

Ali Vaziri

Lawrence, KS, USA

Ph.D. Applicant — Mechanical Engineering (Control, Estimation, Machine Learning)

✉ Email — GitHub — in LinkedIn — Google Scholar

Education

- **University of Kansas** Lawrence, KS
M.Sc., Mechanical Engineering (GPA: 4.00/4.00) 2023 – 2025
– Thesis: *Heavy-Tailed Bayesian Inferential Motion Planning for Autonomous Vehicles.*
- **Sharif University of Technology** Tehran, Iran
B.Sc., Marine Engineering (GPA: 3.55/4.00) 2016 – 2021
– Thesis: *Collision-Free Marine Waste-Collection Robot.*

Summary

I develop safe and computationally efficient optimal control frameworks for complex systems governed by neural-network dynamics. My work blends optimal control and Bayesian inference with GPU-accelerated inference to achieve real-time, robust decision-making in high-dimensional, nonlinear dynamical systems (e.g., autonomous vehicles, soft robots, and thermo-fluid systems).

Research/Teaching and Industry Experience

- **Mitsubishi Electric Research Laboratories (MERL)** Cambridge, MA
Research Intern — Machine Learning and Optimization Summer 2024
 - Built physics-constrained Neural ODE/GRU thermal models for HVAC; delivered PyTorch toolkit for MERL researchers.
 - Improved forecasting accuracy and runtime efficiency via data-efficient training and GPU acceleration.
- **Mitsubishi Electric Research Laboratories (MERL)** Cambridge, MA
Research Collaboration — Optimal Control and Estimation of HVAC Spring 2024
 - Collaborated with MERL researchers via KU advisor on optimal inferential control of neural network dynamical systems of HVAC systems.
- **University of Kansas** Lawrence, KS
Graduate Research Assistant 2023 – Present
 - **NeurIPS 2025 (Under Review)**: Continuous-time MPC via Bayesian inference for Neural-ODE-based soft-robot manipulators; achieves $10\times$ accuracy gains and $200\times$ faster solve times versus CasADi + IPOPT.
 - **IEEE T-RO 2025 (Paper)**: Developed learning-based vehicle dynamics models (GRU, ResNet) for AV trajectory planning; validated on real-world driving datasets. GRU models were subsequently applied in MPC benchmark evaluations (CasADi + IPOPT).

- **ACC 2025** ([Paper](#)): Heavy-tailed Bayesian motion planning with Student's- t priors for improving exploration; sequential Monte Carlo ensemble Kalman- t smoother for robust inference; validated on neural-network-based vehicle dynamics.
- **ACC 2025** ([Paper](#)): MPC of convolutional neural networks using gradient-free CUDA-based matrix-variate ensemble Kalman smoothing; achieved $20\times$ faster computations and $12\times$ higher memory efficiency in large-scale neural networks.
- Reinforcement-learning-driven sensor placement for persistent monitoring, optimizing estimation-error covariance for robust coverage.
- **(To Be Submitted in 2025)**: Tensor-variate GPU-compatible ensemble Kalman smoother for optimal control of neural-network-modeled high-dimensional systems (3D, and 2D Navier-Stokes & Burgers' PDEs), enabling millisecond-scale optimal control where classical solvers fail.
- **Applied Thermal Engineering (Under Review)**: Physics-constrained Neural-ODE-GRU for HVAC modeling; achieved 14% accuracy improvement and $5.7\times$ faster runtime with data-efficient training.

- **Sharif University of Technology** Tehran, Iran
Undergraduate Researcher 2020 – 2022
 - Built a mobile robot with a SCARA arm for sea-surface plastic collection; integrated hybrid path planning (RRT, Dijkstra, potential fields) with PID control.
 - Modeled mechanisms and ran simulations in MATLAB/Simulink; created CAD in SolidWorks for rapid prototyping.
- **Sharif University of Technology** Tehran, Iran
Teaching Assistant — Structure Analysis (Prof. M. R. Tabeshpour) Spring 2018 – 2019
 - Led problem-solving sessions, graded assignments/exams, and provided office-hour support to students.

Publications

First-Authored:

- **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”, To be submitted.
- **Ali Vaziri**, et al. “Physics-Constrained Neural ODEs for HVAC: Scalable, Efficient, and Physically Consistent Modeling”, Under review, *Applied Thermal Engineering*.
- **Ali Vaziri**, et al. “Bayesian Inferential Motion Planning Using Heavy-Tailed Distributions”, In 2025 *American Control Conference (ACC)*, ([Paper](#)).
- **Ali Vaziri**, et al. “Optimal Inferential Control of Convolutional Neural Networks”, In 2025 *American Control Conference (ACC)*; Best Student Paper nominee ([Paper](#)).

Co-Authored:

- 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](#)).

Selected Undergraduate Projects in Sharif (2018-2021)

- AUBO-i5 (6R) collaborative robot: forward/inverse kinematics (Robotics Toolbox), Simscape model, Jacobian & singularity analysis; Newton–Euler dynamics with PD control (MATLAB/Simulink).
- Surgical needle navigation GUI (MATLAB): collision-free path planning with RRT.
- SCARA robot: DH-based forward/inverse kinematics; SimMechanics verification.

Certifications

Reinforcement Learning Specialization ([Link](#)) — University of Alberta & AMII (Coursera).

Topics: TD learning, Monte Carlo, SARSA, Q-learning, Policy Gradients, Dyna, function approximation.

Skills

• Control and Estimation

- Optimal Inferential Control; MPC via Bayesian inference, NMPC/MPPI; Optimal control of Neural ODE/PDE systems
- Kalman Filtering and Smoothing (KF/EKF/UKF/EnKF; tensor/matrix-variate EnKF and EnKS); Particle filters
- Robust filtering and smoothing; inference with Student’s- t distribution

• Machine Learning and Dynamical Modeling

- Neural ODE/PDEs, CNNs, GRU/LSTM, physics-informed ML, time-series forecasting
- System identification; dynamic programming and reinforcement learning fundamentals

• Optimization

- Gradient-based methods
- Gradient-free methods; ensemble Kalman inversion for NN training and system identification
- Constrained nonlinear optimization: CasADi + IPOPT integration, benchmarking, sensitivity analysis
- Large-scale linear algebra and convex optimization (QP, SQP)

• Programming

- Languages: Python, MATLAB, C/C++, \LaTeX
- Libraries/Tools: PyTorch, TensorFlow, NumPy/SciPy, CUDA GPUs, cuDNN

Awards, Grants and Honours

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| “Challenge Seeker” Outstanding Student Award, University of Kansas | 2025 |
| Student Travel Award, American Control Conference (ACC) | 2025 |
| Wyatt Memorial Scholarship (Top 1% of graduate students) | 2023 |
| Best Publication Award (MIC) | 2022 |
| Excellent Student Award: 3rd Rank, Sharif Marine Engineering | 2019 |
| Top 0.4% in Iran Nationwide University Entrance Exam | 2016 |

References available upon request.