

Ujjal Mandal



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"Bridging physics and computation to solve real-world problems."



About

Ujjal Mandal is an emerging researcher in the field of computational acoustics, biomedical ultrasound, and photoacoustic imaging. His work primarily focuses on the development of advanced numerical methods for modeling wave propagation in complex and heterogeneous media, with particular applications in medical imaging and therapeutic ultrasound. Mandal's research is centered around solving challenging wave equations such as the Helmholtz equation and thermoacoustic wave equations using modern computational techniques. He has made notable contributions to the development and optimization of the Born series formulation, including GPU-accelerated implementations for large-scale and realistic media simulations. His work in this area has enabled efficient modeling of acoustic fields in biomedical environments, significantly improving computational speed and accuracy. A key aspect of his research involves the integration of numerical frameworks such as the finite-difference time-domain (FDTD) method and k-space pseudospectral methods for simulating ultrasonic and thermoacoustic wave propagation. His studies have provided comparative insights into these techniques, enhancing their applicability in complex petrophysical and biological environments. Mandal has also contributed extensively to photoacoustic imaging, particularly in the quantitative analysis of optical absorption and elastic properties of biological tissues.

Keywords


- Acoustics, Ultrasonics, Photoacoustics
- Neural Networks, Physics-Informed Neural Networks (PINNs)
- Biomedical Ultrasonics, Ultrasound Imaging, Photoacoustic Imaging
- Geophysics, Tissue Characterization
- Inhomogeneous Helmholtz Equation, Wave Propagation
- Born Series, Convergent Born Series, Multiple Scattering
- Modified Green's Function
- Nonlinear Acoustics, Frequency-Domain Modeling
- Numerical Simulation, GPU Acceleration (CUDA)
- k-space Pseudospectral Method
- Heterogeneous Media
- Red Blood Cells, Erythrocytes, Stomatocytes, Echinocytes
- Photoacoustic Spectra, Beamforming

Research Interests



- Computational Acoustics and Numerical Modeling
- Wave Propagation in Complex and Heterogeneous Media
- Inverse Problems in Acoustics and Imaging
- Biomedical Ultrasonics and Therapeutic Ultrasound
- Photoacoustic Imaging and Tomography
- Ultrasound Signal Processing and Beamforming
- Acoustic Materials and Metamaterials
- Nonlinear Acoustics and High-Intensity Ultrasound
- Acousto-Optics and Coupled Wave Phenomena
- Physics-Informed Neural Networks (PINNs)
- Scientific Machine Learning for PDEs
- Deep Learning in Physical Systems Modeling
- Hybrid Physics-Data Driven Modeling
- Reduced-Order Modeling and Surrogate Models
- Numerical Methods for PDEs (FDTD, FEM, Spectral Methods)
- Helmholtz Equation and Frequency-Domain Modeling
- Born Series Methods and Multiple Scattering Theory
- Green's Function Methods and Integral Equations
- GPU-Accelerated Scientific Computing (CUDA)
- High-Performance Computing (HPC) for Wave Simulation
- Parallel Computing and Optimization Algorithms
- k-space Pseudospectral Methods
- Time-Domain and Frequency-Domain Simulations

- Stochastic Modeling and Uncertainty Quantification
- Biophysical Modeling of Cells (e.g., Red Blood Cells)
- Tissue Characterization and Quantitative Imaging
- Photoacoustic Spectroscopy and Imaging Physics
- Geophysical Wave Modeling and Subsurface Imaging
- Seismic and Ultrasound Wave Simulation

Education







Year	Degree / Examination	Institute / University	Percentage / CGPA
2021–2026	PhD in Computational Biomedical Physics	Indian Institute of Information Technology Allahabad (IIITA)	Thesis Submitted (21 st April, 2026)  Thesis Submission Proof
2020–2022	B.Ed in Physical Science	West Bengal University of Teachers' Training, Education Planning and Administration	89.25%
2018–2020	M.Sc in Physics (Computational Physics)	University of Gour Banga (UGB)	73%
2015–2018	B.Sc (Hons.) in Physics	West Bengal State University (WBSU)	63.25%
2012–2014	Higher Secondary (12th)	West Bengal Council of Higher Secondary Education	77.6%
2011	Secondary Examination (10th)	West Bengal Board of Secondary Education	80.01%

