KULBIR SINGH AHLUWALIA

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EDUCATION

Ph.D. in Computer Science, University of Illinois at Urbana-Champaign, USA (June 2022–Present), GPA: 3.91/4
Advisor: Prof. Katherine Driggs-Campbell (since Nov 2026); previously Prof. Girish Chowdhary (2022–2026).
M.Eng. in Robotics, University of Maryland, College Park, USA (Aug 2019–May 2021), GPA: 3.88/4
B.Tech. in Electrical Engineering, Punjab Engineering College, India (Aug 2015–May 2019), GPA: 8.12/10

RESEARCH PAPERS

- **Ahluwalia, K.S.***; Jain, C.*; Cuaran, J.; Gummadi, S.; McGuire, M.; Sivakumar, A.; Hockenmaier, J.; Chowdhary, G. WaypointGen: Learning Grounded Waypoint based Navigation for Mobile Manipulators. Coordinated Science Laboratory Student Conference (CSL SC) 2026, Machine Learning, Generative AI, and Signal Processing Session. (*equal contribution)
- Cuaran, J.; **Ahluwalia, K.S.**; Koe, K.; Uppalapati, N.K.; Chowdhary, G. Active Semantic Mapping with Mobile Manipulator in Horticultural Environments. 2025 IEEE International Conference on Robotics and Automation (ICRA), pp. 12716–12722, doi:10.1109/ICRA55743.2025.11127547.
- Rangwala, M.; Liu, J.; **Ahluwalia, K.S.**; Ghajar, S.; Dhami, H.S.; Tracy, B.F.; Tokekar, P.; Williams, R.K. DeepPaSTL: Spatio-Temporal Deep Learning Methods for Predicting Long-Term Pasture Terrains Using Synthetic Datasets. Agronomy 2021, 11, 2245 (Special Issue: AI and Agricultural Robots).
- Liu, J.; Rangwala, M.; **Ahluwalia, K.S.**; Ghajar, S.; Dhami, H.S.; Tokekar, P.; Tracy, B.F.; Williams, R.K. "Intermittent Deployment for Large-Scale Multi-Robot Forage Perception: Data Synthesis, Prediction, and Planning". IEEE Transactions on Automation Science and Engineering, vol. 21, no. 1, pp. 27–47, 2024.

PAPERS UNDER REVIEW AND IN PREPARATION

- **Ahluwalia, K.S.**, et al. WaypointGen: Compositional Trajectory Generation by Grounding Hierarchical Language Abstractions and Constraint Phrases for Outdoor Navigation. Submitted to the CoRL 2026 Workshop on Compositional Generalization for Real-World Robot Learning (non-archival); under review.
- **Ahluwalia, K.S.**; Jain, C.; Kahlon, G.S.; Cuaran, J.; Lazebnik, S.; Chowdhary, G.; Hockenmaier, J. TaP: Trajectory as Policies for Spatial Reasoning using Hierarchical Abstractions & Grounded Constraint Phrases for Mobile Manipulator Navigation. IEEE Transactions on Robotics (T-RO), manuscript in preparation.

WORK EXPERIENCE

Product Management Intern, Qualcomm Technologies, Inc. (Compute Chipset), San Diego, CA
June 8–Aug 21, 2026

- On-site PM role on Snapdragon X Elite / X2 Elite AI-PC silicon.
- Market/competitive analysis for on-device AI/VLM/generative AI features (positioning Snapdragon X vs. Apple M-series, Intel Lunar Lake, AMD for Copilot+ AI-PC).
- Synthesized feedback into product requirements/roadmap; technical eval of VLM workloads on silicon (power/thermal/latency on Hexagon NPU).
- Cross-functional work with engineering (AIMET, AI Hub Models); internal briefings on edge AI trends.

AI Intern, Earthsense Inc., Urbana, IL, USA *May 2025–Aug 2025*

- Developed a natural language conditioned waypoint generation pipeline for 2D and 3D motion planners for enhancing outdoor robot navigation.
- Created an automatic labeling pipeline for large outdoor robot navigation datasets using Grounded SAM2, streamlining data processing.
- Deployed and integrated open-source Visual Language Models (Molmo-7B-D, Gemma-3-27B, Qwen-2.5-VL-72B, Qwen3-30B-A3B, Llama4-Scout, Spatial-VLM; 3B–72B params) for robot reasoning in image space and open-world NL-conditioned QA for 4-wheeled skid-steer outdoor robots.

