Kartik **Patath**

Robotics Software Engineer · Woven by Toyota

San Francisco Bay Area, CA

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Professional Experience

Woven by Toyota, Vehicle Perception (Odometry & Localization)
Palo Alto, CA

Localization & Mapping Engineer — June 2022 - Present

- **Release validation for the production localization stack:** Co-designed the data pipeline that gates the stack for start of production. Fleet drives become **curated scenario datasets** with **ground-truth workflows**, scored pass/fail per scenario.
  - Serves as the data-loading core of **next-generation localization models** for Toyota's battery-electric vehicles.
- **On-vehicle map software:** Designed and shipped the production software that gives the automated-driving stack its map understanding, hardened with mock-scenario unit tests, **runtime profiling**, and **regression evaluation** over critical autonomy routes:
  - Map Fusion: built the node merging live lane perception with lane-level maps into the planner's world model.
  - Map-priors node [P1]: built the fusion turning fragmented map tiles into continuous road context for lane detection.
- **Fleet data ingestion:** Built the parallel pipeline that turns **crowd-sourced fleet sensor data** into map-generation inputs [P2]; reworked serialization and processing to cut workflow runtime and memory footprint.
- **Factor-graph trajectory optimization:** Fused GNSS with SfM odometry for map change detection in **GTSAM**, writing custom factors and **GNN-based landmark association** [P3].
- **Org-wide developer tooling:** Built visualization, benchmarking, and evaluation tools adopted by teams across the org to shorten their iteration loops.

General-Purpose Loco-Manipulator Snake Robot for Astronaut Assistance
Remote

Researcher · End-to-End Policies for Space Robots — Nov. 2025 - Present

- **Generalist robotics for space:** Building an **astronaut companion** in the lineage of **NASA JPL's EELS platform**; the form factor is the crux, low size, weight, and power to fly with a body going where humanoids and rovers physically cannot:
  - One machine for work that today costs a dedicated robot per mission: collecting samples, servicing lander hardware, entering low-clearance terrain.
  - The obstacle is data: generalist models are trained on Earth embodiments, and no snake-robot corpus exists [1].
- **Zero-shot cross-embodiment transfer:** Not a single snake demonstration exists; the snake still executes fine-tuned policies through **whole-body inverse kinematics** at inference time [1]. Collected the data behind those policies on a low-cost arm (**SO-101**): expert demonstrations in joint space, converted into an **embodiment-agnostic delta end-effector action space**, and used to fine-tune both model families:
  - Vision-language-action models (**GR00T-N1.7, MolmoAct-2**): end-to-end policies resting on a Markov assumption.
  - World-action models (**Lingbot, DreamZero**): built around history, maintaining a learned model of world dynamics.
- **Policy learning under partial observability:** Adapted third-person-pretrained checkpoints to a **single egocentric camera**, the entire perception stack a flight system affords; unlike an Earth lab, space offers no third-person view:
  - The state is only **partially observable** and the dynamics are **non-Markovian**.
  - The setup doubles as a testbed for what history buys when acting and **planning under uncertainty**.
- **Evaluation ladder:** Built rung by rung, so every policy earns its way to hardware:
  - **Offline evaluation**: replaying model inference against ground-truth trajectories in CI with a mock-robot client.
  - Live inference, **visual servoing**: the robot free to move while inference streams action chunks, on **NVIDIA Jetson Thor**.
  - Online evaluation on the **SO-101** robot.
  - **SO-101** evaluations in the Mars-analogue environment.
  - Execution on the snake robot, in Earth and Mars-analogue environments.

Velodyne Lidar
San Jose, CA

Computer Vision Engineer — Aug. 2021 - Mar. 2022

- **LiDAR perception:** Built statistical-filtering-based **3D object tracking** and prediction with **occupancy estimation**, using **ray tracing** and ground-plane segmentation, for the Vella Development Kit, deployed in commercial **ADAS applications**; helped automate training and validation of perception ML pipelines.

Honda Research Institute, USA
San Jose, CA

Robotics Research Intern — Feb. 2021 - May 2021

- **Autonomous exploration:** Built **curiosity-driven exploration** for navigation in unknown indoor environments; benchmarked against a proprietary HRI variant.

NASA Jet Propulsion Laboratory, DARPA Subterranean Challenge
Pasadena, CA

Research Intern (JVSRP) — Aug. 2020 - Jan. 2021

- **Artifact localization:** Built a **camera-LiDAR fusion** method to detect and precisely localize artifacts in **GPS-denied** underground environments.
- **Fielded in the finals:** Deployed on **Team CoSTAR**'s robots in the Challenge finals (2021).
- **NeBula autonomy stack:** Contributions are part of **Team CoSTAR**'s published autonomy solution, **NeBula** [2, 3].

Worcester Polytechnic Institute, AIR Lab — Worcester, MA
Research Assistant — Sep. 2019 - Aug. 2020

- **Semantic SLAM:** Built autonomous **object-level data association**, where landmarks enter the map as objects rather than low-level features, enabling loop closure over semantic landmarks; published at ICRA 2021 [4].