Fellowships and Awards



- Senior Research Fellowship (Senior Research Fellow), Indian Institute of Information Technology Allahabad, 2023
- Junior Research Fellowship (Junior Research Fellow), Indian Institute of Information Technology Allahabad, 2021
- University Grants Commission National Fellowship for Scheduled Caste Students Junior Research Fellow Fellowship Award, National Scheduled Castes Finance and Development Corporation, 2021 
- UGC-Council of Scientific and Industrial Research (UGC-CSIR) NET-JRF joint test, Physical Science, AIR 217, 2020, 

Publications

SCIE/SCI/SCOPUS

- [1] **Ujjal Mandal**, Jagpreet Singh, Ben T. Cox, Ratan K. Saha, "Graphics processing unit accelerated Helmholtz equation solver in two dimensions using the traditional Born series formulation for linear and nonlinear media in biomedical ultrasound," *The Journal of the Acoustical Society of America*, 159(3), 1948–1962, 2026. [SCI/SCIE/SCOPUS, Q1, IF: 2.3], [DOI: 10.1121/10.0042817]   

- [2] **Ujjal Mandal**, Jagpreet Singh, Ratan K. Saha, "On the Born series methods for solving inhomogeneous Helmholtz equation in biomedical photoacoustics," *European Conference on Biomedical Optics, Proc. SPIE 12631, Opto-Acoustic Methods and Applications in Biophotonics VI, 126310W (11 August 2023)*, [SCOPUS Index, h5-index: 21], [DOI: 10.1117/12.2670935]  
- [3] **Ujjal Mandal**, Navroop Singh, Kartikay Singh, Vinit Nana Hagone, Jagpreet Singh, Anshu S. Anand, Ben T. Cox, Ratan K. Saha, "Efficient implementations of a Born Series for computing photoacous-




tic field from a collection of erythrocytes," *Photoacoustics*, vol. 43, 2025, 100724, ISSN 2213–5979. [SCI/SCIE/SCOPUS, Q1, IF: 7.1], [DOI: 10.1016/j.pacs.2025.100724]    

- [4] Ratan K. Saha, **Ujjal Mandal**, "Estimation of optoacoustic spectra for normal and pathological red blood cells using a modified Green's function approach," *European Conference on Biomedical Optics, Proc. SPIE 12631, Opto-Acoustic Methods and Applications in Biophotonics VI, 1263109 (11 August 2023)*, [SCOPUS Index, h5-index: 21], [DOI: 10.1117/12.2670933]  
- [5] **Ujjal Mandal**, "A Robust Numerical Framework for Ultrasonic Wave Characterization in Complex Petrophysical Environments," *The 1st International Online Conference on Non-Destructive Testing, Engineering Proceedings (ISSN: 2673-4591, CiteScore 1.2), (Accepted, 06 May 2026)*, [SCOPUS Index]

