Comparison of Rolling Shutter Effects on Photogrametric Accuracy using UAV Platforms

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Introduction

Within the UAV market, there exists two main camera types that come equipped to the aircraft to gather imagery. Traditionally global shutters, also known as manual shutters have been used for UAV sensors [1]. Global shutters capture the contents within their lens in one motion, which minimizes distortion when images are gathered while the aircraft is moving [2][3]. Many new consumer UAVs are being equipped with rolling shutters due to their lower cost when compared to global shutters. Rolling shutter cameras capture imagery by scanning the lens from top to bottom non instantaneously. This leads to distortion within the imagery when the aircraft captures images while in motion [3].
To try and compensate for the poor quality images produced by rolling shutter sensors a number of programs have been created to attempt to model out the distortion within captured imagery [4]. One such program is Pix4D mapper. Pix4D claims to be able to process the imagery in such a way that imagery captured from a rolling shutter sensor would be comparable to imagery captured from a global shutter sensor [4].

Study Area

Fairfax park within the city of Eau Claire, WI was selected to be the study area due to the large variety of landscape found within the park and surrounding areas and, also due to its ease of accessibility. This landcape variety will better showcase which UAV platform is best at collecting accurate imagery.

Figure 1: Location of Fairfax Park in Eau Claire, Wisconsin.

Methodology

Flight planning and Image acquisition -
The Mavic 2 Pro and Phantom 4 Pro v2 were used. Collection date was september 2020. Nine control points were utilized to obtain higher imagery accuracy (Figure 3). About 555 images were collected each flight. The platform used was Pix4D capture.

Data Preprocessing -
Pix4D Mapper was used to derive DSM rasters (Digital Surface Model).

Image Classification & Accuracy Assessment -
Supervised Classification utilizing the Maximum Likelihood algorithm was applied to the DSM in ArcGIS Pro. Accuracy assessment reports were generated to compute Kappa Coefficient values for individual rasters to validate the classified data.

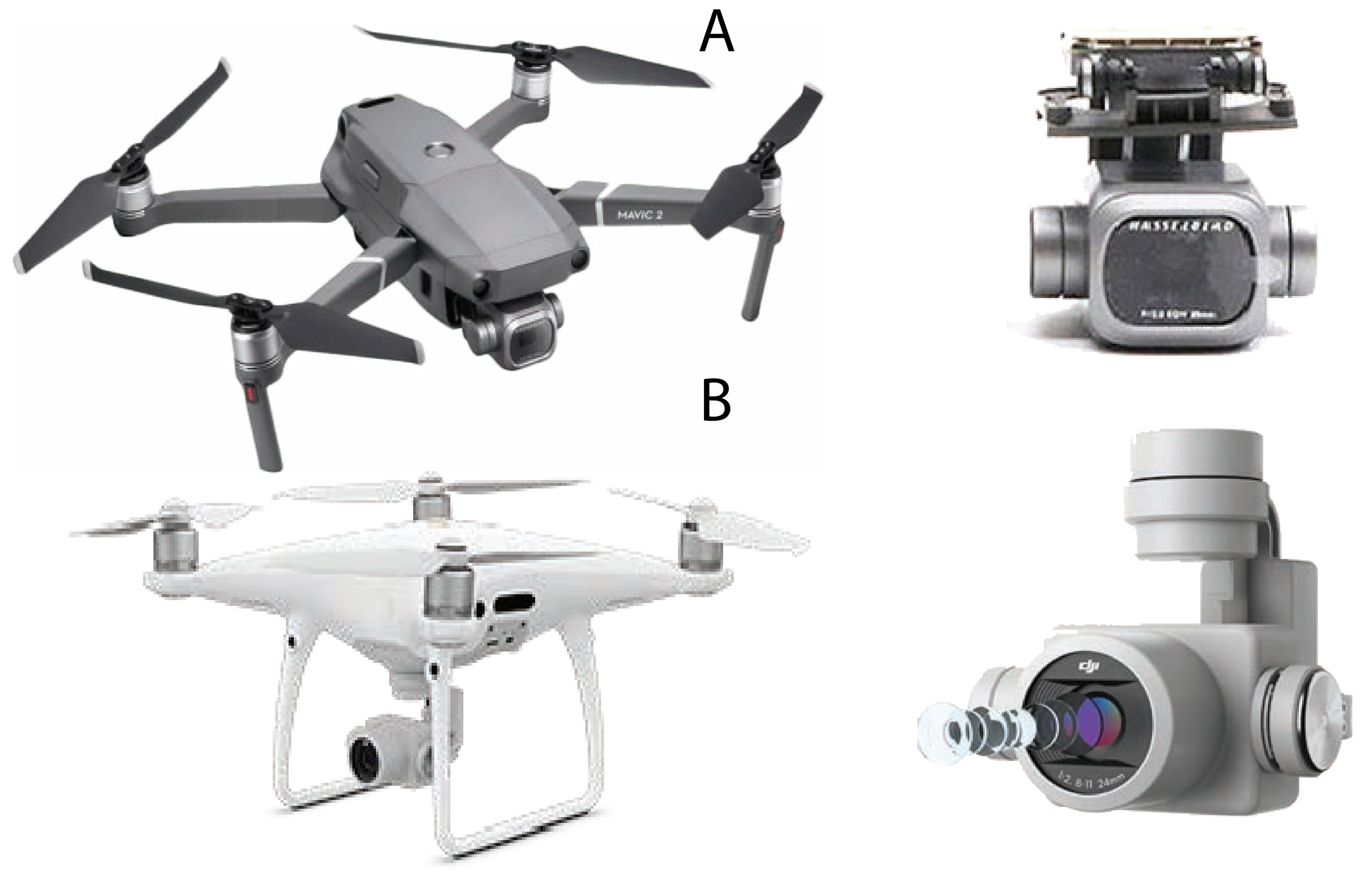

Figure 2A shows the Mavic 2 Pro along with its Hasselblad L1D-20c camera. Figure 2B shows the Phantom 4 Pro v2 along with its CMOS sensor.

