ASHISH PAKA

Robotics Research Engineer | M.S. Robotics and Autonomous Systems, Arizona State University
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PROFILE

Robotics Research Engineer with a life of first principle thinking and relentless curiosity. I grew up between two engineers: my grandfather and my father, a software engineer who were patient with my relentless questions and made it natural to treat curiosity as a way of life and always a layer deeper towards another *why*. That environment pushed me into DIY cars, ships, and radios by seventh grade, and into a lifelong fascination with space, science, and how complex systems actually work. A Mechanical Engineering degree at Manipal Institute of Technology turned that fascination into discipline. As a Senior Structures and Composites Lead at India's first and top student rocketry team led thrustMIT with two flight-proven sounding rockets at the Spaceport America Cup and a co-invented a patented ejection system. Contributed to tool development for steam turbines at BHEL and worked on analysing novel materials for Total Knee Arthroplasty prosthetics. After my undergraduation, I spent three years at Larsen & Toubro Technology Services then gave me the industrial side of that same craft. I learned there was that mechanical intuition alone was not enough for the problems, my innovation needed to be smarter. Returning to my father's world of software and my grandfather's world of electrical systems, I moved into robotics and autonomy — combining control theory, computer science, and computational mathematics into a study of how machines can perceive, learn, and decide. My M.S. in Robotics and Autonomous Systems at Arizona State University and current research at the LOGOS Robotics Lab under Prof. Nakul Gopalan now focus on sparse voxel transformer perception, homeostatic self-modeling for risk-calibrated autonomy, cross-embodiment skill transfer via vision-language models, and affordable multi-sensor platforms that move research out of simulation. I am most interested in building and contributing to science and technology that make the universe a better and safe place to exist in.

EDUCATION

1. **M.S. in Robotics and Autonomous Systems** | **Arizona State University, Tempe, AZ** **GPA: 3.96 / 4.00**
   Aug 2023 – May 2025
   - **Specialization:** Mechanical and Aerospace Design
   - **Core Coursework:** Linear Algebra for Robotics, Machine Learning, Deep Learning, Reinforcement Learning, Perception in Robotics, Modeling and Control of Robots, Advanced System Modeling and Learning, Dynamics and Control, Multi-Robot Systems, Expressive Robotics, AR-VR Systems.
   - **Research and Engineering Focus:** Sparse voxel transformer perception with self-as-token conditioning, homeostatic self-modeling and dual-utility reinforcement learning, cross-embodiment skill representation via vision-language models, continual and few-shot skill learning on manipulators, collaborative multi-robot SLAM and exploration.
   - **Presentations:** ASU SEMTE Paper & Poster, Spring 2025 — *Cross-Embodiment Skill Representation in Robotics*, Southwest Robotics Symposium 2024 — *Swarm Robotics for Autonomous Collaborative Mapping*.
2. **B.Tech. in Mechanical Engineering** | **Manipal Institute of Technology (MAHE), Manipal, India** **CGPA: 7.49 / 10.00**
   July 2016 – June 2020
   - **Minor:** Mechanical Design and Physics.
   - **Core Coursework:** Engineering Mechanics, Thermodynamics, Fluid Mechanics, Heat and Mass Transfer, Machine Design, Strength of Materials, Manufacturing Processes, Dynamics of Machines, Theory of Machines, Control Systems, Mechatronics, Finite Element Analysis, Computer-Aided Design, Material Science and Metallurgy.
   - **Electives:** Fluid Drives and Circuits, IC Engines and Emissions, Fatigue and Fracture, Design for Manufacturing and Assembly (DFMA), Physics of Materials, Radiation Physics, Tribology, Design of Mechanical Systems.
   - **Research and Engineering Focus:** Aerospace structural design and composite manufacturing, gas and steam turbine manufacturing design, biomechanical simulation of Total Knee Arthroplasty prosthetics using non-conventional materials
3. **Pre-University (12th Board)** | **Sri Chaitanya Narayana Junior Kalasala, Hyderabad, India** **Percentage: 95.2%**
   June 2014 – May 2016 Telangana Board of Intermediate Education, Major in Physics, Chemistry, and Mathematics
4. **High School (I.C.S.E.)** | **Kalpa School, Hyderabad, Telangana, India** **Percentage: 91.5%**
   Aug 2013 – May 2014 Indian Certificate of Secondary Education (I.C.S.E)

