

Work Experience

Planned Career Break – International Travel

Nov 2025 – Sept 2026

Extended international travel and personal commitments, now returning to full-time robotics engineering roles.

Robotics Software Engineer — Perception & Simulation

Feb 2021 – Nov 2025

Controls Engineer

Nov 2019 – Feb 2021

AutoGuide acquired by Mobile Industrial Robots — A Teradyne Company

North Reading, MA

Perception

- Architected and shipped three successive generations of 6-DoF pallet pose detection systems over 4 years comprising 2D LiDAR, 3D time-of-flight camera and RGB machine-learning techniques along with **2 granted patents**. Deployed 150+ perception enabled autonomous mobile robots (AMR) across 30 warehouses.
- Established an OptiTrak motion capture lab that cumulatively generated 1.5 million+ training images for Pallet Detection models delivering industry **first AI perception enabled AMR forklift** (MiR1200 PalletJack) allowing it to seamlessly pick up shrink-wrapped or damaged pallets.

Simulation

- Led high-fidelity simulation initiative, based on Isaac Sim framework, including URDF/USD models and collision mesh. Reduced sim to real divergence to <10% against measured Kalman Filter states by calibrating inertia, contact dynamics, drivetrain params and 2D Lidar + RGB noise models.
- Pre-empted 20+ critical safety failures involving pallet docking through SIL testing of perception algorithms.
- Built cloud-native simulation batch-testing pipelines broadening coverage of operational design domain from 30 to 370 test scenarios per pallet and reducing testing time by 95% compared to manual testing.

Embedded

- Delivered the industry **first fully autonomous high-bay forklift** (AutoGuide Max-N HighBay) with a Vision Processing Unit (VPU) based on NVIDIA Jetson Xavier that streams real-time 6-DoF pallet pose estimates for visual servoing during fork insertion at rack heights up to 36 ft.

Cloud, Data & ML Ops

- Built data ingestion & pre-processing pipelines transforming 80k+ raw images into trainable datasets nightly. Automated data integrity checks, schema validation, de-duplication, cloud uploads, and serverless functions for data quality reporting.
- Accelerated new pallet onboarding by 66%, reducing timelines from 3 weeks to 7 days, which unlocked time-sensitive customer segments and generated \$12M in new revenue.
- Led the org-wide initiative to deprecate manual provisioning and establish Terraform Infrastructure-as-Code foundation for Azure. Authored 18 modules adopted by ML, Data, and Simulation teams governing \$250K/yr in cloud spend. Reduced post-migration infra spend by \$120k/year (~48%) through orphaned resource reclamation, right-sizing compute and shared disk provisioning.

Software Lead (Volunteer) — Autonomous Underwater Vehicle

Aug 2021 – Feb 2025

Robots in Service of the Environment — a non-profit partnered with World Wildlife Fund

Bedford, MA

- Spearheaded team of 8 volunteer engineers to develop in-house control and perception stack for unmanned underwater vehicle to capture invasive lionfish.
- Co-led field expeditions in Pensacola and West Palm Beach coasts. Captured first ever lionfish autonomously by a robot; **featured on PBS News Hour, IEEE** and numerous other news media. (Guardian LF1 Robot)
- Architected ROS2 stack on Ubuntu Server including hardware abstraction layer, state-space control, NTP sync, autonomy modes, and heartbeat/failsafe mechanisms, replacing legacy UUV control unit. Developed Qt-based UI with live sensor gauges, live camera with fish tracking overlays, operating modes, and diagnostics.
- Trained and optimized lionfish detection models achieving precision of 0.88 (mAP 50-95) on YoloV7 integrating with DeepSORT multi-object tracking; curated 20k+ strong image dataset; implemented autonomous target seek mode.

Education

M.Eng., Robotics

Aug 2017 – May 2019

University of Maryland, College Park

B.Sc., Mechatronics & Control

Sep 2011 – Jul 2015

University of Engineering and Technology, Lahore

Patents

- US Patent 12,560,930 B2** — *Identifying Transport Structures* (granted 2026). Co-inventor. Pallet and transport-structure detection from 2D LiDAR scans for autonomous mobile robots.
- US Patent 11,977,392 B2** — *Identifying Elements in an Environment* (granted 2024). Co-inventor. 3D camera point-cloud processing for environment element identification in warehouse automation.
- US Patent Application Pub. 2021/0347617 A1** — *Engaging an Element*. Co-inventor.

Skills: C++17, Python, ROS, MoveIt!, Qt, IceOryx, gRPC, PCL, OpenCV, 2D & 3D Lidar, 3D ToF Camera, VSLAM-Lab, OptiTrak Motion Capture, IsaacSim, USD, PyTorch, TensorFlow, YOLO (v7/v10), DeepSORT, Azure, Terraform, NVIDIA AGX Orin/Xavier, GMSL2, CAN Bus