

**Dynamic Scheduling of a Battery-Operated Queue**

Dr. Xu Sun

Assistant Professor

Department of Industrial and Systems Engineering

University of Florida

Abstract

Operations Research Seminar

About the Speaker

Martin Hall

M-103

Friday, February 7

11:15 am – 12:15 pm

Dr. Xu Sun is an Assistant Professor of Data Analytics and Applied Operations Research in the Department of Industrial and Systems Engineering at the University of Florida. His research includes the analysis and optimization of stochastic service systems, the theory of stochastic-process limits, and the design and control of sustainable urban transport systems. His research findings were published in Manufacturing & Service Operations Management, Operations Research Letters, European Journal of Operations Research, Mathematics of Operations Research, and Stochastic Systems. He was a finalist of the Best Student Paper Competition in INFORMS Finance Section in 2017 and a recent recipient of the Travel Award from Institute for Mathematics and its Applications.

As a model of drone parcel delivery system, we consider a dynamic scheduling problem for a multiclass, single-server queue. A distinctive feature of our system is that the server is battery-powered and each service would consume certain amount of energy. Once depleted, the battery will be swapped out for a fully charged one -- thus the total energy consumption for the duration between two consecutive battery swaps (hereinafter referred to as a "cycle") cannot exceed the capacity of the battery. The system serves multiple demand streams, each having a class-dependent holding cost and electrical energy requirement. The system manager strives to minimize long-run average holding cost by dynamically making sequencing decisions subject to battery charge level constraint. Our work focuses on improving drone delivery operations, which can reduce costs and improve user satisfaction. Because the exact analysis of the scheduling problem seems intractable, we resort to an approximation in the heavy traffic regime. In that regime, we characterize the dynamics of the parcel delivery operation and derive the control policy where job classes are prioritized according to a workload-dependent dynamic index rule. Unlike known results where the prioritizing process is made by dynamically assigning an available server to a job from one of the classes, the prioritization is achieved by optimally selecting a portfolio of jobs that can be accomplished with a full battery (hereinafter referred to as an "activity") at the beginning of every cycle. To minimize the average holding cost, the system manager can rely on an optimal activity combination (that is of equal size to the number of job classes) to achieve the intended prioritization. Roughly speaking, the best activity combination is selected such that the variability of the system is minimized.