Accuracy Assessment of a Drone Mapping System

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Introduction

The practical application of a drone is dependent on the accuracy of its sensors. The California Department of Transportation (Caltrans) requested a study to assess the use of drones in engineering projects such as transportation planning and design. Historically, the task was outsourced and the aerial imagery acquisition was left to a third party leaving it prone to high cost and long delays.

Problem

Drones have gained popularity and the variety of uses are continuing to expand to new markets and areas of interest. However, the sensors that are proprietary to the drone have not undergone a thorough accuracy assessment nor has a statistical evaluation been conducted that compares the newly collected drone data to the existing data Caltrans used in its engineering projects. Without a thorough accuracy assessment, drone mapping would be difficult to be adopted as a viable approach for use in survey and engineering applications.

Methodology

The study area was flown at four altitudes (50m, 80m, 100m, and 120m) with a DJI Phantom 4 Pro using the Pix4DCapture app on an iPad. The flight path was set in a grid formation at the specified altitude with 50% - 70% endlap and sidelap.

The group of images were then processed with Esri's Drone2Map software to generate an orthomosaic and a digital surface model using 0, 3, 6, and 10 Ground Control Points selected from 592 survey points provided by Caltrans.

16 sets of orthomosaics and digital surface model were then analyzed in ArcMap 10.4 using the Interpolate Point of the 3D Analyst tools to determine each of the 20 check points X, Y, and Z values. This information was manually checked and transferred to a Microsoft Excel sheet then converted into a CSV file.

A Python script was written based on the American Society for Photogrammetry and Remote Sensing's (ASPRS) Positional Accuracy Standards for Digital Geospatial Data to determine the RMSE_x, y, z of each of the 16 orthomosaics by comparing the measured point values provided by Caltrans with the calculated values.

Preliminary Results

The results are currently undergoing statistical analyses to determine if the DJI Phantom 4 Pro is a viable drone to pursue and, if so, to what extent. Additionally, the workflow and Python script will allow for further testing of additional Drone Mapping Systems by Caltrans.

Generally, the RMSE and the map's accuracy have an inverse relationship, where the image with the lower RMSE is considered to be more accurate.

The Image Overlay Figures illustrate that the middle of orthomosaics tend to have more coverage than the edges.

In the 2D Point Match figures, the darkness of the links is relative to the number of 2D points that were matched in the imagery. For this study area, the parking lot has more matches than the soccer fields with fewer recognizable features.

Orthomosaic of 80m altitude using 6 ground control points

Workflow