Hardware Integrated LiDAR Simulation for the Development of Collision Avoidance Algorithms

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Navigating an Unmanned Aerial Vehicle (UAV) in complex and dynamic environments poses challenges for human operators, and can be mitigated through the use of autonomous control systems. In this paper, a novel method for the autonomous navigation of a UAV using a 3D perception sensor is considered. In this application, LiDAR (Light imaging, Detection and Ranging), a sensor that perceives objects in the environment through laser light pulses, measures both obstacle location in addition to distance. A new algorithm that takes into account the known kinematics of the UAV and the LiDAR data is developed to create a high-performance collision avoidance algorithm. The algorithm relies on predicting the trajectory of the UAV and extrapolating data from a LiDAR point cloud to determine if a collision is imminent, in which case the algorithm calculates a new trajectory to a clear area. In experiments, the algorithm was 20-40 times faster than current pathfinding methods. It accomplished this by calculating only a single path between two nodes each iteration rather than an entire route, but at the expense of routing efficiency. This behavior leads the UAV to be more capable of autonomous navigation than current methods in dynamically changing environments.

Awards Won:
NASA: Second Award of $750