Shengfei Yin, Ph.D.

Senior Optimization Engineer

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Expertise

Theories: Mathematical Programming, Machine/Deep Learning, and Stochastic Optimization.
Applications: Energy System Operations and Large-scale Systems' Decision-making.

Skill

- Python (OOP)
- MATLAB/Simulink
- Gurobi/CPLEX/FICO-Xpress
- PLEXOS
- TensorFlow/PyTorch
- Linux/Bash
- Java
- SQL
- Git

Education

Southern Methodist University, Dallas, TX, USA — GPA: **3.87**/4.00
Ph.D. in Electrical Engineering. Advisor: **Prof. Jianhui Wang** — *01/2018 – 08/2021*

Specializing in Power System Optimization

Dissertation title: Electricity Market Operations with Massive Renewable Penetration: New Designs

Illinois Institute of Technology, Chicago, IL, USA — GPA: **3.81**/4.00
M.S. in Electrical Engineering. Advisor: **Prof. Zuyi Li** — *08/2016 – 12/2017*

Specializing in Energy Economics

Hunan University, Changsha, Hunan, PRC
B.Eng. in Electrical Engineering and Automation — *09/2012 – 06/2016*

Work Experience

06/2024 – Present — **Senior Optimization Software Engineer - Lead Professional**
GE Vernova, Inc

Role outline

Work for the Market Clearing Engine team as the lead optimization architect/developer for the energy management system. **Report to: Maria Tamayo - Senior Manager, Software Engineering**

Achievements

- Develop ISO-scale unit commitment and dispatch operations, working for national-level energy market clearing engines used by MISO, PJM, SPP, and ISO-NE covering 30+ states' electricity management in the US.
- Conduct research and development on large-scale and distributed mathematical optimization models with practical implementations.
- Lead on the production-level optimization software development on **Java/CPLEX** API with best software development practice and solver tuning to achieve computational performance and more flexible user interface.
- Upgrade and optimize the workflow and automatic test pipelines between operation codebase, customers, and database.
- Communicate with clients and lead a seasoned team with technical know-how.

03/2022 – 06/2024 **Senior Optimization Engineer**
Ascend Analytics, LLC

Role outline

Work for the Development Department as the chief optimization architect/developer for the flagship millions-earning software PowerSIMM®. **Report to: Vena Kostroun - SVP of Development**

Achievements

- Develop large-scale mixed-integer programming models, including wholesale energy market operations, battery storage bidding, and model predictive control-based multi-timescale unit commitment and dispatch.
- Lead on the production-level software refactoring from GAMS to **Python-Xpress** API with solver tuning to achieve higher computational performance and a more flexible user interface.
- Upgrade and optimize the workflow and automatic test pipelines between operation code and database, accelerating pre-/post-processing within the solution procedure.
- Develop new features in optimization models to satisfy clients' needs, involving tens of unit modules such as battery storage, hydro operation, multi-energy networks, etc.
- Communicate with clients and help to deliver consulting services with high-dimensional customer data.

09/2021 – 03/2022 **Postdoctoral Research Associate**
Lawrence Berkeley National Laboratory (LBNL)

Role outline

Work for the LBNL Electricity Market and Policy Department. This research-based position involves the investigation on future clean energy market planning with environmental impacts via machine learning and optimization. **Report to: Dr. Jiang Lin - Staff Scientist**

Achievements

- Predict and analyze the solar generation potential in existing building rooftops by deep learning techniques, including **Graph Neural Nets**.
- Implement Python programs for automatic I/O data flow with professional simulation software. Develop GUI and SQL databases for open-source power system optimization software.
- Model and simulate the national power capacity expansion planning and production cost modeling in PLEXOS through 2020-2035, considering the power reliability and CO_2 emission.
- Draft grant proposals for US DOE and California funding agencies, including the California multi-objective power-eco optimization and 2050 carbon neutrality projects.
- Mentor interns and visiting Ph.D., host research calls, and manage academic seminars.

05/2020 – 06/2021 **Research and Development Fellow (Co-op)**
Midcontinent Independent System Operator (MISO)

Role outline

Work for the MISO R&D Department. This research-based position involves real-time supply chain optimization in MISO's daily operations. **Report to: Dr. Yonghong Chen - R&D Senior Consulting Advisor**

Achievements

- Perform time-series prediction of power generators' startup/shutdown trajectory by employing **Gradient Boosting Tree** for the offline task and **Long Short Term Memory network** for the online task.
- Design the deterministic MISO real-time look-ahead power supply chain optimization routine and implement it in Python with calibration via the MISO production engine.
- Query and parse the time-series data of units' startup and shutdown processes by **SQL** in the MISO private database, with cleaning and restructuring of original data pairs.
- Induce the improved start/shutdown curves in the stochastic supply chain optimization model on several typical operation days. The daily production cost saving on average is around **8% (10^6 level in dollars)**.
- Assist in software documentation, team collaboration, and milestone reports.

05/2019 – 08/2019 **Market Engineer (Intern)**
National Renewable Energy Laboratory (NREL)

Role outline

Work for Power System Engineering Center. This research position builds integrated optimization models between steady-state scheduling and transient-state dynamics, focusing on assessing solar energy's potential in the energy-reserve market. **Report to: Dr. Bryan Palmintier - Principal Research Engineer**

Achievements

- Build the multi-timescale optimization framework for short-term market analyses in **Python-Gurobi** API with unique steady-state turbine physical models for renewables.
- Conduct techno-economic assessments of solar panels' potentials with built-in energy storage systems in the energy & reserve co-optimization, considering the multi-timescale coordination.
- Debug the simulation software and perform sensitivity analyses with different parameters while adding new and reliable features with validations to mimic the practical market environment better.
- Help to design the interface between the steady-state scheduling in Python and the transient-state dynamics.
- Responsible for software documentation, team collaboration, and milestone reports.

