Debdeep Bhattacharya

Contact Information

Department of Mathematics
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Research Interests

Analysis of partial differential equations, especially nonlocal and nonlinear dispersive equations, continuum mechanics, signal processing, and machine learning

Employment

Louisiana State University

Postdoctoral Researcher, May 2020 - present
Host: Prof. Robert Lipton

Education

The George Washington University

Ph.D. in Mathematics, May 2020
Advisor: Prof. Frank Baginski
Thesis title: Harmonic Analysis Techniques in Nonlinear Dispersive Equations and Signal Processing

Tata Institute of Fundamental Research Centre for Applicable Mathematics, Bengaluru, India

Master of Science (MSc) in Mathematics, May 2014

Indian Statistical Institute, Bengaluru, India

Bachelor in Mathematics, May 2012

Summer Research Experience

Oak Ridge National Laboratory

Mathematical Sciences Graduate Internship (MSGI), National Science Foundation (NSF), Summer 2019
Supervisor: Dr. Pablo Seleson

University of Hawai'i at Manoa

Visiting Scholar, Summer 2018
Supervisor: Prof. Peter Gorham

Publications

1. **Peridynamics-based discrete element method (PeriDEM) model of granular systems involving breakage of arbitrarily shaped particles.** Prashant K Jha, Prathamesh S Desai, Debdeep Bhattacharya, Robert P Lipton. Journal of the Mechanics and Physics of Solids, 2020. doi:10.1016/j.nonrwa.2021.103331 (arXiv:2010.07218)
2. **Unusual Near-Horizon Cosmic-Ray-like Events Observed by ANITA-IV.** P. W. Gorham et al. Physical Review Letters, 2021. doi:10.1103/PhysRevLett.126.071103 (arXiv:2008.05690)
3. **Global well-posedness of the mZK equation in 2 dimensions for low-regularity data.** Debdeep Bhattacharya, Luiz Gustavo Farah, and Svetlana Roudenko. Journal of Differential Equations, 2019. doi:10.1016/j.jde.2019.11.092 (arXiv: 1906.05822)

4. **Simulating grain shape effects and damage in granular media using PeriDEM.** Debdeep Bhattacharya, Robert P. Lipton. (Submitted) (arXiv:2108.07212)
5. **Peridynamics for Quasistatic Fracture Modeling.** Debdeep Bhattacharya, Patrick Diehl, Robert P. Lipton. (Submitted) (arXiv:2107.14665)
6. **Mass concentration of H^s blowup solution to 2D modified Zakharov-Kuznetsov equation** (Submitted) (arXiv: 2007.15773
7. **Reduction of three-dimensional axisymmetric problems to two dimensions in Peridynamics** with Pablo Seleson and Jeremy Trageser (In preparation)

Reports

1. **Deconvolution problem and application to ANITA signals**, submitted to ANITA collaboration at University of Hawai'i at Manoa (link)
2. **Reduction of three-dimensional axisymmetric problems to two dimensions in Peridynamics**, submitted to the NSF as part of MSGI program (link)

Honors and Achievements

- Dean's Graduate Conference Travel Grant, The George Washington University, 2017
- Columbian College of Arts of Sciences Fellowship, The George Washington University, 2015 – present
- Junior Research Fellowship from Tata Institute of Fundamental Research, India, 2012–2014
- INSPIRE Scholarship from Department of Science and Technology, Government of India, 2010-2012
- Student Fellowship from Indian Statistical Institute, 2009-2012
- Secured an all-India rank 31 in National Eligibility Test (NET) jointly conducted by Council of Scientific and Industrial Research and University Grant Commission, Government of India, 2013

Invited talks

- *Simulating grain shape effects and damage in granular media using PeriDEM*, 16th U.S. National Congress on Computational Mechanics (USCNNM16), July 25, 2021, Chicago, USA (Virtual)
- *Effect of particle shapes on particle bulk using a Peridynamics-based discrete element method*, ALOP Workshop on Nonlocal Models, July 13, 2021, Universität Trier, Germany (Virtual)
- *Modeling particle beds with arbitrary particle shapes with peridynamics and short-range contact forces*, MURI seminar series, March 16, 20201 (Virtual)
- *Modeling particle beds using Peridynamics*, The 3rd Annual Meeting of the SIAM Texas-Louisiana Section, October 16-18, 2020, College Station, TX, USA (Virtual)
- *Modeling granular media with Peridynamics and short-range contact forces*, MURI seminar, September 9, 2020 (Virtual)
- (Postponed due to COVID-19) *On low regularity solutions to the 2D modified Zakharov-Kuznetsov equation*, 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, June 5-9, 2020, Atlanta, USA
- *Reduction of 3D axisymmetric models to 2D in peridynamics*, Computational and Applied Math (CAM) seminar, Computer Science and Mathematics Division, Oak Ridge National Laboratory, August 8, 2019
- *Fourier-Wavelet Regularized deconvolution (ForWaRD) in multi-antenna setup*, RIT in Applied Harmonic Analysis, Norbert Weiner Center, University of Maryland, May 13, 2019
- *Global Well-posedness of 2d Modified Zakharov-Kuznetsov Equation for Low-regularity Data*, Spring 2019 conference on Applied Mathematics, George Washington University, May 4, 2019

- *Deconvolution in a multi-antenna setup and application to ANITA data*, Antarctic Impulse Transient Anetann (ANITA) collaboration, December 10, 2018
- *Deconvolution problem and its application to ANITA data*, University of Hawai'i at Manoa, June 28, 2018
- *The I-method and its applications*, Graduate Student Seminar, The George Washington University, October 27, 2017