PROFESSIONAL EXPERIENCE

1. **Robotics Research Engineer** | **LOGOS Robotics Lab** ↗**, Arizona State University, Tempe, AZ**
   Jan 2025 – Present
   - Lead author on *PerSPARAMA*, a unified architecture that couples a sparse voxel transformer world model with a continuously updated homeostatic self-model through bidirectional cross-attention, mission reward and self-preservation reward are arbitrated via dual-utility PPO with a learned state-conditioned exchange rate, and a shared reality-alignment loss jointly updates world and self for risk-calibrated mission autonomy

- Collaborating with PhD researcher Weiwei Gu and Prof. Nakul Gopalan on extending the CoRL 2024 paper *Continual Skill and Task Learning via Dialogue* ↗ toward cross-embodiment skill transfer between human demonstrations and a Franka Emika FR3 manipulator, results presented at the ASU SEMTE Symposium, Spring 2025
- Deployed ResNet-18 visual encoders and ACT-LoRA transformers for trajectory-based unsupervised skill learning and few-shot continual adaptation on the FR3 arm, improved pre-trained skill performance by 74.75% and achieved 91.4% skill-matching confidence on the RH20T dataset after integrating Gemini VLM and structured semantic descriptors into the dialogue framework

2. **Engineer (Scania ODC)** | **Larsen & Toubro Technology Services (LTTS), Bangalore, Karnataka, India**
   Jan 2022 – June 2023
   - CATIA Engineer on the Scania Offshore Delivery Centre team, supporting European programs on buses and heavy trucks, delivered part and assembly design, structural modifications, and professional-grade CAD rendering for internal and client design reviews.
   - Produced feasibility and performance analyses on components, sub-assemblies, and systems, contributed 3D modeling and technical documentation across multiple vehicle programs within Scania's PDM and design-standards workflow.
3. **Associate Engineer (Carrier Transicold)** | **Larsen & Toubro Technology Services (LTTS), Chennai, Tamil Nadu, India**
   Jan 2021 – Jan 2022
   - Led concept development and detailed design of container refrigeration systems for Carrier's PrimeLine product family, owned the weight-reduction initiative on PrimeLine One through alternative materials and reduced wall thickness while preserving structural and thermal performance.
   - Redesigned components and assemblies across Truck / Trailer refrigeration products, analyzed field-testing logs, identified recurring defects, and implemented corrective design solutions traceable to manufacturing and assembly causes.
   - Completed the LTTS Genesis Program with formal training in GD&T, tolerance stackup, DFMEA, DFMA, Design Standards, IP Rating, and CAD-CAM tools (SOLIDWORKS, Creo Parametric), authored Creo Illustrate training material compatible with Windchill PDM.
   - *Tenure summary (Sept 2020 – June 2023):* consulted for Carrier Transicold, Scania, Eaton Corporation, and Cooper Lighting across design, simulation, tolerance stackup, material and parts selection, manufacturing design, and intellectual-property protection, completed eight client projects at 100% quality delivery and progressed Intern → Graduate Engineer Trainee → Associate Engineer → Engineer in under two years.
4. **Mechanical Design Intern** | **Larsen & Toubro Technology Services (LTTS), Vadodara, Gujarat, India**
   Sept 2020 – Dec 2020
   - Supported senior drafters in structural design of products, read and interpreted blueprints, technical drawings, schematics, and computer-generated analysis reports, recommended design modifications to eliminate machine and system malfunctions before absorption into the Carrier Transicold program.
5. **Senior Structures & Composites Lead** | **thrustMIT ↗, Manipal Institute of Technology, Manipal, India**
   Aug 2017 – Sept 2020
   - Led the Mechanical Structures subsystem of thrustMIT, India's first and top collegiate rocketry team (2017–2020), bore direct responsibility for structural integrity, composite manufacturing, and in-workshop fabrication of the full airframe.
   - Managed a 13-member sub-team across two flight-proven sounding rockets — Project Vyom (2018) and Project Arya (2019) — both launched at the Spaceport America Cup, New Mexico, organized by the Experimental Sounding Rocket Association (ESRA).
   - Modeled the complete rocket in Fusion 360, CATIA, and SOLIDWORKS, performed structural, fatigue, fracture, buckling, and thermal-impact simulations in ANSYS Workbench, drafted manufacturing-grade technical drawings and component-level design documentation.
   - Owned in-workshop manufacturing of the airframe via fibreglass and carbon-fibre hand layup with aerospace-grade resin, contributed to the airbrake deployment system, redesigned landing legs for soft touchdown, and developed stiffer and lighter bulkheads and fins.
   - Co-invented a pressurized-canister ejection system with reported reliability of 99.97% vs. black-powder systems — granted **Indian Patent No. 506725** ↗ — "A System for Ejection" (Application No. 201941044944).
   - Received the *Spot Award for Design* at Spaceport America Cup 2019 for Project Arya, mentored junior engineers within thrustMIT and provided peer review and technical assistance to collegiate teams, including BITS Pilani, in establishing their own rocketry programs.

