Aniruddha Bora

CONTACT INFORMATION

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RESEARCH INTERESTS

Scientific Machine Learning, Data-driven scientific computing, Physics Informed Neural Networks, numerical analysis, deep learning, mathematical modelling, Nano-scale heat conduction, Computational Fluid Dynamics

SKILLS

Programming Languages: Python, Jax, PyTorch, FORTRAN, Fenics, MATLAB, Octave.

Statistical Packages: R, SAS

HPC environment: OSCAR (Brown); ALCF — Theta (KNL & GPU nodes), Polaris (HPE Cray EX; AMD EPYC + NVIDIA A100), Aurora (HPE Cray EX; Intel Sapphire Rapids + Intel Data Center GPU Max).

Scheduler: Slurm, Cobalt

WORK EXPERIENCE

- Assistant Professor, Department of Computer Science, Texas State University (2025 - currently ongoing)
- Postdoctoral Research Associate, Department of Applied Mathematics, Brown University (2022-2025)

EDUCATION

Louisiana Tech University, Louisiana USA Nov, 2021

Ph.D. in Computational Analysis & Modelling

Dissertation Title: Gradient Preserved Method and Neural Network Method for Solving Heat Conduction Equation with Variable Thermal Conductivity in Double Layered Structures.
Advisor: Prof. Weizhong Dai

- Developed artificial neural network method for solving the parabolic two temperature microscale heat conduction in double-layer thin films exposed to ultrashort-pulsed lasers.
- Developed numerical method for solving heat conduction with variable thermal conductivity in multi layer structure and application to parabolic two step heat equation to predict electron and lattice temperature when metal layers with interfaces are exposed to ultrashort-pulsed laser heating. The method has been proven to be unconditionally stable and applied to the Parabolic Two Temperature Model for gold coated mirrors.

South Asian University, New Delhi, INDIA

M.S., Applied Mathematics, May, 2015

- *Thesis*: Finite Difference Method of Order Two in Time and Four in Space for the Solution of Non-Linear Parabolic Equation. **Advisor:** Prof. Ranjan K. Mohanty
- *Project* : Computational fluid dynamics project for lid driven cavity using vorticity stream function formulation.

Cotton College, Guwahati, Assam, INDIA

B.Sc., Mathematics, May, 2013

Teaching Experience

Texas State University, San Marcos, Texas, USA

CS4379G: Data Analysis Vizualization **Spring 2026 - ongoing**
CS5325: Reinforcement Learning **Fall 2025**

Brown University, *Providence, Rhode Island, USA*

Teaching Assistant- Deep Learning for Scientists & Engineers **November 2021 - June 2025**
(Funded by NVIDIA, a unique course from basic deep learning techniques to recently published research papers)
Duties: Testing various optimization algorithms for benchmark in optimization, Analyzing mathematical formulations and proofs, and Preparing course contents from research papers and textbooks.

The Sheridan Teaching Seminar, *Providence, Rhode Island, USA*

Reflective Teaching (Certificate I) **September 2022 - December 2022**

Brown University, *Providence, Rhode Island, USA 2022*

Internship mentor **June 2022 - July 2023**
Mentored Sotos Lois a student from Imperial College London. Guided him with training him in the mathematical basics required for scientific machine learning and guided him to work on mathematical finance using physics-informed neural networks and operator-based learning.

Brown University, *Providence, Rhode Island, USA 2022*

SPRINT UTRA scholarship application reviewer **October 2023**

Brown University, *Providence, Rhode Island, USA 2022*

Applied Mathematics - Directed Reading Program Mentor **March 2023 - Ongoing**
The Directed Reading Program provides undergraduates with the opportunity to work one-on-one with graduate students and post-docs in the Division of Applied Mathematics (APMA) on independent reading projects. It is a fantastic opportunity for motivating undergraduates to learn new mathematical & computational skills forge connections and explore higher-level mathematics outside of the undergraduate curriculum. ***https://www.dam.brown.edu/drp/projects.html***

Louisiana Tech University, *Ruston, Louisiana, USA*

Teaching Assistant- Phys-261/262 **September 2016 - August 2021**
Duties at various times have included office hours and leading weekly computer lab exercises. Also taking full classes with student strength of 20. During stay home order , prepared video resources for all the lab experiments to teach online for the students.

Adjunct Instructor - Phys-209 **September 2021 - November 2021**
Duties at various times have included taking full classes with student strength of 64. Study sessions on weekends and office hours. Conducting quiz, exam and daily assignments.

Publications

1. ***Aniruddha Bora****, Shixuan Zhang, Khemraj Shukla, Ruby Leung and George Em Karniadakis.* ***Hybrid neural operator based phase corrections in dynamical systems: Application to climate modelling*** *(Manuscript submitted to Nature Communication)*
2. *Ramona Rubini, Siavash Khodakarami,* ***Aniruddha Bora****, George Em Karniadakis, Michele*

Dassisti, Process-Informed Forecasting of Complex Thermal, 2025 (Manuscript submitted to Neural Networks).

