NOOPUR KOSHTA

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Career Highlights

- **Innovation:** Set new performance benchmarks by delivering 20x faster model convergence through optimized architectures and loss functions.
- **Core Development:** Passionate about algorithmic efficiency and mathematical foundations, demonstrated through logic optimization and CUDA acceleration.
- **Emerging AI Focus:** Driven by suriosity, currently exploring applications of diffusion models in world foundation models for advancing robotics capabilities.
- **Leadership:** Mentored 4 junior engineers in GPU optimization while collaborating across cross-functional teams.
- **Open Source Contributions:** Collaborated with experienced developers at Red Rabbit Robotics for ROS2 migration, and learnt package development from ground up through StarFinder (SpaceROS extension) project.
- **Self-Driven Growth:** Independently mastered tech stack (ROS2, PyTorch, CUDA), simulation frameworks (Gazebo, Blender), and ML/deep learning concepts alongside work.

Professional Experience

Graduate Research Assistant - MER Lab, Worcester Polytechnic Institute　　　　　　　　**January 2024 – December 2024**

- **Deep Learning-Based Visual Feature Tracking System** (Mentor: Prof. Berk Calli):
  * Developed **Graph Convolution Network (GCN)**, attaining MSE loss less than 0.4 in robot joint estimation despite visual obstructions.
  * Accelerated joint estimation training, cutting time from 5 hours to 15 minutes per iteration, facilitating rapid deployment and streamlined robot control updates.
  * Adopted a hybrid UKF-GCN approach, switching to **Unscented Kalman Filter (UKF)** for robust tracking during occlusions.

- **Multi-Agent Localization** (Mentor: Prof. Siavash Farzan):
  * Implemented **distributed EKF with Voronoi Tessellation** system for warehouse automation, coordinating 8+ robots achieving zero path conflicts.
  * Developed multi-robot coordination using Voronoi tessellation for dynamic space partitioning, facilitating collision-free target encirclement with mean localization error ≤ 0.8.

Graduate Research Assistant - BioRobotics Lab, Carnegie Mellon University　　　　　　　　**March 2024 – April 2024**

- **Shape Estimation of Snake Robot** (Mentor: Prof. Howie Choset):
  * Investigated **forward/inverse kinematics for a surgical snake robot** to enable precise 3D navigation and control during heart procedures.

Senior AI Engineer - Ignitarium Technology Solutions Pvt　　　　　　　　**November 2021 – June 2022**

- **Parallel Image Processing for High-Performance Computing on GPU devices:**
  * Directed peers in reengineering **OpenCV core algorithms into warp-optimized CUDA kernels** for resource-constrained SoC devices, attaining minimized inference time on edge device.
  * Optimized GPU memory through **shared and coalesced memory pattern**, reducing memory bandwidth by 20% for embedded systems.

Senior Machine Learning Engineer - Persistent Systems Pvt Ltd　　　　　　　　**May 2016 – April 2020**

- **Medical Image Segmentation of Diabetic Retinopathy:**
  * Implemented **hierarchical CNN with cascaded feature pyramids and dense connectivity**, achieving 96.9% dice score in lesion segmentation, enabling ophthalmologists to identify subtle progression markers and microaneurysms on IDRiD dataset.

- **Attendance Tracking with Facial Recognition:**
  * Enhanced face detection pipeline through **Haar-HOG performance analysis** (85% to 91% accuracy) and CNN-based TensorFlow implementation, achieving 96% accuracy in department-wide attendance monitoring system deployed across 50+ employees.

- **Medical Text Summarization for Diagnostic Coding:**
  * Engineered **LSTM architecture with clinical embeddings and self-attention** for multi-class ICD code classification, delivering 85% precision.
  * Eliminated manual patient history reviews and reduced physician diagnosis time by 40%.

Technical Skills

Programming: C++, Python, MATLAB, CUDA
ML Frameworks: PyTorch, TensorFlow, TensorRT, OpenCV, Gym, PCL, Optuna
Development Tools: Docker, Blender, Git, ROS/ROS2, Gazebo, RViz

Achievements

Red Rabbit Robotics (Open Source Contribution) ⌨　　　　　　　　**January 2025**

- Leading migration of RX1 humanoid robot framework from ROS1 to ROS2, implementing node architecture and protocols for seamless control.

Meta and AWS Hackathon for XR and GenAI (Winner - 2nd place) 📹　　　　　　　　**September 2024**

- Built a VR language learning application with OCR scanning that converts text to interactive 3D visualizations in Oculus Quest 2, boosting vocabulary retention

Generative AI Projects

One-Shot Safety Alignment for Large Language Models (LLMs) via Optimal Dualization (In Progress) | *Python* ⌨

- Reproducing MOCAN/PECAN algorithms from published research to validate proposed computational efficiency gains in RLHF for LLM safety alignment.

Deep Learning Projects

Exploring Query-Key Relationships in Vision Transformers Through Singular Value Decomposition (SVD) (In Progress) | *PyTorch, Python* ⌨

- Reproducing research on transformer interpretability methodology analyzing self-attention singular modes to understand feature direction interactions.

Deep Q-Learning for Reward Optimization in Atari Breakout Game | *Python, Gym* ⌨

- Analyzed Deep Q-Network (DQN) architecture implementation for Atari Breakout, examining agent performance across 120,000 episodes to achieve a score of 91.

3D scene reconstruction with Structure from Motion (SfM) | *PyTorch, OpenCV* ⌨

- Developed 3D reconstruction using Epipolar Geometry and Perspective-n-Point (PnP) with cheirality constraints, achieving 0.98 MSE in camera pose estimation

Multi-Sensor Fusion for Autonomous Driving | *C++, Python, OpenCV, MATLAB* ⌨

- Engineered sensor fusion pipeline (LiDAR, radar, camera) with UKF-based multi-object tracking, achieving ≤ 0.6 MSE for surrounding vehicle localization.

Education

Worcester Polytechnic Institute　　　　　　　　**December 2024**

Master of Science in Robotics Engineering　　　　　　　　*Worcester, MA*