RESEARCH

1. **PerSPARAMA — Perception of a Self-worth Perspective Agent with Reality-Aligned Mission Autonomy** | **LOGOS Robotics Lab, ASU** | **Working draft, 2025–2026**
   - First-author research on continual self-supervised world and agent modeling for autonomous platforms operating in GPS- and communication-denied, unstructured environments — settings in which a solo agent's world model and self-model degrade silently and simultaneously.
   - Central thesis: an agent built around three coupled concerns — *perception* (the only window to reality), *self* (who the agent is right now, not at deployment), and *mission* (the attractor that gives decisions direction) — makes better decisions than the standard pipeline that treats these as separable subsystems.
   - Contributes a sparse voxel transformer world model with *self-as-token* conditioning, a homeostatic state vector, and *bidirectional cross-attention* between world and self that yields a joint situational latent, so every perceptual act is conditioned on the perceiver's physical state and every self-evaluation is conditioned on the current scene.
   - Introduces *dual-utility reinforcement learning*: mission reward and self-preservation reward are arbitrated through a learned, state-conditioned exchange rate, operationalizing self-worth as a continuous decision prior rather than a hard safety constraint.
   - Adds state-conditioned competence memory, generalized skill-boundary detection (execute / adapt / improvise, applied to every decision, not only named skills), temporal voxel state with learned environment-class-dependent decay, and a formal embodiment interface contract enabling the same cognitive architecture across wheeled, aerial, aquatic, and humanoid platforms. A.L.B.E.R.C. is the primary embodiment target.

