BISWAJIT BERA

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Research Objective

As a dedicated PhD scholar in Mathematics and Computing at IIT (ISM) Dhanbad, I am deeply motivated to advance the frontiers of computational photography and computer vision through rigorous research and innovative problem-solving. My research focuses on developing robust domain generalization frameworks that enable AI systems to perform reliably across diverse and previously unseen environments, particularly in the context of drone-based aerial imagery and real-world vision applications. With a strong foundation in deep learning, mathematical modeling, and a proven track record in developing generalizable AI solutions, I aspire to contribute meaningfully to the academic community by publishing high-impact research, collaborating with interdisciplinary teams, and bridging theoretical advancements with practical applications. I am committed to pushing the boundaries of computer vision research while fostering knowledge dissemination through teaching, mentorship, and active participation in the global research ecosystem.

Education

Indian Institute of Technology (ISM) Dhanbad, Ph.D. in Mathematics and Computing — January 2026 – Present

- **Research Area:** Computational Photography and Computer Vision
- **Focus:** Domain Generalization in Vision Systems
- **Supervisor:** Dr. Sudhakar Kumawat, Department of Mathematics & Computing
- Investigating novel approaches to develop AI models that maintain robust performance across varying domains, with applications in aerial imagery analysis, surveillance systems, and adaptive vision technologies.

Indian Institute of Technology (ISM) Dhanbad, M.Sc. in Mathematics and Computing — July 2023 – May 2025

- CGPA: 8.74/10.0
- **Related Coursework:** Probability & Statistics, Data Structures & Analysis of Algorithms, DBMS, Operating Systems, Machine Learning, Deep Learning.

Vidyasagar University, Midnapore, B.Sc. in Mathematical Science — Aug 2020 – July 2023

- CGPA: 9.13/10.0
- **Related Coursework:** Numerical Methods, LPP, Multivariate Calculus, PDE, Linear Algebra, Number Theory, Graph Theory, C & C++, Python, Mathematical Modelling.

Mathuri Kalayanika Vidhyabhaban - WBCHSE Board, H.S. in PCMB — Apr 2018 – Jun 2020

- Percentage: 76.4%

Mathuri Kalayanika Vidhyabhaban - WBBSE Board, Secondary — Jan 2017 – Apr 2018

- Percentage: 77.3%

Research Experience

Junior Research Fellow (JRF) — July 2025 – December 2025
Indian Institute of Technology (ISM), Dhanbad

- Project Title: Developing Generalizable AI Models for Drone Imagery in Complex and Varied Indian Landscapes
- Principal Investigator: Dr. Sudhakar Kumawat, Department of Mathematics & Computing
- Developed domain-generalized AI models for drone-based aerial imagery using PyTorch and semi-supervised learning techniques to address domain shift challenges.
- Created robust solutions for applications in traffic monitoring, disaster response, and infrastructure assessment across diverse Indian landscapes.
- Conducted extensive literature review on domain adaptation and generalization techniques in computer vision.

Summer Research Project: Neural Machine Translation, IIT(ISM) Dhanbad Jun 2024 - July 2024

- Explored and applied NMT models, experimenting with different architectures including RNN, LSTM, GRU with Encoder-Decoder mechanisms and Transformer architectures.
- Implemented back translation techniques to expand training data and enhance model performance for low-resource language pairs.
- Gained hands-on experience with sequence-to-sequence modeling and attention mechanisms.

Master's Thesis

Multilingual Chatbot for Translating Indian Local Languages, IIT(ISM) Dhanbad , Jan 2025 - May 2025

- Developed a multilingual chatbot using LLaMA-3 for real-time translation of Indian languages, addressing the critical need for linguistic inclusivity in AI systems.
- Curated and augmented datasets from AI4Bharat and IndicCorp to improve support for low-resource Indian languages.
- Implemented fine-tuning strategies and evaluated model performance across multiple language pairs.
- Tools: Llama-3, Python, PyTorch, Hugging Face, AI4Bharat Datasets.