Project Experience

SMU Projects

05/2019 - 09/2021 **Stochastic Optimal Power Flow for Real-time Management of DERs (SLAC)**
Funding source: DOE ARPA-E ($4.35M)

Work outline

- The project focused on developing new stochastic power flow model and solution techniques. I worked on tailoring the large-scale distributed ADMM algorithm and deployed it in the stochastic optimal power flow model with practical market operations. The multi-thread processing was utilized when solving independent stochastic subproblems.
- I generated stochastic scenario trees based on historical wind and solar data by applying the K-means clustering.

09/2018 - 11/2021 **Multi-timescale Integrated Dynamic And Scheduling (MIDAS)**
Funding source: DOE SETO ($3.00M)

Work outline

- Extended project of the NREL internship. The project targeted a generalized open-source Python software package for multi-timescale short-term market operations interfaced with the system dynamics simulation.
- Focusing on the scheduling part, I designed and realized flexible and user-friendly functions for system operations, such as retrievals of system sensitivities like LMPs. The I/O interfaces between different optimization modules were also implemented.

10/2019 - 10/2020 **Hybrid Stochastic Energy Storage Management for Integrated Energy Systems**
Funding source: GEIRI-NA ($500K)

Work outline

- This research project targeted a power market simulation platform for the multi-energy network, including electricity, gas, and heat, exemplified by the operations of multi-energy storage systems. Nonconvex power flow, gas flow, and heat flow equations are convexified via the second-order cone.
- Energy storage's capability of providing different energy products in the steady-state energy market was analyzed. Scenario-based stochastic programming for a massive amount of distributed renewable resources was employed.

01/2018 - 01/2020 **Multi-Stage Stochastic & Robust Power System Capacity Expansion Planning**
Funding source: DOE NEPA ($400K)

Work outline

- This research project targeted a multi-stage and multi-timescale capacity expansion planning framework considering plant contingencies and renewable uncertainties. I formulated the problem as a hybrid stochastic and robust optimization program with discrete and continuous decision variables.
- I devised a Benders-embedded Column-and-Constraint Generation algorithm to facilitate the solution. Extensive economic assessments were carried out to evaluate long-term renewable paybacks.

IIT Projects

01/2017 - 08/2017 **Stochastic Market Clearing with Improved Renewable Forecasts**
Funding source: ComEd Chicago

Work outline

- The project targeted scenario-based stochastic programming for power production problems induced with improved wind/solar forecasts by artificial neural nets.
- The neural net found the optimal forecast of renewables and produced stochastic scenarios. Afterward, the scenarios were loaded into the stochastic programming problem for a more accurate market clearing with more competitive marginal prices.

Selected Publication (Citations: 516)

[1] **S. Yin** and J. Wang, "Generation and Transmission Expansion Planning Towards a 100% Renewable Future," IEEE Transactions on Power Systems, vol. 37, no. 4, pp. 3274–3285, 2022.

[2] **S. Yin** and J. Wang, "Distributionally Robust Decentralized Scheduling Between the Transmission Market and Local Energy Hubs," IEEE Transactions on Power Systems, vol. 38, no. 2, pp. 1845–1856, 2023.

[3] **S. Yin**, J. Wang, Z. Li, and X. Fang, "State-of-the-art Short-term Electricity Market Operation with Solar Generation: A review," Renewable and Sustainable Energy Reviews, vol. 138, p. 110647, 2021.

[4] **S. Yin**, J. Wang, and H. Gangammanavar, "Stochastic Market Operation for Coordinated Transmission and Distribution Systems," IEEE Transactions on Sustainable Energy, vol. 12, no. 4, pp. 1996–2007, 2021.

[5] **S. Yin**, J. Wang, X. Fang, and J. Tan, "A Generalized Multi-timescale Market Operation Framework Interfaced with Dynamic Simulation," IEEE Transactions on Power Systems, 2023. Under the 1^{st} round review.

[6] **S. Yin**, J. Wang, and F. Qiu, "Decentralized Electricity Market with Transactive Energy – A Path Forward," The Electricity Journal, vol. 32, no. 4, pp. 7–13, 2019.

[7] **S. Yin**, J. Wang, and Z. Li, "Decomposable Solution Paradigm for Uncertainty-based Transmission and Distribution Coordinated Economic Dispatch," in 2019 IEEE Power Energy Society General Meeting (PESGM), pp. 1–5, 2019.

[8] **S. Yin**, J. Wang, Y. Lin, X. Fang, J. Tan, and H. Yuan, "Practical Operations of Energy Storage Providing Ancillary Services: From Day-Ahead to Real-Time," in 2021 North America Power Symposium (NAPS), pp. 1–6, 2021.

[9] A. Zhou, M. Yang, X. Zheng, and **S. Yin**, "Distributionally Robust Unit Commitment Considering Unimodality-Skewness Information of Wind Power Uncertainty," IEEE Transactions on Power Systems, pp. 1–12, 2022.

Academic Participation

- Reviewer of European Journal of Operational Research
- Reviewer of Applied Energy
- Reviewer of IEEE Transactions on Power Systems
- Reviewer of IEEE Transactions on Smart Grid
- Reviewer of IEEE Transactions on Sustainable Energy
- Reviewer of IEEE Transactions on Vehicular Technology

Awards

- **SMU's Outstanding Graduate Student Award 2021 (one recipient every school)**