Dikshant

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Education

University of Alberta (*UofA*) *Edmonton, Canada*
Masters in Computing Science *(Aug '24 - Present)*
Guide: Matthew Taylor
Cumulative GPA: *3.65*/4.0

Indian Institute of Technology Bombay (*IITB*) *Mumbai, India*
Bachelors of Technology in Civil Engineering *(Jul '18 - May '22)*
With Minor in Electrical Engineering; Cumulative GPA: *9.0*/10.0
Department Rank *5* in a batch of 112 students

Work Experience

Infrastructure Cooperative Safety Assist System *(Oct '22 - Aug '24)*
Advisor: Mr. Tokitomo Ariyoshi, Chief Engineer, CS Domain *Honda R&D Ltd. Japan*
- Spearheaded the project to enhance safety of Honda's self-driving car in **occluded regions** using infrastructure cameras
- Modeled traffic-user trajectories with the intelligent driver model (**IDM**) implemented using Frenet Coordinates system
- Optimized (**2x faster**) and deployed the Collision Risk Map algorithm to proactively alert VRUs to potential collisions
- Implemented **3D-Net** model for monocular object detection to obtain the position and velocity of traffic participants
- Established a remote control room to access live CCTV streams utilizing python socket library over **4G** networks
- Simulated collision detection on Gazebo and employed advanced **HMI** techniques to alert users of potential collisions

Meta Learning *(Jun '22 - Aug '22)*
Advisor: Prof. Matthew Taylor, Intelligent Robot Learning Lab *University of Alberta, Canada*
- Implemented Model Agnostic Meta Learning (**MAML**) on a multi-task SinWave regression using the **JAX** framework
- Replaced iterative learning algorithm with Markov Reward Process for learning approximate meta value functions
- Conducted experiments to comprehend the reason behind **poor memory scaling** on increasing gradient descent steps

Camera and Radar Fusion *(May '22 - Jul '22)*
Advisor: Mrs. Misa Komuro, Assistant Chief Engineer, CS Domain *Honda R&D Ltd. Japan*
- Merged camera and radar-based object detection results to improve the traffic user detection efficiency by **20%**
- Applied temporal and spatial alignment techniques to **synchronize** the sensor inputs, increasing the tracking precision
- Visualized the fusion results on **RViz** using ROS Visual Markers and tested robustness of algorithm in crowded regions

Scalable Multi-Agent RL Training School for Autonomous Driving - SMARTS *(May '21 - Aug '21)*
Advisor: Prof. Matthew Taylor, Intelligent Robot Learning Lab *University of Alberta, Canada*
- Constructed a training pipeline in SMARTS for multiple ego agents across varying map and traffic-pattern complexities
- Trained single ego-agent scenarios using **PPO** over increasingly difficult maps and traffic, **modelling human learning**
- Initialised multiple ego-agent training with single-agent weights, obtaining **3x faster convergence** over a fixed horizon
- Enhanced T-intersection safety by training agents with additional **hand-coded** positional data shared across neighbours

Multi-Agent Patrolling *(Apr '20 - Apr '21)*
Advisors: Prof. Arpita Sinha and Prof. Leena Vacchani, Department of Systems & Control *IIT Bombay*
- Devised an **IoT**-based multi-robot patrolling algorithm using **Deep Q-Network** for effective monitoring in remote areas
- Created an interface for communication between the agents in **SUMO** by using Traffic Control Interface (**TraCI**) library
- Formulated a **decentralized junction-based** decision making approach, reducing the junction visit intervals by **2x**
- Engineered sensor-failure resilience by thresholding node idleness; beat SOTA in topologies with large failures by **8%**
- Co-authored a research **manuscript** titled as "*Interconnecting Vehicles using IoT Framework for Multi-Agent Patrolling*"

Room Service Automation Bot *(Jun '20 - Jul '20)*
Golden Oak Projects Private Limited *Tech startup*
- Developed an autonomous hotel service robot adept at delivering amenities and responding to room service orders
- Implemented **SLAM** for real-time mapping of the environment by integrating the data from encoder, IMU and 2D-Lidar
- Simulated the scenarios on a custom-made Gazebo environment and utilized **DWA** algorithm for efficient navigation

