DEPARTMENT of ISE
UNIVERSITY of HOUSTON

FRIDAY SEMINAR SERIES

BROADEN HORIZONS | EXTEND MINDS

Dr. Tanveer Hossain Bhuiyan
Mechanical, Aerospace and Industrial Engineering
The University of Texas at San Antonio
San Antonio, TX

Date: Friday, March 28, 2025
Time: 1 p.m. - 1:50 pm
Location: D2 Lect2

An Improved Branch-and-Price Algorithm for Routing and Scheduling of Electric School Buses for Power Restoration Around Disasters

Abstract: Natural disasters threaten the resilience of power systems, causing widespread power outages that disrupt critical loads and endanger public safety. Compared to the time-consuming conventional restoration methods, leveraging government-controlled electric school buses (ESBs) having large battery capacity and deployment readiness offers a promising solution for faster power restoration to critical loads during disasters while traditional maintenance is underway. We study the problem of dispatching, routing, and scheduling a heterogeneous fleet of ESBs to satisfy the energy demand of critical isolated loads around disasters addressing the following practical aspects: combined transportation and energy scheduling of ESBs, multiple back-and-forth trips of ESBs between isolated loads and charging stations, and spatial-wise coupling among multiple ESB routes. We propose an efficient mixed-integer programming model for routing and scheduling ESBs accounting for these practical aspects to minimize the total restoration cost over a planning horizon. We develop an efficient exact branch-and-price (B&P) algorithm and a customized heuristic B&P algorithm integrating dynamic programming and labeling algorithms. Numerical results based on a realistic case study of Florida hospitals demonstrate that our proposed exact B&P and heuristic B&P algorithms are computationally 193 and 343 times faster, respectively, than Gurobi. Using network sparsity to incorporate the limitation in shelter-ESB type compatibility in the model demonstrates that the total restoration cost increases, on average, by 217% as the network becomes fully sparse compared to fully connected. The effective usable capacity metric reflects that the largest-capacity ESBs are up to 10 times more effective than the least-capacity ESBs in critical load restoration. Additionally, results demonstrate that the required fleet size increases by 429% as the weather changes from normal to adverse.

Biography: Dr. Tanveer Hossain Bhuiyan is an Assistant Professor in the Mechanical, Aerospace, and Industrial Engineering Department at The University of Texas at San Antonio (UTSA). Before joining UTSA, he worked as a Postdoctoral Fellow at the Idaho National Laboratory. He received a Ph.D. degree in Industrial Engineering from The University of Tennessee-Knoxville and an M.S. in Operations Research with a minor in Statistics from Mississippi State University. Dr. Bhuiyan's research is focused on developing data-driven optimization algorithms and data analytics methods for solving decision-making problems under uncertainty in areas including electrified and sustainable transportation networks, security of cyber-physical systems, and power systems resiliency and operation integrating distributed energy resources. His research has been published in journals including the European Journal of Operational Research, Omega, Applied Energy, and Journal of Manufacturing Systems. His research has been funded by the U.S. Department of Energy and U.S. Navy. He is serving as a director in the Logistics and Supply Chain Division of the Institute of Industrial and Systems Engineers (IISE). He is also a member of INFORMS and IISE.