

Mobility-Centric Modeling and Scalable Optimization on Demand Flexibility in Electric Vehicle Charging

Yi Ju

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Abstract Electric vehicles (EVs) promise substantial demand flexibility for the power system. That flexibility is rooted in mobility: where vehicles travel, where they stay, and how much energy they need for future trips. This talk develops mobility-aware flexibility, which allows charging to shift across a vehicle's week-long itinerary as long as its mobility needs remain feasible. ***At the system level, I study how millions of EVs can be coordinated when both distribution-feeder headroom and shared public charging ports are scarce, and how the two infrastructures should be co-expanded.*** Despite the resulting metropolitan-scale, nonconvex problem, I develop iterated price response algorithm, structure-exploiting per-vehicle solvers, and primal-dual certificates that make near-optimal coordination tractable for 1.84 million EVs, 1,303 feeders, and 17,300 existing public charging ports. In the modeled 30% EV-adoption scenario for the San Francisco Bay Area, coordinated mobility-aware charging reduces estimated feeder and charger expansion costs from \$15.3 billion to \$114 million; once unidirectional charging is fully coordinated, bidirectional charging adds only about 5% further savings.

The research views EV charging management as ***a large-scale, tightly coupled complex system*** and asks what flexibility is actually realizable and actionable. I will close by discussing my recent thoughts on some emerging directions of sustainable infrastructure systems.

Yi Ju is a Postdoctoral Fellow at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS). His research focuses on energy and infrastructure systems, with recent interests in demand flexibility from distributed energy resources. Yi expects to receive his PhD in Systems Engineering and MS in Computer Science from UC Berkeley in 2026. He received his Bachelor's degree in Engineering from Tsinghua University in 2020, along with a second bachelor's degree in Economics from Peking University. His work has received the Building Simulation 2023 Best Student Paper Award and the ASME Energy Systems Technical Committee Best Paper Award in 2024 and 2026, among other honors. He was also named an Outstanding Graduate Student Instructor at UC Berkeley in 2026. Yi founded eMERGE, a weekly seminar series that provides a platform for early-career researchers in energy, mobility, infrastructure, and sustainability to share their work and build connections across fields.

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Venue Rm 510, Soda Hall, UC Berkeley

Zoom 998 1115 8447 (pw:123456)

