

# VINEET JAGADEESAN NAIR

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## EDUCATION

<b>Massachusetts Institute of Technology</b>   PhD in Computational Science & Engineering   <b>GPA:</b> 5.0/5.0	2/21 - 5/25
<i>Thesis:</i> Coordination of distributed energy resources for a reliable, resilient, and affordable decarbonized grid	
<b>Massachusetts Institute of Technology</b>   SM in Computational Science & Engineering   <b>GPA:</b> 5.0/5.0	9/19 - 9/21
<i>Thesis:</i> Cumulative prospect theory passenger behavioral models for dynamic pricing & transactive control of shared mobility	
<b>University of Cambridge</b>   MPhil in Energy Technologies   Gates Cambridge Scholarship   First-Class Honors	9/18 - 9/19
<i>Thesis:</i> Optimal design & energy management of islanded, hybrid microgrids for off-grid communities in sub-Saharan Africa	
<b>University of California, Berkeley</b>   <b>GPA:</b> 3.85/4.0   Dean's Honors List   Phi Beta Kappa	8/14 - 5/18
B.S. Mechanical Engineering (Honor), B.A. Economics   Distinction   Tau Beta Pi, Pi Tau Sigma, Omicron Delta Epsilon	
Minors in Electrical Engineering & Computer Sciences, Human-Centered Design, Entrepreneurship & Technology	

**Programming:** Python, Julia, MATLAB/Simulink, JAX, PyTorch, TensorFlow, Pyomo, Gurobi, Git, LaTeX, JuMP

## RESEARCH EXPERIENCE

<b>Research Intern</b>   Tata Motors, Pune, India	9/25 - present
Artificial intelligence (AI)-based advanced motor control algorithms for electric vehicle power converters	
<b>Postdoctoral Research Associate</b>   MIT Mechanical Engineering & Schwarzman College of Computing	6/25 - present
<b>Human Frontier Collective Specialist</b>   Scale AI	6/25 - present
Evaluating capabilities of large language foundation AI models for control, optimization, and energy system applications	
<b>Computational Research Intern</b>   Shell (Shipping & Maritime), London, United Kingdom	9/25 - 12/25
Applied machine learning, optimization, and geospatial data analysis to reduce ship fuel use, emissions, & methane slip	
<b>Research Intern</b>   Catalyst Investment Management, Amman, Jordan	6/25 - 8/25
Techno-economic analysis & optimization of sustainable AI data centers in Middle East and North Africa (MENA) region	
<b>Graduate Research Assistant</b>   Active Adaptive Control Lab, MIT Mechanical Engineering	9/19 - 6/25
<ul style="list-style-type: none"><li>Applied optimization, game theory, machine learning &amp; control tools to model power grids &amp; electricity markets</li><li>Advised by Dr. Anuradha Annaswamy, thesis committee: Prof. Andy Sun &amp; Prof. Kamal Youcef-Toumi</li><li>Designed new local market structures &amp; algorithms to coordinate &amp; compensate distributed energy resources (DERs)</li><li>Modeled dynamic pricing for shared, mobility-on-demand services using cumulative prospect theory</li><li>Worked with external partners including Ford, Siemens, Shell, GE, PNNL, NREL, Dept. of Energy &amp; Princeton University</li><li>Managed global collaborations with faculty in Portugal, Spain, Switzerland, &amp; Brazil</li><li>Helped with proposal writing &amp; coordination to secure \$4 million+ in grant funding from US DOE &amp; MIT Energy Initiative</li></ul>	
<b>Visiting Researcher</b>   Universidad Politécnica de Madrid, Madrid, Spain	10/23 - 12/24
Applied blockchain infrastructure & smart contracts for novel electricity markets & distributed optimization algorithms	
<b>Computational Scientist PhD Resident</b>   [Google] X, the moonshot factory, Mountain View, CA	5/23 - 9/23
<ul style="list-style-type: none"><li>Built improved inverter models &amp; power system simulators for the grid with Project Tapestry</li><li>Scientific, physics-informed machine learning to enhance speed &amp; accuracy of transient dynamic numerical simulations</li><li>Improved stochastic optimization for power system planning with hydro &amp; renewables to study value of battery storage</li></ul>	
<b>Graduate Research Intern</b>   National Renewable Energy Laboratory (NREL), Golden, CO	6/22 - 8/22
Power grid modeling & digital real-time simulation for hardware-in-the-loop validation of optimization/control algorithms	
<b>Research Consultant for Innovation Challenge</b>   Avangrid, Orange, CT	5/21 - 8/21
<ul style="list-style-type: none"><li>Worked with Smart Grid Innovation team to implement distributed energy resources management system (DERMS) pilot</li><li>Developed hybrid, federated software architecture &amp; decision-making method to enhance cybersecurity &amp; interoperability</li></ul>	
<b>Research Intern, Artificial Intelligence/Deep Learning for Smart Grids</b>   Siemens, Princeton, NJ	5/20 - 9/20
Developed bilevel optimization framework & market mechanism for grid integration of distributed energy resources	

