

Parv Maheshwari

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EDUCATION

Indian Institute of Technology Kharagpur

West Bengal, India

Major : Integrated M.Sc. (5 Year Program) in Mathematics and Computing | GPA : 9.25/10 Expected Apr 2024

PUBLICATIONS

- **PIAug - Physics Informed Augmentation for Learning Vehicle Dynamics for Off-Road Navigation** [pdf]
P. Maheshwari et al. under review at **ICRA 2024**
- **TartanDrive 2.0: More Modalities and Better Infrastructure to Further Self-Supervised Learning Research in Off-Road Driving Tasks**
M. Sivaprakasam, P. Maheshwari et al. under review at **ICRA 2024**
- **Learning Risk-Aware Costmaps via Inverse Reinforcement Learning for Off-Road Navigation** [pdf]
S Triest, M. G. Castro, P. Maheshwari et al. accepted at **ICRA 2023**
- **Multiple Waypoint Navigation in Indoor Environments** [pdf]
P. Maheshwari* et al. accepted at **2022 International Conference on Control and Robotics (ICCR)**
- **TartanDrive 1.5: Improving Large Multimodal Robotics Dataset Collection and Distribution** [pdf]
M. Sivaprakasam, ..., P. Maheshwari et al. accepted in **ICRA 2023 Workshop** on Pretraining4Robotics Lightning
- **Local NMPC on Global Optimised Path for Autonomous Racing** [pdf]
P. Maheshwari* et al. accepted at **ICRA 2021 Workshop - Opportunities and Challenges with Autonomous Racing**
- **[Re] Contrastive Learning of Socially-aware Motion Representations** [pdf]
R. Sen, S. Sinha, A. Jha, P. Maheshwari accepted in **RescienceC 2022** and presented at **2022 NeurIPS**
- **[Re] Differentiable Spatial Planning using Transformers** [pdf]
R. Ranjan, H. Bhakta, A. Jha, P. Maheshwari accepted in **RescienceC 2022** and presented at **2022 NeurIPS**

* - Shared First Authorship

EXPERIENCE

AirLab, Robotics Institute

Carnegie Mellon University

Research Intern under [Dr. Wenshan Wang](#) and [Prof. Sebastian Scherer](#) | [Certificate](#)

April 2022 – Present

Project: Improving the accuracy of a data-driven vehicle dynamics in case of domain gap

- Designed a novel framework by **augmenting the dataset using physics prior** while training a multi-modal net
- Formulated the augmentation as a **Physics-Informed Neural Network** to enhance the generalisation capability
- Improved **real-time deployment** by optimizing inference runtime by 6x and GPU memory requirements by 1.9x
- **Navigated 4x tighter tracking constraints** compared to a nominal model at out-of-domain velocities.

Project: Online System Identification for Off-Road Driving using past and future modalities.

- Formulated a throttle-based vehicle model and performed traditional offline system identification for its parameters
- Proposed an **online system identification** using modalities like a history of odometry combined with images
- Collected 7 hours+ diverse data and **reduced the modeling error by 25%** for a full-scale modified Yamaha ATV

ARTPARK in collaboration with NOKIA

IISc Bangalore

Summer Research Fellow under [Prof. Amrutur Bharadwaj](#) | [Certificate](#)

May 2021 – Sept 2021

Project: Use a high-performance network infrastructure to create a safe network-aware autonomy for multiple robots.

- Developed a Multi-Robot Task Allocation module based on an **auction approach** to optimize total execution time
- Implemented **Multi-Robot Path Planning** by extending the NAV2 library by improving TF and namespacing
- Proposed a **novel decentralized algorithm to avoid other robots** using information received over the network
- **Reduced the number of collisions by up to 71%** in between 7 robots and this was [submitted](#) at ICRA 2022

Autonomous Ground Vehicle Research Group

Undergraduate Researcher under [Prof. Debashish Chakravarty](#)

IIT Kharagpur

Mar 2020 – Present

- Developed a ROS-compatible Frenet-Optimal Trajectory **local planner** supporting static and **dynamic obstacles** and optimized its runtime by 6x using **parallel processing, OpenMP**, for sampling step and map updation
- Spearheaded 2 of 43 accepted reports in **Machine Learning Reproducibility Challenge 2022** by implementing and ablating over **state-of-art** like socially aware motion representations and spatial planning via transformers
- Part of various **international competitions** like Indy Autonomous Challenge and IROS Navigation Challenge

