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Managing Reusable Packages in Modern Supply Chain Systems: A Lagrangian Decomposition Approach for the Standard Vehicle Routing Problem with Backhauls

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About the Speaker

Dr. Monireh Mahmoudi, is an Assistant Professor in the School of Packaging, College of Agriculture and Natural Resources, at Michigan State University. She received her Ph.D. in Transportation Engineering from Arizona State University in 2018. Her research interest is in the application of operations research in logistics and transportation. Her areas of expertise can be summarized in two categories: (1) operations research in transportation: last mile delivery, pickup and delivery with transfers, activity-based vehicle routing, vehicle routing with back-hauls, and (2) operations management: dynamic decision-making in operations management, mechanisms to mitigate supply chain disruption risks. Dr. Mahmoudi's research has gained accolades from ITE Western District, INFORMS IBM Service Science, and INFORMS OR/MS Monsanto Society.

About the Talk

Using reusable packages for basic products is an excellent idea; however, managing their transportation operations in real-world transportation networks is a complex task. Delivery of full packages and picking up empty ones can be mathematically modeled by the standard Vehicle Routing Problem with Backhauls (VRPBs). In the standard VRPB, the customers are partitioned into linehaul and backhaul customers who require deliveries and pickups, respectively. Both linehaul and backhaul customers must be visited exactly once, all linehauls must be visited before backhauls, and all routes must contain at least one linehaul customer. All deliveries have to be loaded at the depot, and all pickups have to be transported to the depot. In this paper, we propose a new mathematical model for the standard VRPB that allows us to break the main problem into three sub-problems, i.e., two open Vehicle Routing Problems and one Assignment Problem, resulting in a problem decomposition that is deemed vital for real-world implementations. We test our framework on two benchmark datasets in the extant literature and a randomly generated dataset, geographically distributed on the Lansing transportation network. To reduce the computational burden of solving the VRPB on the latter dataset, we present a cluster-first route-second algorithm.

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