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Contact-Prioritized Planning of Impact-Resilient Aerial Robots with an Integrated Compliant Arm

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The article develops an impact-resilient aerial robot (s-ARQ) equipped with a compliant arm to sense contacts and reduce collision impact and featuring a real-time contact force estimator and a non-linear motion controller to handle collisions while performing aggressive maneuvers and stabilize from high-speed wall collisions. Further, a new collision-inclusive planning method that aims to prioritize contacts to facilitate aerial robot navigation in cluttered environments is proposed. A range of simulated and physical experiments demonstrate key benefits of the robot and the contact-prioritized (CP) planner. Experimental results show that the compliant robot has only a 4% weight increase but around 40% impact reduction in drop tests and wall collision tests. s-ARQ can handle collisions while performing aggressive maneuvers and stabilize from high-speed wall collisions at 3.0m/s with a success rate of 100%. Our proposed compliant robot and contact-prioritized planning method can accelerate computation time while having shorter trajectory time and larger clearances compared to A* and RRT* planners with velocity constraints. Online planning tests in partially-known environments further demonstrate the preliminary feasibility of our method to apply in practical use cases.