3. *Learning Turbulent Flows with Generative Models: Super-resolution, Forecasting, and Sparse Flow Reconstruction, Vivek Oommen, Siavash Khodakarami,* ***Aniruddha Bora****, Zicheng Wang, and George Em Karniadakis, (Manuscript submitted to Nature Communications) arxiv*
   Dynamics in Pharmaceutical Manufacturing
4. *Jiawen Wei,* ***Aniruddha Bora****, Vivek Oommen, Chenyu Dong, Juntao Yang George Em Karniadakis and Gianmarco Mengaldo, XAI4Climate: Attributing the role of climate change on extreme-weather precursors via interpretable machine learning, Tackling Climate Change with Machine Learning, ICLR Workshop 2025. arxiv*
5. *Siavash Khodakarami, Vivek Oommen,* ***Aniruddha Bora*** *and George Em Karniadakis, Mitigating Spectral Bias in Neural Operators via High-Frequency Scaling for Physical Systems, Neural Networks, 2025 link*
6. *Shxiuan Zhang, Ruby Leung, Bryce Harrop,* ***Aniruddha Bora****, Khemraj Shukla, and George Em Karniadakis, Improved nudging strategy for constraining humidity and temperature fields in E3SM, Atmosphere Model, Geoscientific Model Development, 2025. (Manuscript submitted to Journal of Advances in Modeling Earth Systems (JAMES))*
7. ***Aniruddha Bora****, Isabel K Alvarez, Julie Chalfant, Chryssostomos Chryssostomidis and George Em. Karniadakis, Enhancing Heat Sink Efficiency in MOSFETs using Physics Informed Neural Networks: A Systematic Study on Coolant Velocity Estimation. (Manuscript submitted to International Journal of Heat and Mass Transfer)*
8. *Farnaz Rezaei, Weizhong Dai, Shayan Davani and* ***Aniruddha Bora A physics-informed neural network method for thermal analysis in laser-irradiated 3D skin tissues with embedded vasculature, tumor and gold nanorods****, International Journal of Heat and Mass Transfer 245 (2025): 126980, March 2025 link*
9. *Hanxun Jin, Boyu Zhang, Qianying Cao, Enrui Zhang,* ***Aniruddha Bora****, Sridhar Krishnaswamy, George Em Karniadakis, and Horacio D. Espinosa.* ***Characterization and Inverse Design of Stochastic Mechanical Metamaterials Using Neural Operators****, Advanced Materials, April 2025. adma.202420063*
10. *Vivek Oommen,* ***Aniruddha Bora****, Zhen Zhang and George Em Karniadakis.****Integrating Neural Operators with Diffusion Models Improves Spectral Representation in Turbulence Modeling****, Proceedings of the Royal Society A, 2025, March. arXiv:2409.08477*
11. ***Aniruddha Bora*** *and Weizhong Dai.* ***Artificial Neural Network Method for Solving Phase Lagging Heat Transport Equation*** *(Manuscript under preparation)*
12. *Laurence Finch, Weizhong Dai , and* ***Aniruddha Bora****, An Artificial Neural Network Method for Simulation of Wave Propagation Based on the Rosenau-KdV-RLW Equation on Unbounded Domain, Mathematics 2025, 13(7), 1036; link.*
13. *Alan John Varghese,* ***Aniruddha Bora****, Mengjia Xu and George Em Karniadakis.* ***TransformerG2G: Learning temporal graph embeddings with long-range historical information****, Neural Networks. 2024 Apr 1;172:106086.*
    https://arxiv.org/pdf/2307.02588.pdf
14. ***Aniruddha Bora****, Khemraj Shukla, Shixuan Zhang, Ruby Leung and George Em Karniadakis.* ***Learning bias corrections for climate models using deep neural operators****, AAAI 2023. doi:* ***https://doi.org/10.48550/arXiv.2302.03173***
15. *Joshua P. Wilson, Weizhong Dai,* ***Aniruddha Bora****, and Jocob C. Boyt.* ***A new artificial neural network method for solving schrö dinger equations on unbounded domains****, Communications in Computational Physics 32 (2022) 1039–1060.*
    doi : ***https://doi.org/10.4208/cicp.OA-2022-0135***

16. *Somdatta Goswami,* ***Aniruddha Bora****, Yue Yu, and George Em Karniadakis.* ***Physics-informed deep neural operator networks****. Machine Learning in Modeling and Simulation: Methods and Applications 2023 Oct 4 (pp. 219-254). Cham: Springer International Publishing.*
https://doi.org/10.48550/arXiv.2207.05748*.*

17. ***Aniruddha Bora****, Weizhong Dai, Joshua P. Wilson, Jocob C. Boyt, and Sergey L. Sobolev.* ***Neural network method for solving nonlocal two-temperature nanoscale heat conduction in gold films exposed to ultrashort-pulsed lasers****, International Journal of Heat and Mass Transfer 190 (2022) 122791. doi :* ***10.1016/j.ijheatmasstransfer.2022.122791***

