# Vrushabh Donge

**Personal Information**

✉ vrushabhdonge@gmail.com ⚲ EEID, GRID-C, Oak Ridge National Laboratory, 1 Bethel valley Road
Oak Ridge, TN 37830, USA ☎ +1-682-360-7776

🌐 Portfolio:Vrushabh  🔗 Linkedin  🐙 Github  🎓 Google Scholar  🖥 ORCiD  🖥 Web of Science

**Summary**

Postdoctoral Research Associate with expertise in applying AI, Systems & control, and optimization for complex challenges in power systems and power electronics, with a focus on real-time, data-driven control, and scalable solutions. My research spans optimal control, reinforcement learning, health monitoring, multiagent systems, and intelligent control of dynamic energy systems.

## Education

**University of Texas at Arlington, Arlington, TX** — Jan 2021 – Dec 2023
*Ph.D. (Electrical Engg.)* — 4.00/4.00
Advisor : Dr. Ali Davoudi and Dr. Frank Lewis
Thesis : Learning and Control of Complex Multiagent Systems

**Veermata Jijabai Technological Institute (VJTI), Mumbai, India** — 2018–2020
*M. Tech (Electrical Engg.)* — 9.51/10.00
Advisor : Dr. N. M. Singh and Dr. S. R. Wagh
Thesis : Stochastic Optimal Control : Path Integral Control & Reinforcement Learning

Studying for entrance exams – GATE and IES — 2017

**Government College of Engineering, Aurangabad, India** — 2013 – 2016
*BE (Electrical, Electronics and Power)* — 8.785/10.00

**MSBTE, Mumbai, India** — 2010 – 2013
*Diploma (Electrical Engg.)* — 89.12%

## Work Experience

**Oak Ridge National Laboratory (ORNL), Oak Ridge, TN** — March 2024 - Present
*Postdoctoral Research Associate* — (MATLAB/Simulink, OpenDSS, Python)

— Developed and coded supporting neural network-based network coordinator to limit voltage deviations of a power system feeder.

— Developed an end-to-end simulation workflow using MATLAB/Simulink + OpenDSS + Python for rapid iteration and evaluation.

— Designed a health monitoring framework for power semiconductor modules, including a real-time degradation classification algorithm.

— Developed intelligent health monitoring framework for power modules using physics of failures informed LSTM.

**The University of Texas at Arlington (UTA), Arlington, TX**
*Research Assistant (Volunteer)* — Jan 2024 - Feb 2024
*Graduate Research Assistant* — Jan 2021 - Dec 2023

— Developed model-based and model-free inverse reinforcement learning (RL) algorithms for uncovering cost functions from expert behavior in graphical apprentice games, with validation through the simulated case study of DC microgrid

— Developed an accelerated model-free RL algorithm leveraging online behaviors and dynamic mode decomposition to address scalability issues, validated on a consensus and a power system network

— Developed a data-efficient model-free RL algorithm using Koopman operators for nonlinear systems, enabling high-dimensional optimal control through a data-driven approach. Validated the algorithm's efficacy on power system excitation control

— Developed a model-based policy iteration framework and an online data-driven off-policy inverse RL algorithm for multiplayer games in continuous-time dynamical systems

— Developed scalable model-free inverse RL algorithm to solve the reward-shaping challenge in large-scale multiagent systems

**VJTI, Mumbai, India – Control and Decision Research Center** — May 2019 - May 2020
*Graduate Research Assistant* — (MATLAB/Simulink, Python)

— Developed a path integral control and adaptive dynamic programming algorithm for stochastic and deterministic optimal control problems

— Designed the exact embedding method to convert and analytically solve optimal control problems of Markov decision processes (MDPs) in a linearly solvable framework- Path integral model predictive control using Markov Chain Monte Carlo sampling

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| **SKILLS** | — **Programming Languages :** MATLAB/Simulink, Python, OpenDSS, C, C++, R, HTML |
| | — **Software :** CVX, TensorFlow, PyTorch, Scikit-Learn, LaTeX, MS Office, Adobe Creative Suite |
| | — **Hardware :** Typhoon HIL, DigSilent PowerFactory, PLC |
| | — **Specializations :** Advanced Algorithms Development, Neural Network-Based Control, Power Electronics, Model-Based Prognostics and Diagnostics, Data Analysis and Visualization |

**RESEARCH PUBLICATIONS**

— **Journal Articles (Published)** :

[1] V. S. Donge, B. Lian, F. L. Lewis and A. Davoudi, "Efficient Reward Shaping for Multiagent Systems," in *IEEE Trans. Control Netw. Syst.*, 2024.

[2] V. S. Donge, B. Lian, F. L. Lewis and A. Davoudi, "Data-Efficient Reinforcement Learning for Complex Nonlinear Systems," in *IEEE Trans. Cybern.*, vol. 54, no. 3, pp. 1391-1402, 2024.

[3] V. S. Donge, B. Lian, F. L. Lewis and A. Davoudi, "Multiagent Graphical Games with Inverse Reinforcement Learning," in *IEEE Trans. Control Netw. Syst.*, vol. 10, no. 2, pp. 841-852, 2023.

[4] V. S. Donge, B. Lian, F. L. Lewis and A. Davoudi, "Accelerated Reinforcement Learning Via Dynamic Mode Decomposition," in *IEEE Trans. Control Netw. Syst.*, vol. 10, no. 4, pp. 2022-2034, 2023.