NON-SCIE/NON-SCOPUS/PREPRINTS/arXiv/SSRN

- [6] **Ujjal Mandal** "Application of Lippmann-Schwinger Scattering Series with an Adaptive Preconditioner", Multidisciplinary Digital Publishing Institute in Basel, Switzerland, Preprints 2026, 2026031548, [DOI: 10.20944/preprints202603.1548.v1]   
- [7] **Ujjal Mandal**, Navroop Singh, Kartikay Singh, Vinit Nana Hagone, Jagpreet Singh, Anshu S. Anand, Ben T. Cox, Ratan K. Saha, "Efficient implementations of a Born Series for computing photoacoustic field from a collection of erythrocytes," *Social Science Research Network (Preprint)*, Elsevier, 1 Nov 2024, [DOI: 10.2139/ssrn.5007424] 
- [8] **Ujjal Mandal**, Jagpreet Singh, Ben T. Cox, Ratan K. Saha, "GPU Accelerated Transducer-Field Calculation using the Traditional Born Series Formulation for Realistic Media," *Medical Physics*, Cornell University (arXiv), 18 Jul 2025, [DOI: 10.48550/arxiv.2507.13754]    
- [9] **Ujjal Mandal** "Numerical Simulation of Time Domain Thermoacoustic Wave Equation Using the Finite Difference Time Domain Method with Comparison to the K-Space Pseudospectral Approach", *American Journal of Modern Physics*, 15(3), 77-85, [DOI: 10.11648/j.ajmp.20261503.12] 
- [10] **Ujjal Mandal** "A Comparative Study of Exact and Fractional Derivative Model via Mittag-Leffler Function", Multidisciplinary Digital Publishing Institute in Basel, Switzerland, Preprints 2026, 2026031548, [DOI: 10.20944/preprints202604.1061.v1] 
- [11] **Ujjal Mandal** "Photoacoustic Imaging Quantitative Analysis of Elastic and Absorption Contrast of the k-Wave Pseudospectral Simulation Framework", *ScienceOpen*, Boston, 131 Hartwell Ave., Suite 210, Lexington, MA 02421 USA, [DOI: 10.14293/PR2199.003302.v1] 
- [12] **Ujjal Mandal** "A Robust Numerical Framework for Ultrasonic Wave Characterization in Complex Petrophysical Environments", *Research Square*, [DOI: 10.21203/rs.3.rs-9293893/v1] 
- [13] **Ujjal Mandal** "Comparison of an explicit-implicit Scheme and a Nonuniform Finite Difference Framework of Two-Dimensional Wave Propagation", *Research Square*, [DOI: 10.21203/rs.3.rs-9533386/v1] 
- [14] **Ujjal Mandal** "Physics-informed Neural Networks for Solving Second-order Boundary Value Problems Comparison with FEM, FD Methods", *Science Discovery Physics*, 1(2), 118-130, [DOI: 10.11648/j.sdp.20260102.14] 

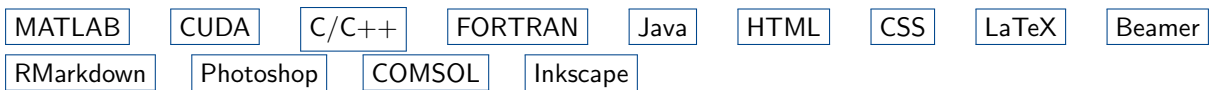
Teaching Experience

- 2024 **Numerical Methods**
B.Tech 7th Semester, M.Tech and PhD, IITA 
- 2024 **Tomography Imaging**
B.Tech 6th Semester, IITA 
- 2021–2024 **Engineering Physics**
B.Tech 1st Semester, IITA 
- 2019–2020 **Physics Teacher**
Hatimari High School

Workshops

- Photonics for Health, Atmosphere, Safety and Education (PHASE 2023), IIT Gandhinagar
- Symposium on Medical Imaging, IISER Thiruvananthapuram
- Workshop on Biomedical Imaging Applications, IITA

Technical Skills



Poster Presentation

“Solution of Inhomogeneous Helmholtz Wave Equation in Photoacoustics by Born Series Approach” Poster Presentation, IIT Gandhinagar, 2023

Publication Metrics & Journal Insights

No.	International Journal	IF	Quartile	No. of Articles	Percentile
1	The Journal of the Acoustical Society of America	2.3	Q1	1	20.00%
2	Photoacoustics	6.8	Q1	1	5.66%
3	Science Discovery Physics	×	×	1	×
4	American Journal of Modern Physics	×	×	1	×

Reviewer Experience

- Appointed as a Reviewer for the *American Journal of Modern Physics*, valid from April 2026 to April 2029.  [Certificate for Reviewer](#)
- Appointed as a Reviewer for the *International Journal of Research and Analytical Reviews*, The Board of IJRAR Awarded "Reviewer Certificate" IJRAR (www.ijrar.org) — E-ISSN 2348-1269, P- ISSN 2349-5138 Holding, Member ID : 120464  [Certificate for Reviewer](#)