Droneport Placement Optimization and Capacity Prediction

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Abstract— Increasing demand for Unmanned Aerial Vehicles (UAVs, or drones) in urban airspace brings many concerns about safety issues. Take-off, approach and landing phases of drones have a strong occurrence possibility of accidents and incidents. Concerning the potential safety issues of thousands of drones taking off and landing in the metropolitan areas, we conceive a facility called droneport to accommodate and manage assorted drones in a protected space, which is suitable for applying air traffic control to departing and approaching drones. This paper presents several contributions to the concept of droneport: (1) The Holt-Winters' seasonal method was adopted to forecast future delivery drone demand based on historical online retailer data. (2) A multi-objective optimization model was established to determine the optimum placement and number of droneports considering both costs and societal value from three aspects: maximizing e-commerce demand coverage, minimizing drone service distance and maximizing area coverage. (3) Gaussian noise was introduced to the optimization model to make the measurement of service distance more practical. (4) The future capacity of each droneport was estimated. A real-world case study was carried out for Singapore. Developed on the forecasted demand distribution, the optimization result with 7 droneports and a 10 km radius of operation showed a 99% demand coverage and 93% subzone coverage. Overall, this paper presented an intuitive and efficient optimization model for the placement of droneports with predicted drone demand and forecasted the capacity of each droneport.