Autonomous Quadcopter-Based Indoor Mapping System

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Autonomous indoor unmanned aerial vehicles (UAV) navigation requires mapping techniques to build an accurate space estimation for flying. This work proposes a system to map an indoor environment using data fusion of sensors embedded in a quadcopter in a GPS-denied area. A micro-UAV was developed from scratch to be used as the system's development platform. Distance, position and orientation estimation sensors and techniques were evaluated looking for a combination of high accuracy and small size and weight. Flight stabilization was achieved using PID controllers. A wireless data link provided data to a ground station to build the map, analysis the flight performance and generate a real-time visualization of the UAV position. Empirical tuning of the PID controllers was sufficient to stabilize the aircraft. Inertial data provided by an IMU, in combination with laser distance sensors and an optical flow measurement was used to estimate the quadcopter's orientation and position, as well as the obstacles' locations. The positioning system, together with the quadcopter, was able to locate itself in a dead-reckoning fashion, enabling a ground station to generate a map of the UAV's environment. Further experiments could develop other mapping strategies, allowing it to map more complex environments.

Awards Won:

National Aeronautics and Space Administration: Honorable Mention