

VINEET JAGADEESAN NAIR

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EDUCATION

Massachusetts Institute of Technology | PhD in Computational Science and Engineering | **GPA:** 5.0/5.0 *Jan 2021 - May 2025 (expected)*
PhD Candidate in the Mechanical Engineering department

Massachusetts Institute of Technology | SM in Computational Science and Engineering | **GPA:** 5.0/5.0 *Sep 2019 - Jan 2021*
Thesis: Estimating cumulative prospect theoretic passenger behavioral models for dynamic pricing & transactive control of shared mobility

University of Cambridge | MPhil in Energy Technologies | Gates Cambridge Scholarship *Sep 2018 - Sep 2019*
Thesis: Optimal design & energy management of islanded, hybrid microgrids for off-grid communities with no external power exchange

University of California, Berkeley | **Cumulative GPA:** 3.842/4.0 | Dean's Honors List | Phi Beta Kappa *Aug 2014 - May 2018*
B.S. Mechanical Engineering (Honors), B.A. Economics | Distinction | Honor Societies: Tau Beta Pi, Pi Tau Sigma, Omicron Delta Epsilon
Minor in Electrical Engineering & Computer Sciences | Certifications in Human-Centered Design and Entrepreneurship & Technology

Programming: Python, Julia, MATLAB/Simulink, Java, JAX, R, PyTorch, TensorFlow, Fortran, Git, STATA, LaTeX

Reviewer for: IEEE Conference on Decision & Control, IEEE Transactions on Control of Networked Systems, NeurIPS Tackling Climate Change with Machine Learning Workshop, ACM e-Energy Conference, IEEE Transactions on Control Systems Technology, IEEE International Conference on Automation Science and Engineering, International Journal of Electrical Power and Energy Systems, International Federation of Automatic Control World Congress, IEEE Transactions on Automatic Control

RESEARCH EXPERIENCE

Graduate Research Assistant | Active Adaptive Control Lab, MIT Mechanical Engineering Department *Sep 2019 - present*

- Advised by Dr. Anuradha Annaswamy, thesis committee: Prof. Andy Sun and Prof. Kamal Youcef-Toumi
- Applying optimization, game theory, machine learning and control tools to model power grids and electricity markets
- Designed new local market structures and algorithms to better coordinate and compensate distributed energy resources (DERs)
- Modeled dynamic pricing for shared, mobility-on-demand services using cumulative prospect theory
- Worked with external partners including Ford, Siemens, Shell, GE, PNNL, NREL, Dept. of Energy and Princeton University
- Managed global collaborations with faculty in Portugal, Spain, Switzerland, and Brazil

Computational Scientist PhD Resident | [Google] X, the moonshot factory, Mountain View, CA *May - Dec 2023*

- Built improved inverter models & power system simulators for the grid with Project Tapestry
- Applied scientific, physics-informed machine learning to enhance the speed and accuracy of transient dynamic numerical simulations
- Improved stochastic optimization model for power system planning with hydro and renewables to study value of battery storage

Graduate Research Intern | National Renewable Energy Laboratory (NREL), Golden, CO *May - Aug 2022*

- System modeling and digital real-time simulation for hardware-in-the-loop validation of optimization/control algorithms in power grids

Research Intern, Artificial Intelligence/Deep Learning for Smart Grids | Siemens, Princeton, NJ *May - Sep 2020*

- Developed a bilevel optimization framework and market mechanism for grid integration of DERs along with demand response

Graduate Student Researcher | Control Group, Cambridge University Engineering Department *Nov 2018 - Aug 2019*

- Researched the optimal design, energy management, dispatch, and control of hybrid, islanded microgrids, supervised by Dr. Ioannis Lestas

Mechanical and Process Engineering Intern | Applied Materials, Santa Clara, CA *May - Aug 2017*

- Developed a more accurate, real-time and cost-effective method for monitoring levels of solid chemicals inside process chambers
- Drafted 3D models, detail drawings, collaborated with suppliers to implement alternative sensors and measurement techniques

Honors Undergraduate Researcher | UC Berkeley *Jan 2017 - May 2018*

- Designed and prototyped low-cost energy monitors, scaled up to produce 80+ units for field trials in Nicaragua via laser cutting
- Researched user incentives, programmed sensor networks to optimize electricity use and improve behavioral energy efficiency
- Studied optimal electric vehicle charge scheduling from a hybrid systems perspective
- Advised by Prof. Duncan Callaway, Prof. Kameshwar Poolla, and Prof. Claire Tomlin

