Het Maheshkumar Sekhalia

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EDUCATION

Carnegie Mellon University Pittsburgh, PA
Master of Science in Mechanical Engineering-Research | *GPA: 4.0/4.0* May 2026
Relevant Coursework: Deep Reinforcement Learning, Planning and Decision-making in Robotics, Modern Control Theory, Intro to Deep Learning, Computer Vision, Electromechanical Systems Design, Probability and Estimation Methods for Engineering Systems

Indian Institute of Technology (IIT) Indore Indore, India
Bachelor of Technology in Mechanical Engineering | *GPA: 8.57/10* May 2024
Relevant Coursework: Instrumentation and Control System, Numerical Methods, Machine Design, Machining Science and Metrology

PROFESSIONAL EXPERIENCE

Komatsu Ltd. Pittsburgh, PA
Graduate Researcher, CERLAB – Prof. Kenji Shimada Nov 2024 - Present

- Engineered a modular autonomy stack for an autonomous wheel loader to perform loading and dumping, covering full trajectory planning, smoothing, and closed-loop control within a ROS2 + Isaac Sim simulation environment
- Designed kinematically feasible trajectories using RRT, RRT*, and Hybrid A* algorithms for the vehicle's articulated steering model
- Applied B-spline smoothing and velocity profiling to generate dynamically feasible reference paths for downstream control
- Implemented a nonlinear model predictive controller (NMPC) with real-time feedback using the ACADO toolkit
- Deployed a nonlinear MPC in ROS2 and architected a dual-Docker integration with Isaac Sim for real-time closed-loop simulation

PROJECTS

Deep Q-Networks (DQN) for Control Sept 2025

- Implemented DQN and Double DQN agents with experience replay and greedy exploration, assessing stability in control tasks
- Mitigated overestimation bias by integrating Double DQN into the baseline, decoupling action selection from evaluation to deliver more stable and reliable learning outcomes
- Benchmarked DQN and Double DQN against REINFORCE and N-step A2C agents using a custom evaluation framework with 5×1,000 training episodes, periodic rollouts, and performance visualizations across trials

Policy Gradient RL for Control Aug 2025

- Developed and evaluated a suite of deep reinforcement learning agents to solve CartPole-v1, applying policy-gradient methods
- Engineered REINFORCE, REINFORCE with Baseline, and N-step A2C in PyTorch, with a modular architecture for easy experimentation across methods and hyperparameters
- Conducted rigorous multi-seed evaluations with policy checkpointing, demonstrating smooth and reliable convergence to optimal performance, for REINFORCE with Baseline and A2C (N=10, 100), in under 300 episodes

Retrieval-Augmented Generation (RAG) for Question Answering Apr 2025

- Built a question-answering system that combines semantic retrieval with LLMs to extract answers from long documents
- Designed a RAG system with Sentence-BERT to embed text chunks and retrieve top results using similarity search
- Deployed local inference using Hugging Face Transformers (Gemma-2B-IT), applying multi-shot prompting to enhance coherence and depth of generated answers
- Adapted LLMs to domain-specific data using Hugging Face PEFT and LoRA on a RAFT dataset using minimal parameter tuning

Transformer-Based PDE Sequence Prediction Mar 2025

- Modeled nonlinear PDE (Burgers' equation) with decoder-only Transformer for autoregressive prediction of spatiotemporal states
- Implemented scaled dot-product and multi-head attention mechanisms, validating architecture through output comparison
- Integrated sinusoidal positional encoding, causal self-attention, and relative L2 loss for dynamics learning
- Achieved low autoregressive loss (near 0.077) over 50 epochs and visualized predication fidelity to support sequence modelling

Autonomous Vehicle Control Oct 2024 - Dec 2024

- Simulated full-stack autonomous driving behavior for a Tesla Model 3 in Webots using custom vehicle dynamics and control modules
- Modeled linearized bicycle dynamics to design PID controllers for real-time lateral and longitudinal trajectory tracking
- Implemented state-space control via pole placement for improved stability and responsiveness under curvature variations
- Developed discrete-time LQR controller to optimize lateral steering performance under noisy conditions and road constraints
- Programmed A* path planning for real-time obstacle-aware trajectory generation and safe local navigation
- Deployed EKF-SLAM to estimate vehicle position and heading in GPS-denied environments, leveraging sensor noise modeling and range/bearing measurements to enhance localization accuracy

SKILLS

Programming Languages: Advance - Python, MATLAB; Intermediate - C++, C
Platforms & Tools: Docker, Git, Isaac Sim, ROS2, Arduino, Webots, OpenFOAM, AutoCAD, Fusion360, SolidWorks
Frameworks & Libraries: PyTorch, Gym, OpenCV, NumPy, SciPy