Sri Aditya Deevi

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Education

California Institute of Technology *(Sept '22 - Jul '23)*
M.S. Electrical Engineering CGPA: **4.3/4.3**
Master's Research Title: RGB-X Object Detection via Scene-Specific Fusion Modules [Link]

Indian Institute of Space Science and Technology (IIST) *(Aug '18 - Jun '22)*
B.Tech Electronics & Communication Engineering CGPA: **9.60/10**, Batch Rank: **1st**/140
Undergraduate Thesis Title: Autonomous Robotic Grasping [Link]

Key Publications

Sri Aditya Deevi, Connor Lee, Lu Gan, Sushruth Nagesh, Gaurav Pandey, and Soon-Jo Chung. "*RGB-X Object Detection via Scene-Specific Fusion Modules.*" In Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (**WACV**), Waikoloa, Hawaii, United States, pp. 7366-7375. 2024. [Link]

- Addressed the challenge of enabling autonomous vehicles to visually understand their surroundings in all weather conditions by developing effective multimodal deep sensor fusion methods for object detection, guided by Dr. Lu Gan and Prof. Soon-Jo Chung of Caltech.
- Developed an efficient RGB-X fusion network that fuses pretrained single-modal models using lightweight, scene-specific convolutional attention-based fusion modules. It outperformed state-of-the-art methods on benchmark RGB-thermal and RGB-gated datasets, achieving mean Average Precision (IoU=0.5) scores >81%.
- The proposed approach yielded comparable results with 75% less coregistered training data, reducing fusion training time and dependence on hard-to-obtain multimodal, co-registered datasets.

Sri Aditya Deevi, and Deepak Mishra. "*Expeditious Object Pose Estimation for Autonomous Robotic Grasping.*" In International Conference on Computer Vision and Image Processing, pp. 15-30. **Springer Nature** Switzerland, 2022. [Link]

- Spearheaded the research for improving object Pose Estimation techniques using Deep Learning for Autonomous Robotic Grasping in cluttered scenes under the guidance of Prof. Deepak Mishra from IIST.
- Designed a series of neural network-based pose estimation models without post-refinement stages, for estimating the 6D pose of an object, using only a single RGB image. The best-performing model achieved high Average Distance (ADD) metric scores >93% for objects tested in the benchmark *LINEMOD* dataset.
- Implemented an end-to-end object Pose Estimation pipeline using Unity and ROS Noetic. The developed pose estimation models were deployed in a simulated pick-and-place task utilizing a *UR3* robotic arm.

Suraj Kumar, **Sri Aditya Deevi**, Aditya Rallapalli, and Bharat Kumar G V P. "*Adaptive Q-law Control for Closed-loop Electric Propulsion Orbit Transfer.*" (Accepted in 2026 American Institute of Aeronautics and Astronautics (AIAA) Scitech Forum, Orlando, Florida, United States)

- Proposed an adaptive approach consisting of a Lyapunov-based modification to the classical Q-law controller for low-thrust, many-revolution orbit transfers ensuring closed-loop stability and real-time onboard implementability as part of GNC development for ISRO's All Electric Propulsion System mission.
- Designed a two-stage, simulation-based hybrid optimization framework to train state- and time-dependent Q-law control gains parameterized by a neural network for minimum-time orbit transfers.
- For sub GTO-GEO orbit transfer, achieved a $\sim 90\%$ reduction in transfer-time variability, cut maximum transfer duration by nearly 30 days—substantially lowering operational costs—and enhanced adaptivity for robust, efficient trajectory planning under practical uncertainties, advancing autonomous low-thrust guidance.

