# Shengfei Yin, Ph.D.

Optimization Engineer - Ascend Analytics

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## Expertise

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

## Skill

- Python (numpy/pandas/tensorflow)
- GAMS/AMPL
- SQL
- MATLAB/Simulink
- R
- Git
- Gurobi/CPLEX/Xpress
- Linux/Bash
- Microsoft Office Suite

## 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 Energy 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 System Economics

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

## Work Experience

**03/2022 – Present** — **Optimization Engineer**
**Ascend Analytics, LLC**

*Role outline*

Work for the Development Department. This industry-based position involves improving software development efficiency and upgrading/debugging the optimization toolkit. **Line Manager: Vena Kostroun - VP of Development**

*Achievements*

- Lead on the software refactoring from GAMS to Python-Xpress API to achieve higher computational performance and more flexible user interface.
- Upgrade and optimize the workflow pipeline between GAMS and Python, automating pre-/post-processing within the solution procedure.
- Develop new features in Python-Xpress to satisfy clients' needs, involving in tens of unit modules such as battery storage, hydro operation, and multi-energy networks, etc.
- Communicate with clients and help delivering consulting services with high-dimensional customer data.
- Assist in renewing PowerSIMM™, the flagship software of the company, working with different pipeline teams such as the SAS development.

**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 investigation on future clean energy market planning with environmental impacts via machine learning and optimization. **Line Manager: 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, Gridpath.
- Model and simulate the national power capacity expansion planning and production cost modeling through 2020-2035, considering the power reliability and $CO_2$ emission.
- Draft several project proposals for US DOE and California funding agencies, including the California multi-objective power-eco optimization and 2060 carbon neutrality projects.
- Mentor interns and visiting Ph.D., host research calls, and write academic papers.

**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 the real-time supply chain optimization in MISO's daily operations. **Line Manager: Dr. Yonghong Chen - R&D Senior Consulting Advisor**

*Achievements*

- Perform timeseries 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 in Python with calibration via the MISO production model.
- Query and parse the timeseries 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% (million 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 potentials in the energy-reserve market. **Line Manager: Dr. Bryan Palmintier - Principal Research Engineer**

*Achievements*

- Build the multi-timescale optimization framework for short-term market analyses in Python 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 better mimic the practical market environment.
- Help designing 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 ($435M)*

*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 applying the K-means clustering.

**09/2018 - 11/2021** **Multi-timescale Integrated Dynamic And Scheduling (MIDAS)**
*Funding source: DOE SETO ($300M)*

*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 dynamic 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 a 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.

## Publication

[1] **S. Yin** and J. Wang, "Generation and Transmission Expansion Planning Towards a 100% Renewable Future," *IEEE Transactions on Power Systems*, pp. 1–1, 2020.

[2] **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.

[3] **S. Yin**, J. Wang, and H. Gangammanavar, "Stochastic market operation for coordinated transmission and distribution systems," *IEEE Transactions on Sustainable Energy*, pp. 1–1, 2021.

[4] **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*, 2021. Under the $1^{st}$ round review.

[5] **S. Yin**, Y. Chen, B. Knueven, L. Zhao, M. Faqiry, A. Thatte, and J. Wang, "Capturing Unit Startup and Shutdown Uncertainties in the Real-time Commitment Process," *IEEE Transactions on Power Systems*, 2021. Under the $2^{nd}$ round review.

[6] **S. Yin** and J. Wang, "Distributionally Robust Decentralization between the Transmission Market and Local Energy Hubs," *IEEE Transactions on Power Systems*, 2022. Under the $2^{nd}$ round review.

[7] **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.

[8] **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.

[9] **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.

[10] B. Knueven, M. Faqiry, M. Garcia, Y. Chen, R. Treinen, T. Werho, J. Zhang, V. Vittal, L. Zhao, A. Thatte, and **S. Yin**, "Stochastic Look-Ahead Commitment: A Case Study in MISO," *IEEE Transactions on Power Systems*, 2021. Under the $1^{st}$ round review.

[11] C. Chen, M. Cui, F. Li, **S. Yin**, and X. Wang, "Model-Free Emergency Frequency Control Based on Reinforcement Learning," *IEEE Transactions on Industrial Informatics*, vol. 17, no. 4, pp. 2336–2346, 2021.

[12] Y. Chen, C. Chen, X. Zhang, M. Cui, F. F. Li, X. Wang, and S. Yin, "privacy-preserving baseline load reconstruction for residential demand response considering distributed energy resources," *IEEE Transactions on Industrial Informatics*.

[13] Y. Chen, C. Chen, X. Zhang, M. Cui, F. F. Li, X. Wang, and **S. Yin**, "privacy-preserving baseline load reconstruction for residential demand response considering distributed energy resources," *IEEE Transactions on Industrial Informatics*.

[14] M. Tian, M. Cui, Z. Dong, X. Wang, **S. Yin**, and L. Zhao, "Multilevel Programming-Based Coordinated Cyber Physical Attacks and Countermeasures in Smart Grid," *IEEE Access*, vol. 7, pp. 9836–9847, 2019.

[15] C. Chen, M. Cui, X. Wang, K. Zhang, and **S. Yin**, "An Investigation of Coordinated Attack on Load Frequency Control," *IEEE Access*, vol. 6, pp. 30414–30423, 2018.

[16] Y. Lin, X. Zhang, **S. Yin**, J. Wang, and D. Shi, "Real-Time Economic Dispatch for Integrated Energy Microgrid Considering Ancillary Services," in *2020 IEEE Power Energy Society General Meeting (PESGM)*, pp. 1–5, 2020.

## Academic Participation

- Reviewer of *European Journal of Operational Research*
- Reviewer of *IEEE Transactions on Power Systems*
- Reviewer of *IEEE Transactions on Sustainable Energy*
- Reviewer of *Applied Energy*

## Awards

- **SMU's Outstanding Graduate Student Award 2021**
- **Lyle School Dean's Award for Research**
- **Golden Key Honor**