Teaching Assistant, CS 440/ECE 448: Artificial Intelligence, UIUC *Fall 2026*

- Course taught by Prof. Margaret Fleck.

Teaching Assistant, CS498GC: Mobile Robotics for Computer Scientists, UIUC *Fall 2025*
Instructor: Dr. Girish Chowdhary.

- Co-developed the graduate course curriculum (ROS 2, sensor fusion, SLAM, mobile manipulation); authored and maintained the public course website and assignments; held weekly office hours and mentored students on robotics software.
- Recorded and published TA reference runs for the SLAM-ing Mars assignment (Husky + UR3 in the Mars Gazebo world, SLAM Toolbox occupancy map), Oct 2026.

Teaching Assistant, CS519: Scientific Visualization, UIUC *Summer 2025*

- Communicated complex data-visualization concepts to a multidisciplinary student audience and guided project work.

Teaching Assistant, CS444: Deep Learning for Computer Vision, UIUC *Jan–May 2024, 2025, 2026*
Instructor: Dr. Svetlana Lazebnik.

- Updated assignment starter code and assessed student submissions using Canvas.
- Provided support during in-person office hours and via Campuswire, addressing student queries and concerns.
- Designed and developed multimodal (Reasoning LLM/VLM proof) quiz questions, including single-choice, multiple-choice, and matching formats for students.

RESEARCH EXPERIENCE

University of Illinois, Human-Centered Autonomy Lab *Nov 2026–present*
Ph.D. researcher. Advisor: Prof. Katherine Driggs-Campbell.

University of Illinois, Distributed Autonomous Systems Lab *Aug 2022–Dec 2023*
Graduate Research Assistant. Mentors: Dr. Girish Chowdhary & Dr. Julia Hockenmaier.

- Investigated 3D semantic representations for robot environment mapping and relocalization after failure.
- Categorized recovery action sequences for various failure cases and constructed topological maps for visual language navigation.

University of Illinois, Distributed Autonomous Systems Lab *Aug 2022–Dec 2023*
Graduate Research Assistant. Mentors: Dr. Girish Chowdhary & Dr. Julia Hockenmaier.

- Fine-tuned CodeT5 for natural language grounding and code generation.
- Created datasets for grounding natural language commands and analyzed location data distributions.
- Developed a Python package for the farmbot agricultural robot.

University of Maryland, Robotics Algorithms & Autonomous Systems Lab *Jul 2020–Aug 2021*
Independent Study. Mentor: Dr. Pratap Tokekar.

- Processed point clouds from LiDAR-mounted quadcopters for pasture simulation.
- Automated gazebo world construction for grass pastures with unique plant poses.

University of Waterloo, Ontario, Canada *Mar–Jul 2018*
Visiting Scholar. Mentor: Dr. Simarjeet Saini.

- Developed an orange sweetness detector using scaled conjugate gradient backpropagation.
- Designed, programmed and 3D printed low-cost photonic devices, including a urea-in-milk detector and a fundus eye camera.

Indian Institute of Technology, Roorkee *Jun–Jul 2016*
Research Intern. Mentor: Dr. Dharmendra Singh.

- Investigated the effect of radio wave absorbers on Radar Cross Section using Ansys HFSS.

RESEARCH ARTICLES AND ABSTRACTS

- Cuaran, Jose; **Ahluwalia, Kulbir Singh**; Koe, Kendall; Chowdhary, Girish. "Active Semantic Mapping with Mobile Manipulator in Horticultural Environments", 2024, accepted at the 40th Anniversary of the IEEE Conference on Robotics and Automation (ICRA@40).
- The multispectral Fundus Eye camera prototype was featured in *Optics and Photonics News* (OPN), February 2019: Saini, Simarjeet Singh; Sridhar, Aneesh; and **Ahluwalia, Kulbir**. "Smartphone optical sensors." *Optics and Photonics News* 30, no. 2 (2019): 34–41.

CONFERENCE PRESENTATION

- Yuqi Li, **Kulbir S. Ahluwalia**, and Simarjeet S. Saini. "Reinforcement learning integrated with supervised learning for training of near infrared spectrum data for non-destructive testing of fruits." In Sensing for Agriculture and Food Quality and Safety XII, vol. 11421, p. 114210J. International Society for Optics and Photonics, 2020.

