

DETERMINING THE OPTIMUM NUMBER OF IMAGES FOR GENERATING 3D POINT CLOUDS USING STRUCTURE FROM MOTION

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ABSTRACT:

Structure from Motion (SfM) is a technique that recovers scene geometry from sets of overlapping digital photographs. SfM does not rely on camera parameters that are critical in traditional photogrammetry. This technique is thus advantageous when collecting imagery from small Unmanned Aircraft Systems (UAS), which are unstable platforms that typically carry low cost and lightweight consumer grade digital cameras. SfM enables reconstruction of a 3D point cloud by matching key features between overlapping images. The accuracy of the point cloud greatly depends on the amount of overlap between adjacent images. Therefore, it is essential to acquire sufficient overlapping images to accurately describe a scene. However, SfM is a computationally intensive method because it must search for matching key features throughout the entire set of images. As the amount of images increases, the computation time exponentially increases. In addition, adding many images to the model does not necessarily improve the resulting point cloud. For example, including too many images may introduce noise in the model, and may create unnecessary densification of the point cloud without adding any new geometric features. This study uses SfM to create 3D point clouds for a number of different natural and manmade scenes. For each scene, images were captured from terrestrial and/or UAS platforms. Then, SfM point clouds were generated using varying subsets of the sets of images. Afterwards, the resulting point clouds were compared to a point cloud generated from terrestrial lidar scans. Finally, the optimum number of images for each scene was determined based on the conformance of the SfM point cloud with the lidar point cloud. The results of this study provide an initial estimate of the quantity of images required for optimally generating SfM point clouds of scenes with similar scale, geomorphological texture, and surface complexity to those surveyed in this study.

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