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Real-Time Path Planning for Unmanned Air Vehicles Using Improved Rapidly-Exploring Random Tree and Iterative Trajectory Optimization

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Abstract : A real-time path planning framework for Unmanned Air Vehicles, and in particular multi-rotors is proposed. The framework is designed to provide feasible trajectories from the current UAV position to a goal state, taking into account constraints such as obstacle avoidance, problem kinematics, and vehicle limitations such as maximum speed and maximum acceleration. The framework computes feasible paths online, allowing to avoid new, unknown, dynamic obstacles without fully re-computing the trajectory. These features are achieved using an iterative process in which the robot computes and optimizes the trajectory while performing the mission objectives. A first trajectory is computed using a modified Rapidly-Exploring Random Tree (RRT) algorithm, that provides trajectories that respect a maximum curvature constraint. The trajectory optimization is accomplished using the Interior Point Optimizer (IPOPT) as a solver. The framework has proven to be able to compute a trajectory and optimize to a locally optimal with computational efficiency making it feasible for real-time operations.

Keywords : interior point optimization, multi-rotors, online path planning, rapidly exploring random trees, trajectory optimization
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