**Graduate Student Researcher** | Control Group, Cambridge University Engineering Department

11/18 - 9/19

Researched optimal design, management, & control of hybrid, islanded microgrids, supervised by Dr. Ioannis Lestas

**Honors Undergraduate Researcher** | UC Berkeley

1/17 - 5/18

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

**Cal Energy Corps Research Intern** | Academia Sinica, Taipei, Taiwan

6/16 - 8/16

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

**Undergraduate Research Apprentice** | Indoor Air Lab, Civil & Environmental Engineering, UC Berkeley

1/16 - 6/16

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

## PROFESSIONAL EXPERIENCE

**AI Fellow** | MIT-Pillar AI Collective

1/24 - 6/24

- Customer discovery to explore commercial applications of my research in timeseries forecasting & physics-informed AI
- Participated in the National Science Foundation (NSF) Innovation Corps (I-Corps) Spark and Fusion programs at MIT

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

8/23 - 12/23

Represented MIT to observe international negotiations at the 2023 United Nations Climate Change Conference

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

1/21 - 11/23

- Worked with scientists, community leaders, legislators, utility representatives, environmental advocates, & local citizens
- Developed greenhouse gas inventory and energy plan for Otsego County, New York

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

7/18 - 8/18

Modeled & optimized hourly/daily price forward curves to predict natural gas prices in European markets,

**Mechanical & Process Engineering Intern** | Applied Materials, Santa Clara, CA

5/17 - 8/17

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

**External Consultant** | Electric Power Research Institute & Amazon Web Services

1/16 - 6/17

- Identified key drivers for H<sub>2</sub> production, storage, transport, & usage for iron & steel decarbonization
- Analyzed technical, financial, & policy issues for battery storage (with renewables) in Amazon data centers

## TEACHING & MENTORSHIP

**Research Mentorship and Supervision (9/23 – present)**

- Danielle Knutson (MIT undergraduate): Data curation & machine learning analysis for large-scale energy datasets
- Peer Brigger (master's student, ETH Zurich): Assessing true marginal value of batteries in the future decarbonized grid
- Luca Hartmann (master's student, ETH Zurich): Distributed model predictive voltage control with circuit dynamics
- Jose Vargas (MIT undergraduate): Probabilistic forecasting of electricity supply, demand & flexibility with uncertainty

**AI Lead Instructor** | MIT International Science & Technology Initiatives, Lima, Peru

10/24 - 1/25

Developed & taught 3-week intensive course on machine learning and data science for early & mid-career professionals

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

11/23 - 1/24

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

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

11/22 - 1/23

- Organized 3-week machine learning & entrepreneurship course at Universidad Tecnológica del Uruguay
- Developed & taught interactive lessons on various machine learning topics
- Mentored teams of students & professionals working on diverse startups & research projects

## PUBLICATIONS

**Vineet Nair.** "Optimal transmission switching and grid reconfiguration for transmission systems via convex relaxations." *Electricity* (2025)

**Vineet Nair** et al. "Resilience of the electric grid through trustable IoT-coordinated assets." *Proceedings of the National Academy of Sciences* (2025).