Technical Projects

SeDriCa | Unmesh Mashruwala Innovation Cell *(Aug '20 - Apr '22)*
*Worked in a **20+** member team aiming to develop a **Se**lf-**Dri**ving **Ca**r capable of traversing unstructured environments*

- Designed a hybrid **MPC** controller using **dynamic bicycle model** to attain higher speeds and tackle adverse scenarios
- Crafted a drive-by-wire (**DBW**) system from ground up for mapping accelerator pedal position to DBW throttle body
- Integrated sub-modules for real-time deployment using **CAN** module to establish communication with the hardware
- Performed end-to-end simulation for the entire setup from perception to control on a self-made Gazebo environment
- Implemented RRT* and Hybrid A* for path planning and optimized the route by integrating data from Google Maps

Intelligent Picking Robot | Flipkart Grid 2.0-Robotics Challenge *(Jun '20 - Aug '20)*
Led a team of 5 developing a robotic arm capable of picking and transporting items in a warehouse | Top 2% across India

- Designed a **4-DoF** robotic manipulator and visualized its grasping mechanism on **RViz** using the **MoveIt** framework
- Implemented **YOLOv3** algorithm for object detection and identified potential grasping points using **OpenCV** functions
- Mapped the area between pick and drop stations using **SLAM** and employed **A*** algorithm for efficient path planning

Terrace Farming Bot | Inter-IIT Technical Meet 8.0 *(Oct '19 - Dec '19)*
Worked in a team of 8 to develop an autonomous step-climbing robot to perform terrace farming operations

- Employed a linear actuator mechanism using stepper motors and developed **CAD** models for precise manufacturing
- Fused monocular **visual odometry** and data from MPUs and stepper motor encoders for efficient state estimation
- Deployed a **PID**-based position and orientation controller employing ultrasonic sensors to provide accurate feedback

Parallelizing A* and D* Algorithms | High Performance Scientific Computing *(Feb '21 - May '21)*
Advisor: Prof. S. Gopalakrishnan, Mechanical Engineering Department *Course Project*

- Enhanced the computational efficiency of A* and D* by parallelizing them with **OpenMP** and **CUDA** frameworks
- Demonstrated and visualised improved path planning of parallel A* by implementing it using **pygame** library

Autonomous Quadruped Robot | RoboCup Rescue League Challenge *(Sep '19 - May '20)*
*Part of **17** member team working on autonomous quadruped for its easy maneuvering on any terrain*

- Performed **Inverse Kinematic** analysis for quadruped control to ensure an optimum balance on uneven ground
- Studied rhythmic movement of each leg of the quadruped for optimal **gait selection** based on speed and terrain

Other Technical Activities

- Delivered **talks** on RL for autonomous driving and Control Theory to **70+ students** with demonstrations *('20)*
- Guided **150+** freshmen teams in XLR8 competition to build and debug a wireless bluetooth controlled bot *('19)*
- Replicated **Thor's Hammer** using electromagnetism and RFID for Institute Technical Council Orientation *('19)*
- Designed a **line-follower robot** capable of solving a complex maze in the Institute's technical fest competition *('19)*
- Assembled a **bluetooth-controlled robot** and applied differential-drive mechanism for optimum control *('19)*
- Developed **Xylobands** to represent the robotics club in the Institute Technical Orientation for the freshmen batch *('19)*

Scholastic and Technical Achievements

- Acquired **N5** level of certification in the Japanese Language Proficiency Test (**JLPT**) *('23)*
- Conferred with the **Department Technical Excellence Award**, given annually to **1** in **400** students *('22)*
- Recipient of the Kishore Vaigyanik Protsahan Yojana (**KVPY**) Fellowship awarded by the Government of India *('18)*
- Secured **97.8 percentile** in JEE Advanced entrance examination among **0.15** million+ candidates *('18)*