Technical Skills

Programming Languages: Python, C, C++, SQL, MATLAB, LaTeX.

Deep Learning & ML Frameworks: PyTorch, TensorFlow, scikit-learn, Keras, Hugging Face Transformers.

Data Science Tools: Pandas, NumPy, Matplotlib, Seaborn, OpenCV, Streamlit.

Research Specialization: Computer Vision, Computational Photography, Domain Generalization, Natural Language Processing, Semi-Supervised Learning.

Selected Projects

Legal-Lens: AI-Powered Legal Research Platform for Commercial Courts , Aug 2024

- Developed a case prediction system using PyTorch to analyze legal data and forecast court case outcomes with high accuracy.
- Built an end-to-end platform with features for document upload, multi-language support, and intelligent legal query resolution.
- Implemented transformer-based models for legal document understanding and case similarity matching.
- Tools Used: PyTorch, Hugging Face Transformers, Docker, NLP.

Semantic Image Segmentation using U-Net Architecture , March 2024

- Expanded the dataset from 20 to 80 images using advanced data augmentation techniques to improve model generalization.
- Designed and implemented a U-Net architecture with PyTorch for precise pixel-level semantic segmentation.
- Achieved exceptional results: 99.48% precision, 80.15% IoU score, and 95.75% recall, demonstrating high segmentation quality.
- Conducted ablation studies to analyze the impact of different architectural components and loss functions.
- Tools: PyTorch, segmentation_models_pytorch, U-Net, OpenCV.

Conferences & Workshops

International Conference on Recent Developments in Research June 2023,

Organized by the Department of Mathematics, Tamralipta Mahavidyalaya, Tamluk, West Bengal, India.

- Participated and gained insights into recent advancements in mathematical research and its applications in computational sciences.
- Engaged with researchers from diverse domains, fostering interdisciplinary perspectives.

Artificial Intelligence (AI) Workshop August 2023,

Organized by Naresh Vashisht Centre for Thinking & Innovation (NVCTI), IIT(ISM) Dhanbad.

- Completed a comprehensive 12-hour introductory workshop divided into four sessions, covering fundamental AI concepts and their real-world applications.

- Gained theoretical knowledge of AI techniques and hands-on implementation experience with practical use cases.
- This workshop significantly influenced my research direction and continues to inform my current projects.

Honors & Awards

Champion - CLASH of T-AI-TANS Hackathon, Saras AI Institute, New Jersey, USA Aug 2024,

- Won first place in a prestigious international computer vision hackathon with 300+ participating teams from top institutions including IITs and NITs.
- Developed an innovative real-time emergency surveillance system using advanced computer vision techniques to automatically detect and alert responders to critical situations (fires, violence, medical emergencies).
- Addressed limitations of traditional human-operated systems, demonstrating potential for significant impact in saving lives and property.

WB-SET 2024: Qualified with 46.67% score in Mathematical Science, demonstrating eligibility for Assistant Professor positions.

GATE 2024: Achieved All India Rank (AIR) 914 in Data Science and Artificial Intelligence among thousands of candidates.

IIT JAM 2023: Secured All India Rank (AIR) 365 in Mathematics, qualifying for M.Sc. admission at IITs.

Professional Development

SWAYAM-NPTEL Certifications (Online Courses)

- Machine Learning (IIT Kharagpur) - Comprehensive course covering supervised and unsupervised learning algorithms.
- Deep Learning (IIT Ropar) - Advanced neural network architectures and training techniques.
- Computer Vision (IIT Kharagpur) - Fundamental and advanced concepts in image processing and vision systems.
- Generative AI & Large Language Models (IIM Bangalore) - Latest developments in generative models and LLMs.

Coursera Certifications (Online Courses)

- Google Data Analytics Professional Certificate - Comprehensive data analysis and visualization training.
- Python for Data Science, AI & Development - Advanced Python programming for data science applications.
- Tesla Stock Price Prediction using Facebook Prophet - Time series forecasting techniques.
- Deep Learning with PyTorch: Image Segmentation - Hands-on implementation of segmentation models.