- Vineet Nair**, "Enhanced physics-informed neural networks for high-order power grid dynamics." NeurIPS Workshop on Tackling Climate Change with Machine Learning (2024).
- Vineet Nair** et al. "Federated learning forecasting for Strengthening Grid Reliability & Enabling Markets for Resilience." International Conference on Electricity Distribution (CIRED) USA Workshop (2024).
- Luca Hartmann, **Vineet Nair**, Florian Dörfler, & Anuradha M. Annaswamy. "Circuit-aware distributed optimal voltage control for distribution grids." MIT "A+B" Applied Energy Symposium (MITAB 2024).
- Vineet Nair**, & Anuradha M. Annaswamy. "A game-theoretic, market-based approach to extract flexibility from distributed energy resources." 5th IFAC Workshop on Cyber-Physical Human Systems (CPHS 2024).
- Lucas Pereira, **Vineet Nair**, et al. "Accurate federated learning with uncertainty quantification for distributed energy resource forecasting applied to smart grids planning & operation: The ALAMO vision." International Conference on Electricity Distribution (CIRED) Europe Workshop (2024).
- Vineet Nair**, et al. "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**, & Anuradha M. Annaswamy. "Local retail electricity markets for voltage control & distribution grid services." 7th IEEE Conference on Control Technology & Applications (CCTA 2023).
- Priyank Srivastava, Rabab Haider, **Vineet Nair** et al. "Voltage regulation in distribution grids: A survey." Annual Reviews in Control (2023).
- Anuradha M. Annaswamy\* & **Vineet Nair**. "Human Behavioral Models Using Utility Theory & Prospect Theory." In Cyber-Physical-Human Systems: Fundamentals & Applications. UK: Wiley, in Press (2023).
- Vineet Nair** et al. "A Hierarchical Local Electricity Market for a DER-rich Grid Edge." IEEE Transactions on Smart Grid (2022).
- Thomas Lee\*, **Vineet Nair**\* et al. "Impacts of Dynamic Line Ratings on the ERCOT Transmission System." 54th IEEE North American Power Symposium (NAPS 2022).
- Vineet Nair** & Lucas Pereira. "Improving accuracy & convergence of federated learning edge computing methods for generalized DER forecasting applications in power grids." NeurIPS Tackling Climate Change with Machine Learning workshop (2022).
- Vineet Nair**. "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** et al, "Sensitivity Analysis of Passenger Behavioral Model for Dynamic Pricing of Shared Mobility on Demand." Preprint (2020).
- Vineet Nair**. "Optimal design & 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 & TALKS

- Vineet Nair** & Anuradha Annaswamy. "Maximizing Security and Resilience to Cyber-attacks in a Power Grid." MIT Energy Initiative Future Energy Systems Center Fall Workshop (2024).
- Vineet Nair**. "Towards a grittier grid: Data-driven decision-making for distributed energy resources." Stanford University seminar (2024).
- Lucas Pereira, **Vineet Nair**, et al. "Machine learning-based time series forecasting for distributed energy resources in power grids to enhance resilience." 18<sup>th</sup> Annual Graduate Climate Conference (2024).
- Vineet Nair**. "Data-driven distributed optimization, markets, and control for an IBR-rich grid edge." NSF Workshop on Enabling Cyber-Resilient Distribution Systems with Edge Inverter-Based Resources (IBR), MIT (2024).
- Vineet Nair**. "Better Decision Making & Coordination for Future Power Grids." Invited seminar at Universidad Politécnica de Madrid (2024).
- Vineet Nair** et al. "Hierarchical Local Retail Electricity Markets for Distributed Energy Resources." IEEE Power & Energy Society General Meeting (PESGM 2023).
- Vineet Nair** & 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).
- Thomas Lee\*, **Vineet Nair**\*, & 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).
- Vineet Nair**, & 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** et al. "Secure & Private Market-based Coordination of Grid Edge IoT Devices." Invited presentation at INFORM 2021 Annual Meeting: Session on Data Analytics in Cyber-Physical Systems.

