

Dr. Andrew L. Liu Associate Professor School of Industrial Engineering Purdue University West Lafayette, IN 47907-2023

February 27, 2025

Editor-in-Chief Operations Research INFORMS

**Subject:** Submission of Manuscript: Decentralized Integration of Grid Edge Resources into Wholesale Electricity Markets via Mean-field Games

Dear Editor-in-Chief,

We are pleased to submit our manuscript, Decentralized Integration of Grid Edge Resources into Wholesale Electricity Markets via Mean-field Games, for consideration in Operations Research. This paper presents a novel mean-field game framework that enables electricity consumers who own distributed energy resource (DER), termed as prosumers, to autonomously optimize their participation in wholesale electricity markets, thereby enhancing grid efficiency and market stability. Our work addresses the significant challenge of integrating a large number of decentralized DERs into a wholesale electricity market while maintaining a fully decentralized decision-making process.

## Our key contributions include:

- 1. Formulating a scalable mean-field game model for prosumer participation in wholesale electricity markets, proving the existence of a mean-field equilibrium, and establishing an ε-Markov-Nash equilibrium for large but finite populations.
- 2. Developing a low-overhead, decentralized learning algorithm that enables prosumers to adaptively optimize their bidding and storage strategies in response to locational marginal prices.
- 3. Demonstrating the effectiveness of our approach through numerical experiments, showing reduced price volatility and peak demand, particularly under supply and demand shocks.

We believe our study makes a noteworthy contribution to the field of multi-agent systems and learning-based algorithms in electricity market design. Given the journal's focus on innovative methodologies for operations research and their applications in complex systems, we consider Operations Research an ideal venue for our work.

We confirm that this manuscript has not been published elsewhere and is not under consideration by any other journal. All authors have approved this submission, and there are no conflicts of interest to disclose.

We appreciate your time and consideration and look forward to your feedback. Please let us know if any additional information is required.

315 N. Grant Street, West Lafayette, IN, 47907

Office: 765-494-5400

## Sincerely yours,

## Andrew L. Lin

Andrew (Lu) Liu, Ph.D. Associate Professor School of Industrial Engineering Purdue University West Lafayette, IN 47907 Tel: (765) 494 – 4763

Email: AndrewLiu@purdue.edu

Website: https://engineering.purdue.edu/Intel2Grid