Carnegie Mellon University, Biorobotics Lab — Pittsburgh, PA
Summer Research Scholar (RISS) — May 2017 - Aug. 2017

- **Real-time stiffness visualization** for surgical robotics: built the RViz plugin that wraps live stiffness maps onto 3D organ models with **projective-geometry texture mapping**, rendering stereo augmented views in the surgical space [5, 6, 7].
- **Vision system for a modular 6-legged robot** built for search-and-rescue: monocular **LSD-SLAM** and **LiDAR-based Hector SLAM** (RealSense, Hokuyo), with person detection and tracking [8].

IvLabs, VNIT Robotics Lab — Nagpur, India
Undergraduate Researcher — 2015 - 2018

- **Where it started:** Perception and image processing for a **20-DoF kid-sized humanoid** built for FIRA 2016; granted India patent [P4].
- **Autonomous navigation:** TurtleBot and a custom AGV on the ROS navigation stack.
- **First deep-learning work:** A **Siamese network** for multi-focal image fusion.

Publications

- [1] S. Agrawal*, **K. Patath***, R. Saraf*, S. Vemu*, et al., J. Burdick, H. Ono, R. Thakker, "Towards an Era of General-Purpose Space Exploration with an Autonomous Loco-Manipulator: A-EELS", in preparation for submission to ICRA 2027. *Equal contribution.
- [2] B. Morrell, K. Otsu, A. Agha, et al. (incl. **K. Patath**), "An Addendum to NeBula: Towards Extending Team CoSTAR's Solution to Larger Scale Environments", IEEE Transactions on Field Robotics, 2024.
- [3] B. Morrell, R. Thakker, Á. Santamaria-Navarro, et al. (incl. **K. Patath**), "NeBula: Team CoSTAR's Robotic Autonomy Solution that Won Phase II of the DARPA Subterranean Challenge", Field Robotics, 2022.
- [4] Z. Qian, **K. Patath**, J. Fu, J. Xiao, "Semantic SLAM with Autonomous Object-Level Data Association", ICRA 2021.
- [5] N. Zevallos, R. A. Srivatsan, et al. (incl. **K. Patath**), "A Real-time Augmented Reality Surgical System for Overlaying Stiffness Information", RSS 2018.
- [6] N. Zevallos, R. A. Srivatsan, et al. (incl. **K. Patath**), "A surgical system for automatic registration, stiffness mapping and dynamic image overlay", ISMR 2018.
- [7] **K. Patath**, R. A. Srivatsan, N. Zevallos, H. Choset, "Dynamic Texture Mapping of 3D Models for Stiffness Map Visualization", IROS 2017 Workshop on Medical Imaging.
- [8] **K. Patath**, H. Salman, H. Choset, "Visual System for Modular 6-Legged Robot", RISS Working Papers Journal, vol. 5, pp. 138-141, 2017.

Patents

Dec. 2025	**[P1] Super Road Identification**, Application Number 19/421,859	USA
Oct. 2025	**[P2] Systems and Methods for Generating Map Data**, Application Number 18/621,360	USA
Jan. 2024	**[P3] Systems and Methods for Estimating a Gap Between Positioning and Odometry Signals**, Notice of Allowance received, Application Number 18/428,329	USA
May 2017	**[P4] Humanoid Robot**, Patent Number 517158, granted	India
Dec. 2016	**[P5] Robotic Cleaning System**, Application Number 201621043891	India

Skills

Programming	C++ (production, real-time on-vehicle), Python (production)
ML & Robot Learning	PyTorch, VLA fine-tuning & evaluation, RLDS, dataset curation, ground-truth pipelines
Robotics	GTSAM / factor graphs, SLAM & visual odometry, sensor fusion, ROS, LeRobot, NDS.Live maps
Infrastructure	Monorepo development, CI & test infrastructure, parallel data pipelines, Parquet, AWS S3, GCP, Docker, Jetson edge deployment

Education

Worcester Polytechnic Institute (WPI) — MA, USA
Masters of Science in Robotics Engineering GPA - 4.0/4.0 — Aug. 2019 - May 2021

Visvesvaraya National Institute of Technology (VNIT) — Nagpur, India
B.Tech in Electronics and Communication Engineering — June 2014 - June 2018

Achievements & Awards

2017	**Summer Scholar**, Robotics Institute Summer Scholars Program	Pittsburgh, PA
2017	**Scholarship**, Federation of Indian Chambers of Commerce and Industry (FICCI)	Pittsburgh, PA

Coursework

- Deep Learning, WPI
- Reinforcement Learning, WPI
- Computer Vision, WPI
- Advanced Robot Navigation, WPI
- Robot Dynamics, WPI
- Flow Matching and Diffusion Models, MIT
- CS231n: Convolutional Neural Networks for Visual Recognition, Stanford
- Introduction to Computer Vision, Udacity

Extracurricular Activity

- Teaching Assistant at WPI: ECE 2312 Discrete-Time Signals and Systems, ECE 3311 Principles of Communication Engineering, ECE 2019 Sensors, Circuits and Systems.
- Peer reviewer for the RISS 2017 journal.
- Mentored a team of four sophomores to the quarterfinals of the Texas Instruments Innovation Challenge 2016.
- Conducted institute workshops on image processing, microcontroller programming, and circuit design.

The Robots

