The Hong Kong University of Science and Technology

Dept of Information Systems, Business Statistics and Operations Management
Dept of Industrial Engineering & Decision Analytics
Joint Seminar Announcement

Joint Inventory-Routing Optimization for Battery Swapping Networks with Hybrid Charging

By

Professor Long HE

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Date	:	**5 June 2026 (Friday)**
Time	:	**10:30 – 11:45 AM**
Venue	:	**Classroom 2003, 2/F, LSK Business Building**

Abstract: The rapid expansion of electric vehicle battery-swapping networks is placing unprecedented pressure on urban power grids. This study investigates a hybrid battery swapping-charging system comprising multiple local swapping stations (SSs) and a centralized charging station (CS). Under this framework, depleted batteries are either recharged on-site at SSs or transported to the CS for centralized charging and periodic redistribution. We formulate a joint inventory-routing problem to optimize replenishment policies and delivery routes, aiming to minimize total operational costs while satisfying service-level constraints. By characterizing the battery deficit processes at both the CS and SSs, we derive closed-form expressions for their first two moments, yielding tractable inventory policies. To solve the resulting optimization problem efficiently, we exploit the submodular cost structure under knapsack constraints to derive facet-defining extended polymatroid inequalities (EPIs). We further develop enhanced EPIs within a customized branch-and-cut framework. Case studies using real-world data demonstrate that for large-scale instances, these enhanced EPIs reduce average solution times by approximately 52% and 83% relative to improved and classical EPIs, respectively. Our results show that while hybrid charging is optimal for moderate operational scenarios, fully centralized or decentralized strategies become preferable as network characteristics, such as station dispersion, on-site capacity, and transportation costs, become extremes.

Bio: Long He is an associate professor of Decision Sciences at the School of Business, George Washington University. Prior to joining GW, Long was an associate professor of Analytics & Operations at NUS Business School, National University of Singapore. He received his Ph.D. in Operations Research from the University of California, Berkeley, and his B.Eng. in Logistics Management and Engineering from HKUST. His current research combines data-driven optimization and ML/AI to address practical problems in smart city operations, sustainable energy systems, and supply chain management. This line of research has been recognized with the M&SOM Journal Best Paper Award, TSL Best Paper Award, the ENRE Best Publication Awards in Energy and in Natural Resources, and the Daniel H. Wagner Prize from INFORMS. He currently serves as an Associate Editor for Manufacturing & Service Operations Management (M&SOM) and Omega.

All interested are welcome!
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