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Communication-Aware UAV Path Planning

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# Abstract

Autonomous air drones, known as Unmanned Aerial Vehicles (UAVs), often accomplish missions with real-time video streaming leveraging the available cellular network. Video streaming is a typical application with stringent Quality of Service (QoS) requirements, which are not always supported in the whole mission area. In this thesis, we address the offline path planning problem of finding the optimal path from a source to a destination in 2D space in order to maximize the communication quality, given a cellular coverage, and thus providing throughput guarantees to the video streaming. In addressing the problem, the restricted amount of available energy, the wind effect, and the path post-smoothing problem are considered. We propose two innovative path planning algorithms and we show that our algorithms outperform classical approaches that are oblivious of communication network coverage. Both algorithms are variants of classical A\* algorithm and they optimize the path jointly in terms of distance and of the experienced throughput by the drone: in this way, the quality of the video streaming along the path is optimized while preserving the energy budget for the flight. We describe both of the algorithms and investigate their performance. Moreover, we introduce a novel path smoothing method that outperform classical approaches in terms of distance and computation cost. Finally, in order to prove that our algorithms can be practically utilized in the real-world path planners, we integrate our proposed path planning algorithms into the popular QGroundControl (QGC) control station.