Jaskaran Singh Sodhi

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Education

Indian Institute of Technology Kharagpur West Bengal, India

Major : B.Tech. Manufacturing Science and Engineering (Mechanical Engineering Dept.) Jul 2019 - Apr 2023
Minor : Computer Science and Engineering **Specialization** : Embedded Control & Software Design
GPA : 9.19/10 – **Ranked 1st in Major**, out of 31 students

Publications

[1] S. Sood, **J. S. Sodhi**, P. Maheshwari, K. Uppal, D. Chakravarty, **"Multiple Waypoint Navigation in Unknown Indoor Environments"**, 2022 International Conference on Control and Robotics, ICCR [arXiv]

Experience

Autonomous Mobile Robotics Laboratory UT Austin
Guide : Prof Joydeep Biswas Sep 2021 – Present

- Extended MPC-MPNet architecture to kinematically constrained local planning in indoor cluttered scenarios.
- Developed I-RRT* global planner for non-holonomic constraints and achieved 900Hz average planning frequency.
- Exploring transformer-based approaches for intelligent tree expansion for local planning in cluttered environments.

Autonomous Ground Vehicle Research Group IIT Kharagpur
Undergraduate Researcher [certificate] Mar 2020 – Present

- Benchmarked and tested various SLAM algorithms such as ICP, VINS-Fusion, ORBSLAM and LeGO-LOAM.
- Developed multi-LiDAR and GPS based localisation module for race cars in pre-mapped environment using ICP.

Preimage Bangalore, India
Computer Vision Intern Sep 2021 – Dec 2021

- Developed tracks-validation module for testing of feature matching pipeline for UAV-based offline 3D reconstruction
- Implemented adaptive inlier thresholds for homography-based feature matching and removed intrinsic dependency.

Vecros Technologies Private Limited New Delhi, India
Summer Robotics Intern [certificate] May 2021 – Jul 2021

- Implemented altitude planning and surface tracking algorithms on UAVs using one dimensional LiDAR scans.
- Developed depth mapping based obstacle avoidance and planning algorithms for UAVs in indoor environments.

Projects

Design of Low-Cost Manipulator and Quadruped Robot IIT Kharagpur
Guide : Prof Aditya Bandopadhyay Aug 2022 – Present

- Constructing a 3-DOF manipulator with modular end effectors with RGBD-based autonomous pick-and-place.
- Designing a leg mechanism with passive damping for an in-house developed inexpensive quadruped robot.

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

- Developed RGBD normal estimation and plane segmentation for road detection in snowy mountain conditions
- Optimised tree-based UAV planner for precise motion control and next waypoint prediction of unmanned UGV.

GPS Denied Localisation Pipeline for Autonomous Car IIT Kharagpur
Guide : Prof Debashish Chakravarty [GitHub] Aug 2020 – Feb 2022

- Implemented photometry based residual minimisation for stereo camera relocalization in LiDAR environments.
- Optimized translation error using Ceres Solver to **0.2-0.3m** on KITTI urban dataset, tested on Gaussian noise.

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

- Developed the wheel, chassis and suspension for rover prototype with 15 deg gradeability and max speed 20cm/s.
- Designed a 5-DOF modular robotic manipulator with 2-finger grip for semi-autonomous on-board equipment repair.

Racecar Localisation in Mapped Environment — Indiana Motor Speedway, Indiana
Indy Autonomous Challenge 2021 — Guide : Prof Sohel Anwar — May 2021 – Oct 2021

- Designed tightly/loosely coupled *high-speed localisation in mapped environment* and **reduced bank error to 0.1°.**
- Integrated the BVS sensor and testing stack for the Indy Autonomous Challenge 2021 IUPUI-IITKGP-USB team.

Navigation and Manipulation in Unknown Environments — Prague, Czech Republic
IROS-RSJ Navigation and Manipulation Challenge 2021 [Link] — 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 exploration.

Tightly Coupled Integration of GPS, INS and IRNSS — IIT Kharagpur
Guide : Prof Susmita Bhattacharya — Nov 2020 – Aug 2021

- Implemented tightly coupled integration of GPS and INS using Kalman Filter and simulating it on a UAV dataset.
- Integrated random walk based models to simulate real-time sensor noise and atmospheric signal attenuation.

DRDO DGRE's Vision Based Obstacle Avoidance Drone — DRDO & IIT Guwahati
Inter IIT Tech Meet 9.0 [Presentation] — Mar 2021

- Optimised contour detection and kmeans clustering algorithms for motion planning and obstacle avoidance.
- Integrated gbplanner and next-best-view planners with AruCo detection and landing in an FSM based model.

Achievements

INTERNATIONAL COMPETITIONS

2022	**Perception Lead**, in ICRA F1Tenth Autonomous Grand Prix (Quarterfinals)	Philadelphia, USA
2022	**Team Lead**, in University Rover Challenge	Utah, USA
2021	**Winner**, in IROS Navigation and Manipulation Challenge [certificate]	Prague, Czech Republic
2021	**Participant**, in Indy Autonomous Challenge	Indiana, USA

DOMESTIC COMPETITIONS

2022	**Winner**, in Inter IIT Tech Meet 10.0 [certificate]	DRDO/IIT Kharagpur
2021	**1st Runner Up**, in Inter IIT Tech Meet 9.0 [certificate]	DRDO/IIT Guwahati
2021	**Winner**, in Open IIT Data Analytics [certificate]	IIT Kharagpur
2021	**Finalist**, in Anadigix, Top 15 among 422 participants [certificate]	IIT Kharagpur

ACADEMIC ACHIEVEMENTS

2019	**Ranked in Top 0.28%**, out of 1.2 million candidates	JEE (Main) 2019

Technical Skills

Languages C, C++, Python, MATLAB || **Frameworks** ROS, ArduPilot, RealSense, Webots, Atmel Studio
Libraries OpenCV, Open3D, OpenMP, PCL, Ceres, Eigen, Keras, Arduino, multiprocessing, dronekit
CAD/CAE Simulink, Solidworks, ANSYS Static Structural, ADAMS, Altair Suite, LTSpice
Simulation CARLA, gazebo, Mission Planner, LGSVL || **Other Languages** AVR, HTML, CSS, LaTeX

Relevant Coursework

* indicates MOOC

Software Systems & Control, Deep Learning*, Soft Computing, Introduction to OpenMP*, Data Structures
Robotics Control of Mobile Robots*, Image Processing, Introduction to Computer Vision*, Soft Computing
Mechatronics Fundamentals of Embedded Control and Software, Principles of Automotive Dynamics & Control

Teaching Experience

Computer Vision Mentor — IIT Kharagpur
IEEE Winter Workshop [certificate] — Mar 2021

- Mentored 160+ first-year students in by teaching them about Image Processing and Computer Vision algorithms.

Extracurriculars

Governor and Actor - English Dramatics Society, IIT Kharagpur **Quizzing** - National Semi-Finalist, 2017
Volunteer - NSS, IIT Kharagpur (2019-21), TYCIA Foundation (2018) **Debating** - Delhi State Winner, 2017