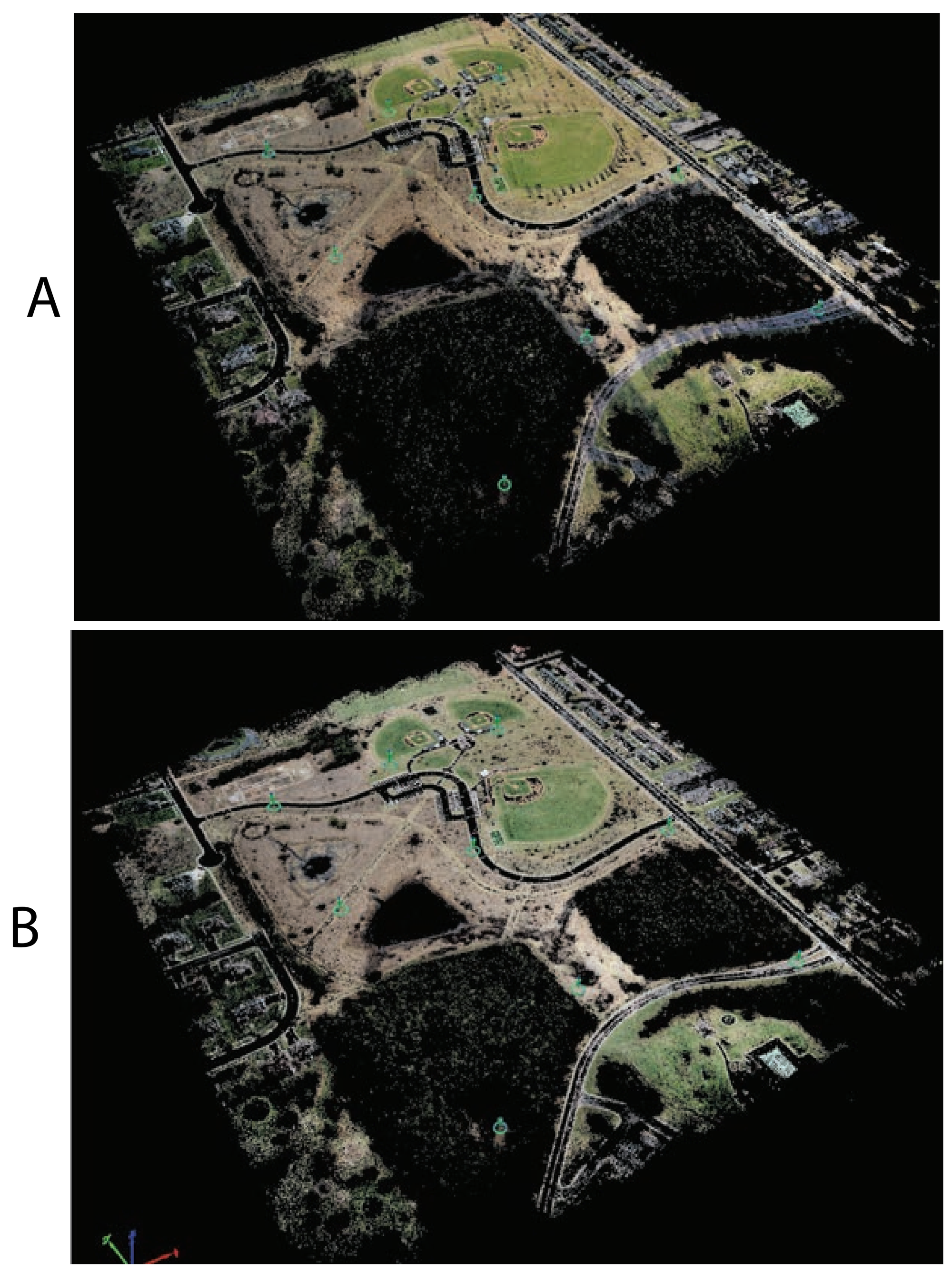

Figure 3A shows the Ground Control Points (GCPs) for the Mavic 2 Pro acquired imagery. Figure 3B shows the GCPs for the Phantom 4 Pro v2 acquired imagery.

Results

The classified images in figure 4 show the landuse and land cover information of the study area. Six different classes were determined based on prior knowledge and ground truthing of the study area.
The Kappa Coefficient was 0.85 for the raster acquired from Mavic 2 Pro and 0.83 for the raster acquired from Phantom 4 Pro v2. The lower accuracy for the Phantom 4 Pro v2 can be attributed to the existing cloud cover at the time of flight. The Phantom 4 Pro v2 was able to capture a better imagery with less noise.

Figure 4: A and B shows the DSM rasters acquired from the Mavic 2 Pro and the Phantom 4 Pro v2 respectively along with their corresponding classifed rasters.

References

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Acknowledgments

We would like to acknowledge the Office of Research and Sponsored Programs (ORSP) at the University of Wisconsin, Eau Claire for funding our research.