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Optimal 3D Deployment and Path Planning of Multiple Uavs for Maximum Coverage and Autonomy

Authors : Indu Chandran, Shubham Sharma, Rohan Mehta, Vipin Kizheppatt

Abstract : Unmanned aerial vehicles are increasingly being explored as the most promising solution to disaster monitoring, assessment, and recovery. Current relief operations heavily rely on intelligent robot swarms to capture the damage caused, provide timely rescue, and create road maps for the victims. To perform these time-critical missions, efficient path planning that ensures quick coverage of the area is vital. This study aims to develop a technically balanced approach to provide maximum coverage of the affected area in a minimum time using the optimal number of UAVs. A coverage trajectory is designed through area decomposition and task assignment. To perform efficient and autonomous coverage mission, solution to a TSP-based optimization problem using meta-heuristic approaches is designed to allocate waypoints to the UAVs of different flight capacities. The study exploits multi-agent simulations like PX4-SITL and QGroundcontrol through the ROS framework and visualizes the dynamics of UAV deployment to different search paths in a 3D Gazebo environment. Through detailed theoretical analysis and simulation tests, we illustrate the optimality and efficiency of the proposed methodologies.

Keywords : area coverage, coverage path planning, heuristic algorithm, mission monitoring, optimization, task assignment, unmanned aerial vehicles
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