UAV Pickup and Delivery Model with Data Rate Maximization and No-Fly Zones Avoidance

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***Abstract*—Unmanned aerial vehicles (UAVs) are increasingly used in logistics, yet the pickup and delivery problem (PDP) remains challenging due to no-fly zones (NFZs) and communication requirements. This paper proposes an improved pickup and delivery model (PDM) that incorporates NFZ constraints and air-to-ground communication to maximize transmission data rate. The PDP is decomposed into path planning and flying sequence planning, solved by a Dijkstra-based algorithm and a genetic algorithm, respectively. Numerical results show improved communication efficiency and energy feasibility over existing methods.**

***Index Terms*—UAV pickup and delivery model, UAV communication.**

I. Introduction and Proposed Approach

Unmanned aerial vehicles (UAVs) have become an important solution in modern logistics systems [1] due to their flexibility and high operational efficiency. Despite their growing adoption, effectively solving the pickup and delivery problem (PDP) for UAV-based logistics remains challenging. In practical environments, the presence of no-fly zones (NFZs) and increasing demands for reliable air-to-ground communication [2] significantly complicate UAV operations. However, most existing studies either ignore NFZ constraints or focus primarily on maintaining connectivity, without explicitly optimizing transmission data rates for real-time monitoring.

This paper proposes an improved pickup and delivery model (PDM) that incorporates NFZ constraints and air-to-ground communication to maximize transmission data rate. The PDP is decomposed into path planning and flying sequence planning. A Dijkstra-based algorithm jointly optimizes flight distance and communication performance, while a genetic algorithm (GA) with a weight violation-degree sorting method minimizes energy consumption. Simulation results show that the proposed approach satisfies all weight constraints and ensures energy feasibility for the UAV.

II. Simulation Results

Fig. 1 presents the optimization results obtained by the proposed method. Fig. 2 illustrates the carried goods weight in each flight segment. It can be observed that the payload remains within the prescribed constraint throughout all flight segments.

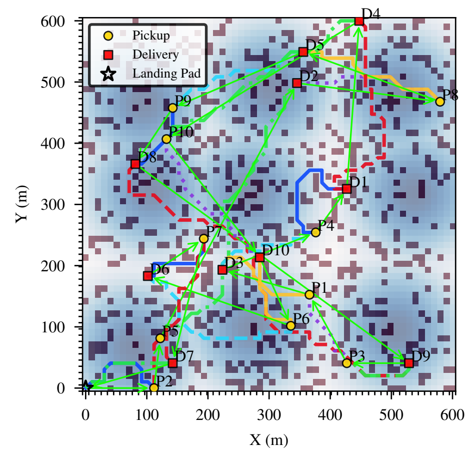

Fig. 1. Minimum energy consumption UAV path generated by GA with weight violation-degree sorting.

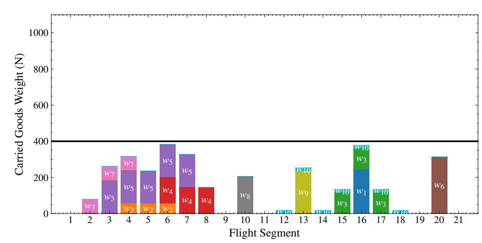

Fig. 2. The carried goods weights in each flight segment of the proposed scheme optimizing the energy consumption.

Acknowledgment

This work was supported by NRF grant No. RS-2024-00336983. S.-W. Jeon is the corresponding author.

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