Subir Majumder, Ph.D.

subir-em@ieee.org | +91 84528-74621 | sum-em.github.io | ORCID: 0000-0003-0237-8376

Highlights

- Power and energy systems researcher studying behavior-driven flexibility in emerging electricity loads, including AI data centers and cryptocurrency mining.
- Combines power-system modeling, optimization, causal inference, and AI/data-driven methods.
- Research spans AI-enabled power-grid operations, resilient control, transmission planning, storage sizing, and virtual power plant operation.

Education

Indian Institute of Technology Bombay, Mumbai, India, and *2020*
University of Wollongong, Wollongong, Australia
Ph.D. in Electrical Power Engineering; Cotutelle / Joint Ph.D. Agreement
Dissertation title: *Techno-economic analysis of electricity networks with renewable energy sources and storage devices*
Advisors: Prof. S. A. Khaparde and Prof. A. P. Agalgaonkar

Indian Institute of Technology Bombay, Mumbai, India *2014*
M.Tech. in Energy Systems Engineering

Kalyani Govt. Engineering College, West Bengal, India *2012*
B.Tech. in Electrical Engineering, West Bengal University of Technology

Research Experience

For each appointment, one representative research contribution is highlighted. Bracketed labels connect each contribution to the corresponding working paper or publication listed below.

Independent Researcher, Power Systems and Energy Economics *Aug. 2025–Present*
Collaborators: Prof. Le Xie; Dr. Ignacio Aravena

[W1] Developed a quasi-experimental econometric framework to estimate the demand response of Bitcoin-mining loads. The analysis shows that Bitcoin-mining facilities can provide substantial demand flexibility, but the flexibility available to the power grid depends in part on revenue conditions in the crypto-financial sector.

Harvard University, MA, USA *Nov. 2024–Aug. 2025*
Postdoctoral Fellow (Visiting); Mentors: Prof. Le Xie; Prof. Minlan Yu

[W2] Developed a bottom-up, trace-calibrated modeling framework that links AI workloads to short-timescale power variability. The model shows that hybrid AI data centers behave as dynamic grid loads. Intermediate mixes of batch and inference workloads can smooth aggregate power variability, but short-horizon ramping can remain elevated.

Texas A&M University, TX, USA *Apr. 2023–Aug. 2025*
TEES Senior Research Engineer I; Mentors: Prof. Le Xie; Dr. Ignacio Aravena

[J3] Evaluated whether large language models can serve as operator-facing assistants for power-grid applications. Testing across tasks such as forecasting, power-flow problem solving, and document interpretation showed that LLMs can help human experts navigate complex grid data but still require domain-specific tools for reliable decision-making.

West Virginia University, WV, USA *Sep. 2021–Mar. 2023*
Engineering Scientist; Mentor: Prof. Anurag Srivastava

[J5] Developed a hybrid proactive controller for power-grid operation during wildfires. RL provides anticipatory generator-setpoint guidance, while a per-step constrained optimization layer enforces feasible real-time dispatch.

Washington State University, WA, USA *Jan. 2020–Aug. 2021*
Postdoctoral Research Associate; Mentor: Prof. Anurag Srivastava

[C5] Developed a cyber–physical co-simulation testbed to evaluate the performance of DER-based distributed controllers under realistic communication constraints. Used the testbed to assess the resilience of a distributed feedback-based voltage-control algorithm under cyber-attack scenarios.

Indian Institute of Technology Bombay, MH, India *Jul. 2019–Dec. 2019*
Research Associate; Mentor: Prof. S. A. Khaparde

[J6] Developed a game-theoretic framework for fairly sharing voltage-sag mitigation resources among multiple industrial customers. The resources are modeled as partially excludable common-pool resources because customers are not collocated. The methodology allocates benefits in a way that discourages unilateral free-riding.

Working Papers

[W1] **S. Majumder**.
"Hashprice moderates the electricity demand response of Bitcoin miners."
arXiv preprint arXiv:2606.00587v2, 2026.

[W2] **S. Majumder**, M. Yu, and L. Xie.
"Workload composition smooths aggregate power demand while sustaining short-horizon ramps in AI data centers."
arXiv preprint arXiv:2604.10769, 2026.

Selected Publications

Selected refereed publications are listed below; preprints are available on my personal website; the complete publication list is available on my Google Scholar profile.

Policy briefs:

[P1] R. Mural, D. Pherwani, C. Gupta, Y. Yu, A. Takahashi, D. Kim, **S. Majumder**, H. Lee, M. Yu, and L. Xie.
"AI, data centers, and the U.S. electric grid: A watershed moment."
Belfer Center for Science and International Affairs, Harvard Kennedy School; Power and AI Initiative, Harvard SEAS, 2026.

