

Impact of Electric Vehicles on Distribution Networks

The increasing penetration of Electric Vehicles (EVs) into distribution networks entails significant technical and operational implications. The rise in peak demand due to simultaneous charging may lead to transformer and distribution line overloading, while the variability of charging profiles introduces voltage fluctuations and power quality issues, such as harmonics and phase imbalances. Moreover, higher overall network losses can result in reduced efficiency. These challenges highlight the need for advanced planning and management strategies, including smart charging, the integration of energy storage systems, and the adoption of vehicle-to-grid (V2G) technologies, in order to ensure the stability and reliability of the power system.

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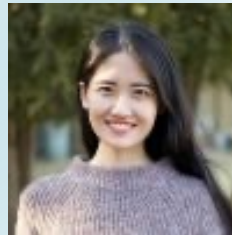
Council Room

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Sijia Geng is an assistant professor in the Department of Electrical and Computer Engineering (ECE), a core researcher at the Ralph O'Connor Sustainable Energy Institute (ROSEI), and a member of the Data Science and AI Institute. She founded and directs the Power and Energy Network System Analysis (PENSA) Laboratory at Johns Hopkins.

Geng's research integrates methodologies from system and control theory, mathematical analysis, and optimization to address pressing and fundamental challenges in complex and networked energy systems. Her research aims at driving the widespread utilization of renewable energy resources while enhancing energy system resiliency and efficiency through developing rigorous theory and cutting-edge computational tools.

Recent projects include developing a modeling, dynamics analysis, and control design framework to provably ensure the stability of power systems that host heterogeneous inverter-based resources; developing data-driven decision-making techniques for nonlinear and hybrid dynamical systems of unprecedented scale and complexity; and developing efficient optimization tools and algorithms geared toward planning and operating future multi-energy systems and transportation systems. Her research has been funded by the National Science Foundation, U.S. Department of Energy, MIT Energy Initiative (MITeI), and industry partners.

At ROSEI, Geng co-leads the institute's Grid pillar, which focuses on eliminating reliance on fossil fuels and converting to clean electrical power systems: a key component in moving toward a more sustainable energy future. She is also the co-PI of the NSF-funded Electric Power Innovation for a Carbon-free Society (EPICS) center, which fosters global innovation and collaboration with UK and Australian academics and industry and policy stakeholders from the globe.

Before joining Johns Hopkins in 2023, Geng was a postdoctoral associate at the Laboratory for Information & Decision Systems (LIDS) at the Massachusetts Institute of Technology (MIT) in 2022. She earned a doctorate and master's degree in electrical and computer engineering, as well as a master's degree in mathematics, all at the University of Michigan-Ann Arbor, in 2022 and 2021. She received her undergraduate degree in automation from the School of Astronautics at the Harbin Institute of Technology in 2016. She was a visiting scholar at the Purdue University in 2015 and a graduate student researcher at the Pacific Northwest National Laboratory in 2018.

Her work has received numerous honors and awards. She is the recipient of a Best Paper Award at the 2022 MIT/Harvard Applied Energy Symposium and was also named a Rising Star in Electrical Engineering and Computer Science by MIT in 2021. At the University of Michigan, she was named a Barbour Scholar in 2021, which is among the oldest and most prestigious awards granted by UM for scholars of the highest academic and professional caliber. She also received a Richard F. and Eleanor A. Towner Prize for Distinguished Academic Achievement in 2018 and a Gerald and Esther Forrest Graduate Student Fellowship in 2016, in honor of her accomplishments in research, excellence in teaching, and contributions to leadership and service. Her dissertation research received an honorable mention for the Towner Prize for Outstanding Ph.D. Research.



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