Debdeep Bhattacharya

CONTACT INFORMATION

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RESEARCH INTERESTS

I study analysis and partial differential equations, in particular, nonlocal and nonlinear dispersive equations and their application to continuum mechanics (classical and peridynamics) and granular media using high-performance computing. I am also interested in signal processing and machine learning. See my [research page](/research/) for more details.

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. **Mass concentration of H^s blowup solution to 2D modified Zakharov-Kuznetsov equation** Debdeep Bhattacharya. Partial Differential Equations and Applications doi:0.1007/s42985-021-00139-y arXiv: 2007.15773
2. **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. 10.1016/j.jmps.2021.104376 arXiv:2010.07218
3. **Simulating grain shape effects and damage in granular media using PeriDEM.** Debdeep Bhattacharya, Robert P. Lipton. (Submitted) arXiv:2108.07212

4. **Peridynamics for Quasistatic Fracture Modeling.** Debdeep Bhattacharya, Patrick Diehl, Robert P. Lipton. (Submitted) arXiv:2107.14665
5. **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
6. **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)
7. **Reduction of three-dimensional axisymmetric problems to two dimensions in Peridynamics** with Pablo Seleson and Jeremy Trageser (Preprint available upon request)
8. **Nonlocal fracture modeling with quasistatic loading** with Robert Lipton (Preprint available upon request)

Other writings

1. **Harmonic Analysis Techniques in Nonlinear Dispersive Equations and Signal Processing.** Ph.D Dissertation, May 2020. ProQuest: 27831360
2. **Deconvolution problem and application to ANITA signals**, Report, submitted to ANITA collaboration at University of Hawai'i at Manoa (link)
3. **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

- International Mechanical Engineering Congress and Exposition (IMECE2021), November 3, 2021 (Virtual)
- Applied Math Seminar, George Washington University, October 1, 2021, Washington, D.C., USA
- 16th U.S. National Congress on Computational Mechanics (USCNNM16), July 25, 2021, Chicago, USA (Virtual)
- ALOP Workshop on Nonlocal Models, July 13, 2021, Universität Trier, Germany (Virtual)
- MURI seminar series, March 16, 20201 (Virtual)
- The 3rd Annual Meeting of the SIAM Texas-Louisiana Section, October 16-18, 2020, College Station, TX, USA (Virtual)
- MURI seminar, September 9, 2020 (Virtual)
- 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, June 5-9, 2020, Atlanta, USA
- Computational and Applied Math (CAM) seminar, Computer Science and Mathematics Division, Oak Ridge National Laboratory, August 8, 2019

- RIT in Applied Harmonic Analysis, Norbert Weiner Center, University of Maryland, May 13, 2019
- Spring 2019 conference on Applied Mathematics, George Washington University, May 4, 2019
- Antarctic Impulse Transient Anetann (ANITA) collaboration, December 10, 2018
- University of Hawai'i at Manoa, June 28, 2018
- 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

- 2015 - 2020: Calculus I, II, III, Calculus with Pre-calculus, Calculus for the Social and Management Sciences, Partial Differential Equations

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) Parallelization using `openmp` and `mpi`. 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

Responsibilities

- Co-organizer of 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.