## WORKING PAPERS

- Vineet Nair**. "Enhanced physics-informed neural networks and neural operators for transient simulations of high-order power grid dynamics", Submitted, under review (2025).

**Vineet Nair.** "Multiobjective optimization-based design & dispatch of islanded, hybrid microgrids for remote, off-grid communities in sub-Saharan Africa." Submitted, under review (2025).

**Vineet Nair**, Morteza Vahid Ghavidel, & Anuradha Annaswamy. "Dynamic resource coordination can significantly increase power grid hosting capacity to accommodate more renewables, storage, and electrified load growth." In preparation (2025). Layla Araiinejad\*, **Vineet Nair\***, "The potential for nuclear fusion to sustainably & reliably power AI data centers." In preparation (2025).

**Vineet Nair**, Jesús Rodríguez-Molina, Juan Garbajosa, & Anuradha Annaswamy, "Blockchain-enabled energy price formation in local electricity market via energy traceability with Smart Contracts." In preparation for IEEE Internet of Things (2025).

Danielle Knutson, **Vineet Nair**, & Anuradha Annaswamy. "Understanding technical & socioeconomic drivers behind the spatial distribution & heterogeneity of distributed energy resources in California." In preparation (2025).

Peer Brigger, **Vineet Nair**, & Anuradha Annaswamy. "Assessing the true value of battery storage under uncertainty in distribution grids." In preparation (2025).

Luca Hartmann, **Vineet Nair**, & Anuradha Annaswamy, "Circuit-aware distributed model predictive voltage control for distribution grids." In preparation for Control Engineering Practice (2025).

**Vineet Nair.** "Techno-economic analysis of low-carbon data centers in the Middle East & North Africa." In preparation (2025).

**Vineet Nair**, Michael Hetherington, & Stephen Brown. "Data-driven approaches to reduce the emissions impacts of global LNG shipping." In preparation (2025).

## REVIEWER SERVICE

**Journals:** IEEE Transactions on Smart Grid, Annual Reviews in Control, IEEE Transactions on Automatic Control, International Journal of Electrical Power & Energy Systems, Energies, Scientific Reports, Reliability Engineering & System Safety, IEEE Transactions on Control of Networked Systems, IEEE Transactions on Control Systems Technology, Communications Engineering

**Conferences:** IEEE Conference on Decision & Control, Journal of Energy Storage, ACM e-Energy Conference, IEEE International Conference on Automation Science & Engineering, International Federation of Automatic Control World Congress, American Control Conference, NeurIPS Tackling Climate Change with Machine Learning Workshop