Refereed journal articles:

[J1] I. Aravena, C.-C. Sun, R. Shi, **S. Majumder**, W. Yan, J.-Y. Joo, L. Xie, and J. Wang.
"Open power system datasets and open simulation engines: A survey toward machine learning applications."
IEEE Open Access Journal of Power and Energy, vol. 12, pp. 353–365, 2025.

[J2] L. Xie, **S. Majumder**, T. Huang, Q. Zhang, P. Chang, D. J. Hill, and M. Shahidehpour.
"The role of electric grid research in addressing climate change."
Nature Climate Change, vol. 14, no. 9, pp. 909–915, 2024.

[J3] **S. Majumder***, L. Dong*, F. Doudi*, Y. Cai*, C. Tian, D. Kalathil, K. Ding, A. A. Thatte, and L. Xie.
"Exploring the capabilities and limitations of large language models in the electric energy sector."
Joule, vol. 8, no. 6, pp. 1544–1549, 2024. (*Equal contribution.)

[J4] **S. Majumder**, S. A. Khaparde, A. P. Agalgaonkar, S. V. Kulkarni, A. K. Srivastava, and S. Perera.
"Chance-constrained pre-contingency joint self-scheduling of energy and reserve in a VPP."
IEEE Transactions on Power Systems, vol. 39, no. 1, pp. 245–260, 2024.

[J5] S. U. Kadir, **S. Majumder**, A. K. Srivastava, A. Chhokra, A. Dubey, H. Neema, and A. Laszka.
"Reinforcement learning based proactive control for enabling power grid resilience to wildfire."
IEEE Transactions on Industrial Informatics, vol. 20, no. 1, pp. 795–805, 2024.

[J6] **S. Majumder**, S. A. Khaparde, A. P. Agalgaonkar, S. V. Kulkarni, and S. Perera.
"Graph theory based voltage sag mitigation cluster formation utilizing dynamic voltage restorers in radial distribution networks."
IEEE Transactions on Power Delivery, vol. 37, no. 1, pp. 18–28, 2022.

[J7] **S. Majumder**, A. P. Agalgaonkar, S. A. Khaparde, P. P. Ciufo, S. Perera, and S. V. Kulkarni.
"Allocation of common-pool resources in an unmonitored open system."
IEEE Transactions on Power Systems, vol. 34, no. 5, pp. 3912–3920, 2019.

[J8] **S. Majumder**, S. A. Khaparde, A. P. Agalgaonkar, P. P. Ciufo, S. Perera, and S. V. Kulkarni.
"DFT-based sizing of battery storage devices to determine day-ahead minimum variability injection dispatch with renewable energy resources."
IEEE Transactions on Smart Grid, vol. 10, no. 1, pp. 626–638, 2019.

[J9] **S. Majumder**, R. M. Shereef, and S. A. Khaparde.
"Two-stage algorithm for efficient transmission expansion planning with renewable energy resources."
IET Renewable Power Generation, vol. 11, no. 3, pp. 320–329, 2017.

Refereed conference papers:

[C1] D. Kim, **S. Majumder**, and L. Xie.
"A multi-source data repository and profit-robust framework for energy storage planning."
In: *Proceedings of the 57th North American Power Symposium (NAPS).*
Hartford, CT, USA, 2025.

[C2] **S. Majumder**, I. Aravena, and L. Xie.
"An econometric analysis of large flexible cryptocurrency-mining consumers in electricity markets."
In: *Proceedings of the 58th Hawaii International Conference on System Sciences (HICSS).*
Waikoloa Village, HI, USA, 2025.

[C3] M. Zeid, **S. Majumder**, H. Ibrahim, P. Enjeti, L. Xie, and C. Tian.
"Predicting DC-link capacitor current ripple in AC-DC rectifier circuits using fine-tuned large language models."
In: *Proceedings of the 50th Annual Conference of the IEEE Industrial Electronics Society (IECON).*
Chicago, IL, USA, 2024.

[C4] D. Kim, **S. Majumder**, and L. Xie.
"Line-post insulator fault classification model using deep convolutional GAN-based synthetic images."
In: *Proceedings of the 55th North American Power Symposium (NAPS).*
Asheville, NC, USA, 2023.

[C5] P. S. Sarker, **S. Majumder**, M. F. Rafy, and A. K. Srivastava.
"Impact analysis of cyber-events on distributed voltage control with active power curtailment."
In: *Proceedings of the 2022 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES).*
Jaipur, India, 2022.

