

# Aditya Chandra Mandal

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## EDUCATION

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- **Indian Institute of Technology (BHU) Varanasi** Varanasi, India  
*Integrated Dual Degree (B.Tech, M.tech) - Mining Engineering; GPA: 8.32/10* July 2017 - June 2022  
**Degree Courses:** *Fiber Optics (A), Fourier Optics & Imaging (A\*) Optical Communication Networks (A\*), Fundamental of Electrical Engineering (A-), Distributed Computing (A-), Solar and Space Plasma Physics (A-), Probability and Statistics (A), Reliability Engineering (A)*  
*A\*:Outstanding, A:Excellent, A-:Very Good*

## RESEARCH INTERESTS

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- Optical Imaging and Holography
- Optical Microscopy and Deep-Learning Assisted Microscopy
- Imaging through Scattering Media
- AI for Healthcare
- Machine Learning and Deep Learning

## PUBLICATIONS

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- **Mandal, A. C.**, Sarkar, T., Zalevsky, Z., & Singh, R. K. (2022). Structured transmittance illumination coherence holography. *Scientific Reports*, 12(1), 4564.: [Journal Publication.](#), [Citation: 8](#)
- Manisha, **Mandal, A. C.**, Rathor, M., Zalevsky, Z., & Singh, R. K. (2023). Randomness assisted in-line holography with deep learning. *Scientific Reports*, 13(1), 10986.: [Journal Publication.](#)
- Sarkar, T., **Mandal, A. C.**, Ziyang, C., Jixiong, P., & Singh, R. K. (2021). Correlation holography with a single-pixel detector: A review. *Laser & Optoelectronics Progress*, 58(10), 1011011.: [Journal Publication.](#), [Citation: 3](#)
- Manisha, Tanushree Karmakar, **Aditya Chandra Mandal**, and Rakesh Kumar Singh. "Roadmap on Computational Methods in Optical Imaging and Holography," Chapter: "Computational Imaging with Post-Processing of Randomness." *Applied Physics B*, Springer.: [Invited from the journal and pending publication.](#)
- **Mandal, A. C.\***, Phatak, A.\* , Balaji, J. J., & Lakshminarayanan, V. (2021, August). A deep learning approach to pupillometry. In *Applications of Machine Learning 2021* (Vol. 11843, pp. 260-272). SPIE.: [Conference Publication, SPIE Optics + Photonics, Remote, 2021.](#), [Citation: 1](#)
- **Mandal, A. C.**, & Phatak, A. (2023, August). Optimizing deep learning based retinal diseases classification on optical coherence tomography scans. In *Optical Coherence Imaging Techniques and Imaging in Scattering Media V* (Vol. 12632, pp. 231-239). SPIE.: [Conference Publication, European Conferences on Biomedical Optics \(ECBO\), Munich, 2023.](#)
- **Mandal, A. C.**, Manisha, Phatak, A., R. K. S. Twin image removal with deep learning for multi-wavelength digital in-line holography.: [XLIV OSI Symposium on Frontiers in Optics and Photonics 2021 \(FOP21\) Indian Institute of Technology Delhi, Optical Society of India. September 24-27 \(2021\).](#)
- Manisha, **Mandal, A. C.**, & Singh, R. K. (2023, September). Second-order correlation of randomness for enhanced quality imaging. In *Biomedical Imaging and Sensing Conference* (Vol. 12608, pp. 167-170).: [SPIE OPIC 2024, Yokohama, Japan](#)

## PREPRINTS

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- Phatak, A.\* , **Mandal, A. C.\*** , Balaji, J. J., & Lakshminarayanan, V. (2023). Direct Estimation of Pupil Parameters Using Deep Learning for Visible Light Pupillometry. [arXiv preprint arXiv:2305.06425.](#): [Currently in the review process in the Journal of Modern Optics, Taylor & Francis.](#)
- **Mandal, A. C.**, Phatak, A., Zalevsky, Z., Singh, R. K. (2022). Reconstructing complex field through opaque scattering layer with structured light illumination. [arXiv preprint arXiv:2205.09677.](#): [Completed experimental validation and manuscript preparation and will submit it to a Journal.](#)

## EXPERIENCE

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- **EXL Service** Noida, India  
*Assistant Manager - Data Scientist / AI Engineer (Full-time)* July 2022 - Present
  - **Data Standardization and Extraction:**
    - \* Standardized data from diverse PDF templates with tabular content.
    - \* Employed AWS Textract, SageMaker, transformer models, NER, and regex for efficient data extraction.
  - **NLP Solutions for Call Transcripts:**
    - \* Developed NLP solutions using transformer-based models and achieved a 93% accuracy rate.