Ravi Kumar L, Samuel Lakkoju, Bhanu Kartikeyan, **Sri Aditya Deevi**, Aakash Chaudhary, Murali Krishna Bhagavan G and Sudhakar S. "*High Fidelity Hardware-in-Loop Simulation of Autonomous Spacecraft Rendezvous and Docking using Dual-Robot Platform on Track.*" (Submitted in 2025 International Conference on Space Robotics (iSpaRo), Sendai, Japan)

- Established a high-fidelity hardware-in-the-loop facility, Rendezvous Simulation Laboratory (RSL), with dual 6-DoF robotic manipulators on an 18 m track to emulate autonomous spacecraft rendezvous and docking.
- Demonstrated sub-millimetre positioning accuracy and robust soft-docking in closed-loop tests under varying approach trajectories, lighting conditions, and communication delays.
- Validated NGC algorithms for proximity operations in ISRO's SPADEX (SPAce Docking EXperiment) mission through exhaustive ground verification and proposed extensions to RSL for future docking and on-orbit servicing missions.

Research Internships

Atmospheric Parameter Forecasting for Optical Channel Characterization *(Aug '23 - Nov '23)*
Guide: Dr. Sabino Piazzolla, **Jet Propulsion Laboratory (JPL)**, **Caltech**, **Pasadena**

- Spearheaded research in the *Optical Communication Systems* group to forecast key atmospheric parameters like temperature, pressure, windspeed, humidity & turbulence, critical for optical channel characterisation.
- Proposed effective neural network architectures resulting in significant improvements in sequence forecasting and nowcasting accuracy, achieving up to 25% reduction in prediction errors.
- The developed methods were evaluated using graphical plots, numerical metrics, and Shapley value explanations. The best performing models are deployed for live forecasting at the JPL weather stations located at *Goldstone* and *Table Mountain Facility (TMF)*.

Anomaly Detection in Satellite Telemetry Data *(May '20 - Aug '20)*
Guides: Sharvari Gundawar & Nitish Kumar, Scientists, **U.R. Rao Satellite Centre**, **ISRO**, Bengaluru

- Contributed to the *Integrated System Health Management for Power Systems (ISHM)* project, focusing on Phase-II: Fault Detection, by developing advanced anomaly detection techniques.
- Developed a robust Anomaly Detection system, integrating LSTM-based Nominal Behavior Modeling and Non-parametric Dynamic Error Thresholding blocks, to identify potential anomalies in satellite telemetry.
- Tested the designed anomaly detection pipeline on two datasets of Power Systems parameters in Satellite Telemetry Data, demonstrating its effectiveness and showcasing its applicability to space subsystems.

Work Experience

Scientist/Engineer 'SC' @ Mission Simulation Group *(Apr '24 - Present)*
U.R. Rao Satellite Centre, **ISRO**, Bengaluru

- Actively contributing to ISRO's Cooperative (SPADEX) & Non-Cooperative Docking Missions, Electric Propulsion Mission, Human Spaceflight Mission, Indian Space Station Mission, and Mars Landing Mission.
- Addressing diverse AI and robotics research challenges in aerospace systems by being engaged in notable technology demonstration projects such as pose estimation and tracking of uncooperative spacecraft using monocular images & point-cloud data, and autonomous navigation & mobile manipulation for rovers.
- Spearheading augmentations to the *Rendezvous Simulation Laboratory (RSL)*, including a high-precision motion-capture system (0.1 mm, 0.1 degree), a laser diode motion simulator for extended docking-sensor test range, contact dynamics simulation, and a gravity-offloading system.

Scholastic Achievements

- Achieved a perfect 4.3 CGPA while earning a Master of Science in Electrical Engineering from Caltech.
- Won the Innovative Student Projects Award 2022 and inducted as a student member by *Indian National Academy of Engineering (INAE)* for my undergraduate thesis titled "*Autonomous Robotic Grasping*".
- Received Institute Gold Medal of Academic Excellence (Undergraduate) from IIST.
- Secured the highly competitive *Dr. Satish Dhawan Fellowship* from the *Department of Space*, Government of India, earning a fully funded opportunity to pursue a Masters program at the prestigious Caltech.
- Received the *Department of Space (DoS)* Semester Fee Financial Assistance and Book Grant for Academic Excellence for all semesters during undergraduate studies.
- Scored the highest marks in my institution in the *Telangana State Board Intermediate Examination*.
- 5 times winner of annual proficiency prize for best academic performance in school, 2011-2016.

