CSERP
COLLEGIATE SCIENCE AND ENGINEERING RESEARCH PROGRAM

Determining the Viability of Small Scale Drones in Creating Localized 3D Maps

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Abstract

The research objective was to determine whether size and cost would hinder the creation of digital terrain models (DTM) when scaling down airborne laser swath mapping (ALSM) from full-size, manned aircraft to smaller, unmanned drone platforms. These drones have the potential to deliver cheaper, more accessible, and more localized 3D terrain maps to the fields in which cost is a prohibitive factor.

Hardware/Methodology

The main components of the system were the following (see *Fig. 1*):

- An aircraft
- A 3D mapping LIDAR (light detection and ranging) sensor
- A data logging autopilot system

When functioning in unison, the LIDAR and the autopilot should provide sufficient data to create 3D terrain maps of the ground below as the plane flies overhead. In total, the cost of the entire drone and LIDAR was less than $3,000, compared to the multimillion dollar cost of a full-size aircraft and LIDAR system.

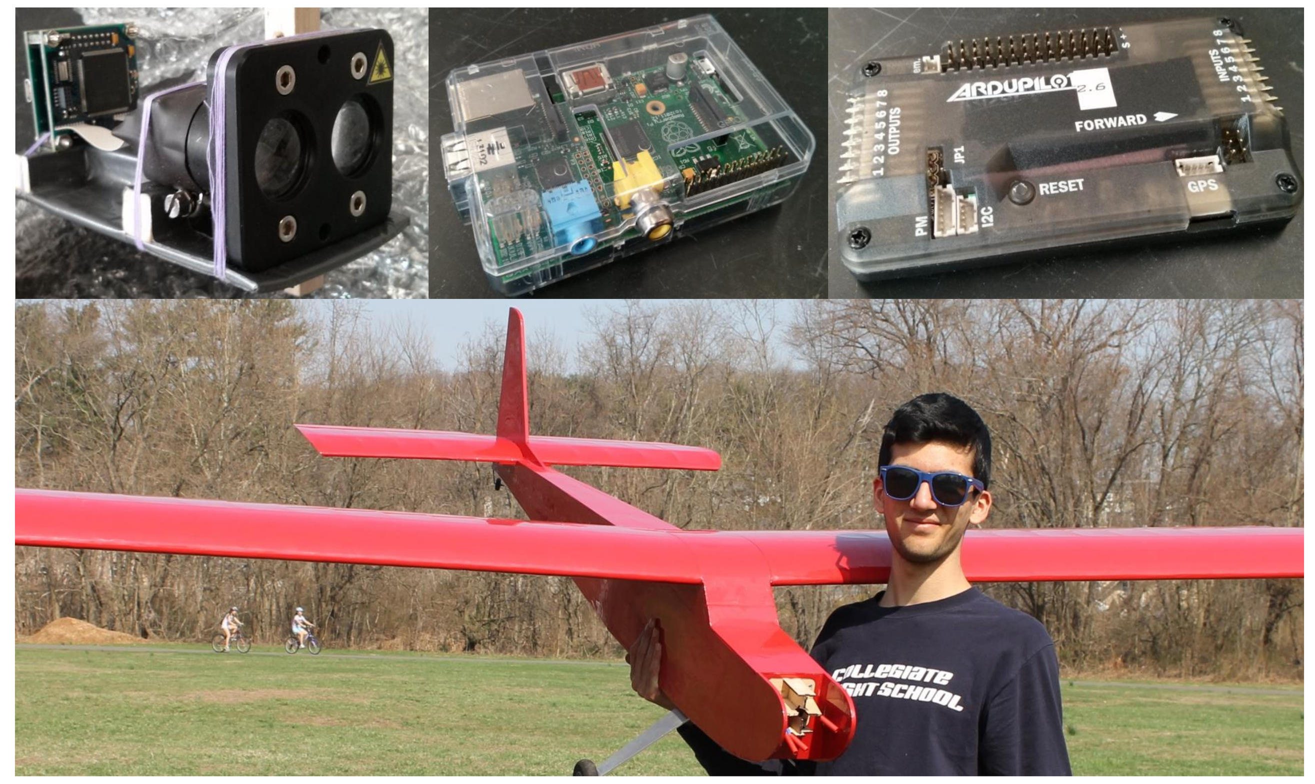

Fig. 1. From top left clockwise: SF-01 laser rangefinder, Raspberry Pi (to record LIDAR data), Arduino autopilot system, Author with drone (motor and propeller removed)

