Nathan Gray

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Cyber-Physical Power System Modeling – Distributed Optimization – Microgrid Control

Education and Certifications

Ph.D. in Electrical Engineering, Washington State University — Pullman, WA
Advisor: Dr. Anjan Bose — In Progress

Engineer-in-Training (EIT), Washington State — 2017

Bachelor Of Science in Engineering, Walla Walla University — College Place, WA
Electrical Engineering with Global Humanitarian Emphasis — June 2017
Magna Cum Laude

Skills

Programming Languages: Python, Matlab, C/C++, C#, Julia

Research Tools: GridLAB-D, OpenDSS, ns-3, HELICS, CVXPY, SciPy, Pandas, Plotly Dash, Git, LaTeX

Work Experience

Washington State University — Pullman, WA
Research Assistant and Ph.D. Student — Aug 2018—Present

- Developed a cyber-physical multi-agent co-simulation platform with HELICS, GridLAB-D, ns-3, and Python
- Developed a Python package for asymetric three-phase optimal power flow using the linear branch flow model with support for OpenDSS models
- Modeled and simulated cyber-physical systems
- Studied distributed and decentralized algorithms for distribution system optimization and resiliency under adverse communication conditions
- Tested algorithms for distributed and decentralized control of microgrids to prevent voltage collapse

Key Technology — Walla Walla, WA
Electrical Engineer—Hardware and Reliability — Mar 2018—Jul 2018

- Fixed issues with circuit boards
- Planned for replacement of obsolete parts
- Designed test fixtures
- Wrote test procedures
- Worked with a team of interdisciplinary Engineers

Key Technology — Walla Walla, WA
Assembly Technician—Tested and troubleshot new machines before shipping — Aug 2017–Feb 2018

ANR Group Inc (assigned to CHPRC) — Richland, WA
Intern Electrical Engineer in support of 100K Area Facility Engineering — Jun 2016—Sep 2016

- Completed and submitted CHPRC Engineering Change Request package
  - Used AutoCAD to create drawing to fully describe the system
  - Updated existing engineering documentation for affected systems
  - Consulted with Electrical and Operations Managers to ensure a practical design
  - Carefully studied the National Electrical Code and applied it in designs
- Analyzed facility electrical system to update SKM model for arc flash energy calculations

Volunteer Experience

Engineers Without Borders WWU Local Project Team College Place, WA
Mentor 2023—Present

- Provide management and technical advise to student leader

Engineers Without Borders WSU Project Team Pullman, WA
Electrical Engineer 2018—2019

- Designed solar-powered water pump system for off-grid community in Panama
- Constructed solar and electrical systems on site
- Provided technical support following installation

Engineers Without Borders WWU International Project Team College Place, WA
Electrical Engineer/Lead Electrical Engineer Sep 2015—Jun 2017

- Used AutoCAD to draft designs for home solar PV systems for a remote community in Peru
- Trained Community Members to use and maintain their PV systems
- Researched and designed micro-hydro based mini-grid
- Modeled loads and AC distribution grid characteristics

Research Projects

Spokane Connected Communities Project; Edo Energy, Avista, McKinstry, PNNL, Urbanova
Objective: Demonstrate non-wires solutions by creating virtual power plants from existing buildings.

Grid Data Transport Analysis Framework (GDTAF); PNNL, Supported by the DOE
Objective: Coordination of power system and communication system planning.

CITADELS; PNNL, Supported by the DOE
Objective: Utilize distribution system assets to support grid resiliency.

Clean Energy Fund 2 (CEF2); Avista Utilities, Supported by the Wasington Clean Energy Fund (CEF)
Objective: Demonstrate benefits of Avista's shared energy economy model.

Clean Energy and Transactive Campus (CETC); PNNL, Supported by the DOE and CEF
Objective: Optimization of building energy loads and renewable energy with energy markets.

Publications

[1] N. Gray, S. Paul, A. Dubey, A. Bose, Md. Touhiduzzaman, and J. Ogle, "Robustness Assessment of Distributed Optimal Power Flow under Communication Non-idealities", *IEEE Industry Applications*, In Review.

[2] N. Gray, R. Sadnan, A. Bose, A. Dubey, T. L. Vu, J. Xie, L. D. Marinovici, K. P. Schneider, C. Klauber, and W. Trinh, "Distributed Coordination of Networked Microgrids for Voltage Support in Bulk Power Grids", *IEEE Industry Applications*, In Review.

[3] J. Xie, K. P. Schneider, F. K. Tuffner, X. Chen, R. Sadnan, T. L. Vu, L. D. Marinovici, A. Dubey, A. Bose, N. Gray, and C. Klauber, "Coordinated Self-Assembly of Networked Microgrids Using Irving's Algorithm", in *2024 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*, Washington, DC, USA: IEEE, Feb. 19, 2024, pp. 1–5, ISBN: 9798350313604.

[4] N. Gray, R. Sadnan, A. Bose, A. Dubey, T. L. Vu, J. Xie, L. D. Marinovici, K. P. Schneider, C. Klauber, and W. Trinh, "Distributed Coordination of Networked Microgrids for Voltage Support in Bulk Power Grids", in *2023 IEEE Industry Applications Annual Meeting*, IEEE, 2023.

[5] S. Paul, N. Gray, A. Dubey, A. Bose, M. Touhiduzzaman, and J. Ogle, "Robustness Assessment of Distributed OPF Under Communication Non-Idealities Using Cyber-Physical Co-Simulation Framework", in *2023 IEEE Industry Applications Society Annual Meeting (IAS)*, Nashville, TN, USA: IEEE, Oct. 29, 2023, pp. 1–8, ISBN: 9798350320169.

[6] R. Sadnan, N. Gray, A. Bose, and A. Dubey, "Bulk-power Grid Support: Distributed OPF for Voltage and Frequency Regulation", in *2023 IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm)*, Oct. 2023, pp. 1–7.

[7] R. Sadnan, N. Gray, A. Bose, and A. Dubey, "Simulation-Integrated Distributed Optimization for Unbalanced Power Distribution Systems", arXiv:2212.04615 [eess.SY], 2022.

[8] N. Gray, R. Sadnan, A. Bose, and A. Dubey, "Effects of Communication Network Topology on Distributed Optimal Power Flow for Radial Distribution Networks", in *2021 North American Power Symposium (NAPS)*, College Station, TX, USA: IEEE, Nov. 14, 2021, pp. 1–6, ISBN: 978-1-66542-081-5.

[9] R. Sadnan, N. Gray, A. Dubey, and A. Bose, "Distributed Optimization for Power Distribution Systems with Cyber-Physical Co-Simulation", in *2021 IEEE Power & Energy Society General Meeting (PESGM)*, Washington, DC, USA: IEEE, Jul. 26, 2021, pp. 1–5, ISBN: 978-1-66540-507-2.

[10] S. Szablya, G. Goldsmith, K. Allen, and N. Gray, "A Water System Using a DC Pump for Remote Solar Installations", in *2019 IEEE Global Humanitarian Technology Conference (GHTC)*, Seattle, WA, USA: IEEE, Oct. 2019, pp. 1–1, ISBN: 978-1-72811-780-5.