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Daniel Arnold

SKILLS

- Mathematical: nonlinear and adaptive control, convex optimization, black-box optimization, time series analysis, state estimation, machine learning, optimal control, reinforcement learning, signal processing, statistical modeling, linear algebra
- Software: python (numpy, pandas, sklearn, matplotlib, tensorflow/keras, cvxpy, statsmodels, elasticsearch, beautifulsoup, bokeh, pyspark), C++, matlab (cvx), OpenDSS, GridLAB-D, SQL, Apache Spark, Docker, CPLEX
- Communication & Interpersonal Skills: managing technical projects, authoring academic papers and technical reports, crafting and giving presentations to stakeholders and project sponsors, mentoring staff, fundraising

EXPERIENCE

Lawrence Berkeley National Laboratory, Berkeley, Ca. — *Research Scientist*

July 2017 - PRESENT

- Development of reinforcement learning and state estimation algorithms for control and estimation of battery storage systems in electric grids
- Apply data analytics and machine learning techniques to gain insight from electric power grid data (SCADA, PMU)
- Develop optimization and control algorithms to integrate distributed energy resources into the electric power system

Civil and Environmental Engineering Dept., UC Berkeley, Berkeley, Ca. — *Lecturer*

Jan. 2018 - PRESENT

- CE 295 (Spring & Fall 2021) - Data Science for Energy (https://ecal.berkeley.edu/ce295.html)
  - Introduces data science fundamentals and programming techniques to graduate and upper division students, with energy focus
  - Course content: dynamic systems modeling, state estimation, convex optimization, machine learning, and optimal control
- CE 191 (2018 - 2020) - Engineering Systems Analysis (https://ecal.berkeley.edu/ce191.html)
  - Introduces optimization fundamentals and programming techniques to graduate and upper division undergraduate students
  - Course content: linear programming, quadratic programming, mixed integer programming, nonlinear programming, search algorithms, and dynamic programming

Lawrence Berkeley National Laboratory, Berkeley, Ca. — *ITRI-Rosenfeld Postdoctoral Fellow*

Jan. 2016 - July 2017

- Develop data analysis pipeline in python for clustering and regression analysis of electric power distribution grid synchrophasor data
- Develop model-free optimization algorithms for real-time control of distributed energy resources

EDUCATION

U.C. Berkeley, Berkeley, Ca. — *Ph.D Mechanical Engineering*

Sept. 2009 - Dec. 2015
Advisors: Duncan Callaway and David Auslander
Dissertation: Extremum Seeking Control of Distributed Energy Resources

U.C. San Diego, San Diego, Ca. — *M.S. Mechanical Engineering*

Sept. 2005 - Dec. 2006
Advisor: Miroslav Krstic

U.C. San Diego, San Diego, Ca. — *B.S. Mechanical Engineering (cum laude)*

Sept. 2001 - Sept. 2005

RELEVANT PROJECTS

Supervisory Parameter Adjustment for Distribution Energy Storage (SPADES), PI — *$3,000,000 award*

- Sponsor: Cyber Security for Energy Delivery Systems (CEDS) program, U.S. Department of Energy
- Objective: Creation of reinforcement learning-based controllers to manage battery storage systems to counteract cyber attacks on the electric grid.
- Role: Principal Investigator, responsible for overall research and management of project, developed python module to represent dynamic behavior of storage devices, development of reinforcement learning algorithm

Cybersecurity via Inverter-Grid Automatic Reconfiguration (CIGAR), co-PI — *$2,500,000 award*

- Sponsor: Cyber Security for Energy Delivery Systems (CEDS) program, U.S. Department of Energy
- Objective: Creation of reinforcement learning-based controllers to manage rooftop solar panels to counteract cyber attacks on the electric grid
- Role: co-Principal Investigator, responsible for overall research and management of project, developed python module to represent dynamic behavior of photovoltaic smart inverter autonomous control functions, development of reinforcement learning algorithm

SELECT PUBLICATIONS

Conference

D. Arnold, S. Ngo, C. Roberts, Y. Chen, A. Scaglione, S. Peisert, “Adam-based Augmented Random Search for Control Policies for Distributed Energy Resource Cyber Attack Mitigation”, American Control Conference (ACC), 2022 *submitted*.

