KULBIR SINGH AHLUWALIA

Website ◇ Google scholar ◇ GitHub

SUMMARY

Fifth-year PhD student in the Department of Computer Science at the University of Illinois at Urbana-Champaign, advised by Prof. Katherine Driggs-Campbell since November 2026; previously Prof. Girish Chowdhary (2022–2026). Research focuses on natural-language grounding for outdoor field robots for navigation, recovery from navigation failures, and adaptive robot learning. Brings **excellent communication skills** - as a UIUC Teaching Assistant, co-developed a graduate mobile-robotics curriculum, authored public course and research websites, peer-reviewed papers (ICRA 2025, IEEE TASE, Agronomy) and a featured article in *Optics & Photonics News* - and **high levels of creativity and problem-solving**, recognized by the National Bal Shree Award for Creative Scientific Innovation and multiple first-prize robotics/hardware awards.

EDUCATION

Ph.D. in Computer Science, University of Illinois at Urbana-Champaign, USA (Jun 2022–Present), GPA: 3.91/4
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.
- **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.

AWARDS & HONORS

- **National Bal Shree Award for Creative Scientific Innovations** - Ministry of Human Resource Development, Government of India (2011): national honor for creativity and original scientific problem-solving.
- **First Prize**, Texas Instruments Hardware Hackathon (2017) - "Smart Garden" autonomous system.
- **First Prize**, B.Tech. Major Project (2019) - teleoperated gesture-controlled robotic arm.
- **First Prize**, Autonomous "Pick-n-Place" Transporter Bot, IIT Roorkee; **6th of 400 teams**, IIT Bombay Techfest.

EXPERIENCE

Qualcomm Technologies, Inc., San Diego, CA, USA *June 8–Aug 21, 2026*
Position: Product Management Intern, Compute Chipset

- Conducted market/competitive analysis for on-device AI/VLM/generative AI features on Snapdragon X Elite/X2 Elite silicon (positioning vs. Apple M-series, Intel Lunar Lake, AMD Ryzen AI for AI-PC/Copilot+ workloads).
- Synthesized customer/partner/engineering feedback into prioritized product requirements and roadmap inputs.
- Technical evaluation of VLM/multimodal inference workloads on prototype/production silicon (power/thermal/latency/memory/accuracy trade-offs on Hexagon NPU).
- Cross-functional coordination with silicon/software teams (AIMET quantization, AI Hub Models) + marketing/BD; prepared internal briefings on edge AI trends.

Earthsense Inc., Urbana, IL, USA *May 2025–Aug 2025*
Position: AI Intern (Supervisor: Michael McGuire, Lead CV Engineer)

- 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 six open-source VLMs (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.
- Enhanced ROS-based systems for real-world agricultural applications, directly supporting Physical AI advancement.

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

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 *Spring 2024, 2025, 2026*
Instructor: Dr. Svetlana Lazebnik.

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 & Hockenmaier Lab *Aug 2022–Dec 2023*
Graduate Research Assistant. Mentors: Dr. Girish Chowdhary & Dr. Julia Hockenmaier.

- Built 3D, dynamic, semantic representations for objects and grounded 3D voxel value maps for outdoor in-the-wild robot navigation.
- Categorized and collected manual recovery action sequences for failure cases arising from visual occlusions, sensor noise, and mechanical failures.

TECHNICAL SKILLS

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

PROJECTS

- **WaypointGen: Grounded Waypoint Navigation for Mobile Manipulators** (CSL SC 2026; journal version in preparation for IEEE T-RO): Map-free, language-conditioned 2D path planner. Open-vocabulary grounding (DINO-X, SAM3, DAM) of regions of interest, then a Qwen3-MoE-30B-A3B VLM picks the target and one of the MPPI trajectory candidates in bird's-eye view.
- **Active Semantic Mapping with Mobile Manipulator** (ICRA 2025): Probabilistic semantic octomaps + NBV planning with information gain for a mobile manipulator in horticultural environments; co-authored with J. Cuaran (first author) et al.
- **Enhancing Stereo Depth Maps via RGBD-Conditioned Diffusion** (CS598): Fine-tuned Stable Diffusion V2 for monocular depth; 46% Abs Rel improvement over Marigold/Depth-Anything-V2 on IRS/VKITTI/NYUv2.
- **EarthSense AI Intern projects** (2025): 6 VLMs (Molmo-7B-D to Spatial-VLM, 3B–72B) deployed on Jetson for outdoor robot NL reasoning + waypoint gen; SAM2 auto-labeling pipeline; ROS enhancements for ag robots.
- **Self-adjusting roadmaps (LD-PRM)**: Lifelong Dynamic PRM that restructures as occupancy evidence is gathered in unknown environments.
- **Optimized GestureGAN for resource-constrained settings**: MobileNet-backed cross-view image gen with 5.7× param reduction.
- **Autonomous Vaccine Delivery Robot**: QR/arrow-based nav + vision/IMU/encoder/ultrasonic for block retrieval/transport in arena. 1st prize IIT Roorkee, 6th/400 at IIT Bombay; featured video.
- **Image segmentation using superpixels**: SLIC + VGG16 feature extraction pipeline for superpixel classification.
- **A* / Dijkstra Path Planning on Turtlebot3 / rigid robots**: Configuration-space A*/Dijkstra with non-holonomic constraints and obstacle avoidance (ENPM661).
- **Teleoperated gesture-controlled robotic arm**: Web-based remote control with live video + gesture for object transport between rooms; on-board power, LED, speaker (B.Tech major project, awards).
- **ARIAC 2019 industrial system**: UR10 arms + conveyors + AGVs for part picking, fault disposal, assembly, AGV delivery.