White Paper

SurveyWhirrx Accuracy Assessment

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Abstract

There are increasing numbers of drone manufacturers and processing platforms available to Professional Land Surveyors. All of the available drone and processing platforms refer to accuracy in RMSE (Root-Mean-Square-Error). Surveyors report their accuracy in a maximum error above or below the actual elevation. Current drone platforms claim, "High accuracy aerial mapping" and typically claim "1cm accuracy". Although, when you read the fine details in their White Papers, you will find that they are obtaining around 2-3cm **RMSE** in the vertical. This still looks good to a surveyor who isn't familiar with how RMSE works but is nowhere near the RMSE a survey regularly achieves, which is in the mm's. If you read the really fine details in current drone White Papers, you will find that they typically list 5-10cm of maximum error above or below the actual elevation and in some cases the maximum error exceeds 30-40cm, which is unacceptable for road design surveys. This White Paper will detail the only drone system and processing software on the market today which can achieve the same accuracy that surveyors regularly achieve today, which is truly 1.5cm **maximum** vertical error.

Introduction

Surveyors are most concerned with very highly accurate vertical elevations. During construction projects, these same vertical elevations are used as control for design as a pavement surface is constructed and surveyors measure the subbase, rock, and top of pavement as they are built. The United States, Department of Transportation (USDOT), Federal Highway Administration (FHWA) Mapping Ground Topography and Planimetrics Specifications state that surveys must "Maintain a vertical and horizontal accuracy for well-defined planimetric features within 0.05 foot (i.e. edge of road, concrete slabs, curb and gutter and walls)". This means that the ground verifiable vertical accuracy of all hard surface features must be located within ~1.5cm (0.05 foot), at the maximum. No current drone platform on the market today can achieve this accuracy, except the one described in this white paper.

This White Paper will detail out how the accuracy of the SurveyWhirrx drone system was rigorously tested and verified using traditional surveying instruments. The drone system has been tested multiple times, on multiple projects, by multiple third-parties in both the private and government sectors. In all of these tests and test projects, the results were the same. Read below through one of the test projects completed in Sherburne County, Minnesota, USA.