C. Roberts, S. Ngo, A. Milesi, A. Scaglione, S. Peisert, and D. Arnold, “Deep Reinforcement Learning for Mitigating Cyber-Physical DER Voltage Unbalance Attacks", American Control Conference (ACC), New Orleans LA, 2021, pp. 2861-2867.

C. Roberts, S. Ngo, A. Milesi, S. Peisert, S. Saha, A Scaglione., N. Johnson, A. Kocheturov, D. Fradkin, and D. Arnold “Deep Reinforcement Learning for DER Cyberattack Mitigation", IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm), Tempe, AZ, USA, 2020, pp. 1-7.

Journal

D. Arnold, S.Saha, S. Ngo, C. Roberts, A. Scaglione, N. Johnson, S. Peisert, and D. Pinney, “Adaptive Control of Distributed Energy Resources for Distribution Grid Voltage Stability”, IEEE Transactions on Power Systems, *in review.*

S. Saha. D. Arnold, A. Scaglione, E. Schweitzer, C. Roberts, S. Peisert, and N. Johnson, “Lyapunov Stability of Smart Inverters Using Linearized DistFlow Approximation”, IET Renewable Power Generation, vol. 15, no. 1, pp. 114-126, 2021.

R. Dobbe, W. Van Westering, S. X. Liu, D. Arnold, D. S. Callaway and C. Tomlin, "Linear Single- and Three-Phase Voltage Forecasting and Bayesian State Estimation with Limited Sensing," IEEE Transactions on Power Systems, vol. 35, no. 3, pp. 1674-1683, May 2020.

E. Schweitzer, S. S. Saha, A. Scaglione, N. G. Johnson and D. Arnold, "Lossy DistFlow Formulation for Single and Multiphase Radial Feeders," IEEE Transactions on Power Systems, vol. 35, no. 3, pp. 1758-1768, May 2020.

R. Dobbe, O. Sondermeijer, D. Fridovich-Keil, D. Arnold, D. Callaway, C. Tomlin, “Towards Distributed Energy Services: Decentralizing Optimal Power Flow with Machine Learning”, IEEE Transactions on Smart Grid, vol. 11, no. 2, pp. 1296-1306, March 2020.

M.D. Sankur, R. Dobbe, A. von Meier, E. Stewart, and D. Arnold, “Model-Free Optimal Voltage Phasor Regulation in Unbalanced Distribution Systems”, vol. 11, no. 1, pp. 884-894, Jan. 2020.

C. Roberts, A. Scaglione, M. Jamei, R. Gentz, S. Peisert, E. Stewart, C. McParland, A. McEachern, and D. Arnold, “Learning Behavior of Distribution System Discrete Control Devices for Cyber-Physical Security”, IEEE Transactions on Smart Grid, vol. 11, no. 1, pp. 749-761, Jan. 2020.

D. Arnold, M. Negrete-Pincetic, M. Sankur, and D. Callaway, “Model-Free Optimal Coordination of Distributed Energy Resources for Provisioning Transmission-Level Services” IEEE Transactions on Power Syst., vol. 33, issue 1, pp. 817-828, 2018.

D. Arnold, M. Negrete-Pincetic, M. Sankur, D. Auslander, and D. Callaway, “Model-Free Optimal Control of VAR Resources in Distribution Systems: An Extremum Seeking Approach,” IEEE Transactions on Power Systems, vol. 31, issue 5, pp. 3583-3593, 2016.

C. Zhang, D. Arnold, N. Ghods, A. Siranosian, and M. Krstic, “Source Seeking with Nonholonomic Unicycle Without Position Measurement and with Tuning of Forward Velocity,” Systems and Control Letters, vol. 56, pp. 245-252, 2007.