PROJECTS

1. **A.L.B.E.R.C. — Autonomous Learning Bot to Explore, React and Collaborate** | **LOGOS Robotics Lab, ASU** | **2025 – 2026 (target publication: 2026)**
   - Designer of a three-tier differential-drive indoor research robot for 3D mapping, dynamic obstacle evasion, and natural-language human-robot collaboration, full mechanical, electrical, firmware, and software stack delivered under a sub-$1000 bill of materials and a compact power envelope.
   - **Sensing and compute:** Unitree L1 4D LiDAR, Stereolabs ZED Mini stereo VIO, 9-axis ICM-20948 IMU, ultrasonic array, quadrature wheel encoders, a docked smartphone, a Jetson Orin Nano Super as primary compute, and an Arduino Mega 2560 as real-time I/O co-processor.
   - **Perception and SLAM:** Extended Kalman Filter fusing encoders, IMUs, and VI-SLAM, dual 2D/3D simultaneous localization and mapping via SLAM Toolbox and RTAB-Map, two-tier SDK-native plus TensorRT-accelerated segmentation, multi-object 3D Kalman tracking with persistent IDs.
   - **Planning and reactive evasion:** three runtime-selectable global planners (A*, RRT*, Voronoi GVD) with MPPI local trajectory optimization at 20 Hz, frontier-based exploration, *mission-context-dependent reactive evasion* gated against LLM-designated interaction targets — the robot actively evades everything it is not currently collaborating with.
2. **Swarm Robotics for Autonomous Collaborative Mapping** ↗ | Dec 2024
   - Led a multi-robot exploration study using Voronoi-pattern swarm decomposition for optimal area coverage across heterogeneous teams, with fused 2D SLAM via gmapping and Hector SLAM on ROS 2, validated with TurtleBot3 swarms in Gazebo.
   - Integrated Gymnasium-based reinforcement learning environments and time-of-flight depth cameras, attaining 5× faster 3D reconstruction compared with sequential single-robot baselines, results presented at the Southwest Robotics Symposium 2024.
3. **Optimized VoxFormer for Autonomous Driving** ↗ | May 2024
   - Redesigned the VoxFormer sparse-voxel transformer into a 75% more resource-efficient 3D Semantic Scene Completion model using deformable self-attention and cross-attention over multi-scale BEV features, predicting semantic occupancy from 2D camera input alone.
   - Trained on nuScenes (1000 scenes, 1.4M images, 40k keyframes), SemanticKITTI (3.6 billion labelled points), and KITTI with PyTorch distributed training and mixed precision, achieved a 10% IoU improvement on occluded voxel estimation and 10% higher accuracy than LiDAR-based baselines in occluded and close-range scenes.
   - Integrated with the CARLA simulator for real-time inference at 20 FPS, instrumented training with TensorBoard, Open3D, and Weights & Biases for loss visualization, 3D voxel rendering, and hyperparameter optimization.
4. **Expressive Robot Hand** | **May 2024**
   - Built a computer-vision-guided robotic hand capable of real-time gesture mimicry and autonomous operation, integrating dynamic motion tracking with AI/ML/RL control loops, interfaced as a human-robot interaction module and personal assistant to explore expressive robotics.
5. **AR/VR Passthrough & Virtual Reality Environment** | **May 2024**
   - Developed immersive AR/VR applications, games and environments using Meta Quest Development Hub (MQDH) and Unity, covering software and hardware interfacing (headset, controllers, passthrough sensors) for MR experience

6. **6-DOF Path Planning for Industrial Robot Arm** ↗ | **Dec 2023**
   - Engineered forward and inverse kinematics solvers and a trajectory-planning algorithm for a 6-DOF industrial cobot navigating between 3D coordinates, optimized trajectory smoothness and joint-limit compliance for precision pick-and-place workflows.
7. **ML/DL Image-Recognition Comparison for E-Commerce** | **Dec 2023**
   - Conducted a comparative study of three ML/DL methods for image classification on e-commerce product datasets, built a pipeline for automatic product sorting and personalized recommendation, benchmarking accuracy, inference latency, and training cost.
8. **Bones & Bru — Progressive Web App for a Local Cafe** ↗ | **Feb 2026**
   - Designed and shipped a full-stack progressive web application for Bones & Bru, a pet-friendly coffee shop and all-natural dog treats in Tempe, AZ run by John, Charity, and their dog Bru. Deployed and in active daily use by the owners and their regulars.
   - Built with React 19 and TypeScript on Vite 6 and Tailwind CSS with key-value storage, custom JWT (HMAC) and Google OAuth authentication, bcrypt password hashing, and TOTP-based visit verification.
   - Delivered a customer storefront (rewards loyalty program, in-cafe ordering with real-time status, socials, maps, contacts, installable web app and NFC/QR) as well as a 7-tab owner dashboard (POS, orders, customers, menu editor, profile, analytics, full backup/restore and employee access control)
9. **Total Knee Arthroplasty (TKA) Implant Design & Simulation** | **Manipal Institute of Technology** | **Jan 2020 – May 2020**
   - Designed and simulated TKA implants under Prof. Nitish Naik and investigated the biomechanical response of several non-conventional implant materials through FEA-driven strength of materials and mechanical systems design
10. **Plain Plug Gauge Development** | **Bharat Heavy Electricals Limited (BHEL), Hyderabad** | **Summer 2018**
    - Developed a precision plain plug gauge in the steam-turbine department, studied thermodynamics and manufacturing design of gas and steam turbines at BHEL Hyderabad as part of the internship program.

