Aarya Sumuk

+1-408-426-6961 | asumuk@stanford.edu
aarya-sumuk | aaryasum.github.io

EDUCATION

Stanford University *Expected June 2026*
Master of Science - *Robotics Track* GPA: 4.20*/4.00
Coursework: Principles of Robot Autonomy | Robot Perception | Deep Learning for Computer Vision

Indian Institute of Technology Madras *July 2024*
Bachelor of Technology in Mechanical Engineering CGPA: 9.34/10.00
Coursework: Mechatronics | Pattern Recognition and Machine Learning | Foundations of Data Science

PUBLICATIONS

1. **Sumuk A.**, Khan Q. "A Sensing Device For Real-Time Road Condition Monitoring". In 2023 IEEE Asia Pacific Conference On Postgraduate Research In Microelectronics And Electronics ,India, Nov 2023.
2. **Sumuk A.**, Martinez K. B., Rouhani H. "3D Modelling of Human Hand Using Instrumented Gloves". In 2023 Annual Alberta Biomedical Engineering Conference, Banff, Canada, Oct 2023.

RESEARCH EXPERIENCE AND PROJECTS

Bimanual Robotic Assembly with Contact-Rich Manipulation *Stanford, USA*
Interactive Perception and Robot Learning Lab (IPRL), *Prof. Jeannette Bohg* *May 2025 – Present*
- Built full **teleoperation + data pipeline** for dual Franka arms using **Oculus** and a custom **OSC controller**
- Implemented self and **dual-arm collision avoidance strategies** for safe, reactive bimanual motion
- Trained and deployed **diffusion**, **SERL** and **HIL-SERL** policies for contact-rich assembly
- Investigating **NIST board tasks** with IL + residual RL using **force cues and active perception**

Learning Actionable Affordances from Pairwise Human Preferences *Stanford, USA*
CS329H Machine Learning from Human Preferences, *Prof. Sanmi Koyejo* *Oct 2025 – Present*
- Collected **pairwise human graspability preferences** over local image patches for supervision
- Learned a **Bradley–Terry preference model** on frozen **DINOv2** embeddings to re-rank visual features
- Produced dense **affordance heatmaps** that suppress visual saliency and highlight graspable regions

Real-Time 6D Pose Estimation for Robotic Assembly (LEGO Case Study) *Odense, Denmark*
Elite Robotics Summer School, University of Southern Denmark, *Prof. Henrik Gordonsson* *Aug 2025*
- Developed **6D pose estimation** pipelines using **YOLO + SAM**, **PnP + ICP**, and deep learning regression
- Trained a **ResNet regression network** on synthetic + real data with translation and rotation losses
- Achieved **30+ brick poses in <3s** with **1.2 cm error**, validated via **ADD/ADD-S** for robotic grasping

Lightweight 3D Inpainting for Cultural Heritage Restoration Using Diffusion Models *Stanford, USA*
CS231N Deep Learning for Computer Vision, *Prof. Fei Fei Li* *Apr 2025 - Jun 2025*
- Built a two-stage **vision pipeline** with **2D U-Net mask prediction** and **3D diffusion inpainting**
- Trained a **3D diffusion model** with composite losses (**BCE, L1, perceptual**) for geometry optimization
- Achieved **3× better Chamfer distance (0.0031)** and **55% higher F-score (0.846)**, with **PSNR = 27 dB**

Dexterous Manipulation and Perception with Stretch Robots *Stanford, USA*
CS225A Experimental Robotics, *Prof. Oussama Khatib* *May 2025 - Jun 2025*
- Programmed two **Hello Stretch robots** with **perception-based control** to cut and arrange dough on trays
- Designed **end-effector tools** and applied **SAM2 + Grounded DINO** for dough detection

Haptic Interface Design for Robot Proprioception and Control *Stanford, USA*
Collaborative Haptics and Robotics in Medicine Lab (CHARM), *Prof. Allison Okamura* *Sep 2024 – Apr 2025*
- Engineered a wearable **haptic feedback system** with dual linear actuators for **force and motion sensing**
- Developed real-time mapping from **IMU orientation** to actuator response for proprioceptive experiments
- Integrated **motion capture and flex sensors** to benchmark feedback accuracy and latency

RoboDelivery: A Q-Learning Approach to Autonomous Package Distribution *Stanford, USA*
- Implemented **Q-learning** with epsilon-greedy approach for **autonomous warehouse robot** navigation
- Developed a 500-state Markov Decision Process model for dynamic package pickup and delivery tasks

Frontier Explorer Robot: Autonomous Navigation and Mapping *Stanford, USA*

- Developed **frontier exploration** and **SLAM algorithms** for autonomous TurtleBot navigation using ROS2
- Implemented **A* and RRT* for path planning**, with **LQR gain scheduling** for trajectory optimization
- Applied **EKF for state estimation**, pose graph optimization for SLAM with **LiDAR**-based ICP mapping

Shoulder Exoskeleton for Rehabilitation *Chennai, INDIA*

Biomechatronics Neuroprosthetics and Exo (BioNEX), IIT Madras *Feb 2024 - May 2024*

- Developed a 2-DOF shoulder soft exoskeleton for **guided mobility** with malalignment compensation
- Engineered soft exoskeleton using **servo motors** and IMU with Bowden cable-driven **PID** control
- Demonstrated 26% faster target acquisition using MATLAB-based virtual targets with 5 participants

3D modeling of Instrumented Gloves for Sign Language Recognition *Edmonton, CANADA*

Neuromuscular Control & Biomechanics Laboratory, University of Alberta *May 2023 - Aug 2023*

- Innovated a sensor-equipped glove with real-time 3D modeling for **sign language recognition** for the deaf
- Designed a flex sensor, IMU, and **EMG-based glove** with ESP32 for wireless **MATLAB** joint angle tracking
- Simulated a real-time 3D hand model and validated glove accuracy using **VICON motion capture system**

Sensory Device for Real-time Road Condition Monitoring and Drive Assistance System *Chennai, INDIA*

Young Research Fellowship Program, Indian Institute of Technology Madras *Sep 2022 - Apr 2023*

- Invented a retrofit sensory device for **road anomaly detection** and traffic safety optimization
- Engineered an ESP32-based device with IMU and **ultrasonic sensors** for real-time wireless data sampling
- Developed a **threshold-based signal processing** for road anomaly classification and identification

TEACHING & LEADERSHIP

- TA for **Robots and Arts**, mentored interdisciplinary teams developing creative robotics projects
- **Lead TA** for **Principles of Robotic Autonomy I**, managed ROS2-based labs and mentored 200+ students
- TA for **Robot Dexterity**, supported **manipulation, impedance control, and tactile sensing** modules

TECHNICAL SKILLS

1. **Robotics Control:** ROS2, MuJoCo, Gazebo, Franka FR3; trained + deployed IL+RL policies on real robots
2. **Design Tools:** AutoCAD, Fusion 360, Eagle (PCB Design)
3. **Programming Languages:** Python, C/C++, Bash, Arduino IDE, ESP-IDF
4. **ML & Vision:** PyTorch, OpenCV, YOLO, SAM, Grounded DINO, Diffusion Models, SERL