Undergraduate Thesis Project

Autonomous Robotic Grasping *(Jan '22 - May '22)*
Guide: Dr. Deepak Mishra, Indian Institute of Space Science and Technology, Thiruvananthapuram [Link]

- Devised solutions for two intelligent robotics tasks, "Grasping Various Objects in Diverse Environments" and "Dynamic Grasping of Moving Objects", using *UR5* and *Panda* robotic arms in simulation scenes.
- In Task I, various Deep Reinforcement Learning techniques were developed. Using an advanced DNN architecture *O-AHRNet* designed for feature extraction, the agent was able to achieve more than 87% success rate for grasping novel objects in random scenes.
- For Task II, Deep Learning techniques were developed that integrated an LSTM model into the dynamic grasping pipeline, achieving an average success rate of over 75% for grasping objects in sinusoidal motion.
- Created a real world robotic setup for pick and place using a *Kinova Jaco Gen2* robotic arm.

Other Key Projects

Monocular Pose Estimation of Noncooperative Spacecraft *(May '24 - Present)*
Work Project | U.R. Rao Satellite Centre, ISRO
Supervisor: Dr. L. Ravi Kumar, Group Director, Mission Simulation Group

- Problem statement is to develop a highly accurate method for estimating pose of a known but noncooperative spacecraft during rendezvous operations, using a single grayscale image.
- Created a synthetic data generation pipeline in Blender for a pose estimation dataset with grayscale images and ground truth poses of an ISRO satellite. Crafted a high-fidelity Unreal Engine scene featuring Earth, Sun, and Satellite with reflective materials, enabling generation of more realistic datasets for future research.
- Developed a correspondence-based method using object detection, landmark regression, and iterative pose refinement using Perspective-n-Point (PnP) algorithm. Achieved an average translation error of 1.5 cm and an average orientation error of 0.2 degrees on the test dataset.
- Ported the pose estimation pipeline to a NVIDIA Jetson Orin board for edge inference. The plan involves interfacing the board with a camera to perform a real-time, end-to-end demonstration of satellite pose estimation using a physical satellite model, with inference executed directly on the Jetson.

Autonomous Rover Navigation and Mobile Manipulation *(Aug '24 - Present)*
Work Project | U.R. Rao Satellite Centre, ISRO
Supervisor: Dr. L. Ravi Kumar, Group Director, Mission Simulation Group

- This project is aimed at developing navigation and manipulation algorithms for extra-terrestrial rovers.
- Assisted in building of a planetary-analogue rover with rocker-bogie equipped with wheel encoders, an IMU, an OAK-D navigation camera, a monocular manipulation camera, and a 5-DoF robotic arm.
- Demonstrated capabilities by preliminary indoor-lab demonstrations: autonomous navigation to a user-defined point with obstacle avoidance, pick-and-place of identified object, and Vision SLAM.
- Focused in improving the existing performance of the rover and exploring image-goal-based navigation. This research has promising applications in planetary missions, where a drone can capture images of a potential science site, enabling the rover to use those images as targets for autonomous navigation, performing tasks like sample collection and in-situ analysis.

Adaptive Learning-Based Analytical Guidance for Quasi-Optimal Planetary Powered Descent
Work Project | U.R. Rao Satellite Centre, ISRO *(Aug '25 - Present)*
Supervisor: Suraj Kumar, Mission Simulation Group

- Problem statement is to develop an adaptive learning-based analytical guidance framework for planetary powered descent, aiming for quasi-optimal, fuel efficient landings under strict state and action constraints.
- Building a pipeline where a neural network parametrizes feedback gains and time-to-go as a function of state and time, trained using evolutionary optimization on 3-DoF simulations to enable real-time, lightweight onboard implementation.

