Sungho Shin

Assistant Professor, Department of Chemical Engineering, Massachusetts Institute of Technology
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Education and Training

Argonne National Laboratory, Lemont, IL — 2021–2024
Postdoc in Mathematics and Computer Science Division

University of Wisconsin-Madison, Madison, WI — 2021
Ph.D. in Chemical Engineering

Seoul National University, Seoul, South Korea — 2016
B.S. in Chemical Engineering and B.S. in Mathematics

Research Interests

energy systems; nonlinear optimization; control theory

Professional Appointments

Assistant Professor — 2024-Present
Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA

Postdoctoral Appointee (Supervisor: Mihai Anitescu) — 2021-2024
Mathematics and Computer Science Division, Argonne National Laboratory, Lemont, IL

Honors and Awards

COIN-OR Cup, Computational Infrastructure for Operations Research — 2023

W. David Smith, Jr. Graduate Publication Award, AIChE — 2023

Young Author Award, IFAC Conference on Nonlinear Model Predictive Control — 2021

Young Author Award, IFAC International Symposium on Advanced Control of Chemical Processes — 2021

CAST Directors' Student Presentation Award, AIChE — 2020

Selected Publications

[P11] S. Shin, V. Rao, M. Schanen, D. A. Maldonado, and M. Anitescu. Scalable multi-period AC optimal power flow utilizing GPUs with high memory capacities. In *Open Source Modelling and Simulation of Energy Systems*, 2024, 2405.14032. Accepted.

[P10] S. Shin and V. M. Zavala. Diffusing-horizon model predictive control. *IEEE Transactions on Automatic Control*, 2023, arXiv:2002.08556. doi:10.1109/TAC.2021.3137100.

[P9] A. Engelmann, S. Shin, F. Pacaud, and V. M. Zavala. Scalable primal decomposition schemes for large-scale infrastructure networks. *IEEE Transactions on Control of Network Systems*, 2024, arxiv:2212.11571. Accepted.

[P8] S. Shin, P. Hart, T. Jahns, and V. M. Zavala. A hierarchical optimization architecture for large-scale power networks. *IEEE Transactions on Control of Network Systems*, 6(3):1004–1014, 2019, arXiv:2002.09796. doi:10.1109/TCNS.2019.2906917.

[P7] S. Shin, C. Coffrin, K. Sundar, and V. M. Zavala. Graph-based modeling and decomposition of energy infrastructures. In *11th IFAC International Symposium on Advanced Control of Chemical Processes*, volume 54, pages 693–698, 2021, arXiv:2010.02404. doi:10.1016/j.ifacol.2021.08.322. Keynote Paper, Young Author Award.

[P6] S. Shin, M. Anitescu, and F. Pacaud. Accelerating optimal power flow with GPUs: SIMD abstraction of nonlinear programs and condensed-space interior-point methods. *Electric Power Systems Research*, 236:110651, 2024, arXiv:2307.16830. doi:10.1016/j.epsr.2024.110651.

[P5] F. Pacaud, D. A. Maldonado, S. Shin, M. Schanen, and M. Anitescu. A feasible reduced space method for real-time optimal power flow. *Electric Power Systems Research*, 212:108268, 2022, arXiv:2110.02590. doi:https://doi.org/10.1016/j.epsr.2022.108268.

[P4] F. Pacaud, S. Shin, M. Schanen, D. A. Maldonado, and M. Anitescu. Accelerating condensed interior-point methods on SIMD/GPU architectures. *Journal of Optimization Theory and Applications*, pages 1–20, 2023, arXiv:2203.11875. doi:10.1007/s10957-022-02129-5.

[P3] S. Shin, Y. Lin, G. Qu, A. Wierman, and M. Anitescu. Near-optimal distributed linear-quadratic regulator for networked systems. *SIAM Journal on Control and Optimization*, 61(3):1113–1135, 2023, arXiv:2204.05551. doi:10.1137/22M1489836.

[P2] J. Jalving, S. Shin, and V. M. Zavala. A graph-based modeling abstraction for optimization: Concepts and implementation in Plasmo.jl. *Mathematical Programming Computation*, 2022, arXiv:2006.05378. doi:10.1007/s12532-022-00223-3.

[P1] S. Shin, M. Anitescu, and V. M. Zavala. Exponential decay of sensitivity in graph-structured nonlinear programs. *SIAM Journal on Optimization*, 32(2):1156–1183, 2022, arXiv:2101.03067. doi:10.1137/21M1391079.

Grants

PI. Multi-Scale Production Cost Modeling for Optimal Storage Investment. MIT Energy Initiative. Total $100,000. 2024-2025.

PI. Analyzing the Ripple Effect of Consumer Flexibility on Utility Scale Energy System Investments. EQUINOR. Total $304,524. 2024-2025.

PI. Optimal Utilization Strategies of Utility-Scale Battery Storage: Slowing Down Degradation in the Face of Complex Physics and Uncertainties. MIT Energy Initiative. Total $150,000. 2024-2026.

PI. Characterizing the Trade-Off between CO2 Capture Rate and Energy Efficiency in Amine-Based Carbon Capture under Variable Feed Conditions. MIT Energy Initiative. Total $250,000. 2025-2027.

Co-PI. Optimal Design of Carbon Capture Units under Uncertainties in Feed Compositions and Operational Conditions. Department of Energy. $175,000 allocation. (expected to start in 2025).

Co-PI. Digital Twins for Sustainable Low-Cost EV Batteries: Real-Time Monitoring and Charging Optimization. Tata-MIT Alliance. Total $200,000 allocation. (expected to start in 2025).

Co-PI. Watts v/s Bytes: Energy Storage Impact Analysis on Flexible Computing Loads. MIT Energy Initiative. 2025-2026.

Synergetic Activities

- **Conference session organization**: Organized "Optimization Applications in Energy Systems" session at ICCOPT (2025). Organized "accelerated computing for mathematical programming" session at INFORMS Annual Meeting (2024). Session reviewer and chair of AIChE CAST Division (2022-present). International Program Committee of IFAC NMPC Conference (2024).
- **Editorial Board** of Systems and Control Transactions (2025-present).
- **Invited Seminars**: Given several invited seminars about "Nonlinear optimization on GPUs", including Los Alamos National Laboratory (2024), Oklahoma State University (2024), Purdue University (2024), AIChE CAST Webinar series (2024), General Electric (2024), Hitach Energy (2024)
- **Diversity, Equity, and Inclusion**: Contributed department activities at MIT to promote diversity in the field, including Rising Stars in Chemical Engineering (2024).
- **Peer reviews**:

  Proposals: NSF, DoE

  Journals: AIChE Journal; IEEE Transactions on Automatic Control; Automatica; Computers & Chemical Engineering; IEEE Open Journal of Control Systems; IEEE Control Systems Letters; IEEE Transactions on Control Systems Technology; Industrial & Engineering Chemistry Research; INFORMS Journal on Computing; Journal of Physical Chemistry; Journal of Optimization Theory and Applications; Optimization Methods and Software; SIAM Journal on Optimization

  Conferences: American Control Conference; IFAC Conference on Nonlinear Model Predictive Control; IFAC International Symposium on Advanced Control of Chemical Processes