UNIVERSITY of HOUSTON | ENGINEERING

Department of Industrial Engineering

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1:00 PM – 4:00 PM CST

Zoom link: https://uofh.zoom.us/j/94066535039
Meeting ID: 940 6653 5039

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Ph.D. Dissertation Defense
Advisor: Gino J. Lim

"Path Planning and Scheduling Problems for the Use of Drones"

Abstract

Drones, or Unmanned Aerial Vehicles (UAVs), are aircrafts without a human pilot that usually are controlled and programmed by ground base centers. Although drones are becoming more and more popular in recent years, there are a few challenges and drawbacks that should be addressed in drone scheduling.

The first contribution addresses the impact of payload amount on the battery consumption rate (BCR). The design of a parcel delivery system using drones is addressed, which includes strategic planning of the system and operational planning for a given region. We used a minimum set covering approach to model the strategic planning and we also used a mixed integer linear programming problem (MILP) for the operational planning. In order to improve the computational time of the operational planning model, a variable preprocessing algorithm and several upper and lower bounds on the objective function are proposed.

The second contribution considered drone failures in scheduling to minimize the expected loss of demand (ELOD). A Simulated Annealing (SA) heuristic algorithm is developed to reduce the computational time. The proposed SA features a fast initial solution generation based on the Petal algorithm, a binary integer programming model for path selection, and a local neighborhood search algorithm to find better solutions.

The third contribution addresses the implementation of autonomous battery swap stations (ABSSs) to extend flight time in a drone-aided surveillance mission. A mixed integer linear programming (MILP) model is proposed to determine the ABSS location based on the limitation on the maximum revisiting gap at surveillance waypoints. A battery management algorithm is also proposed to optimize the number of batteries secured for each drone by minimizing the battery acquisition and replacement cost over a planning horizon. The impact of average and standard deviation of battery State of Charge (SOC) on capacity degradation is considered in this dissertation.