Joel Mathias, Ph.D.

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Education

2017 – 2022 **Ph.D., Electrical and Computer Engineering, University of Florida**
Dissertation: *Balancing the Power Grid with Distributed Control of Flexible Loads.*
Advisor: Dr. Sean Meyn

2014 **M.S., Electrical and Computer Engineering, University of Florida**

2009 **Bachelor of Engineering, Electronics & Communications, University of Mumbai**

Employment History

May 2024 · · · **Engineer III — Market Design,** Midcontinent Independent System Operator (MISO), Carmel, IN.

- Design and analysis of wholesale electricity markets operated by MISO with a particular focus on ensuring resource adequacy and reliable grid operations while mitigating market inefficiencies.

2022 – 2024 **Postdoctoral Research Scholar,** Arizona State University, Tempe, AZ.

- Focus on design of robust model predictive control and reinforcement learning techniques for automatic dispatch of distributed energy resources in power grid.
- Secondary research involves design of commercial-grade machine learning software to enhance the cybersecurity of the electricity grid.

2019 & 2021 **Research Intern.** Electric Power Engineers, LLC, Austin, TX.

- Implemented a distribution-level short-term load forecasting tool in Python using a deep learning architecture based on LSTM.
- Grant proposals for Google (Carbon-aware datacenter program) and DoE/NSF.

2015 – 2022 **Graduate Research Assistant,** Lab. for Cognition and Control in Complex Systems, University of Florida, Gainesville, FL.

- Formulation of distributed stochastic control architecture to extract virtual energy storage (VES) from residential electric loads for ancillary services: ensures minimal load-to-grid communication, consumer privacy, and load-level QoS.
- Development of optimal control and reinforcement learning techniques for the dispatch of demand-side resources in the power grid.
- Design of simulation testbed to evaluate performance of control architectures.

Employment History (continued)

2009 & 2012 — **Project Associate,** Tata Institute of Fundamental Research, Mumbai, India.

- Hidden Markov Model-based speech recognition project for inquiry of agricultural products & railway ticket reservations in Indian languages.

2010 – 2011 — **Assistant Systems Engineer,** Tata Consultancy Services, Mumbai, India.

- Software testing of an online brokerage application developed for CIBC.

2009 – 2010 — **Technical Editor,** Cactus Communications Pvt. Ltd., Mumbai, India.

Research Interests

- Regulation and dispatch of distributed energy resources in smart power grid
- Reinforcement learning, model predicitive control, stochastic and deterministic optimal control

Skills

Languages	MATLAB, Python
Datascience	Pandas, Keras, TensorFlow
Modeling	Simulink, General Algebraic Modeling System (GAMS)
Mathematics	Real Analysis, Probability Theory, Stochastic & Optimal Control, Convex Optimization
Misc.	LaTeX typesetting, academic research and writing, Jupyter Notebook, VMware virtualization technologies

Research Publications

Journal Articles

1. **J. Mathias**, L. Sankar, and O. Kosut, "Model predictive control of distributed energy resource aggregators for net-demand balancing," *IEEE Transactions on Smart Grid — submitted*, 2024.
2. **J. Mathias**, R. Moye, S. Meyn, and J. Warrington, "State space collapse in resource allocation for demand dispatch and its implications for distributed control design," *IEEE Transactions on Automatic Control*, 2023. DOI: 10.1109/TAC.2023.3293037.
3. **J. Mathias**, A. Bušić, and S. Meyn, "Load-level control design for demand dispatch with heterogeneous flexible loads," *IEEE Transactions on Control Systems Technology*, vol. 31, no. 4, pp. 1830–1843, 2023, ISSN: 1558-0865. DOI: 10.1109/TCST.2023.3245287.

Conference Proceedings

1. **J. Mathias**, R. Anguluri, O. Kosut, and L. Sankar, "Model predictive control for joint ramping and regulation-type service from distributed energy resource aggregations," in *IEEE Power & Energy Society General Meeting*, 2024.
2. F. Lu, **J. Mathias**, S. Meyn, and K. Kalsi, "Convex Q-learning in continuous time with application to dispatch of distributed energy resources," in *IEEE Conf. on Decision and Control*, Dec. 2023.
3. S. Meyn, F. Lu, and **J. Mathias**, "Balancing the power grid with cheap assets," in *IEEE Conf. on Decision and Control*, Dec. 2023.