Cal Energy Corps Research Intern | Academia Sinica, Taipei, Taiwan | Berkeley Energy & Climate Institute *Jun - Aug 2016*

- Optimized organic, low-cost dye-sensitized solar PV cells to raise efficiency from 8 to 9%, improved stability through co-sensitization

Undergraduate Research Apprentice | Indoor Air Lab, Civil and Environmental Engineering, UC Berkeley *Jan - Jun 2016*

- Investigated and modeled temperature effects on airflow patterns and mixing times of gaseous pollutants, under Prof. William Nazaroff
- Independently designed and completed pilot experiment studying ultrafine particle emissions from dust and hot surfaces

PROFESSIONAL EXPERIENCE

Artificial Intelligence (AI) Fellow | MIT-Pillar AI Collective

Jan- Jun 2024

- Customer discovery to explore commercial applications of my research in timeseries forecasting & physics-informed ML for power systems
- Participated in the National Science Foundation (NSF) Innovation Corps (I-Corps) program at MIT

MIT Delegate & UNFCCC Observer | COP28, Dubai, United Arab Emirates

Oct - Dec 2023

- Represented MIT and observed international negotiations at the 2023 United Nations Climate Change Conference of the Parties

Technical Curriculum Developer & Lead Instructor | MIT International Science & Technology Initiatives

Nov 2023 - Jan 2024

- Developed curriculum and taught a high school course on climate change, clean energy & decarbonization in South Africa & Botswana

Data Science & Machine Learning Instructor | MIT International Science & Technology Initiatives, Montevideo, Uruguay

Jan 2023

- Organized 3-week machine learning & entrepreneurship course at Universidad Tecnológica del Uruguay as part of MIT Global Startup Labs
- Developed & taught interactive lessons on neural networks, advanced deep learning methods, model validation, and hyperparameter tuning
- Mentored teams of students and professionals working on diverse applied ML startups and research projects

Research Consultant for Innovation Challenge | Avangrid, Orange, CT

May - Oct 2021

- Worked with Avangrid's Smart Grids Innovation team to implement a distributed energy resources management system (DERMS) pilot
- Developed a hybrid/federated software architecture and decision-making method for DERMS, to enhance cybersecurity & interoperability

Thriving Earth Exchange Community Science Fellow | American Geophysical Union (AGU)

Jan 2021 - Nov 2023

- Part of 2021 cohort, in partnership with American Meteorological Society (AMS) and Association of Science & Technology Centers (ASTC)
- Worked with scientists, community leaders, legislators, gas & power utility representatives, environmental advocates, and local citizens
- GIS data collection, infrastructure planning, and environmental impact assessment to build an energy plan for Otsego County, New York

Energy Management Intern at DEW21 (Energy & Water Authority) | Dortmund, Germany

Jul - Aug 2018

- Modeled and optimized hourly/daily price forward curves to predict natural gas prices in European markets, five years into the future

External Consultant | BERC Innovative Solutions Consulting

Jan 2016 - Jun 2017

- **Electric Power Research Institute:** Identified key drivers and use-cases for production, storage, transport, and use of hydrogen energy
- **Amazon Web Services:** Analyzed technical, financial, and policy issues for battery storage (with renewables) in Amazon data centers

PUBLICATIONS

Vineet Nair, "Enhanced Physics-informed Neural Networks for high-order power grid dynamics." Submitted (2024).

Vineet Nair, "Multiobjective Optimization-Based Design and Dispatch of Islanded, Hybrid Microgrids for Remote, Off-grid Communities in Sub-Saharan Africa." Submitted, under review (2024).

Vineet Nair et al. "Federated Learning Forecasting for Strengthening Grid Reliability and Enabling Markets for Resilience." International Conference On Electricity Distribution (CIRED) 2024 USA Workshop.

Vineet Nair et al. "Resilience of the Electric Grid through Trustable IoT-Coordinated Assets." Submitted to the Proceedings of the National Academy of Sciences (PNAS 2024).

Luca Hartmann*, **Vineet Nair***, and Anuradha M. Annaswamy. "Circuit-aware distributed optimal voltage control for distribution grids." MIT "A+B" Applied Energy Symposium (MITAB 2024).

Vineet Nair, and Anuradha M. Annaswamy. "A game-theoretic, market-based approach to extract flexibility from distributed energy resources." Submitted to 5th IFAC Workshop on Cyber-Physical Human Systems (2024).