Project Setup

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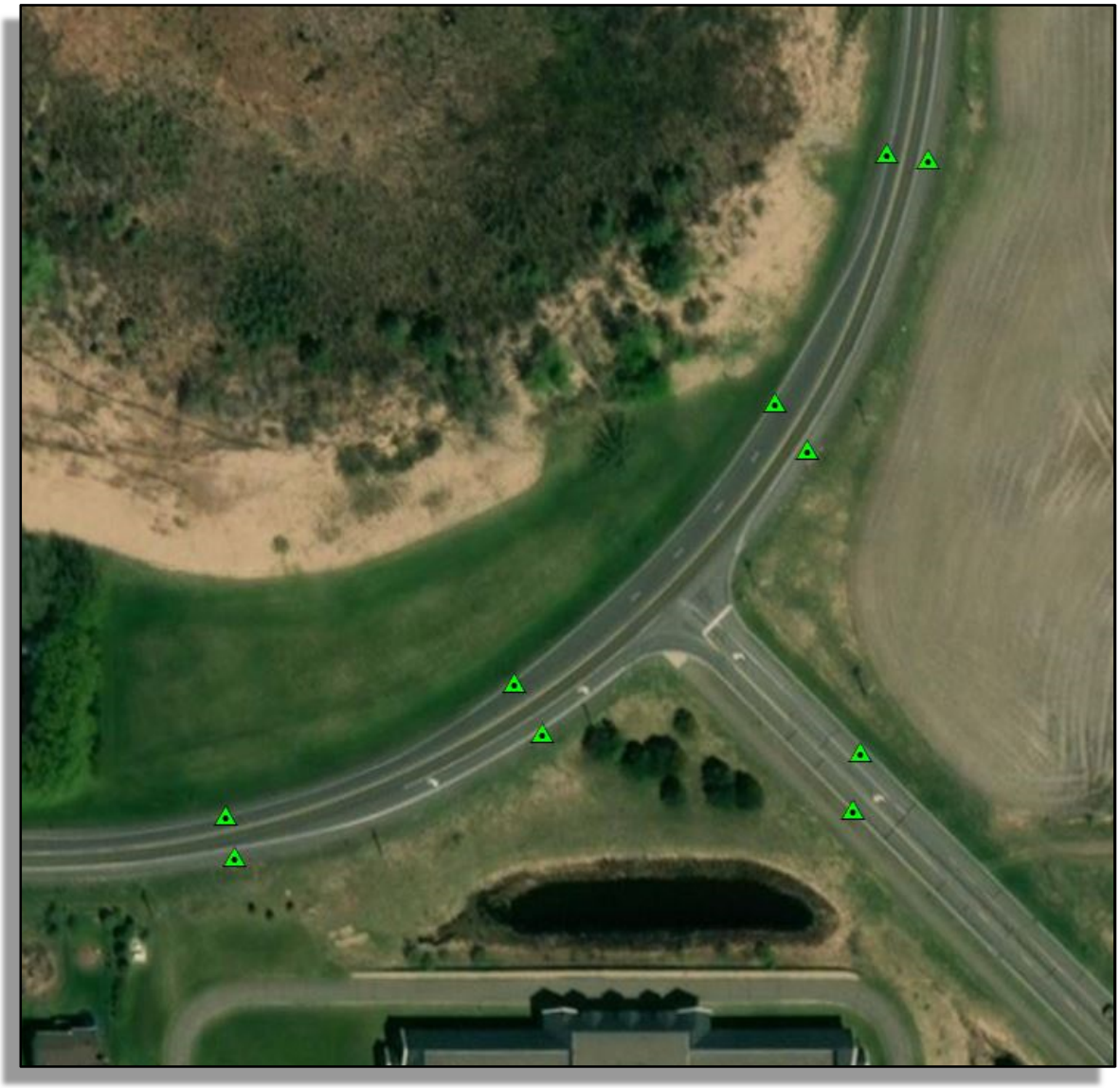
Survey Control and Aerial Targets were set by Sherburne County Public Works Survey Division, MN. Along with the survey control & aerial targets, a traditional topo survey was performed on the site to compare with the accuracy of the drone survey. A single survey control point monument was established with a Trimble R10 GNSS Rover connected to the Trimble MN VRS and used as the reference point for all targets and the topo points. GEOID12B was used with the MN VRS to establish 1cm Horizontal and 2cm Vertical absolute accuracy to MN State Plane & NAVD88. A Trimble S6 Total Station was then setup over the survey control point monument and was used to set the Aerial Targets. Aerial Targets were placed at 250-foot spacing. The total station was also used to perform the traditional cross-section topo of the site. This resulted in relative horizontal and vertical accuracy of <1cm for the Aerial Targets and topo points in relation to the survey control point monument. Below is a map of the aerial target locations:

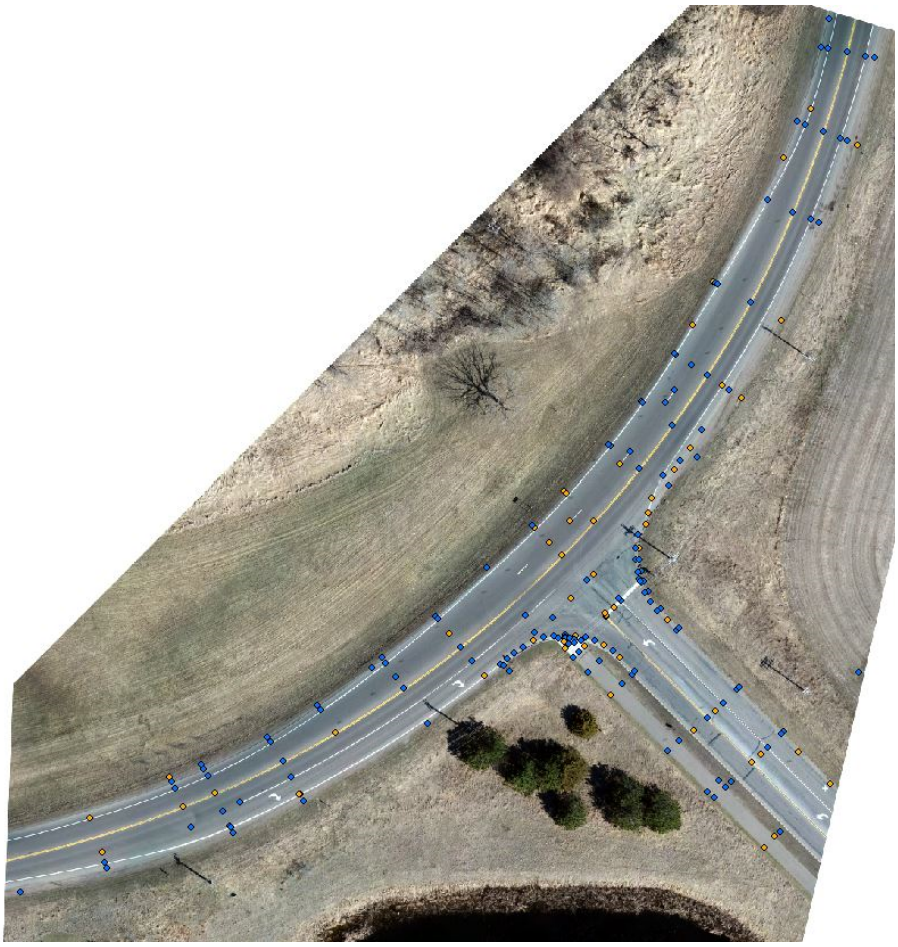


Drone Flight

A SurveyWhirrx drone system was used for the topo survey flight to compare against the traditional cross-section topo survey. The camera on the system was a Sony A7 with a 35mm lens. The flight was completed at an altitude of 200 feet AGL for this project, even though the same accuracy can be achieved at 400 feet AGL with the Survey Whirrx System. A flight speed of 10m/s was used because of the 200 feet AGL height. The forward and side overlap was set to 80%. The flight took approximately 7 minutes to complete. After the flight, all data was uploaded to the SurveyWhirrx cloud processing software.

Accuracy Assessment Results

Once the data was processed with the SurveyWhirrx cloud processing software, the output data was sent to the Sherburne County Survey Division for a Blind Comparison. Outputs included 2cm Ground-Sample-Distance (or resolution) Ortho Image, DTM, DEM, point cloud, and simplified point cloud. The traditional cross-section topo points collected by Sherburne County were used for the blind comparison. The SurveyWhirrx System provided a topo points every ~4cm as compared to the 50-foot cross sections provided by the traditional topo. The topo points shown in the below image were created by the SurveyWhirrx cloud processing software and were within the <1.5cm **maximum** vertical error required by the FHWA Survey Standards. Below is a graphic depiction of the accuracy assessment results of the traditional topo points compared to the SurveyWhirrx points. Blue Topo points are <1cm vertical error and Orange Topo points are <1.5cm vertical error.



Conclusion

Based on the comparison survey performed by the Sherburne County Surveyor and confirmed by Whirrx Surveyors, it was determined that the SurveyWhirrx Drone System can be used reliably for high-accuracy survey needs. These high-accuracy needs include any project where a surveyor requires <1.5cm **maximum** ground verifiable vertical accuracy, which is needed for DOT/FHWA Funded Projects. This includes projects such as engineering design for road pavement and other hard surfaces. Based on the comparison results, the SurveyWhirrx System can perform a topo survey of a project with around 80% efficiency as compared to a traditional ground survey. Based on the resulting point cloud, the SurveyWhirrx System can perform a topo survey with similar point densities to a Mobile LiDAR Survey.

For more information on how to obtain a SurveyWhirrx System, please visit www.whirrx.com