- \* Utilized phrasemachine for processing call transcript data and metadata.
- o **Client Projects and POCs:**
  - \* Played a key role in developing and delivering Proof of Concepts (POCs) and client projects.
  - \* Contributing to the implementation of data and model checks using Amazon Textract, Spacy models, Amazon Comprehend, and LLM-based models.
  - \* Worked on a project to create 5 model checks within the insurance sector: 3 models with accuracy exceeding 90% and two models with 84% and 82% accuracy, respectively.

## ONGOING PROJECTS

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- **Deep Learning-Based Phase Unwrapping for Interferograms in Diffraction Phase Microscopy:** May 2021 – Present (Remote) — Advisor: Dr. Peter So (MIT), Dr. Zahid Yaqoob (MIT), Dr. Dushan N. Wadduwage (Harvard University).
  - o Developed a forward model in MATLAB to extract phase maps from interferograms generated by Diffraction Phase Microscopy (DPM). Complex field extraction was accomplished using the Hilbert transform.
  - o Replaced the traditional forward model with a state-of-the-art CNN-based U-shaped High-resolution Network. The network architecture is based on the U-Net's encoding and decoding structure, enhanced by Multi-Level Convolution Blocks and High-resolution Fusion Blocks to capture both local and global features. A novel compound loss function was designed by combining the SSIM Loss and a L2 loss function, resulting in improved phase reconstruction details.
  - o Successfully trained the network on interferogram datasets from experiments conducted at the So Lab, MIT, to extract phase maps information from under-sampled 2D interferograms (downsampled by factors of 2x, 4x, 8x, and 16x). These under-sampled interferograms exhibited significant aliasing due to under-resolved regions and were characterized by high noise levels. The result was an up to 16x increase in DPM speed, while still maintaining high reconstruction quality.
  - o Utilized a range of tools and technologies, including Python, PyTorch, scikit-learn, Matplotlib, Tensorflow, and MATLAB, to implement and evaluate the models.
- **Deep Learning for Visible Light Pupilometry:** May 2020 – Present (Remote) — Advisor: Dr. Vasudevan Lakshminarayanan (University of Waterloo), Jothi Balaji Janarthanam (Sankara Nethralaya, India).
  - o Developed an innovative approach to pupilometry using deep learning (DL) techniques, specifically a U-Net-based model applied to visible light (VL) eye images. Evaluated the model on 30 distinct VL test samples (completely different type compared to training data), achieving a Mean Dice Score (DSC) of 0.681 and a standard deviation (SD) of 0.280 for pupil segmentation. The mean error in pupil diameter prediction was 3.110, with an SD of 2.318. This work was presented at the SPIE Optics+Photonics Conference in San Diego in 2021.
  - o Extended the above work to derive the parameters of the elliptical pupil boundary directly in addition to the binary pupil mask segmentation. This was accomplished using a modified U-Net model with ellipse regression. Evaluation of 30 VL test samples yielded an average DSC of 0.693 and an SD of 0.123 for pupil segmentation. The mean error in pupil diameter prediction was reduced to 1.226, with an SD of 1.126. This modification eliminated the need for computationally expensive post-processing steps like ellipse fitting and significantly improved segmentation accuracy. Additionally, the time-varying ellipse parameters allowed for the computation of the Pupillary Light Reflex (PLR) dynamics. **This preprint version of this work is available on arXiv.**
  - o Acknowledged the sensitivity and privacy issues related to biometric eye images, especially irises, which can be used for identification. These concerns limit access to such datasets and pose challenges for researchers. Addressed this issue by currently working on Generative Models, including Generative Adversarial Networks (GANs) and Diffusion Models, to generate synthetic examples based on the data distribution. These synthesized examples have the potential to provide advantages over discriminative modeling.
  - o Utilized a range of tools and technologies, including Python, PyTorch, scikit-learn, to implement and evaluate the models.
- **Coherence Holography Using a Single-Pixel Detector:** May 2019 – Present — Advisor: Dr. Rakesh Kumar Singh (IIT (BHU)).
  - o Developed an innovative temporal correlation-based technique for Coherence Holography (CH) to reconstruct complex fields of objects using a single-pixel detector.
  - o Introduced an entirely new approach for the reconstruction of the complex coherence function in coherence holography, eliminating the need for an interferometric setup. This was achieved by projecting structured patterns onto the incoherent source structure and measuring the cross-covariance of intensities with a single-pixel detector. **Notably, this work has been published in the Scientific Reports journal.**
  - o This project is primarily computational in nature, and we are currently working on experimental validation to further demonstrate its practical applications.
  - o Utilized MATLAB to perform the computational validation.
- **Complex Field Reconstruction via Structured Light Illumination in Opaque Scattering Layers:** May 2021 – Present — Advisor: Dr. Rakesh Kumar Singh (IIT (BHU)).

