Comparing the ASPRS Accuracy Standards to UAS Surveys

Kara S. Lee, Sheng Tan, Omar E. Mora
California State Polytechnic University, Pomona

ABSTRACT

Unmanned Aircraft System (UAS) mapping methods determine the three-dimensional (3D) position of surface features. UAS mapping has developed into a common mapping tool that is utilized often, compared to traditional mapping techniques, such as the total station (TS), Global Navigation Satellite System (GNSS) and terrestrial laser scanning (TLS). Traditional mapping methods have become less favorable due to efficiency and cost, especially for medium to large areas. As UAS mapping increases in popularity, the need to verify that UAS mapping meets the American Society for Photogrammetry and Remote Sensing (ASPRS) accuracy standards for digital geospatial data is needed. In this study, an assessment of the accuracy of UAS mapping was performed and compared to the ASPRS accuracy standards for digital geospatial data. Our results suggest that there are many factors that impact the accuracy of UAS photogrammetry products. In specific, the distribution and density of ground control points (GCPs) are particularly significant for a study area of 2.865 km². The best results were obtained by strategizing the distribution and density of GCPs by minimizing the root mean square error (RMSE) for the X, Y, Z and 3D to 0.012, 0.021, 0.038, and 0.045 meters, respectively, with a total of 15 GCPs. Therefore, UAS mapping can meet the ASPRS accuracy standards for digital geospatial data, if proper planning, data collection and processing procedures are followed.

STUDY AREA

Figure 1: Study area location in Spadra Farm, Pomona, California, USA. (Latitude, Longitude) = (34° 02' 21.73" N, 117° 48' 59.44" W).

Figure 2: Study area location within the city limits of Pomona in Los Angeles County, California.

REFERENCES


EXPERIMENTAL TESTS

RESULTS

Table 1: Statistical assessment between the UAS estimated checkpoints and the GNSS measurements from the results shown in Figure 7.

<table>
<thead>
<tr>
<th></th>
<th>10 – 21</th>
<th>Reprojection Error [pixels]</th>
<th>Distances to Rays [m]</th>
<th>RMSE X [m]</th>
<th>RMSE Y [m]</th>
<th>RMSE Z [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>7.448</td>
<td>0.223</td>
<td>0.475</td>
<td>0.048</td>
<td>0.040</td>
<td>0.495</td>
</tr>
<tr>
<td>Median</td>
<td>1.820</td>
<td>0.053</td>
<td>0.080</td>
<td>0.035</td>
<td>0.024</td>
<td>0.063</td>
</tr>
<tr>
<td>Min</td>
<td>1.290</td>
<td>0.043</td>
<td>0.045</td>
<td>0.012</td>
<td>0.021</td>
<td>0.038</td>
</tr>
<tr>
<td>Max</td>
<td>67.170</td>
<td>1.939</td>
<td>4.714</td>
<td>0.089</td>
<td>0.090</td>
<td>4.721</td>
</tr>
</tbody>
</table>

CONCLUSION

To obtain the optimal RMSE in X, Y, Z, and 3D, the distribution and density of the GCPs must be placed strategically. As the project size increases, the number of GCPs increases until the optimal RMSE accuracy results are achieved. When planning a UAS photogrammetric survey, it is critical that sufficient GCPs are distributed and placed strategically throughout the project site. However, this may be a challenge due to access or dangerous site conditions. Therefore, it is critical that during planning the anticipated RMSE is well understood given the density and distribution of GCPs. In this study, the best results were obtained by minimizing RMSE for the X, Y, Z and 3D to 0.012, 0.021, 0.038, and 0.045 meters, respectively, with a total of 15 GCPs. The results support that UAS mapping can meet the ASPRS accuracy standards for digital geospatial data, if proper planning, data collection and processing procedures are followed.