Lucas Pereira, **Vineet Nair**, et al. "Accurate Federated Learning With Uncertainty Quantification For Distributed Energy Resource Forecasting Applied To Smart Grids Planning And Operation: The ALAMO Vision." International Conference On Electricity Distribution (CIRED) 2024 Vienna Workshop.

Vineet Nair, Priyank Srivastava, and Anuradha M. Annaswamy. "Enhancing power grid resilience to cyber-physical attacks using distributed retail electricity markets." 15th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS 2024).

Vineet Nair, and Anuradha M. Annaswamy. "Local retail electricity markets for voltage control and distribution grid services." 7th IEEE Conference on Control Technology and Applications (CCTA 2023).

Vineet Nair, Venkatesh Venkataramanan, Rabab Haider, and Anuradha M. Annaswamy. "A Hierarchical Local Electricity Market for a DER-rich Grid Edge." IEEE Transactions on Smart Grid (2022).

Thomas Lee*, **Vineet Nair***, and Andy Sun. "Impacts of Dynamic Line Ratings on the ERCOT Transmission System." 54th North American Power Symposium (NAPS 2022).

Priyank Srivastava, Rabab Haider, **Vineet Nair**, Venkatesh Venkataramanan, Anuradha M. Annaswamy, and Anurag K. Srivastava. "Voltage regulation in distribution grids: A survey." Annual Reviews in Control (2023).

Vineet Nair and Lucas Pereira. "Improving accuracy and convergence of federated learning edge computing methods for generalized DER forecasting applications in power grids." Tackling Climate Change with Machine Learning workshop at the 36th Conference on Neural Information Processing Systems (NeurIPS) (2022).

Anuradha M. Annaswamy* and **Vineet Nair***. "Human Behavioral Models Using Utility Theory and Prospect Theory." In Cyber-Physical-Human Systems: Fundamentals and Applications, UK: Wiley, in Press (2023).

Vineet Nair, Yue Guan, Anuradha M. Annaswamy, H. Eric Tseng, and Baljeet Singh, "Sensitivity Analysis of Passenger Behavioral Model for Dynamic Pricing of Shared Mobility on Demand." Under review.

Vineet Nair, Anuradha M. Annaswamy. “Estimation of Cumulative Prospect Theory-based Passenger Behavioral Models for Dynamic Pricing & Transactive Control of Shared Mobility on Demand.” Master of Science Thesis in Computational Science & Mechanical Engineering, Massachusetts Institute of Technology (2021).

Vineet Nair, Ioannis Lestas. “Optimal design and energy management of islanded, hybrid microgrids for remote, isolated off-grid communities with no external power exchange.” Master of Philosophy Thesis in Energy Technologies. University of Cambridge (2019).

Sean Anderson, **Vineet Nair**. “Electric vehicle charge scheduling on highway networks from an aggregate cost perspective.” Preprint (2018).

PRESENTATIONS

Vineet Nair, Venkatesh Venkataramanan, Rabab Haider, and Anuradha M. Annaswamy. “Hierarchical Local Retail Electricity Markets for Distributed Energy Resources.” IEEE Power and Energy Society General Meeting (PESGM 2023).

Vineet Nair and Anuradha M. Annaswamy. “Local retail electricity markets for grid services in DER-rich distribution systems.” Transactive Energy Theory Workshop, Pacific Northwest National Laboratory (PNNL) (2022).

Vineet Nair, and Anuradha M. Annaswamy. “Local Hierarchical Electricity Markets for Distribution Grid Services like Voltage Control.” Poster presentation at the NREL Fifth Workshop on Autonomous Energy Systems (2022).

Vineet Nair, Venkatesh Venkataramanan, Rabab Haider, and Anuradha M. Annaswamy. “Secure And Private Market-based Coordination of Grid Edge IoT Devices.” Invited presentation at INFORM 2021 Annual Meeting: Session on Data Analytics in Cyber-Physical Systems.

Thomas Lee*, **Vineet Nair***, and Andy Sun. “Impacts of Dynamic Line Ratings on Security-Constrained Economic Dispatch for Transmission Grids & Wholesale Electricity Markets.” Technical Presentation to Federal Energy Regulatory Commission (FERC) (2022).

