Ali Vaziri

Scientific ML, Real-Time MPC for Complex Systems
Department of Mechanical Engineering
University of Kansas

+1 (785) 764–7916
alivaziri@ku.edu
GitHub | LinkedIn
Google Scholar

I. Professional Summary

Control engineer and machine learning scientist with 4+ years of experience designing real-time estimation and control frameworks for high-dimensional, nonlinear systems in autonomous vehicles, fluid systems, and smart buildings. Expert in Bayesian MPC and optimal inferential control (My Ph.D. work), Kalman filtering (EKF, UKF, EnKF, Auto-Diff EnKF), and particle filtering, with advanced skills in GPU-accelerated inference and physics-informed neural ODE/PDE modeling. Developed scalable, gradient-free MPC algorithms and real-time controllers for neural network dynamics.

II. Education

Ph.D.	Mechanical Engineering – University of Kansas 2023–present GPA 3.98/4.00 — Thesis: *Optimal Inferential Control of ML Models*
M.Sc.	Mechanical Engineering – University of Kansas 2023–2025 GPA 4.00/4.00 — Thesis: *Heavy-Tailed Bayesian Motion Planning for AVs*
B.Sc.	Mechanical Engineering – Sharif University of Technology 2016–2021 GPA 3.55/4.00 — Thesis: Collision-Free Waste-Collection Robot

III. Internships

Summer 2024
Cambridge, MA, U.S.

Research Intern, Mitsubishi Electric Research Laboratories (MERL), Machine learning modeling and optimization

- Developed physics-constrained Neural-ODE-GRU for HVAC modeling—data-efficient training, improved accuracy by 14%, and faster run-time (5.7×). ***(PINNs, Neural ODEs, GRU, HVAC Modeling, Physics-based Learning)***
- Delivered a PyTorch toolkit now used by MERL researchers. ***(PyTorch, Research Software, ML Toolkits)***

Spring 2024
Cambridge, MA, U.S.

Research Intern in MERL, Optimal control and estimation for HVAC

- Developed a gradient-free Bayesian MPC framework for HVAC optimal control with a neural network dynamical system. ***(Bayesian MPC, Neural Network Dynamics, HVAC Control)***
- Released CUDA-based PyTorch packages for real-time control. ***(CUDA, PyTorch, Real-Time Control)***

IV. Work Experience

Graduate Research Assistant, University of Kansas 2023–Present

- Developed Bayesian MPC for continuous-time Neural-ODE–based soft-robot control; achieved 10× higher accuracy and 200× faster solves than CasADi + IPOPT. ***(Bayesian MPC, Neural ODEs, Optimal Control, Pytorch, CUDA)***
- Proposed a tensor-variate, GPU-compatible ensemble Kalman smoother for high-dimensional complex dynamical systems (3D Navier–Stokes and Burgers' PDE) modeled with neural networks; enabled real-time optimal control. ***(Kalman Filtering and Smoothing, GPU Computing, Machine Learning for Dynamical Systems, Pytorch, CUDA)***
- Designed a physics-constrained Neural-ODE-GRU model for HVAC systems; achieved 14% better accuracy and 5.7× faster runtime with data-efficient training. ***(HVAC Modeling, Neural ODEs, Neural ODE-GRUs, PINNs)***
- Developed gradient-free MPC for CNN dynamics using CUDA-based matrix-variate ensemble Kalman-type smoothing; delivered 200× speedup and 12× memory savings. ***(MPC, CNNs, Kalman Filtering and Smoothing, Pytorch, CUDA)***
- Introduced heavy-tailed Bayesian MPC with Student's-t inference for robust motion planning under uncertainty for autonomous vehicles. ***(Python, MATLAB, Real-Time Robust Control and Estimation, Real-Time Robust/Safe Motion Planning)***
- Modeled vehicle dynamics using GRU and ResNet trained on real data; conducted MPC benchmarking via CasADi + IPOPT. ***(Vehicle Modeling, Deep Learning, MPC Benchmarking, Pytorch, CUDA)***
- Designed RL-based sensor placement strategies for persistent monitoring; minimized estimation-error covariance for robust state coverage. ***(Reinforcement Learning, Sensor Placement, Estimation Theory)***

Undergraduate Researcher, Sharif University of Technology 2021–22, Tehran, Iran

- Built a mobile robot with SCARA-arm for sea-surface plastic collection; implemented hybrid path planning (RRT, Dijkstra, potential fields) and PID arm control. ***(Mobile Robotics, Path Planning, PID Control)***

V. Publications

- **Ali Vaziri**, et al. "Continuous-Time Optimal Control of Neural ODEs via Bayesian Inference", Under review, *Conference on Neural Information Processing Systems (NeurIPS)*, 2025.
- **Ali Vaziri**, et al. "Optimal Inferential Control of Machine Learning Models", Under review, *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*.
- **Ali Vaziri**, et al. "Physics-Constrained Neural ODEs for HVAC: Scalable, Efficient, and Physically Consistent Modeling", Under review, *Applied Thermal Engineering* (Work done in MERL).
- **Ali Vaziri**, et al. "Bayesian Inferential Motion Planning Using Heavy-Tailed Distributions", In 2025 *American Control Conference, IEEE*, (Paper).
- **Ali Vaziri**, et al. "Optimal Inferential Control of Convolutional Neural Networks", In 2025 *American Control Conference, IEEE*; Best Student Paper nominee (Paper).
- Iman Askari, **Ali Vaziri**, et al. "Model Predictive Inferential Control of Neural State-Space Models for Autonomous Vehicle Motion Planning", *IEEE Transactions on Robotics (T-RO)*, 2025, (Paper).

VI. Technical Skills

Control & Estimation

- Bayesian MPC & Optimal Inferential Control (My own PhD work)
- PDE Optimal Control
- MPC, NMPC, Path-Integral Control (CasADi / IPOPT & fmincon, MPPI)
- Kalman Filters: KF, EKF, UKF, EnKF, Auto-Diff EnKF
- Ensemble Kalman Smoothing
- Particle Filters, SMC
- Robust Filtering and Smoothing

ML & Dynamical Modeling

- Physics-Informed ML
- Neural ODEs / PDEs
- CNNs, GRUs, LSTMs, FNNs
- Dynamic Programming and RL (Q-Learning, Ψ-Learning)
- Time-Series Modeling

Optimization & SystemID

- GPU Computing (CUDA, PyTorch, TensorFlow)
- Gradient-Free Optimization
- Ensemble Kalman Inversion (For ML Training)
- Expectation Maximization (EM)

VII. Awards, Grants & Honours

- **2025** – "Challenge Seeker" outstanding student award (The University of Kansas)
- **2025** – Student travel award, ACC 2025
- **2025** – Annual GEA research showcase competition at KU
- **2025** – I2S student research symposium (ISRS) at KU
- **2024** – Annual GEA research showcase competition at KU
- **2023** – Wyatt memorial scholarship (Top 1% of graduate students)
- **2022** – Best publication award at MIC 2022
- **2019** – Excellent student award: 3rd Rank among Sharif's Marine Eng. students
- **2016** – Top 0.4% out of 170,000 students participating in Iran's nationwide university entrance exam

References available upon request.