# Nathan Dahlin

| | | |
|---|---|---|
| CONTACT | ETEC 133, 1220 Washington Ave | ndahlin@albany.edu |
| | Albany, NY 12226 | (213)-631-6101 |

WEBSITE    [sites.google.com/view/nathan-dahlin](sites.google.com/view/nathan-dahlin)

RESEARCH INTERESTS

**Networks:** power systems, network economics, game theory
**Stochastic systems:** control and optimization, risk aware optimization, modeling
**Learning/AI:** reinforcement learning (RL), multi-agent/non-stationary/offline RL, deep learning

AFFILIATION

**University at Albany**    Fall 2023 - Present
*Assistant Professor, Department of Electrical & Computer Engineering*

EDUCATION

**University of Southern California**    2015 - 2021
*Ph.D. in Electrical Engineering*
Advisor: Rahul Jain
Thesis: *Smarter Markets for a Smarter Grid: Pricing Randomness, Flexibility and Risk*

**University of Southern California**    2015 - 2020
*M.A. in Applied Mathematics*

**University of Southern California**    2015 - 2020
*M.S. in Electrical Engineering*

**University of Southern California**    2004 - 2008
*B.S. in Electrical Engineering*

RESEARCH EXPERIENCE

**University of Illinois at Urbana-Champaign**    2021 -2023
*Postdoctoral Research Associate, Department of Electrical & Computer Engineering*
Mentor: Subhonmesh Bose

- Established system operator revenue adequacy and generator incentive compatibility under a proposed CVaR sensitive security-constrained economic dispatch formulation and payment framework for simultaneous procurement of generation and reserve capacity in the presence of potential line outage scenarios

- Proposed a computationally tractable, data-driven approach to probabilistic rooftop solar hosting capacity analysis for distribution level power networks, based on the CVaR measure

- Derived a quickest change detection technique for Markovian environments, for use in optimal control problems with non-stationary dynamics and costs

- Developed a decentralized, multi-agent method for collaborative estimation of nonlinear system dynamics under sparse communication via kernel transfer operators in reproducing kernel Hilbert spaces

**USC Viterbi School of Engineering, Los Angeles**    2016 - 2021
*Research Assistant*

- Formulated an optimization-based approach to scheduling non-preemptive flexible loads and proved that optimal solutions under convex relaxation of the given mixed-integer linear program (MILP) scheduling problem yield a method for probabilistically generating optimal schedules in the large economy limit, respecting MILP constraints

- Demonstrated the effectiveness of proposed flexibility aware, optimization based non-preemptive load scheduling algorithm applied to electric vehicle (EV) charging, utilizing the ACN-Data EV charging dataset

- Proved the existence of efficient sequential competitive equilibria in a two-stage electricity market with both supply and demand side services and renewable generation, established sufficient conditions for the existence of efficient Nash equilibria, and detailed an associated market mechanism for implementation of the equilibria

- Specified a risk aware electricity market mechanism for use in a market where a risk averse social planner purchases energy from risk neutral thermal generators to offset shortfalls in renewable energy production

- Designed an incentive compatible, individually rational and efficient market mechanism for a renewable energy provider auctioning stochastic supply to strategic customers
- Distilled knowledge embedded in a deep neural network into decision trees and kernel machines via imitation learning with TensorFlow and Sklearn, yielding controllers with fewer parameters, more transparent decisions, and comparable performance in benchmark OpenAI Gym environment case studies including CarRacing-vo, featuring image based inputs and a reference convolutional neural network trained via the Deep-Q Learning (DQN) algorithm

### Audyssey Laboratories, Los Angeles                                          May 2008 - June 2015
*Senior Research and Development Engineer*

- Designed and experimentally verified audio signal processing algorithms for applications including vehicle speed dependent gain and equalization, video camera servo noise reduction and automated movie theater sound equipment testing
- Coded MATLAB based cataloguing and visualization tools for analysis of a database of hundreds of home theater installation acoustic measurements, utilized by THX founder Tomlinson Holman in 2010 Audio Engineering (AES) published study
- Tasked and advised summer interns on work in audio signal processing algorithm development