TECHNICAL SKILLS

Languages	Python, MATLAB, C++
Analysis & Design	Simulink, Blender, AutoCAD, Solidworks, Ultimaker Cura, Adobe Premiere Pro
Libraries	Torch, Transformers, Numpy, Pandas, OpenCV, SciPy
Other	ROS, Gazebo, RViz, CUDA, Linux, Docker, Git, Doxygen, Anaconda, LaTeX

PROJECTS

- **Enhancing Stereo Depth Maps through RGBD-Conditioned Generative Models**: conditional diffusion model fusing RGB and noisy depth for metric maps; fine-tuned Stable Diffusion V2 (similar to the Marigold training pipeline)

using SimSense simulation to generate depth data; outperforms Marigold/Depth-Anything-V2 on IRS, VKITTI, NYUv2 by up to 46% Abs Rel.
- SLAM from 2D LiDAR data using split-and-merge line extraction algorithm.
- State estimation using Extended Kalman Filter for GPS+IMU+Encoder sensor fusion.
- Processed data from RTK-GPS, IMU and encoders to plot the trajectory of a field robot.
- Autonomous Vaccine Delivery Robot.
- Image segmentation using superpixels.
- Persistent-Monitoring using Multi-Robot (UAV–UGV) Coordination.
- Optimized a GestureGAN for resource-constrained settings.
- Self-adjusting roadmaps - navigation in unknown environments using LD-PRM.
- Estimated the motion of a car using Visual Odometry.

COURSEWORK

Graduate (UIUC): CS598SHW: 3D Vision, CS598YL: Deep Learning for Robotic Manipulation, Advanced NLP (CS546), Machine Learning (CS446), Deep Learning for Computer Vision (CS444), Natural Language Processing (CS447), Mobile Robotics (CS498GC), Autonomous Systems and Robots.

Graduate (UMD): Autonomous robotics, Decision making for robotics, Visual Learning and recognition, Planning for Autonomous Robots, Perception for Autonomous Robots, Control of Robotic systems, Robot modelling, Robot programming, Building Robot software systems.

Undergraduate (PEC): Neural networks and fuzzy systems, Advanced control systems, Microprocessors and interfacing, Power electronics, Mechatronics, Engineering analysis and design, Manufacturing, Biomedical engineering, Electromagnetic theory, Python Programming.

LEADERSHIP AND TEACHING EXPERIENCE

- **Excellent communication skills** demonstrated as a UIUC Teaching Assistant (CS440, CS498GC, CS444, CS519) and through graduate curriculum co-development, technical workshops, and public science outreach (featured in *Optics & Photonics News*).
- Served as **Technology Head** for the Hardware domain of the IEEE PEC Student Branch. Conducted workshops on making a "Pick n Place Transporter Robot" and "Using the Raspberry Pi" to share our team's experiences and techniques with juniors in PEC.
- Taught Math and Science to government high-school students as part of the "PUNARKRITI Welfare Society" (Jan–Apr 2016) and "Junior Einstein" (Dec 2018) social welfare organizations.

OTHER ACHIEVEMENTS AND AWARDS

- Awarded the **National Bal Shree Award in Creative Scientific Innovations** by the Ministry of Human Resource Development, Govt. of India, conferred by the President of India - national recognition for **high levels of creativity and problem-solving**.
- **First Prize** in the MAJOR PROJECT of the B.Tech. Examination in Electrical Engineering (2015–19) for "Teleoperated Gesture-controlled Robotic Arm". [May 2019]
- Received a Certificate of Appreciation for contributions to IEEE PEC. [Aug 2017, Aug 2018]

ADDITIONAL PROJECTS

- AR-Tag detection - superimposed an image and virtual cube on an AR tag.
- Tracked moving objects using a Lucas-Kanade Tracker.
- Baxter transporting cubes in Gazebo.
- Implemented A* algorithm for Path Planning on Turtlebot 3.
- Path planning for point and rigid robot using Dijkstra's Algorithm.
- Lane detection and Turn prediction for a self-driving car.
- Agile Robotics for Industrial Automation Competition (ARIAC) 2019.
- Designed a PID controller for Turtlebot 3.
- Modelled a UR5 arm with a Parallel Gripper in RViz.
- Teleoperated gesture-controlled robotic arm.
- Pick n Place transporter bot (**First Prize**, IIT Roorkee; **6th of 400 teams**, IIT Bombay Techfest).
- Smart Garden (**First Prize**, Texas Instruments Hardware Hackathon).

CONFERENCE REVIEWS

- Workshop on Agricultural Robotics for a Sustainable Future, IROS [Reviewer].
- ICDL 2025 - IEEE International Conference on Development and Learning, September 16–19, 2025, Prague, Czechia [Reviewer].