PROJECTS

Drone Swarm Challenge

Inter IIT Tech Meet 11.0 | [\[Presentation\]](#) [\[Code\]](#)

Drona & IIT Kanpur

Dec 2022 - Feb 2023

- Developed an **Aruco tag-based** state feedback and an adaptive PID controller for an indoor **multi-drone** system
- Implemented a non ROS based **socket communication** with the flight controller using Python and socket library

Navigation and Manipulation in Unknown Environments

IROS-RSJ Navigation and Manipulation Challenge 2021 | [\[Challenge\]](#) [\[Code\]](#)

Prague, Czech Republic

July 2021 – Sep 2021

- Designed a **probabilistic planner** capable of finding near-optimal global paths for **multiple waypoint** scenarios
- Developed real-time 2D LiDAR mapping, with probabilistic planning and **adaptive MPC** for indoor navigation

High Speed Navigation for Autonomous Racing

Indy Autonomous Challenge 2021 under Prof Sohel Anwar | [\[Code\]](#)

Indiana Motor Speedway, Indiana

Dec 2020 – May 2021

- Implemented a dynamic model-based Model Predictive Control using **Pacejka Model** for tire forces at high speed
- Formulated **cost function** accounting for the optimal race line along with maneuvers like overtaking and drafting

Batched Cholesky Decomposition using CUDA

Term Project under Prof Soumyajit Dey | [\[Code\]](#) [\[Report\]](#)

IIT Kharagpur

Jan 2021 – April 2021

- Programmed CUDA-accelerated Cholesky factorization for batch processing of small matrices (size $\leq 100 \times 100$)
- Improved performance by analyzing using Nvprof and formulating interleaved and chunked memory access

Disease Checker Bot – Using Evolutionary Algorithms

Term Project under Prof Nirupam Chakraborti | [\[Code\]](#) [\[Report\]](#)

IIT Kharagpur

Jan 2021 – April 2021

- Developed a primary healthcare disease checker bot and trained it on a customized dataset extracted from SymCat
- Built a **combination of neural networks and evolutionary steps** – Selection, Crossover, and Mutation

ACHIEVEMENTS

INTERNATIONAL

2022	Planning Team Lead , Machine Learning Reproducibility Challenge	Online
2021	Winner , IROS Navigation and Manipulation Challenge [certificate]	Prague, Czech Republic
2021	Participant , Indy Autonomous Challenge	Indiana, USA

DOMESTIC

2022	Winner , Drone Swarm Challenge at Inter IIT Tech Meet 11.0	Drona/IIT Kanpur
2021	Awardee , under Summer Research Fellowship Program 2021 [letter]	IAS/INSA/NASI

TECHNICAL SKILLS

Languages: C, C++, Python, MATLAB **Frameworks:** ROS1/ROS2, ArduPilot, RealSense, Webots

Libraries: NAV2, OpenMP, CUDA, PyTorch, TensorFlow, RTI, OpenCV, Eigen, Keras

Simulators: Gazebo, Webots, VRXperience, LGSVL **Other Languages:** HTML, CSS, LaTeX

RELEVANT COURSEWORK

* INDICATES MOOC

Robotics:	Motion Planning and Path Tracking for Wheeled Robots, Machine Learning*, Deep Learning*
Computer Science:	High Performance Parallel Programming, Genetic Algorithms, Data Structures and Algorithms
Mathematics:	Probability and Statistics, Linear Algebra, Partial Differential Equations, Operation Research

Gopali Youth Welfare Society

Chief Fundrasing Officer | [Certificate](#)

IIT Kharagpur

Aug 2019 – April 2023

- Member of a student-run NGO providing free-of-cost **quality education** to 250 underprivileged students annually
- Spearheaded a team of 30 students to **raise INR 11 Million** and maintained relations with 4 corporate partners

Computer Vision Mentor

IEEE Winter Workshop | [Certificate](#)

IIT Kharagpur

Mar 2021

- Mentored IEEE-certified Robotics Workshop conducted by Technology Robotics Society, with 160+ attendees
- Taught topics like edge and corner detection, contours, template matching, and graph-based algorithms