JOURNAL
PUBLICATIONS

**Risk-Based Hosting Capacity Analysis in Distribution Systems**
Avinash N. Madavan, ***Nathan Dahlin***, Subhonmesh Bose, Lang Tong
*IEEE Transactions on Power Systems (TPS), 2023* (link)

**Two-Stage Electricity Markets with Renewable Energy Integration: Market Mechanisms and Equilibrium Analysis**
***Nathan Dahlin***, Rahul Jain
*IEEE Transactions on Automatic Control of Network Systems (TCNS), 2022* (link)

**Scheduling Flexible Nonpreemptive Loads in Smart-Grid Networks**
***Nathan Dahlin***, Rahul Jain
*IEEE Transactions on Automatic Control of Network Systems (TCNS), 2021* (link)

PEER-REVIEWED
CONFERENCE
PUBLICATIONS

**Exact and Cost-Effective Automated Transformation of Neural Network Controllers to Decision Tree Controllers**
Kevin Chang, ***Nathan Dahlin***, Rahul Jain, Pierluigi Nuzzo
*Accepted to the IEEE Conference on Decision and Control (CDC), 2023*

**Sparse Learning of Dynamical Systems in RKHS: An Operator-Theoretic Approach**
Boya Hou, Sina Sanjari, ***Nathan Dahlin***, Subhonmesh Bose, Umesh Vaidya
*Accepted to the Fortieth International Conference on Machine Learning (ICML), 2023* (link)

**Controlling a Markov Decision Process with an Abrupt Change in the Transition Kernel**
***Nathan Dahlin***, Subhonmesh Bose, Venugopal V. Veeravalli
*Accepted to American Control Conference (ACC), 2023* (link)

**Compressed Decentralized Learning of Conditional Mean Embedding Operators in Reproducing Kernel Hilbert Spaces**
Boya Hou, Sina Sanjari, ***Nathan Dahlin***, Subhonmesh Bose
*37th Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence (AAAI), 2023* (link)

**Practical Control Design for the Deep Learning Age: Distillation of Deep RL-Based Controllers**
***Nathan Dahlin***, Krishna Kalagarla, Kevin Chang, Pierluigi Nuzzo, Rahul Jain
*58th Allerton Conference, 2022* (link)

**Scheduling of Flexible Non-Preemptive Loads**
***Nathan Dahlin***, Rahul Jain
*IEEE Conference on Decision and Control (CDC), 2020* (link)

**A Risk Aware Two-Stage Market Mechanism for Electricity with Renewable Generation**
***Nathan Dahlin***, Rahul Jain

*American Control Conference (ACC), 2020* (link)

**A Two-Stage Market Mechanism for Electricity with Renewable Generation**
***Nathan Dahlin***, Rahul Jain
*IEEE Conference on Decision and Control (CDC), 2019* (link)

**A Two Stage Stochastic Mechanism for Selling Random Power**
***Nathan Dahlin***, Rahul Jain
*American Control Conference (ACC), 2019* (link)

WORKSHOP
PUBLICATIONS

**Designing Interpretable Approximations to Deep Reinforcement Learning**
***Nathan Dahlin***, Krishna Chaitanya Kalagarla, Nikhil Naik, Rahul Jain, Pierluigi Nuzzo
*Reinforcement Learning for Real Life Workshop at ICML 2021* (link)

**A Dictionary Based Approach for Robust and Syllable-Independent Audio Input Transcription by Humming Systems**
Erdem Unal, Shrikanth Narayanan, Elaine Chew, Panayiotis G Georgiou, ***Nathan Dahlin***
*Proceedings of the 1st ACM workshop on Audio and music computing multimedia, 2006* (link)

SUBMITTED
PUBLICATIONS

**Conditional Kernel Imitation Learning for Continuous State Environments**
Rishabh Agarwal, ***Nathan Dahlin***, Rahul Jain, Ashutosh Nayyar (link)

AWARDS
& HONORS

**Deep Learning for Engineers Best Course Project**                                              Spring 2020
Awarded Amazon Web Services (AWS) cash prize, together with two teammates, for work investigating distillation of deep neural network learning into soft decision trees.