4. **J. Mathias**, S. Meyn, H. Ballouz, and M. Ansari, "A distributed control architecture for optimal allocation of grid-responsive load aggregations," in *IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*, 2022, pp. 1–5. DOI: 10.1109/ISGT50606.2022.9817527.

5. **J. Mathias**, R. Moye, S. Meyn, and J. Warrington, "State space collapse in resource allocation for demand dispatch," in *IEEE Conf. on Decision and Control*, Dec. 2019, pp. 6181–6188. DOI: 10.1109/CDC40024.2019.9029384.

6. N. Cammardella, **J. Mathias**, M. Kiener, A. Bušić, and S. Meyn, "Balancing California's grid without batteries," in *IEEE Conf. on Decision and Control*, Dec. 2018, pp. 7314–7321. DOI: 10.1109/CDC.2018.8618975.

7. **J. Mathias**, A. Bušić, and S. Meyn, "Demand dispatch with heterogeneous intelligent loads," in *50th Annual Hawaii International Conference on System Sciences (HICSS)*, Jan. 2017, pp. 3138–3147. DOI: 10.24251/HICSS.2017.380.

8. **J. Mathias**, R. Kaddah, A. Bušić, and S. Meyn, "Smart fridge / dumb grid? Demand dispatch for the power grid of 2020," in *49th Annual Hawaii International Conference on System Sciences (HICSS)*, Jan. 2016, pp. 2498–2507. DOI: 10.1109/HICSS.2016.312.

Books and Chapters

1. Y. Chen, M. U. Hashmi, **J. Mathias**, A. Bušić, and S. Meyn, "Distributed control design for balancing the grid using flexible loads," in *Energy Markets and Responsive Grids: Modeling, Control, and Optimization*, S. Meyn, T. Samad, I. Hiskens, and J. Stoustrup, Eds., New York, NY: Springer, 2018, pp. 383–411, ISBN: 978-1-4939-7822-9. DOI: 10.1007/978-1-4939-7822-9_16.

Preprints

1. H. Ballouz, **J. Mathias**, S. Meyn, R. Moye, and J. Warrington. "Reliable power grid: Long overdue alternatives to surge pricing." arXiv: 2103.06355 [math.OC]. (Mar. 2021).

News Media

1. H. Ballouz, **J. Mathias**, S. Meyn, R. Moye, and J. Warrington, *Addressing misconceptions on the performance of the energy market in Texas*, Utility Dive: https://tinyurl.com/5n933vyp, Apr. 2021.

Miscellaneous Experience

Teaching Assistantships

Spring 2020 — EEL 6935 – Stochastic Control, University of Florida

Spring 2021 — EEL 6935 – Control Systems and Reinforcement Learning, University of Florida

Selected Talks

Dec 2018 — *Balancing California's Grid Without Batteries,* IEEE Conf. Decision & Control, Miami, FL

Dec 2019 — *State Space Collapse in Resource Allocation for Demand Dispatch,* IEEE Conf. Decision & Control, Nice, France

Oct 2021 — *Optimal Control for Demand Dispatch in Smart Grid,* SIAM UF chapter meeting, FL

Selected Workshop Participation

Jul 2021 — IMSI-Chicago Short Program: Introduction to Decision Making and Uncertainty

Jun 2021 — IMSI-Chicago Short Program: Introduction to Mean-Field Games and Applications

Jan 2020 — Bayes Comp 2020, Gainesville, FL

Miscellaneous Experience (continued)

- Feb 2019 — Distributech, New Orleans, LA
- Jan 2017 — Workshop on Cognition and Control, Gainesville, FL

Reviewing Responsibilities

- Conferences — American Control Conference, IEEE Conference on Decision and Control
- Journals — IEEE Trans. on Automatic Control, IEEE Trans. on Information Forensics and Security

Scholarships and Awards

- JN Tata Endowment for Higher Education of Indians abroad for graduate studies in USA
- Lady Navajbai Ratan Tata Trust Higher Education Scholarship for studies in USA
- JRD Tata Scholarship for academic performance during undergraduate studies

References

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Dr. Joseph Warrington
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