

# Sriram Priyadharshan

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## EDUCATION

- **University of Michigan**, Ann Arbor, MI Aug. 2022 - May 2024  
*Master of Science in Robotics* **GPA: 3.69/4.0**  
**Relevant coursework:** (AERO 584) Navigation and Guidance: From perception to control, (ROB 599) Deep Learning, (ROB 535) Self-Driving Cars, (ROB 498) Robot Learning, (ROB 530) Mobile Robotics.
- **SRM Institute of Science and Technology**, India Jul. 2018 - May 2022  
*Bachelor of Technology in Electronics and Communication Engineering, Instrumentation* **GPA: 3.68/4.0**  
**Relevant coursework:** Calculus And Linear Algebra, Probability And Stochastic Process, Engineering Graphics And Design, Control Systems, Computer vision, Data Analysis, IOT In Process Instrumentation And Automation

## TECHNICAL SKILLS

- **Languages :** Python (PyTorch, Pybullet, TensorFlow, Pandas, Scikit-Learn, Caffe, Numpy, OpenCV, Scipy), C/C++(GTSAM, G2o, Eigen, PCL, DBoW2), Bash, MATLAB, HTML, CSS, JavaScript.
- **Framework/Tools :** ROS, ROS2, Moveit, Opti-track(Motive), VICON, LCM, CUDA, Docker, Git, Gazebo, Linux, AutoCAD, Scilab, Simulink, CoppeliaSim.
- **Skills :** Robot Perception and Navigation, Computer Vision, Deep Learning, Machine Learning, Sensor Fusion, Simultaneous Localization and Mapping, Robot Kinematics, Robot control and planning, Adaptive Control, Motion planning, Hardware and Software Integration, System design, Automation.

## RESEARCH EXPERIENCE

- **FLUENT Robotics Lab** University of Michigan  
*Research Assistant, Mentor: Dr. Christoforos Mavrogiannis* Sep 2023 - Ongoing
  - Modelling predictive algorithms than can infer human helpfulness towards robots in social spaces, with the goal of enabling safe and intelligent **Human-Robot Interactions**.
  - Contributed to the **system-level** software development of the perception and navigation system for the **Stretch RE2 robot**. Extensively tested visual and visual-inertial SLAM algorithms on the robots hardware, evaluating state-estimation accuracy and realtime-performance with the **Vicon Motion Capture system**.
  - Incorporated key perception capabilities such as **Human Action Recognition**, **Pose estimation**, with a **Visual SLAM** system using RTABmap and **Move-Base** for motion planning as part of the indoor navigation stack.
- **Biologically Inspired Robotics and Dynamical Systems Lab** University of Michigan  
*Research Assistant, Mentor: Dr. Shai Revzen* May 2023 - Jan 2024
  - Developed a perception and navigation software stack for a **hexapedal Dandelion picking robot** based on the **BigAnt** platform, using an **Intel realsense L515** camera to detect, track and create a map of dandelions.
  - Built a computer vision pipeline to detect and segment semantic masks of dandelions and integrated a 3D LiDAR SLAM system for robot pose estimation while mapping an unknown space with dandelions.
- **Distributed Aerospace Systems and Control Laboratory** University of Michigan  
*Research Assistant, Mentor: Dr. Dimitria Panagou* Jan 2023 - Apr 2023
  - Formulated a continuous **self-triggered control** strategy leveraging **Control Barrier Functions** (CBF) and **Control Lyapunov Functions** (CLF) to ensure real-time implementation on digital platforms with discrete time updates.
  - Designed Self-triggered **Exponential-CBF** controller that uses **Quadratic Program** (QP) optimization applied in **Zero-Order Hold** manner while introducing a notion of safe period for Higher order systems, resulting in safety and stability in safety-critical applications, overcoming the limitations of periodic controllers.

## PROFESSIONAL EXPERIENCE

- **Syrma SGS** Chennai, India  
*Summer Intern* Feb 2021 - May 2021
  - Conceptualized an **autonomous ultrasonic welding** system to enhance production yield and automate hazardous manual welding operations, mitigating accidents and physical risks to humans in RFID-tag production line
  - Fabricated a **ROS** simulation of the autonomous welding system with a **7-DOF franka panda** arm manipulator, in **Gazebo**, and incorporated teach and repeat waypoint navigation for assembly line welding operations, yielding a boost of up to **98.8%** compared to the manual tag welding operations.

