Ritabrata Chakraborty

GitHub | Google Scholar | ResearchGate | Portfolio | LinkedIn | ritabratabits@gmail.com | +91 89107 83548

Education

Birla Institute of Technology and Science, Pilani (BITS Pilani) — **Rajasthan, India**

B.E. in Mechanical Engineering — Minor in Data Science, ***CGPA: 8.27/10 (Expected: 8.57/10)*** — *Oct '22 – May '26*

Publications & Presentations

Conference Publications

- Y. Wang, H. He, Y. Cao, J. Liang, **R. Chakraborty**, and G. A. Sartoretti, ***"CogniPlan: Uncertainty-Guided Path Planning with Conditional Generative Layout Prediction."*** Accepted at **Conference on Robot Learning (CoRL)**, 2025.
- **R. Chakraborty**, T. Mian, and P. Kundu, ***"An Efficient Approach for Synthetic Data Generation and Fault Diagnosis for Rotating Machinery."*** Presented at **Prognostics and System Health Management Conference (PHM)**, 2025. Published in **IET Conference Proceedings**, 2025.
- **R. Chakraborty** and M. Dasgupta, ***"Hockey3D: A Public Field Hockey Shot Trajectory Dataset with 3D Reconstruction and Shot Type Classification."*** To appear in **Conference on Computer Vision and Image Processing (CVIP)**, 2026. In Preparation, 2025.
- K. Kishore and **R. Chakraborty**, ***"Path Planning of Low-Altitude UAV for Tree Canopy Tracking and Orchard Monitoring."*** Filed as **Intellectual Property**, 2025.

Experience – Robotics

ML Intern | Uber

Supervisor: Mr. Siddarth Malreddy, Tech Lead Manager & Mr. Ishan Nigam, Senior ML Engineer, Uber — *July '25 – Present*

- Augmented uLabel with deep learning object tracking for automated RGB/IR video annotation, reducing manual effort.
- Deployed XGBoost anomaly detection in human-in-the-loop tracking validation for frame-level annotation accuracy.

Vision-Attention-Driven Autonomous Navigation with Semantic Understanding

Supervisor: Dr. Guillaume Sartoretti, Assistant Professor, MARMoT Lab, NUS — *Aug '25 – Present*

- Enhanced *CogniPlan* with cross-attention between frontier and node embeddings to enrich node representations.
- Incorporated Visual Navigation Transformer (ViNT) to capture semantic context for adaptive exploration strategies.

Design and Development of Smart Automated Field Hockey Ball Launcher

Supervisor: Dr. Mani Shankar Dasgupta, Senior Professor, BITS Pilani — *Apr '24 – Oct '25*

Physics-Based Launcher Mechanical Design and FEM Analysis

- Fabricated programmable launcher achieving 150 km/h using CFRP composite and stainless steel components.
- Performed FEM analysis and CAD using Fusion 360, achieving safety factor 2.07 at 496 RPM.

Computer Vision Pipeline for 3D Trajectory Reconstruction and Shot Classification

- Devised 3D ball localization from monocular videos using diameter-based depth and PnLCalib (0.76m RMSE).
- Developed TCN-attention classifier fusing trajectory and statistical features, achieving 95.2% classification accuracy.

Uncertainty-Guided Path Planning via Conditional Layout Prediction

Supervisor: Dr. Guillaume Sartoretti, Assistant Professor, MARMoT Lab, NUS — *Mar '25 – Aug '25*

- Architected CogniPlan, integrating Wasserstein GAN-based conditional inpainting model and graph attention network for uncertainty-aware navigation.
- Achieved up to 17.7% shorter exploration paths and 3.9% improved navigation efficiency over state-of-the-art baselines across 100+ unseen maps, using a lightweight model with fewer than 0.35M parameters enabling real-time CPU inference.

Monocular Vision-Based UAV Navigation for Orchard Monitoring

Supervisor: Dr. Kaushal Kishore, Senior Scientist, CSIR-CEERI — *Jan. '24 – Feb '25*

- Engineered a UAV-based orchard monitoring system using YOLOv11 (Box mAP50: 95.5%, Mask mAP50: 96.5%).
- Programmed B-spline trajectory logic and implemented custom yaw-roll controller to minimize drift under wind.

Image-Based Visual Servoing for Automated Radar Control and UAV Tracking

Supervisor: Dr. Rishi Verma, PPEMD Head, Bhabha Atomic Research Centre (BARC) — *Jun '24 – July '24*

- Orchestrated radar alignment using YOLOv8 + DeepSORT, boosting tracking recall to 91% and speed by 13%.
- Implemented PLC-based actuation system for continuous UAV lock-in.