Poster Presentations

- *Fracture modeling in axisymmetric problems using peridynamics*, Workshop on Experimental and Computational Fracture Mechanics: Validating peridynamics and phase field models for fracture prediction and experimental design, February 26-28, 2020
- *Fracture modeling in axisymmetric problems using peridynamics*, Oak Ridge Postdoctoral Association (ORPA) Research Symposium, Oak Ridge National Laboratory, August 6, 2019
- *Global Well-posedness of 2d Modified Zakharov-Kuznetsov Equation for Low-regularity Data*, 2019 Workshop on Nonlinear Dispersive Partial Differential Equations and Inverse Scattering, The Fields Institute, Toronto, Canada, May 21 - 24, 2019
- *Global Well-posedness of 2d Modified Zakharov-Kuznetsov Equation for Low-regularity Data*, GW Research Days, George Washington University, April 9, 2019

Teaching Experience

Instructor

- Summer 2017: Linear Algebra I
- Summer 2016: Calculus with Pre-calculus I

Teaching Assistant

- Spring 2020: Calculus for the Social and Management Sciences
- Fall 2019: Calculus III
- Spring 2019: Calculus I
- Fall 2018: Calculus II
- Spring 2018: Calculus I
- Fall 2017: Calculus with Pre-calculus I
- Spring 2017: Partial Differential Equation
- Fall 2016: Calculus I
- Spring 2016: Calculus for the Social and Management Sciences
- Fall 2015: Calculus with Pre-calculus I

Programming Experience

github.com/ debdeepbh

- **Python** (Proficient) Machine learning using `scikit-learn`, `TensorFlow 2.0`, `Keras`, `pandas` and `matplotlib`, automated theorem twitting twitter-bot
- **C++/C** (Proficient) Shared-memory parallelization using `openmp`. Signal processing library `libWTools` using wavelet-based tools
- **MATLAB** (Proficient) Numerical simulations of crack branching using peridynamics, finite difference methods for solving partial differential equations, signal processing using Fourier and wavelet analysis
- **R** (Fluent) Author of package `rexpense` to generate complex expense reports and statistics in a multi-user setup
- **BASH** (Proficient) 8+ years of experience as a Linux and BASH user

Responsibilities

- Organized GWU-SIAM conference on Applied Mathematics, April 29, 2017 with Eric Shehadi and Chong Wang
- Vice president of the SIAM chapter at the George Washington University, January 2016 - 2018

Reading projects

- **Spring 2015:** Algebraic Topology at Indian Statistical Institute, Kolkata, course taught by Prof. Goutam Mukherjee
- **Summer 2011:** Differential Geometry at Indian Institute of Science Education and Research, Mohali, under the guidance of Prof. Kapil Hari Paranjape
- **Winter 2010:** Measure Theory at Indian Statistical Institute, Bangalore with Prof. K. Ramamurthy
- **Summer 2010:** Point Set Topology at Indian Statistical Institute, Kolkata with Prof. S. M. Srivastava

Conferences and Workshops Attended

- Workshop on *Experimental and Computational Fracture Mechanics: Validating peridynamics and phase field models for fracture prediction and experimental design*, February 26-28, 2020, Baton Rouge, Louisiana, USA
- 2019 Workshop on Nonlinear Dispersive Partial Differential Equations and Inverse Scattering, The Fields Institute, Toronto, Canada, May 21 - 24, 2019
- *February Fourier Talks*, February 21-22, 2019, University of Maryland, USA
- *IAS/PCMI 2018 Summer Graduate School on Harmonic Analysis*, July 1-21, 2018, Park City, Utah, USA
- *February Fourier Talks*, February 15-16, 2018, University of Maryland, USA
- Workshop on *Dispersive Equations, Solitons, and Blow-up*, September 4-8, 2017, Hausdorff Center of Mathematica, Bonn, Germany
- *French-American Conference on Nonlinear Dispersive PDEs*, June 12-16, 2017, Centre International de Rencontres Mathematiques (CIRM), Luminy, Marseille, France
- Research School on *Random Structures in Statistical Mechanics and Mathematical Physics*, March 6 -10, 2017, Centre International de Rencontres Mathematiques (CIRM), Luminy, Marseille, France
- PDE/Analysis Mini School on *Dynamics of the energy critical wave equations* by Thomas Duyckaerts, University of North Carolina, Chapel Hill, 13-15 February, 2017
- PDE/Analysis Mini School on *Random Schrödinger operators: Basic properties, localization, and spectral statistics* by Peter Hislop, University of North Carolina, Chapel Hill, 27-28 October 2016
- Workshop on *Getting Started with PDEs*, The Hebrew University, Jerusalem, Israel, September 11 - September 15, 2016
- *Third Chicago Summer School In Analysis*, University of Chicago, June 13 - June 24, 2016
- PIRE-CNA 2016 Summer School on *New Frontiers in Nonlinear Analysis for Materials*, Carnegie Mellon University, Pittsburgh, June 2-10, 2016
- Workshop on *Finite Element Method on Navier Stokes Equations*, Indian Institute of Science, September, 2014
- Compact Course on *Navier Stokes Equations*, Tata Institute of Fundamental Research Centre for Applicable Mathematics (TIFRCAM), Bangaluru, India, June, 2014
- Completed a semester-long course on *Mathematical Modelling* at TIFRCAM, Bangaluru, India, August – December, 2012
- *Advanced Instructional School on Analysis and Geometry*, July, 2013, TIFRCAM, India
- *ATM Workshop on Riemannian Geometry*, 16th-28th July, 2012, TIFRCAM, India.