- Developed an innovative technique for structured light illumination to image through opaque scattering layers. The proposed method is reference-free and capable of reconstructing the complex field from speckle pattern intensities. This achievement is made possible through phase-shifting in the structured light illumination process and the application of spatial averaging in the intensity correlation measurements. **A preprint version of this work is available on arXiv.**
  - This project primarily involves computational efforts. Recently, we conducted **experimental validations with promising results in the reconstruction of complex fields.** Currently, we are preparing a manuscript for publication to detail our findings.
  - Utilized MATLAB to perform the computational validation.
- **Deep Learning-Based Twin Image Suppression in In-line Holography Reconstruction:** May 2022 – Present — Advisor: Dr. Rakesh Kumar Singh (IIT (BHU)).
    - Developed a new method to record an in-line hologram in intensity correlation rather than the intensity as in conventional holography. The novelty of our work lies in demonstrating enhanced complex field imaging with a better reconstruction quality. The narrower point spread function in the intensity correlations plays a critical role in enhancing the quality of reconstruction in our technique. Further, a common issue of twin images in in-line holography is tackled with an unsupervised DL method by utilizing an auto-encoder model to perform blind single-shot hologram reconstruction. **Notably, this work has been published in the Scientific Reports journal.**
    - Designed a compact digital in-line polarization holography system assisted with a deep learning framework based on generative adversarial networks (GAN). This framework incorporates a discriminative network to assess reconstruction quality of in-line hologram semantically while using a generative network to approximate the inverse of hologram formation. The result is high-quality image reconstruction from a single intensity measurement in in-line holography. Our polarization holography design concurrently detects the in-line hologram intensity corresponding to the sample's polarization components. Experimental validation demonstrates the feasibility of this technique with a learning based framework. **We are preparing a manuscript for submission to the IEEE Transactions on Computational Imaging journal.**
    - Utilized a range of tools and technologies, including Python, PyTorch, scikit-learn to implement and evaluate the models.

## GRANTS

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- **Ministry of Coal (India) Project Grant:** March 2021 – May 2022 Received a project grant [Code- MT-174, Sl No.-11] of USD \$49k from the Ministry of Coal for the design and development of a drone-mounted optical sensor. This sensor is for continuous monitoring of particulate matter in opencast mines, and I was appointed as the primary student researcher for this project. I worked under the guidance of Dr. Rakesh Kumar Singh and Dr. Piyush Rai at IIT (BHU) Varanasi.

## SKILLS SUMMARY

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- **Languages:** Python, C++, MATLAB
- **Frameworks:** Scikit, NLTK, SpaCy, TensorFlow, Keras, PyTorch
- **Developer Tools and Libraries:** Amazon Textract, Google Colab, NumPy, OpenCV, Matplotlib
- **Soft Skills:** Leadership, Event Management, Public Speaking, Writing, Time Management

## CONFERENCES AND WORKSHOPS

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- Participated and presented a poster at SPIE European Conferences on Biomedical Optics (ECBO), 2023, Munich, Germany.
- Participated in remote KSOP-QMat Summer School 2020, KIT Germany.
- Participated in MIT India Initiative workshop, Mumbai 2020.
- Participated in IONS OPUMA, Optical Society of America, 2020 (National Autonomous University of Mexico), CLEO virtual Conference 2020.

## EXTRACURRICULAR ACTIVITIES

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- Led educational outreach programs of Information Photonics Lab, IIT (BHU), explaining optical concepts to diverse audiences.
- Guided students of engineering physics through curriculum and research design with a focus on enhancing their expertise in optical imaging techniques and applications.