Experience – Predictive Maintenance

Synthetic Sensor Data Generation and Fault Classification for Bearing Systems

Supervisor: Dr. Pradeep Kundu, Assistant Professor, KU Leuven *Sep '24 – Oct '25*

Auxiliary Classifier WGAN-GP for Time-Series Sensor Data Generation

- Built ACWGAN-GP with TCN discriminator to augment minority fault classes, reaching ∼100% classification accuracy.
- Evaluated synthetic data by comparing real and generated FFT spectra using PCC, Cosine Similarity, MMD, and KL Div.

Conditional Latent Diffusion-GAN for CWT Generation and LiteFormer-based Classification

- Developed Conditional Latent Denoising Diffusion GAN (LDDGAN) with Supervised Contrastive Loss (SCL) for latent class separation (99.9% AE accuracy, 16× compression with EvoNorm-S0).
- Designed LiteFormer variants integrating Continuous Wavelet Convolution (CWC), Haar DWT, WDCNN-BiLSTM-Siamese Network, and CWMS-GAN-inspired architectures, achieving up to 99.18% fault classification accuracy.

Projects

Autonomous Drone Navigation | MathWorks Global Student Drone Challenge 2025 *Mar '25 – Apr '25*

- Programmed vision-based control for Parrot Mambo drone using masking, ray-tracing, and closed-loop yaw control.
- Optimized speed control and zone-based auto-landing to reduce track completion time.

ExoMy Rover Navigation and UR3 Arm Motion Planning | ERC 2023 Remote *Apr '23 – Sep'23*

- Navigated ExoMy rover using ArUco detection, Ackermann steering, and spot turns for autonomous hazard avoidance.
- Calibrated UR3 arm with MoveIt and OMPL planner for collision-free manipulation (98% success).

Leadership & Teaching

President & Secretary

Mechanical Engineering Association (MEA), BITS Pilani *Jun '24 – Present*

- Coordinated 10+ events and career sessions for 300+ students, facilitating technical exposure and alumni interaction.
- Managed production of 500+ merchandise items and led outreach, boosting student participation by 20%.

President & Tech Fest Coordinator

Indian Society of Heating, Refrigerating, and Air Conditioning Engineers (ISHRAE), BITS Pilani *Oct '24 – Jul '25*

- Led a team of 25+ members to organize 4+ technical workshops with HVAC industry experts.
- Hosted 3 competitions and networking events, engaging 200+ students in HVAC innovation and awareness.

Project Manager

Tinkerer's Lab (TL), BITS Pilani *May '24 – Jul '25*

- Supervised 5 interdisciplinary robotics teams (30+ members) on Micromouse and Hexapod projects.
- Oversaw lab resources, conducted weekly reviews, and mentored 50+ students in hands-on technical skills.

Teaching Assistant

ME F218: Advanced Mechanics of Solids, BITS Pilani *Jan '25 – May '25*

ME F216: Materials Science and Engineering, BITS Pilani *Sep '24 – Dec '24*

- Assisted 100+ students in labs and tutorials, clarifying concepts and linking theory to practical applications.
- Evaluated assignments and supported faculty in delivering high-impact teaching sessions.

Awards & Achievements

3rd Place — MathWorks Global Drone Student Challenge 2025 **Mar '25**

Finalist — AI for Space and Geospatial Innovation (ISRO Immersion Challenge) **Jul '24**

Top 15 Overall, Top 5 in College — American Express Campus Challenge 2024 **Jul '24**

5th Place & Best Maintenance Award — European Rover Challenge 2023 (Remote Finals) **Sep '23**

Technical Skills

Relevant Courses: Machine Learning, Deep Learning, Foundations of Data Science, Applied Statistical Methods, Linear Algebra, Computer Programming, Engineering Optimization, Differential Equations, Design of Machine Elements, Digital Twins

Programming Languages: Python, C++, C, Shell (Linux)

Robotics & Simulation: ROS (with Gazebo, Rviz), MAVROS, Navigation Stack, MoveIt, AirSim, MATLAB, Simulink, QGIS

Machine Learning: PyTorch, TensorFlow, Scikit-Learn, OpenCV, Open3D, Matplotlib, Weights & Biases (W&B)

Hardware & Embedded Systems: NVIDIA Jetson (Nano, Orin), Raspberry Pi, Arduino, IMUs, Stereo Camera, 3D LiDAR

CAD & Mechanical Simulation: ANSYS Mechanical, SolidWorks, Fusion 360