## HONORS & AWARDS

<b>European Forum Alpbach Scholarship</b>	8/25
<b>Aarav Amar Bajpayee Memorial Prize for Graduate Student Societal Impact</b>   MIT Mechanical Engineering <i>For excelling in research with societal impact related to the Health of the Planet or Global Energy Sustainability</i>	5/25
<b>Sigma Xi Scientific Research Honor Society Full Member</b>	2/25
<b>Stanford Energy Postdoctoral Fellowship Finalist</b>   Stanford University Precourt Institute for Energy	12/24
<b>Cyber-physical Human Systems (CPHS'24) Fellowship</b>   International Federation of Automatic Control (IFAC)	10/24
<b>Stanford University Postdoctoral Recruitment Initiative in Sciences and Medicine (PRISM) award</b>	9/24
<b>ARPA-e Energy Innovation Summit Student Program Award</b>   US Department of Energy	5/22, 5/24
<b>National Science Foundation Innovation Corps (I-Corps) Spark and Fusion Grants</b>	5/24
<b>Conference Travel Grant Award</b>   MIT Graduate Student Council	3/24
<b>MIT-Pillar AI Collective Fellowship</b>   Pillar VC & MIT Deshpande Center for Technological Innovation	12/23
<b>Den Hartog Travel Award in Mechanics</b>   MIT Mechanical Engineering Department	1/23
<b>Out in STEM (oSTEM) Scholarship</b>   Berkshire Hathaway Energy Foundation	10/22
<b>Best Paper Award: 3<sup>rd</sup> Place</b>   54 <sup>th</sup> North American Power Symposium	10/22
<b>MIT MADMEC Sustainability Challenge: 2<sup>nd</sup> Place</b>   MIT Materials Science & Engineering Department	10/22
<b>NREL Workshop on Autonomous Energy Systems Travel Grant</b>   National Renewable Energy Lab	7/22
<b>Martin Family Society Fellowship for Sustainability</b>   MIT Environmental Solutions Initiative	3/22
<b>Runner up</b>   MIT Entrepreneurship & Maker Skills Integrator (MEMSI) Hardware Startup Bootcamp	1/22
<b>International Clean Energy Challenge Winner</b>   Upper Austria	7/19
<b>Ruhr Fellowship</b>   University Alliance Ruhr & TU Dortmund, Germany	4/18
<b>43rd Annual Business Today International Conference Impact Challenge Finalist</b>   Princeton University	11/17
<b>Smart Cities Innovation Collider Winner</b>   Sutardja Center, Pear VC, Bosch, & City Innovate Foundation	4/17
<b>Dean's Startup Seed Fund Winner</b>   Haas School of Business, UC Berkeley	5/17

## LEADERSHIP, TEAMWORK & ACTIVITIES

<b>Board of Directors Member</b>   MIT Alumnx Pride	4/25 - present
<b>Finance lead</b>   MIT Global Startup Workshop (GSW), Warsaw, Poland	10/24 - 3/25
<b>Impact Officer &amp; AI x Climate/Health Project Lead</b>   Global Shapers Cambridge Hub, World Economic Forum	9/23 - 4/25
<b>Graduate Student Representative</b>   MIT Corporation Joint Advisory Committee on Institute-Wide Affairs	8/22 - 8/23
<b>Co-President</b>   MIT Energy & Climate Club	4/22 - 5/23
<b>Content &amp; Operations Team Member</b>   MIT Global Startup Workshop (GSW), Athens, Greece	10/21 - 3/23
<b>Technical Research Seminar Organizer</b>   MIT International Science & Technology Initiatives (MISTI)	9/22 - 11/22

<b>Elite Summer School in Robotics, Automation &amp; Entrepreneurship</b>   Innovation Centre Denmark	8/22
<b>Co-Managing Director</b>   2022 MIT Energy Conference	5/21 - 4/22
<b>Co-Director of Applicant Experience</b>   2021 Climate & Energy Prize (CEP) @ MIT	9/20 - 4/21
<b>Young Professionals Affinity Group Team Lead</b>   Clean Energy for America (CE4A)	6/20 - 11/20
<b>Graduate Student Leadership Incubator Fellow</b>   MIT 2019-20 Cohort	9/19 - 9/20
<b>Engage for Change Fellow</b>   Cambridge Hub & University of Cambridge Environment & Energy Team	1/19 - 4/19
<b>Undergraduate Student Representative At-Large</b>   The Green Initiative Fund, UC Berkeley	8/17 - 5/18
<b>Project Manager &amp; Consultant</b>   Bay Area Environmentally Aware Consulting Network (BEACN)	9/15 - 5/18