A hybrid-encoding-based Genetic Algorithm for Multi-Objective Multi-UAV Scheduling

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Unmanned aerial vehicles (UAVs) are increasingly used for firefighting due to security. Multiple UAVs depart from a site and cooperate to execute tasks with time-varying demands in different locations. To better execute firefighting tasks, the reasonable scheduling of UAVs is crucial. Although multiple methods have been developed to solve the multi-UAV scheduling problem, they still face challenges in scenarios with multiple conflicting optimization objectives. This paper models the problem as a bi-objective optimization problem, aiming to minimize two important objectives: the makespan and the total travel distance of UAVs. A hybrid encoding-based genetic algorithm (HEGA) is developed to address the problem. In HEGA, a hybrid encode scheme is adopted for solution representation, in which the execution order of all tasks is represented as a sequence and the task assignment for UAVs is represented as a binary encode. Correspondingly, solutions can be constructed in two steps: task sequence generation first and then task assignment. Crossover and mutation operations are specifically designed to improve solution diversity. Experimental results on instances with various scales demonstrate that HEGA significantly outperforms state-of-the-art algorithms in terms of solution optimality and diversity.