PUBLICATIONS, PRESENTATIONS & PATENTS

1. **Patent (Granted)** | Indian Patent No. 506725 ↗ — *"A System for Ejection"*. Application No. 201941044944, granted Nov 2019. Co-inventor of a pressurized-gas ejection system for sounding rockets with reported reliability of 99.97% vs. black-powder ejection.
2. **Paper & Poster Presentation** | ASU SEMTE Symposium, Spring 2025 — *Cross-Embodiment Skill Representation in Robotics: a shared action space for human-robot collaboration* (Advisor: Prof. Nakul Gopalan).
3. **Paper Presentation** | Southwest Robotics Symposium 2024 — *Swarm Robotics for Autonomous Collaborative Mapping*.
4. **Working Draft** | *PerSPARAMA: Perception of a Self-worth Perspective Agent with Reality-Aligned Mission Autonomy* — first-author manuscript, target submission 2026.

TECHNICAL SKILLS & PROFICIENCIES

1. **Areas of Expertise:** Autonomous Systems and Navigation, Perception in Robotics, Simultaneous Localization and Mapping (SLAM), Sensor Fusion, Motion Planning and Reactive Evasion, Control Systems, Multi-Robot and Swarm Systems, Transformer Models and Vision-Language Models, Continual and Reinforcement Learning, Computer Vision and 3D Scene Understanding, CUDA and GPU Programming, Embedded Systems and Robotics Hardware Integration, Human-Robot Interaction, Expressive Robotics, AR/VR Systems.
2. **Software Tools:** TensorFlow, PyTorch, Hugging Face Transformers, OpenCV, scikit-learn, TensorRT, OpenAI Gym, Gymnasium, Weights & Biases, TensorBoard, Git, Docker (ARM64 and x86), ROS 1/2 (Humble), Catkin, Nav2, Gazebo, Isaac Sim, MoveIt, MuJoCo, PyBullet, V-Rep (CoppeliaSim), CARLA, Unity AR/VR, Meta Quest Development Hub (MQDH), WebXR, Linux, CUDA 12.x, JetPack 6.x, Python, C/C++, Java, MATLAB, Arduino
3. **CAD / CAE / PDM:** Creo Parametric 4.0, SOLIDWORKS, Autodesk Inventor, Autodesk Fusion 360, CATIA v4/v5/v6, Siemens NX Unigraphics, ANSYS Workbench (Static Structural, Transient Thermal, Fluent, APDL), Hypermesh, OpenRocket, SimScale, AutoCAD, PTC Windchill, Dassault Enovia, 3DExperience, Creo Illustrate.
4. **Additional Skills:** Product Design, Simulation, and Life-Cycle Management, Material Science and Composites, Aerospace Structural Design, Sustainable Design, Refrigeration Systems. Fibreglass and carbon-fibre layup, 3D printing and rapid prototyping, GD&T, DFMA, DFMEA, Environmental Rating.

CERTIFICATIONS

1. **Machine Learning: Modern Computer Vision and Generative AI LPT** — Udemy, Jul 2025.
2. **Self-Driving and ROS 2 — Odometry and Control** (Antonio Brandi) — Udemy, Jun 2025.
3. **Self-Driving and ROS 2 — Map and Localization** (Antonio Brandi) — Udemy, Jun 2025.
4. **Robotics and ROS 2 — Manipulators** (Antonio Brandi) — Udemy, May 2025.