Technical Proficiency

Languages	Python, C++, Matlab, OpenCL, Octave, Bash, CSS, Markdown, LaTeX
Softwares	Webots, Gazebo, CARLA, SUMO, OSM, Netedit, TraCI, Simulink, Auto-CAD
Frameworks/Libraries	ROS, Gym, PyTorch, Tensorflow, RLlib, JAX, Sockets, Optax, CV, Pygame
Electronics	Jetson Orin, Raspberry Pi, Arduino, Node MCU, ESP32

Leadership and Mentorship Roles

Team Leader | SeDriCa, UMIC *(May '21 - May '22)*

Led a 26-member team representing IIT Bombay at the International Ground Vehicle Competition

- Managed operations, finances, logistics and knowledge-transfer in a **4-tier**, **multi-disciplinary** student technical team
- Setting vision and strategy for the mechatronics subsystem | Spearheaded exploration of **RL-based control** methods
- Organized regular meetings between the PiC and students to keep all the tasks up-to-date and synchronized
- Raised **Rs 3.5 M** from IITB and Mahindra RISE, and forged relations with multiple academic and industry experts

Teaching Assistant | MA108 Differential Equations *(Spring '22)*

- Conducted regular tutorial sessions to clear doubts, solve questions and mentor over **40** first-year undergrad students
- Explained advanced topics beyond the prescribed curriculum (like Bessel functions), aligning with the batch's major

Technical Head | Inter-IIT Tech Meet 9.0 *(Jan '21 - Mar '21)*

Part of a 50-member strong contingent working on 10 projects of medium and high-level difficulties

- Conducted **40+** stringent interviews for selecting contingent managers, project leads, sponsors and financial advisors
- Mentored all project teams, providing actionable **feedback** on the reports, presentation, and content delivery
- Provided critical technical support for resolving the issues in docker, ROS, gazebo, and integration in various projects

Convener | Electronic and Robotics Club, Institute Technical Council *(May '19 - Apr '20)*

Part of a 15+ member team that conceptualizes and organizes events for tech enthusiasts in the Institute

- Hosted a widely-attended **ROS workshop** aimed at beginners during the COVID, drawing over **300 tech enthusiasts**
- Spearheaded XLR8, handling **600+** participants (up **30%**), achieving highest bot-completion rate (**92%**) in four years
- Conducted tutorial sessions on Arduino, Raspberry Pi, Image Processing, and **Serial Communication Protocols**
- Ideated and conducted '**Jhatka GC**,' an electronics and robotics puzzles-based inter-hostel championship

Key Courses Undertaken

Computer Science	Foundation of Intelligent & Learning agents (RL), Artificial Intelligence and Machine Learning, Deep Learning Specialization, Introduction to Machine Learning, Automatic Speech Recognition, Computer Programming and Utilisation
Controls and Robotics	Motion Planning & Coordination of Autonomous Vehicles, Linear and Non-linear systems, Introduction to Robotics, Intelligent Feedback & control systems, Adaptive Control theory, Linear Algebra, Differential Equations, ROS: Localization, Navigation and SLAM, High Performance Scientific Computing
Electrical	Probability and Random Processes, Power Electronics, Signal Processing
Interdisciplinary	Calculus, Differential Equations, Quantum Physics, Psychology, Economics

Extracurriculars

Sports	• Participated in Annual Tokyo Midtown **Futsal** Tournament 2023, representing Honda • Secured **1st place** in the Institute's annual inter-hostel football & cricket tournaments 2021 • Represented IITB in Football, Cricket and Athletics at the **Annual Training Camp** 2019
Volunteering	• Served as an **NCC cadet** in the 2-Maharashtra Engineering Regiment, 2018-19 contingent • Selected as cadet for the **Republic Day Parade** '19; awarded with NCC ATC certificate • Counseled students from local municipal schools for IITB's **Career Counseling Campaign**
Miscellaneous	• Attended Enhanced Safety of Vehicles Conference (**ESV**) 2023 through Honda R&D • Bagged **1st position** in the **Logic GC** organized by the Maths and Physics Club of IITB • Awarded **Hostel Technical Special Mention** for exemplary contribution to institute tech