SkyCatcher: An Annular-Structured UAV for Enhanced Grasping and Delivery Solutions

Xu, Zijun (School: Saint Stephen's Episcopal School)

This paper introduces "SkyCatcher," a novel annular-shaped retractable quadrotor UAV specialized for cargo transportation. Unlike other morphing quadrotors with complex platforms and challenging control dynamics, "SkyCatcher" features a unique ring-shaped design with all components distributed around the periphery, leaving a spacious circular center for package transport. This design efficiently utilizes the central space, and through an innovative mechanism involving only a servo motor for morphing, it achieves effective transformation across two degrees of freedom, allowing the drone to navigate through smaller spaces in its compact form. Moreover, the UAV is equipped with a feedforward PID control algorithm, complemented by a Model Predictive Control (MPC) for precise trajectory tracking, enhancing its flight performance. Furthermore, "SkyCatcher" incorporates a SLAM (Simultaneous Localization and Mapping) algorithm that enables the drone to model and analyze its surroundings to avoid obstacles, deliver objects to precise locations automatically, and plan its route efficiently, which makes the drone especially useful in indoor environments. This paper details the design, manufacturing, and assembly processes of each component, including the construction of the electrical system and software tuning. Finally, the UAV is subjected to a series of experiments to test its capabilities and potential limitations, followed by iterative improvements and re-evaluations under more stringent conditions.

Awards Won:

Fourth Award of $500

The University of Texas at Dallas: Scholarship awards of $5,000 per year, renewable for up to four years