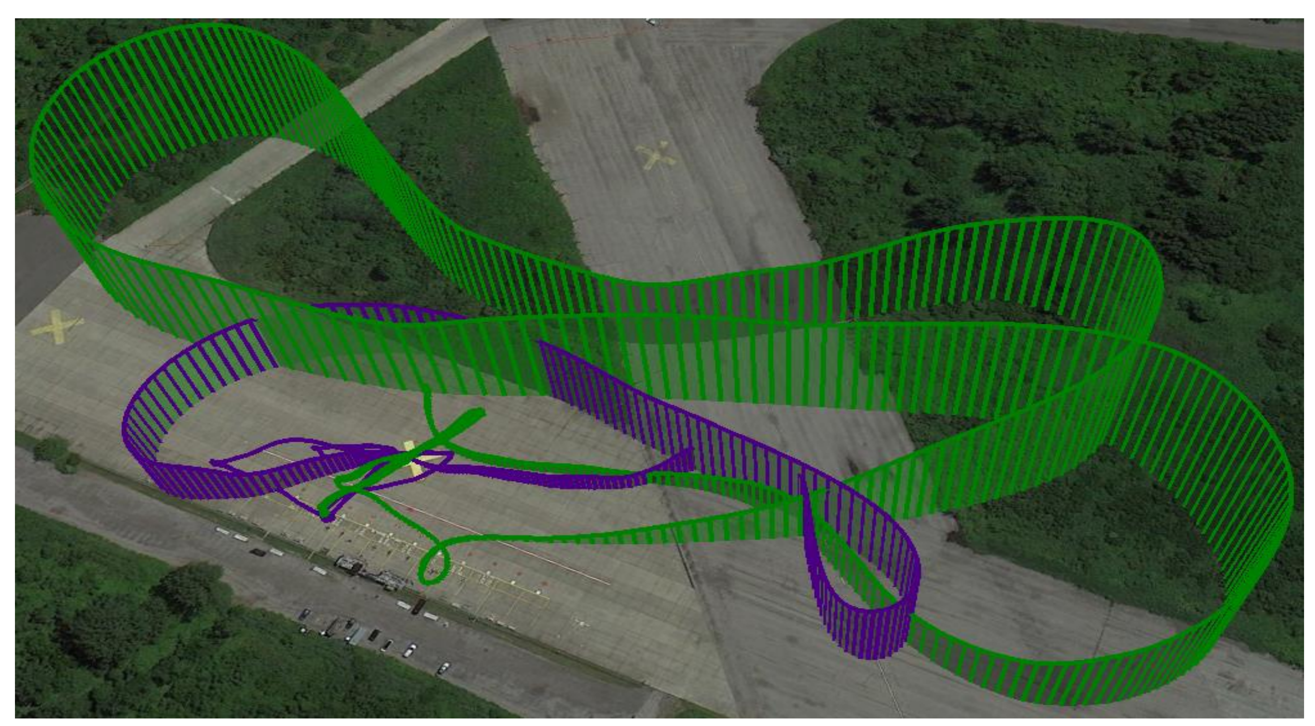

Fig. 2. Flight 1 in purple, Flight 2 in green

Results

Due to windy and less than ideal conditions that would have resulted in completely unusable data had the laser been sweeping, the laser was instead fixed in a downward position and its readings were compared to the altitude readings given by the autopilot.

Results (cont’d)

Furthermore, during steep climbs or banking maneuvers (high orientation constant), the laser lost data or slowed data collection considerably. However, when functional, it did provide fairly accurate altitude readings which closely match those provided by the autopilot’s GPS.