[5] B. Lian, V. S. Donge, W. Xue, F. L. Lewis and A. Davoudi, "Distributed Minmax Strategy for Multiplayer Games : Stability, Robustness, and Algorithms," in *IEEE Trans. Neural Netw. Learn. Syst.*, vol. 35, no. 3, pp. 3265-3277, 2024.

[6] B. Lian, V. S. Donge, F. L. Lewis, T. Chai and A. Davoudi, "Data-Driven Inverse Reinforcement Learning Control for Linear Multiplayer Games," in *IEEE Trans. Neural Netw. Learn. Syst.*, vol. 35, no. 2, pp. 2028-2041, 2024.

— **Conference Papers (Accepted)** :

[1] Vrushabh S. Donge, Joao O. Pereira Pinto, Aswad Adib, Radha Sree Krishna Moorthy, Madhu Chinthavali, "Data-Driven Voltage Regulation of Distribution Grid using Nonlinear Autoregressive Model with Exogenous Inputs (NARX)," *IEEE ECCE*, Philadelphia, USA, 2025.

— **Conference Papers (Published)** :

[1] B. Lian, V. S. Donge, F. L. Lewis, T. Chai, and A. Davoudi, "Inverse Reinforcement Learning Control for Linear Multiplayer Games," *IEEE Conf. Decis. Control (CDC)*, Cancun, Mexico, pp. 2839-2844, 2022.

[2] D. Vrushabh, K. Shalini, K. Sonam, S. Wagh, and N. M. Singh, "Adaptive Dynamic Programming for Optimal Synchronization of Kuramoto Oscillator," *American Control Conf. (ACC)*, Denver, CO, USA, pp. 1755-1760, 2020.

[3] D. Vrushabh, P. Akshay, K. Sonam, S. Wagh, and N. M. Singh, "Robust Path Integral Control on Stochastic Differential Games," *Mediterranean Conf. Control Autom. (MED)*, Saint-Raphael, France, pp. 665-670, 2020.

[4] D. Vrushabh, S. K. and K. Sonam, "Actor-Critic Algorithm for Optimal Synchronization of Kuramoto Oscillator," *Int. Conf. Control, Decis. Info. Techno. (CoDIT)*, Prague, Czech Republic, pp. 391-396, 2020.

**COURSES AND PROJECTS**

— **Ph.D. (Electrical)**- Power Electronics Engineering, Distributed Decision & Control, Convex Optimization, Nonlinear systems, Power Electronic Drives

  — MATLAB simulations of nonlinear and chaotic systems- Dynamic system analysis
  — Simulated a consensus-based formation control system with nonlinear dynamics nodes
  — Created convex relaxations using LP and SDP methods for non-convex optimization problems
  — Averaged modeling of hard switching PWM converters, DC-DC Boost converter
  — Simulated adaptive sliding mode controller for buck converter via gain scheduling
  — Simulated multiple-input hybrid energy conversion topology
  — Multiple reference frame analysis of non-sinusoidal brushless DC drives, induction motor drives

— **M.tech (Electrical)**- Dynamical systems, Optimal Control, Nonlinear System Analysis & Design, Robotics Dynamics & Control, System Identification & Filtering, Abstract Algebra

  — Studied advanced learning algorithms-online gradient descent and scenario approach to stochastic optimization, Feedback linearization of the buck-boost converter

**AWARDS AND CERTIFICATION**

— Dr. Mo-Shing Chen Scholarship in Power Systems (Jan 2023)
— Laxmi and Raj Mrig Endowed Graduate Fellowship for Electrical Engineering Award (Aug 2023)
— PG Scholarship, All India Council for Technical Education, India (2018-2020)
— First rank among M.Tech Students
— Workshop on Learning and Control for the Application of Machine Learning in Control System, IIT Mandi, 2019
— Workshop on Application of Digital Signal Processing, IIT Bombay, 2016
— Workshop on From Data to Decisions : The Scenario Approach (Systems, Control, Machine Learning), IIT Bombay, 2020
— In-plant Trainee- Production and testing of transformers 2015, Jain Electricals Pvt. Ltd. Aurangabad
— PLC programming at IGTR- Aurangabad, Certificate of training- MSME, Member of BAJA SAE

**SERVICES**

— **Reviewer :** IEEE Transactions on Cybernetics, IEEE Transactions on Neural Networks and Learning Systems (TNNLS), IEEE Transactions on Control of Network Systems (TCNS), IEEE Transactions on Automatic Control, Automatica, IEEE Control Systems Letters (L-CSS), IEEE Robotics and Automation Letters, IEEE Conference on Decision and Control (CDC), American Control Conference (ACC), Journal of Dynamic Systems, Measurement and Control, IEEE Energy Conversion Congress and Exposition (ECCE), Springer Nature's Machine Learning (SNAPP)
— IEEE member, IEEE Eta Kappa Nu member
— International Relocation Friend at ORNL

**INVITED TALKS AND SEMINARS**

— V. S. Donge, "Learning and control for complex multiagent systems," Oak Ridge National Laboratory, invited seminar, Oak Ridge, TN, November 2023.

**INTERNATIONAL VISITS AND PRESENTATIONS**

— Conference paper presented at IEEE CDC, Cancun, Mexico, 2022.
— Conference paper, Denver, CO, USA, conference paper presented at ACC, 2020.
— Conference paper, Saint-Raphael, France, conference paper presented at MED, 2020.