Joel Mathias, Ph.D.

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Education

2017 – 2022 **Ph.D., Electrical and Computer Engineering, University of Florida**
Dissertation title: *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

Jul 2022 · · · **Postdoctoral Research Scholar,** Arizona State University, Tempe, AZ.

- Primary research focuses on designing robust reinforcement learning algorithms for automatic dispatch of distributed energy resources in power grid.
- Secondary research involves the 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.

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, 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, VMware virtualization technologies

Research Publications

Journal Articles

1. **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.
2. **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. 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.
2. S. Meyn, F. Lu, and **J. Mathias**, "Balancing the power grid with cheap assets," in *IEEE Conf. on Decision and Control*, Dec. 2023.
3. **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.
4. **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.
5. 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.
6. **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.
7. **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 Experience

- Spring 2020 — EEL 6935 – Stochastic Control, University of Florida
- Spring 2021 — EEL 6935 – Control Systems and Reinforcement Learning, University of Florida

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

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

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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