PROJECTS

Selected Programming Projects | UC Berkeley, University of Cambridge, MIT *Jan 2018 - present*

- Used natural language processing and deep neural networks for future stock price predictions based on textual news data
- Extended sparse regression techniques to discover partial differential equations and denoised data via dynamic mode decomposition
- Implemented a numerical model in MATLAB to simulate traffic flows on highways and mitigate congestion
- Wrote a finite-element, computational fluid dynamics program from scratch in Fortran to analyze compressible flow through pipes
- Developed finite state machine model based on hybrid systems theory to optimally schedule and coordinate EV charging along highways
- Implemented various Java data structures to build a basic version of Google Maps, an auto grader, and an interactive, 2D game

Selected Controls, Modeling, and Design Projects | UC Berkeley, University of Cambridge, MIT *Aug 2014 - May 2018*

- Designed and built an automated, voice-controlled coconut processor as part of senior year capstone mechatronics project
- Designed and built a voice-controlled, miniature car using Python, Arduino, and proportional control schemes in negative feedback
- Designed feedback control systems for magnetic levitation and a self-erecting inverted pendulum, implemented via MATLAB/Simulink
- Designed and 3D printed a mini-windmill to maximize structural strength and stability, built control system for optimal power output
- Designed and prototyped versatile, kinetic lighting structures based on tensegrity soft robots with programmable motion and color schemes

HONORS & AWARDS

Conference Travel Grant Award | MIT Graduate Student Council *Mar 2024*

MIT-Pillar AI Collective Fellowship | Pillar VC & MIT Deshpande Center for Technological Innovation *Dec 2023*

Den Hartog Travel Award in Mechanics | MIT Mechanical Engineering Department *Jan 2023*

Out in STEM (oSTEM) Scholarship | Berkshire Hathaway Energy Foundation *Oct 2022*

Best Paper Award: 3rd Place | 54th North American Power Symposium *Oct 2022*

MIT MADMEC Sustainability Challenge: 2nd Place | MIT Materials Science & Engineering Department *Oct 2022*

Martin Family Society Fellowship for Sustainability | MIT Environmental Solutions Initiative *Mar 2022*

Runner up | MIT Entrepreneurship & Maker Skills Integrator (MEMSI) Hardware Startup Bootcamp *Jan 2022*

International Clean Energy Challenge Winner | Upper Austria *Jul 2019*

Ruhr Fellowship | University Alliance Ruhr & TU Dortmund, Germany *Apr 2018*

43rd Annual Business Today International Conference Impact Challenge Finalist | Princeton University *Nov 2017*

Robotics Institute Summer Scholars Acceptance | Carnegie Mellon *May 2017*

Smart Cities Innovation Collider Winner | Sutardja Center, Pear.VC, Bosch, and City Innovate Foundation *Apr 2017*

Dean's Startup Seed Fund Winner | Haas School of Business, UC Berkeley *May 2017*

LEADERSHIP, TEAMWORK & ACTIVITIES

Impact Officer & Project Lead | Global Shapers Cambridge-MA Hub, World Economic Forum *Sep 2023 - present*

Graduate Student Representative | MIT Corporation Joint Advisory Committee on Institute-Wide Affairs *Aug 2022 - Aug 2023*

Co-President | MIT Energy & Climate Club *Apr 2022 - May 2023*

Content & Operations Team Member | MIT Global Startup Workshop (GSW) *Oct 2021 - Mar 2023*

Technical Research Seminar Organizer | MIT International Science & Technology Initiatives (MISTI) *Sep - Nov 2022*

Elite Summer School in Robotics, Automation & Entrepreneurship | Innovation Centre Denmark *Aug 2022*

Co-Managing Director | 2022 MIT Energy Conference *May 2021 - Apr 2022*

Co-Director of Applicant Experience | 2021 Climate & Energy Prize (CEP) @ MIT *Sep 2020 - April 2021*

Young Professionals Affinity Group Team Lead | Clean Energy for Biden (CE4B) *Jun - Nov 2020*

Graduate Student Leadership Incubator Fellow | MIT 2019-20 Cohort *Sep 2019 - Sep 2020*

Engage for Change Fellow | Cambridge Hub and University of Cambridge Environment & Energy Team *Jan - April 2019*

Undergraduate Student Representative At-Large | The Green Initiative Fund, UC Berkeley *Aug 2017 - May 2018*

Project Manager & Consultant | Bay Area Environmentally Aware Consulting Network (BEACN) *Sep 2015 - May 2018*