Shivam Sood

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shivamsood2000@gmail.com to-the-abyss Shivam Sood

Education

Indian Institute of Technology Kharagpur — West Bengal, India
Major : Mechanical Engineering - GPA : 8.56 — Jul 2019 - Apr 2024 (Expected)

Bhupendra International Public School — Patiala, India
High School : 91.8%, Secondary School - GPA : 10.0 — Apr 2019

Research Interests

Legged Robotics || Reinforcement Learning || Motion Control || Autonomous Vehicles

Publications

[1] Force control for Robust Quadruped Locomotion: A Linear Policy Approach

Under Review at **ICRA 2023**

- Developed a novel action space for a computationally inexpensive linear policy-based force control for a quadruped
- Used modified PGPE for learning action space in < 30 minutes and deployed it using Raspberry Pi 3 alone

[2] Multiple Waypoint Navigation in Unknown Indoor Environments

Accepted at **ICCR 2022** [link]

- Proposed probabilistic path planner with integrated adaptive MPC stack for efficient multiple-waypoint navigation

Experience

Stochastic Robotics Lab — IISc Bangalore
Summer Research Intern — May 2022 – Present

- Implemented a modified motion imitation algorithm by training a linear reinforcement learning policy on hardware
- Benchmarked high-level optimal control algorithms on a quadruped robot (Stoch3) for various gait configurations
- Developed ROS-based lower level position and force control for the quadruped robot running on Raspberry Pi 3

Autonomous Ground Vehicle Research Group — IIT Kharagpur
Undergraduate Researcher — Mar 2020 – Present

- Developed an adaptive weight Model Predictive Control algorithm with practical and computational optimizations
- Benchmarked and tested various Control algorithms such as Stanley, Pure Pursuit, LQR, MPC, and NMPC
- Led the development of MPC-based reactive planning for navigation stack of the ICRA F1Tenth Challenge 2022

Vecros Technologies Private Limited — New Delhi, India
Robotics Software Development Intern — Nov 2021 – Jan 2022

- Implemented Dijkstra-based path planning algorithm for a multi-agent system of drones in a 3D weighted grid
- Deployed YOLO algorithm on RealSense cameras with integrated Kalman Filtering for trajectory detection of a car

Projects and Competitions

Quadruped Locomotion using Reinforcement Learning — IISc Bangalore
Guide : Prof Shishir N. Y. Kolathaya — Jul 2022 – Present

- Trained a linear reinforcement learning policy for force control and shifts in leg trajectory using modified PGPE
- Achieved trotting on rough terrains using domain randomization and zero-shot generalization to velocity commands
- Worked on a novel action space consisting of foot trajectory parameters and the desired wrench on the body
- Used a QP formulation to convert and distribute the wrench into desired ground reaction forces among the legs

MPC Based Control of a Quadruped Robot — IISc Bangalore
Guide : Prof Shishir N. Y. Kolathaya — May 2022 – Jul 2022

- Applied a Representation Free MPC to realize stable trajectory tracking on the quadruped robot Stoch3
- Implemented a Finite State Machine for various gait configurations involving trotting, crawling, and bounding
- Worked on the lower level motor control for swing and stance legs calculating the feedback and feedforward torques

DRDO UAV-Guided UGV Navigation Challenge — DRDO & IIT Kharagpur
Inter IIT Tech Meet 10.0 [Presentation] — Mar 2022

- Implemented NMPC control for an unmanned snow clearing ground vehicle on mountains with steep slopes
- Optimised tree-based UAV planner for precise motion control and next waypoint prediction of unmanned UGV
- Developed RGBD normal estimation and plane segmentation for road detection in snowy mountain conditions

Navigation and Manipulation in Unknown Environments — Prague, Czech Republic
IROS-RSJ Navigation and Manipulation Challenge 2021 [Link] — Jul 2021 – Sep 2021

- Worked on the mathematical and simulation aspects of robust control algorithms of a differential drive robot
- Implemented MPC algorithm with optimizations including adaptive tuning and an adaptive path resolution
- Integrated global and local planning modules for TiaGO Base bot to traverse multiple waypoints in shortest time

Unmanned Rover for Astronaut Assistance — IIT Kharagpur
University Rover Challenge 2022 — Guide : Prof Debashish Chakravarty — Mar 2020 – Dec 2021

- Developed the chassis and a rocker-bogie suspension system for rover prototype for the University Rover Challenge
- Performed static and dynamic simulations of the rover to optimize for load carrying, gradeability, and handling

Garage Door Synthesis — IIT Kharagpur
Term Project for Mechanism Sessional Course [Presentation] — Apr 2021

- Developed 4-bar mechanism based garage door using a 2-position synthesis procedure optimizing space constraints
- Performed motion and displacement analysis of the mechanism for multiple iterations to achieve smoother motion

Achievements

COMPETITIONS

2022	**Quarter Finalist**, in ICRA F1Tenth Challenge [Results : Team AGV]	Philadelphia, PA
2022	**Winner**, in Inter IIT Tech Meet 10.0 [Certificate]	DRDO/IIT Kharagpur
2021	**Winner**, in IROS Navigation and Manipulation Challenge [Certificate]	Prague, Czech Republic

ACADEMIC ACHIEVEMENTS

2019	**Ranked in Top 0.2%**, out of 1.3 million candidates	JEE (Main) 2019

Technical Skills

Languages	C, C++, Python, MATLAB, AVR (Assembly), Arduino, HTML, CSS, LaTeX
Libraries	SciPy, NumPy, qpSWIFT, CasADi, OpenAI/Gym, Pytorch, Matplotlib
Frameworks/CAD	Git, ROS1, ROS2, MavROS, ArduPilot, Mission Planner, Solidworks, Ansys
Simulation/Miscellaneous	Gazebo, Rviz, Webots,LTSpice, Adobe Photoshop, Adobe Premiere Pro

Relevant Coursework

* indicates MOOC

Software	Deep Learning*, Soft Computing, Operations Research, Programming and Data Structures
Robotics	Control of Mobile Robots*, Reinforcement Learning*, Controls Bootcamp*
Mechatronics	Kinematics and Dynamics of Machines, Basic Electronics, Rapid Prototyping

Position of Responsibility

Autonomous Robotics Mentor — IIT Kharagpur
IEEE Winter School of Robotics [Certificate] — Mar 2021

- Mentored a batch of 100+ students, focusing on various aspects of robotics including micro-controllers, AVR programming, sensor integration, basic algorithms for control of mobile robots, and Robot Operating System

Freshmen Mentor — IIT Kharagpur
Student Welfare Group [Certificate] — May 2021 – Present

- Mentoring 5 junior students of my department throughout their college life for their general and academic doubts

Extracurriculars

National Cadet Corps - Participated in parades, blood-donation camps, marathons and arms training
Football - Represented my hall at the Inter-hall Football Championship 2022 among 21 participating halls.