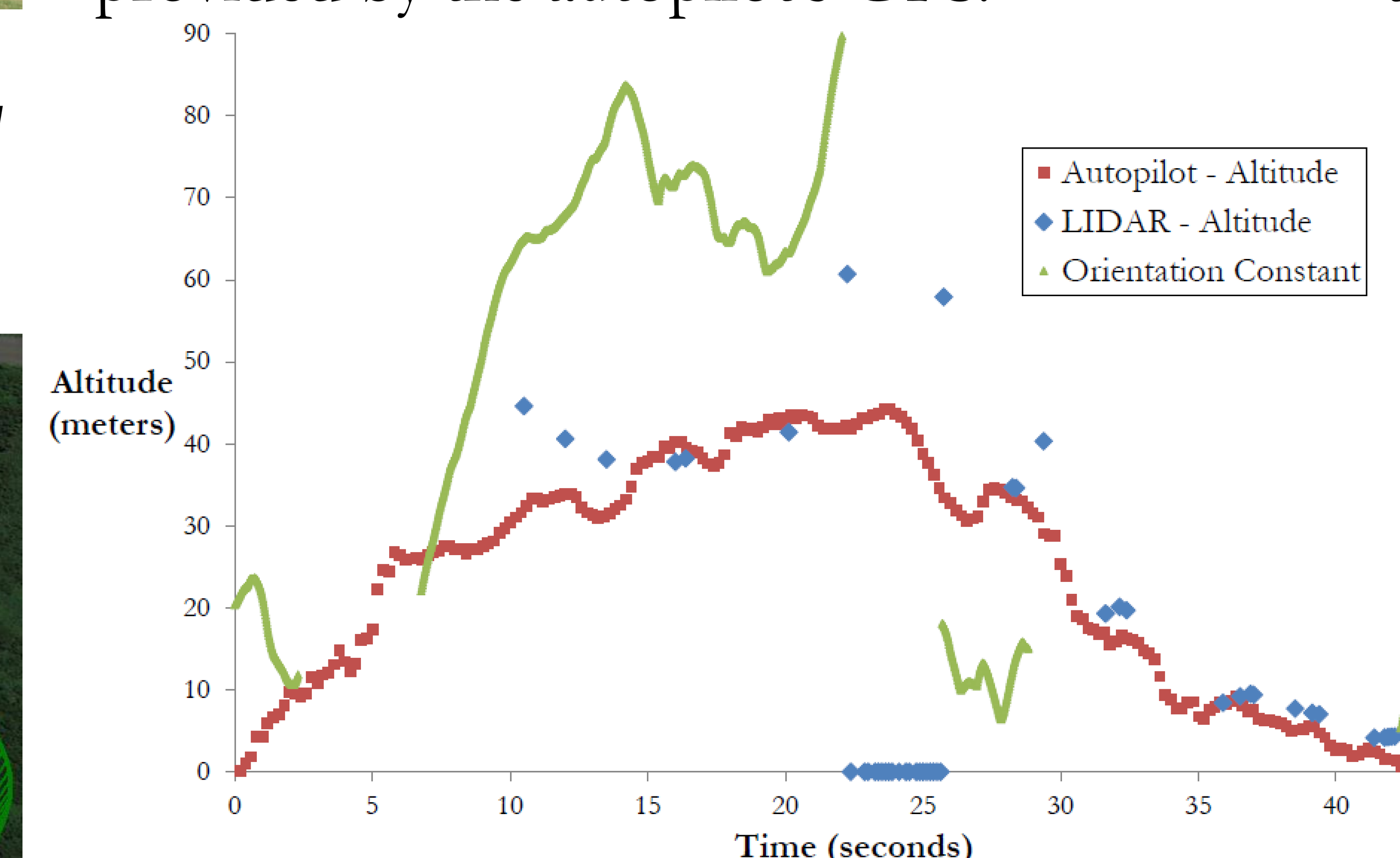

Fig. 3. Flight 1 LIDAR vs. Autopilot Altitude Data

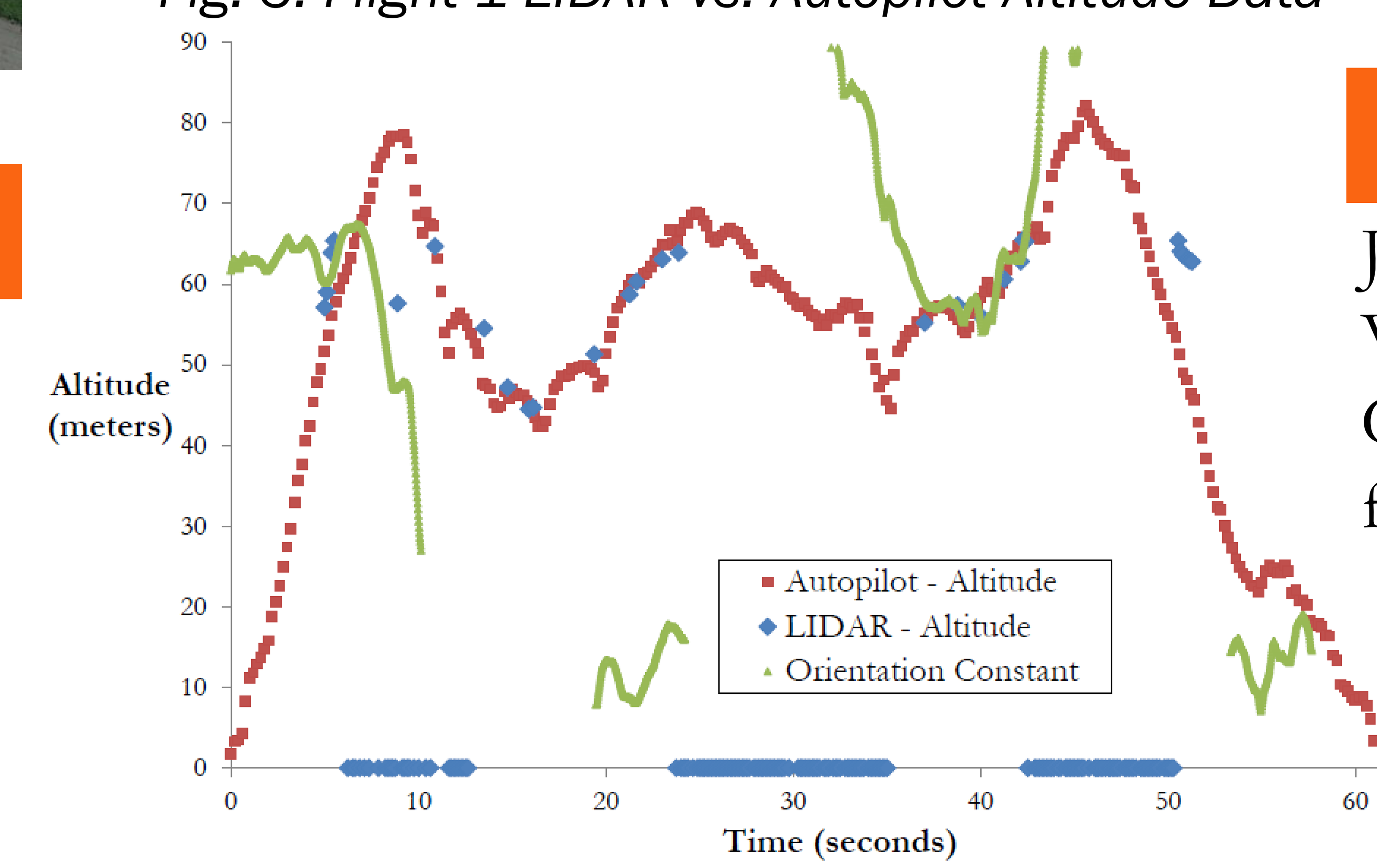

Fig. 4. Flight 2 LIDAR vs. Autopilot Altitude Data

Conclusions

While the system was ultimately unable to collect sufficient data to create a full 3D terrain map, from the data that was collected one can see that a drone-mounted LIDAR can effectively measure altitude, an important initial stepping stone to full 3D capability.

Therefore, from this data, one can conclude that with a revised LIDAR system that can continue to consistently measure data while being jostled during flight and an autopilot/drone setup that provides a more stable platform for readings, it would indeed be possible to make 3D maps of the ground below from a relatively small drone.

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