**NSF Graduate Fellowships Program Honorable Mention**                                                      2017

**Annenberg Fellowship**                                                      USC Graduate School, 2015

**Philip S. Biegler Memorial Award**                                              EE Department, USC, 2008
Award honors the EE student with the highest GPA.

**National Merit Scholarship**                              National Merit Scholarship Corporation (NMSC), 2004
Awarded to a selection of graduating high school students scoring in the top 1 percent on the PSAT.

TEACHING
EXPERIENCE

**IECE 481/581: Linear Control Theory**                                       University at Albany, Fall 2023
*Instructor*

**ECE 503: Probability for Electrical and Computer Engineers**                          USC, Spring 2019
*Teaching Assistant*

**ECE 510: Linear Algebra for Engineering**                                       USC, Spring, Fall 2018
*Teaching Assistant*

MENTORING
EXPERIENCE

**Center for Undergraduate Research in Viterbi Engineering**                      USC, Spring-Summer 2021
*Research Mentor*
- Mentored two undergraduate students in reinforcement learning related research, co-advised with Prof. Rahul Jain and Prof. Pierluigi Nuzzo
- Undergraduate student Yifan Xue's poster *Efficiency Evaluation of RL Training Models in Quadcopter Attitude Control* selected as one of the winners in end of semester symposium, May 2021

ACADEMIC
SERVICE

**External Reviewer for Conferences and Journals**
*Control Theory:* ACC 2018-2022, ACM-TCPS 2021, Automatica 2019, HSCC 2020, ICCPS 2020, IEEE-CCTA 2020-21, IEEE-CDC 2018-21, IEEE-TAC 2020, IEEE-TCCN 2016, IEEE-TCNS 2018-22, IEEE-TNSESI 2019, IEEE-TSTE 2021
*Machine Learning:* ICML 2019, NeurIPS 2019, AAAI 2022, NeurIPS Reinforcement Learning for Real Life Workshop 2022
*Queueing Theory:* Queueing Systems 2020-21
*Power Systems:* European Journal of Operational Research 2020, IEEE-TSG 2016, 2021, IEEE-TSTE 2021, NETGCOOP 2016, Renewable Energy Focus 2021, Utilities Policy 2021

**Conference Presentation Chair**
Power and Energy Conference at Illinois 2022

PATENTS    **System and method for performing voice activity detection**
Sunil Bharitkar, ***Nathan Dahlin***
*US Patent 9,002,030, filed May 2012, issued April 2015*

**Audio content enhancement using bandwidth extension techniques**
Sunil Bharitkar, ***Nathan Dahlin***, Ismael Hamad Nawfal, Chris Kyriakakis
*US Patent 8705764, filed October 2012, issued April 2014*

**System and method for performing automatic gain control in mobile phone environments**
Sunil Bharitkar, ***Nathan Dahlin***, Ismael Hamad Nawfal
*US Patent 8,639,294, filed May 2012, issued January 2014*

PRESENTATIONS    **Planning and Pricing for Uncertainty, Flexibility and Risk**
Rigorous Systems Research Group (RSRG), Caltech, October 2022

**Designing Interpretable Approximations to Deep RL with Soft Decision Trees**
IMT Atlantique, March 2022

**Pricing Randomness, Flexibility and Risk: Market Design for a Smarter Grid**
Center for Cyber-Physical Systems and Internet of Things and Ming Hsieh Institute for Electrical & Computer Engineering
Joint Seminar, University of Southern California, September 2021

**Scheduling Flexible Non-Preemptive Loads in Smart-Grid Networks**
Ohio State University, June 2021

TECHNICAL
SKILLS    *Programming:* Python, Matlab, C/C++ (basic)
*Software/Packages:* TensorFlow, Sklearn, OpenAI Gym, CVXPY, Simulink