5. **Certified Drone Pilot** — sUAS, FAA Part 107, USA.
6. **The Complete Python Bootcamp from Zero to Hero in Python** (Jose Portilla) — Udemy, Jan 2023.
7. **Digital Manufacturing and Design** — The State University of New York, Coursera, Jul 2019.
8. **Autodesk Fusion 360 Integrated CAD/CAM/CAE** — Autodesk Inc., Coursera, Oct 2018.
9. **Introduction to Digital Manufacturing with Autodesk Fusion 360** — Autodesk Inc., Coursera, Oct 2018.
10. **Introduction to Programming with MATLAB** — Vanderbilt University, Coursera, Jun 2018.
11. **Material Science: 10 Things Every Engineer Should Know** — University of California, Davis, Coursera, Jun 2018.
12. **Programming for Everybody (Getting Started with Python)** — University of Michigan, Coursera.
13. **DFMEA Training** — LTTS Genesis Program.

ACHIEVEMENTS & HONORS

1. **Spot Award for Design** | Spaceport America Cup 2019, ESRA | thrustMIT — awarded for structural design on Project Arya.
2. **Project Leader** | Spaceport America Cup 2019 — coordinated the Indian team through design, manufacturing, international transit, and launch operations in New Mexico.
3. **Patent Holder** | Indian Patent No. 506725 — "A System for Ejection".
4. **Paper / Poster Presenter** | ASU SEMTE Symposium, Spring 2025, Southwest Robotics Symposium 2024.

LEADERSHIP & VOLUNTEERING

1. **Senior Structures & Composites Lead** | **thrustMIT, Manipal** | **Aug 2017 – Sept 2020** — led structural design and composite manufacturing for two flight-proven sounding rockets, managed a 13-member sub-team for Project Arya, contributed to airbrake and landing-leg subsystems.
2. **Project Leader & Team Coordinator** | **Spaceport America Cup 2019** — coordinated the Indian team through design reviews, fabrication, international transit, and launch operations.
3. **Volunteer** | **TechTatva '16** — official technical festival of Manipal Institute of Technology.
4. **Volunteer** | **Revels '16** — official non-technical festival of Manipal Institute of Technology.

LETTERS OF RECOMMENDATION

1. **Dr. Sathyashankara Sharma, FIE**
   - Fellow, Professor and Head, Department of Mechanical & Manufacturing Engineering.
   - Manipal Institute of Technology, MAHE, Manipal — 576104, Karnataka, India.
   - M.Tech. (Materials Engineering), PhD (Materials Engineering).
   - Email: ss.sharma@manipal.edu | Phone: +91-820-2925461.
   - *Relationship:* Instructor for Material Science and Metallurgy (3rd semester B.Tech.), undergraduate mentor.
2. **Dr. Srinivas G.**
   - Assistant Professor (Senior Scale), Department of Aeronautical & Automobile Engineering.
   - Manipal Institute of Technology, MAHE, Manipal — 576104, Karnataka, India.
   - *Relationship:* Faculty Advisor for thrustMIT (student rocketry team)
3. **Prof. Navaneeth Krishna Vernekar V.**
   - Assistant Professor (Senior Scale), Department of Mechanical & Industrial Engineering.
   - Manipal Institute of Technology, Manipal — 576104, Karnataka, India.
   - Email: navaneeth.kv@manipal.edu.
   - *Relationship:* Instructor for Mechanical Design I & II and CAD Lab supervisor, mentored undergraduate research.

ADDITIONAL INFORMATION

1. **Work Authorization:** No sponsorship required.
2. **Languages:** English (fluent, professional), Telugu (native), Hindi (fluent).
3. **Current Location:** Tempe, Arizona, United States.