATLAB
- Technical Subjects: Continuum Mechanics, Finite Elements Analysis

## Relevant Coursework (UW Madison)

- **Computational and Applied Mathematics**: MATH 715: Computational Mathematics, MATH 513: Numerical Linear Algebra, MATH 703: Applied Mathematics I, MATH 704: Applied Mathematics II
- **Manufacturing, Design and Tribology**: ME964: Metal Additive Manufacturing, ME753: Friction, Lubrication and Wear, ME535: Computer Aided Geometric Design
- **Scientific Computing**: ME476: Scientific Computing in Engineering Physics, ME601: Applied and Numerical Methods