## PROJECTS

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- **3D Lidar SLAM** Jun 2023 - Dec 2023
  - Engineered a 3D-LIDAR slam system for indoor navigation with an absolute RMSE error of **0.028m**. Key features included real-time odometry estimation, AprilTag-based loop closure detection, and geometric consistency verification.
  - Showcased features such as edge and surface identification, local map update, and odometry estimation, achieved through optimization based on the **Ceres Solver**. Additionally, a pose graph-based global map optimization framework was implemented, leveraging the **Levenberg-Marquardt solver**. **Link**
- **Autonomous Warehouse Robot** Aug 2023 - Sep 2023
  - Led the design and development of a 2 wheeled differential drive robot based on the **Mbot** platform capable of independently localizing, mapping, and navigating unknown spaces for pick-and-place tasks.
  - Deployed an autonomy stack using a **Kalman filter**-based **PID** controller for precise odometry, **AMCL** for localization, 2D grid mapping using **RP Lidar**, motion control algorithms, frontier exploration, and **A\*** path planning. **Link**
- **PrecisionStack: 5DOF Robotic Arm for Visual Object Manipulation.** Oct 2023 - Nov 2023
  - Spearheaded the development of a robotic arm based on the **Interbotix RX200** platform, with a RGBD camera in a checkered, marker-laden workspace to showcase precise, intelligent manipulation capabilities.
  - Implemented a block detection and tracking algorithm using real-time RGBD data, to differentiate and monitor object positions and orientations for dynamic scene understanding and tracking.
  - Incorporated a Forward Kinematics (FK) and Inverse Kinematics (IK) in the project framework, intricately tying them to the trajectory and motion planning of the arm, enabling it to execute complex tasks. **Link**
- **Shakespeare GPT** Apr 2023 - May 2023
  - Programmed a **Generative Pretrained Transformer (GPT)** language model trained on a custom Tiny Shakespeare dataset, employing attention mechanisms, tokenization strategies to replicate Shakespearean language.
  - Experimented with different iterations of the model with variations in attention heads, sizes, layers, and dropout rates, resulting in a notable reduction in loss by **2.04%**, indicating enhanced model performance. **Link**
- **Advanced Control Systems for Autonomous Racing** Feb 2023 - Mar 2023
  - Tailored a control system in **MATLAB** for a self-driving car's navigation on a path filled with obstacles. Leveraged Proportional-Integral-Derivative (**PID**) control in conjunction with the Stanley algorithm to ensure precise track following.
  - Innovated a novel lane-switching method, enhancing the car's ability to navigate around obstacles efficiently. This approach led to the completion of the obstacle-laden track in just **7 minutes**.
- **Learning dynamics for robot planning and control using Neural ODE** Mar 2023 - Apr 2023
  - Developed a pushing dynamic model to train a robot that was simulated using **Pybullet** to push an object to a goal pose. A list of state action trajectories was collected from the **OpenAI-GYM** environment.
  - Implemented Neural ODE's on Residual dynamics learning method to learn the system's dynamics, and studied the performance of the model on the planar pushing task using various fixed step and adaptive step solvers.
  - Modelled an **MPPI** (Model predictive path integral) algorithm controller to plan a sequence of actions for a robot arm to push the block to reach the goal configuration.
- **Mask R-CNN Backbone and Optimization** Jan 2023 - Feb 2023
  - Improvised an in-depth implementation and assessment of the Mask R-CNN model utilizing **Pytorch**'s mask R-CNN and object detection framework for image instance segmentation
  - Explored various backbone architectures, such as **ResNet50** with a Feature Pyramid Network, **MobileNetV2**, **VGG16**, and **AlexNet**, in combination with different optimizer, to improve the model's performance.

## PUBLICATION

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- **IoT-based interactive stroke rehabilitation monitoring system** Nov 2021
  - S. Arjunan, S. Priyadharshan and V. K. S. Kumar, "IOT Based Stroke Rehabilitation Monitoring System," 2021 5th International Conference on Electrical, Electronics, Communication, Computer Technologies and Optimization Techniques (ICEECCOT), Mysuru, India, 2021, pp. 553-557, doi: 10.1109/ICEECCOT52851.2021.9707996. **Link**
- **Dandelion-Picking Legged Robot** To be updated on Feb 2024
  - <https://doi.org/10.48550/arXiv.2112.05383> **Link**

## AWARDS AND ACHIEVEMENTS

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- Won the **Best Project Award** at **Techknow-2019** First Edition, held at *SRMIST*, Chennai, India April 2019