Non-Holonomic Mobile Robots: RRT with Dynamic Replanning and Obstacle Mapping
Academic Project | Courses: Robotics II (Planning and Navigation) & Mobile Robots *(Feb '23 - Jun '23)*
Guide: Dr. Gunter Niemeyer, Caltech, Pasadena [Link-1, Link-2]

- A RRT motion planner for non-holonomic wheeled systems was implemented, utilizing CSC (Curve-Straight Line-Curve) notion of distance, and a post-processing function to enhance path smoothness.
- The planner efficiently and effectively plans through a map and navigates obstacles in various scenarios, including narrow garages, parallel parking, and narrow streets, achieving a 100% success rate in most cases.
- This algorithm was also tested on a real mobile robot (Raspberry Pi based) equipped with ROS.
- Functionalities such as Global Localization using Particle Filter, Path Tracking with PID, and Dynamic Replanning after mapping new obstacles are incorporated so that the robot can drive like a car autonomously while locally localizing itself.

Self Untangling Robotic Snake Arm with Dynamic Obstacle Avoidance *(Nov '22 - Dec '22)*
Academic Project | Course: Robotics I (Robot Kinematics and Dynamics) [Link]
Guide: Dr. Gunter Niemeyer, Caltech, Pasadena

- Implemented effective methods for a robotic snake arm to perform tasks like obstacle avoidance, touching a random target with correct gripper orientation, and untangling itself if entangled in a knot.
- For this problem, we considered a simulated environment in ROS2 with vertically falling obstacles.

Technical Skills

Programming: Python, MATLAB, C++, C, SPICE, Verilog
Software Packages: PyTorch, OpenCV, Kornia, Stable Baselines, Captum
Frameworks: ROS, LaTeX, Git, Blender, Unity3D, Unreal Engine, Docker, Wireshark

Relevant Coursework

Graduate:- Large Language and Vision Models • Mobile Robots • Statistical Inference • Robotics I (Robot Kinematics and Dynamics) • Robotics II (Planning and Navigation) • Machine Learning and Data Mining • Stochastic and Adaptive Signal Processing

Undergraduate:- Machine Learning for Signal Processing • Navigation Systems and Sensors • Deep Learning for Computational Data Science • Advanced Sensors and Interface Electronics • Satellite and Optical Communication • Information Theory and Coding

Conferences, Workshops and Certifications

- Nominated by U.R. Rao Satellite Centre to attend the Tutorial Workshop on *Advanced Guidance, Control and State Estimation for Aerospace Vehicles and Autonomous Systems* held at IISc Bengaluru (2025).
- Presented our paper, "Laser Diode Motion Simulator: Extending the capabilities of Hardware-in-Loop Space Rendezvous Testing", at the *Advances in Robotics (AIR) 2025* conference organized by IIT Jodhpur (2025).
- Participated in the *Training Programme on Advanced Topics in Robotics* and led our team to a runner-up finish by designing robust architectures for extraterrestrial surface navigation (2025).
- Underwent training about various aspects of the Indian Space Programme in ISRO Induction Program (2024).
- Won the AI/ML challenge organized at U.R. Rao Satellite Centre, competing with over 250 scientists, and participated in a 3-day technical workshop on cutting-edge AI applications (2024).
- Participated in the *AGI Leap Summit* organized by SuperAGI and presented our paper, "RGB-X Object Detection via Scene-Specific Fusion Modules," in the AI Applications and Survey track (2024).
- Received certification on "*Integrated Design of Space Vehicles*" by successfully completing the course offered by Dr. B. N. Suresh, Chancellor, IIST (2022).

Co-Curricular Activities

- Presented interactive demos explaining our group's work to school students on *National Space Day* (2024).
- Worked as an undergraduate teaching assistant for the *AVD 624 : Computer Vision* course at IIST (2021).
- Participated in Annual Cultural Fest *Dhanak* and Annual Technical Fest *Conscientia* at IIST (2019).
- Secured first Place in Annual Inter house Sports Meet for Table Tennis at IIST (2019).