[C6] S. Knudsen, **S. Majumder**, and A. K. Srivastava.
"Securely implementing and managing neighborhood solar with storage and peer-to-peer transactive energy."
In: *CIGRE Paris Session.*
Paper No. D2-10414, Paris, France, 2022.

Awards and Recognitions

Tocqueville Fellowship; awarded by Mercatus Center at George Mason University. *2026*
Theme: Exploring the intersection of Bitcoin, political economy, and philosophy.

POSOCO Power System Award; awarded by POSOCO, now Grid Controller of India Limited (Grid-India). *2020*

External-examiner recognition; Ph.D. thesis recommended for the Best Ph.D. Thesis Award, IIT Bombay. *2020*
Cited for innovative research, rigorous analysis, and diverse mathematical approaches.

External-examiner recognition; Ph.D. thesis recommended for Special Commendation for an Outstanding Ph.D. Thesis, University of Wollongong. *2020*
Cited for high-quality publications and innovative research solutions.

University Postgraduate Award and Institute Postgraduate Tuition Award; awarded by University of Wollongong, Australia. *2016–2019*

Invited Talks and Panels

Invited talk, "Modeling the Power Grid Impact of AI Data Centers." *Jul. 2025*
Massachusetts Institute of Technology, Cambridge, MA.

Invited talk, "Necessity of System-Aware Grid-Edge Operations in the Power Grids." *Mar. 2025*
Pran Foundation, India.

Panelist, "The Dual Edge of Technology: Equity and Sustainability in AI Usage." *Mar. 2025*
Harvard University IT, Boston, MA.

Invited talk, "Behavior of Large Cryptocurrency-Mining Firms in Electricity Markets: A Texas Econometric Analysis." *Sep. 2024*
Energy & Power Group Seminar, Texas A&M University, College Station, TX.

Panelist, "Operational Control of the Power Grid through AI in the Advent of Wildfire," panel on "Resiliency of the Power System for Sustainability." *Jul. 2024*
IEEE Power & Energy Society General Meeting, Seattle, WA.

Media and Research Coverage

Harvard SEAS News, "Bringing GPT to the grid: The promise and limitations of large-language models in the energy sector." *Jun. 2024*

Texas A&M Engineering News, "Large language models may revolutionize the electric energy sector." *Jun. 2024*

Teaching and Mentoring Experience

Guest Lecturer, *Smart Grids*, IIT Bombay. *2018*

- Delivered three lectures on battery storage sizing. Class size: 20.

Teaching Assistant, IIT Bombay. *2013–2018*

- *Smart Grids.* Class size: 20. *2018*
- *Energy Management.* Class size: 80. *2016*
- *Fundamentals of Electrical Engineering.* Class size: 70. *2014, 2015*
- *Power Systems.* Class size: 60. *2014, 2015*
- *Fundamentals of Energy Engineering.* Class size: 30. *2013*

Lab Demonstrator, University of Wollongong. *2017*

- *Power Electronics and Drives.* Class size: 24.
- *Electrical Energy Utilization.* Class size: 24.

Selected Research Mentoring

- A. Alonso, undergraduate student, Harvard University. *2025*
  (with Prof. Le Xie).
- M. Zeid, Ph.D. student, Texas A&M University. *2024*
  (with Prof. Prasad Enjeti).
- P. Fu, then working at Future 500; now a student at Harvard Kennedy School. *2023*
  (with Prof. Le Xie).
- Md. F. Rafy, Ph.D. student, West Virginia University. *2022–2023*
  (with Prof. A. Srivastava).
- T. E. Warner, undergraduate student, Washington State University. *2020*
  (with Prof. A. Srivastava).
- M. Ayad, undergraduate student, University of Wollongong. *2017*

Professional Service

Professional memberships: IEEE Member since 2021; American Economic Association member since 2023.

Standards and working groups: Member, IEEE Working Group on Natural Disaster Mitigation Methods and Operation Technology, 2023; member, IEEE Working Group on Modern & Future Distribution System Planning, 2022–2024.

Journal reviewer: *IEEE Transactions on Power Systems*, 2022–2025; *IEEE Transactions on Power Delivery*, 2022–2023; *IEEE Transactions on Smart Grid*, 2024; *IEEE Transactions on Industrial Electronics*, 2025; *IEEE Transactions on Industrial Informatics*, 2023; *Energies*, 2022–2023; *Sensors*, 2022; *Simulation*, 2025.

References

Prof. Le Xie
Harvard University

Prof. Prasad Enjeti
Texas A&M University

Prof. S. A. Khaparde
Indian Institute of Technology Bombay

Prof. Channan Singh
Texas A&M University

Prof. Ashish Agalgaonkar
University of Wollongong

Dr. Ignacio Aravena
Lawrence Livermore National Laboratory