Ayush Gaggar ("I-you-sh Guh-guh-r")

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Education

Northwestern University **2022 - 2027**
Ph.D. Candidate in Mechanical Engineering (Robotics) *Chicago, IL*

University of California, San Diego **2020 - 2022**
B.S. Mechanical Engineering, Minor in Entrepreneurship & Innovation *La Jolla, CA*

Professional Experience

Graduate Researcher, Northwestern University **Jan. 2023 – Present**
Todd Murphey Research Group *Evanston, IL*

- Actively researching data-driven improvements to visual perception, specifically in Neural Radiance Fields (NeRFs).
- Conducting research in Bayesian Neural Networks to incorporate uncertainty in machine learning in robotics.
- Previous research involved linear-complexity ergodic control and developing benchmark tests on the Franka 7DOF arm.
- Research interests include real-time control methods, active and embodied learning, and robotic perception, focusing on designing robot interactions with the environment to actively collect data in the most informative manner.

Undergraduate Researcher, University of California, San Diego **Jan. 2021 – Jun. 2022**
Bioinspired Robotics Design Lab *La Jolla, CA*

- Researched soft robotics under Dr. Mike Tolley for a squid-inspired robot propelled by differential body geometry.
- Optimized cam design for power performance by varying compression to coasting ratios using Arduino and MATLAB.
- Successfully tested displacement and velocity performance when varying cams in an underwater setting.

Mechanical/Thermal Engineering Intern **Jun. 2021 – Sep. 2022**
Advanced Micro Devices, Inc. (AMD) *Sunnyvale, CA*

- Designed a test fixture for EPYC server sockets to ensure pin connectivity remains within specification under static loading tests up to 50 kgf; socket models from 2019-2023 passed, providing empirical support for QA standards.
- Demonstrated proof of concept for retimer chip cooling assembly, which is used in several hundred servers internal to AMD. Involved developing bill of materials, cost justification, soldering, and mechanical clearance checks.
- Took initiative to prototype socket trays to expedite Genoa product launch, preventing failure of up to 50 sockets.

Publications

Under Review

[1] **Ayush Gaggar** and Todd Murphey. "Data Augmentation for NeRF in the Low Data Limit." *[Under Review]*, 2024.

[2] Muchen Sun, **Ayush Gaggar**, Peter Trautman, and Todd Murphey. "Fast Ergodic Search with Kernel Functions." *[Under Review]*, 2024.

Projects

EKF SLAM for Differential Drive Robot **Jan. 2023 - Mar. 2023**

- Implemented Extended Kalman Filter SLAM from scratch in ROS2 C++, using LiDAR data to localize a Turtlebot3.
- Integrated odometry readings, supervised and unsupervised learning from LiDAR data, and created a simulation environment in RViZ2 for the full functioning SLAM algorithm.

Robot Play: Don't Let the Balloon Touch the Ground **Nov. 2022 - Dec. 2022**

- Controlled a 7DOF Franka arm to track, predict, move to, and hit a balloon such that it would never hit the ground.
- Developed a ROS2 control system from scratch, including forward and inverse kinematics in cartesian and joint space.
- Employed a RealSense RGB-D camera to isolate the centroid of moving, red objects and forward predict its motion.

360° Scanning Sound Array **Jan. 2022 - Jun. 2022**

- Designed a novel testing apparatus to measure noise (dB and freq.) emitted by small-scale UAVs for industry sponsor ATA Inc. as a function of drone's 3DOF moment in 3D space, primarily for national defense interests.
- Primarily manufactured using manual and CNC mills and lathes, with FEA analysis for a 4.24 factor of safety.
- Implemented open loop motor control to determine microphones' spherical positioning with an accuracy of $\pm 0.015°$.

Technical Skills

Software: Python, C++, Robotics Operating System (ROS/ROS2), PyTorch, Jax, MATLAB, Linux, Git
Machine Learning: MLPs, Bayesian Neural Networks, Autoencoders, Decision Trees, Gaussian Processes
Design: Solidworks, Fusion 360 (CAD & CAM), Cura, Simulink, LTSpice
Fabrication: FDM 3D Printing, Mill, CNC, Soldering, Instron, Optical Scanner

Awards

Murphy Fellowship, *Northwestern University* **Sept. 2022**
Magna Cum Laude, *University of California, San Diego* **Jun. 2022**
Best Student Presenter, *Project in a Box, UCSD Undergraduate Conference* **May. 2021**
2x Dean's and President's Scholar, *San José State University* **May 2019**
Eagle Scout, *Boy Scouts of America* **Aug. 2018**

Leadership & Services

Private Tutor & Peer Educator **Nov. 2017 – Present**
UCSD Dept. of Engineering & Freelance *Multiple Locations*

- Tutored over 125 UCSD engineering students in Physics and Math, which involves hosting office hours, leading hourly, biweekly review sessions, and creating original worksheet content to help mentor students.
- Increased student engagement by using Discord and unique teaching styles by 225% as compared to other sections.
- A personal passion of mine is teaching in engineering and mentoring students.

Museum Presenter – Volunteer **Apr. 2023, 2024**
Museum of Science & Industry *Chicago, IL*

- Presented my current robotics research to the general public during national robotics week.

Resident Advisor **Aug. 2019 - Jun. 2020**
San José State University Housing *San Jose, CA*

- Built a community for 41 residents, which entailed publicizing events, enforcing policies, and resolving peer conflicts.