

Anant A. Joshi

✉ anantaj2@illinois.edu | 🌐 <https://anantjoshi97.github.io/website> | 📄 anantjoshi97 | 🏠 Google Scholar

Summary

- As a control theorist and applied mathematician, my foundation is in **stochastic differential equations, stochastic optimal control (SOC), and filtering**. I am interested in problems in **sampling, SOC, generative models, and optimization**. My research focusses on **constructing sampling-based algorithms for SOC and reinforcement learning using interacting particle systems**.

Education

Ph.D. in Mech. Engg., Univ. of Illinois Urbana-Champaign (GPA 4.0/4.0, Advisor: Prof. Prashant Mehta)

Jan. 2021 - present

- Awarded: Grainger Engineering Graduate Fellowship

B.Tech. in Mech. Engg. and M.Tech. in Systems and Control Engg., IIT Bombay, India (GPA 9.44/10)

Aug. 2015 - July 2020

- Awarded: Best student paper award, 29th AAS/AIAA Space-Flight Mechanics Meeting, 2019
- Awarded: Undergraduate Research Award

Selected Publications

- Anant A. Joshi**, Saviz Mowlavi, Mouhacine Benosman, "A Dual Ensemble Kalman Filter Approach to Robust Control of Nonlinear Systems: An Application to Partial Differential Equations", accepted to IEEE Conference on Decision and Control (CDC), 2025
- Anant A. Joshi**, Amirhossein Taghvaei, Prashant G. Mehta, "Error Analysis of Sampling Algorithms for Approximating Stochastic Optimal Control", accepted to IEEE Conference on Decision and Control (CDC), 2025
- Anant A. Joshi**, Heng-Sheng Chang, Amirhossein Taghvaei, Prashant G. Mehta, Sean P. Meyn, "Interacting Particle Systems for Fast Linear Quadratic RL", Learning for Dynamics & Control Conference (L4DC), 2024
- Anant A. Joshi**, Amirhossein Taghvaei, Prashant G. Mehta, Sean P. Meyn, "Controlled interacting particle algorithms for simulation-based reinforcement learning", Systems & Control Letters, 2022
- Anant A. Joshi**, Debasish Chatterjee, Ravi N. Banavar, "Robust Discrete-Time Pontryagin Maximum Principle on Matrix Lie Groups", IEEE Transactions on Automatic Control, 2021
- Anant A. Joshi**, D.H.S. Maithripala, Ravi N. Banavar, "A bundle framework for observer design on smooth manifolds with symmetry", Journal of Geometric Mechanics, 2021
- Anant A. Joshi**, Kamesh Subbarao, "Uncertainty Quantification and Analysis of Dynamical Systems with Invariants", AAS-19-368, 29th AAS/AIAA Space-Flight Mechanics Meeting, January, 2019

Research Experience

dual-EnKF Algorithm For Fast Simulation-Based RL (SCL '22, L4DC '25, CDC '25)

UIUC

RESEARCH WITH PROF. P. G. MEHTA, PROF. A. TAGHVAEI, PROF. S. P. MEYN

Jan 2021 - Dec 2024

- Developed a simulation based algorithm (dual-EnKF) for stochastic optimal control and RL in continuous-time continuous-state systems.
- Represented value function as a probability density and deployed the Ensemble Kalman Filter (EnKF) to sample efficiently from it.
- Numerically benchmarked dual-EnKF against policy gradient method, demonstrating upto 100x computational speedup.

Industry Internship: dual-EnKF for Data Driven Robust Control of PDEs (CDC '25)

Mitsubishi Electric Research Labs

RESEARCH INTERN WITH DR. MOUHACINE BENOSMAN AND DR. SAVIZ MOWLAVI

June 2024 - August 2024

- Developed a data-driven robust controller for nonlinear, affine-in-control systems, e.g., models obtained from the spatial discretization of partial differential equations. Combined an optimal control estimated using dual-EnKF with a robust control obtained from Lyapunov redesign.
- Validated the algorithm's performance and robustness through extensive simulations on the heat equation and Burgers' equation.

Error Analysis of Sampling Algorithms for Stochastic Control (CDC'25)

UIUC

RESEARCH WITH PROF. P. G. MEHTA AND PROF. A. TAGHVAEI

Jan 2025 - ongoing

- Developed an interacting particle-based sampling algorithm to numerically approximate discrete-time stochastic optimal control.
- Highlighted the method's scalability by analytically and numerically demonstrating that approximation error in the proposed algorithm avoids "curse of dimensionality" seen in importance sampling.

Robust Discrete-Time Pontryagin Maximum Principle on Matrix Lie Groups (TAC'21)

IIT Bombay, India

MASTERS THESIS WITH PROF. R. N. BANAVAR AND PROF. D. CHATTERJEE

Aug. 2019 - Jul. 2020

- Extended the Pontryagin maximum principle for discrete-time robust optimal control on matrix Lie groups with bounded disturbances. Validated the analytical solution via numerical simulations.

Observer Design for Systems on Smooth Manifolds with Lie Group Symmetry (JGM '21)

IIT Bombay, India

RESEARCH PROJECT WITH PROF. R. N. BANAVAR AND PROF. D. H. S. MAITHRIPALA

Aug. 2018 - Jul. 2019

- Analyzed the observer design problem for systems on smooth manifolds possessing Lie group symmetry. Leveraged symmetry to decompose observer design problem into two smaller tractable subsystems.

Uncertainty Quantification in Dynamical Systems with Invariants (SFM '19 Best paper)

University of Texas at Arlington

RESEARCH INTERNSHIP WITH PROF. K. S. SUBBARAO

May 2018 - July 2018

- Modelled the effect of Gaussian white noise on dynamical systems that possess conserved quantities (invariants). Characterized the temporal evolution of the statistical moments of invariants. Theoretical results were verified with Monte Carlo simulation.

Skills and Coursework

SKILLS: Python, MATLAB (Simulink, Control System Toolbox, Optimization Toolbox), C++

COURSEWORK: Optimal Control, Stochastic Control, Stochastic Differential Equations, Probability Theory, Real Analysis, Partial Differential Equations, Optimization in Vector Spaces, Optimal Transport, Differential Geometry, Machine Learning for Signal Processing