18. ***Aniruddha Bora****, Weizhong Dai, Joshua P. Wilson, and Jocob C. Boyt.* ***Neural network method for solving parabolic two-temperature microscale heat conduction in double-layer thin films exposed to ultrashort-pulsed lasers****, International Journal of Heat and Mass Transfer 178 (2021) 121616. doi :* ***10.1016/j.ijheatmasstransfer.2021.121616****.*

19. ***Aniruddha Bora****, and Weizhong Dai.* ***Gradient preserved method for solving heat conduction equation with variable coefficients in double layers****, Applied Mathematics and Computation 386 (2020) 125516. doi :* ***10.1016/j.amc.2020.125516****.*

Presentation/Talks Workshops/Posters

- ***Rice AI Seminar Series****, Rice University, Title: Mathematically Diverse Multiscale Neural Operators: From Bias Correction to Inverse Forcings, date: October 10th, 2025.*
- ***Scientific Machine Learning for Differential Equations****, The Oden Institute for Computational Engineering & Sciences, The University of Texas at Austin, Title: Enhancing Heat Sink Efficiency in MOSFETs using Physics Informed Neural Networks (Poster). September 25-26, 2025.*
- ***East Coast Optimization Meeting, "Optimization and Digital Twins"****, George Mason University (Arlington Campus) 3351 Fairfax Dr, Arlington, VA 22201, Title: Enhancing Heat Sink Efficiency in MOSFETs using Physics Informed Neural Networks, date: April 17 - 18, 2025.*
- ***Applied mathematics symposium: artificial intelligence meets fluid****, Organizers: IIT Guwahati, IIT Hyderabad and VIT, India. Title: "Learning bias corrections for climate models using deep neural operators", date: 07/07/2023.*

  dynamics
- ***Machine Learning + X, Crunch Seminar, Brown University****, Title: Neural Network Method for Solving Parabolic Two-Step Microscale Heat, Conduction in Double-Layer Thin Films Exposed to Ultrashort-Pulsed Lasers, date: 07/23/2021.*
- ***Computational Mathematics and Machine Learning Workshop, Lorentz Centre: Netherlands****, Title: Neural Network Method for Solving Parabolic Two-Step Microscale Heat, Conduction in Double-Layer Thin Films Exposed to Ultrashort-Pulsed Lasers, date: 11/01/2021.*
- ***Science Seminar****, Louisiana TechUniversity, Ruston, USA, date: 11/28/2021.*
- ***Applications on Riemann Integration and Metric Space (WARIMS-2021)****, workshop on "Applications on Riemann Integration and Metric Space", department of basic sciences, school of technology, Assam Don Bosco University, date: 12/23/2021.*
- ***Machine Learning + X, Crunch Seminar, Brown University****, Title: Combining Differentiable PDE Solvers and Graph Neural Networks for Fluid Flow Prediction (paper review), date: 04/22/2022.*
- ***AAAI 2023 Spring Symposium Series****, Hyatt Regency, San Francisco Airport, California*
  Topic: Learning bias corrections for climate models using deep neural operators
  date: March 27–29, 2023.

Honors and Awards

- *Harry J. Gaston, Jr. Memorial Scholarship in Engineering, Sept 2020- April 2021.*
- *College of Engineering and Science Scholarship, Louisiana Tech University, Sep 2019-Aug 2020.*
- *TA of the year, Louisiana Tech University, 2018-2019.*
- *College of Engineering and Science Scholarship, Louisiana Tech University, Nov 2018-Jul 2019.*
- *Mercedes-Benz Endowed Scholarship, Louisiana Tech University, 2017-2018.*
- *Highest Cumulative Grade Point Average, South Asian University, 2013-2014.*
- *3rd position, 2nd South Asian Karate Championship, Bangalore, 2010.*

Grants

- *Bora, Aniruddha. PIER: Physics-Informed, Energy-efficient, Risk-aware routing, Texas State University, $12000. (Submitted: 2025, Funded: January 2026 - Present). Grant.*
- ***ALCF Director's Discretionary Allocation Grant** for Physics-Informed Generative AI*
- ***ALCF Director's Discretionary Allocation Grant** for quantification of extreme weather based on neural operator approximation, 2022.*
- *Machine Learning Methods for Phase Change Heat Transfer Modeling and Design, **Multidisciplinary University Research Initiatives (MURI) Program (ONR) 2024**. (was part of writing and developing this grant from Brown University)*

Additional Certificates

***ATPESC 2022**, ARGONNE TRAINING PROGRAM ON EXTREME-SCALE COMPUTING, 2022.*

***Machine Learning**, Stanford University, Coursera, 2019. Certificate*

***Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning**, deeplearning.ai, Coursera, 2019. Certificate*

Journal Reviewer

LINK

- *Nature Machine Inteligence*
- *Journal of Computational Physics (Elsevier)*
- *Engineering Applications of Artificial Intelligence (Elsevier)*
- *Neural Computation*
- *International Journal of Applied Mechanics and Engineering*
- *Neurocomputing*