COMPARISON OF DIGITAL TERRAIN MODELS DERIVED USING DIFFERENT TECHNIQUES D.N. Della-Giustina[1], E.K. Kinney Spano[1], M. Chojnacki[1], S. Sutton[1], University of Arizona, Lunar and Planetary Laboratory, Tucson, AZ 85721, USA (danidg@orex.lpl.arizona.edu).

Introduction: In preparation for the OSIRIS-REx Sample Return Mission we examine newly available computer vision and traditional photogrammetry tools capable of producing digital terrain models (DTMs) from stereo imagery. DTMs are essential for terrain analysis in geomorphology and physical geography, and can often provide much higher resolution surface information than whole-object shape models. These terrain models, along with imagery analysis, can be used to understand planetary surface processes. In this work we present the results of a comparison of photogrammetry tools for DTM production.

Stereophotogrammetry is a technique that has been used to determine the topography of many Solar System bodies [1]. Characterizing the terrain and elevation with images taken by the OSIRIS-REx Camera Suite (OCAMS) is a requirement for the OSIRIS-REx Mission, which will survey and sample asteroid (101955) Bennu in 2019 [2]. Understanding the topography of the sample site will be of chief importance—the OSIRIS-REx Touch And Go Sample Acquisition Mechanism (TAGSAM) can only interface with terrain that meets specific slope and regolith aggregate-size thresholds.

To prepare for the OSIRIS-REx sampling event, we are performing a relative comparison between DTM extraction techniques. We examine DTMs produced by two commercial photogrammetry packages: PhotoScan (distributed by AgiSoft LLC) and SOCET SET ® (distributed by BAE Systems, Inc [3]). SOCET SET is a traditional photogrammetric toolbox capable of determining terrain from images taken at different resolutions using a suite of algorithms. PhotoScan is a close-range 3D reconstruction package that has been used successfully for terrestrial aerial photogrammetry applications [4-7].

Methods: SOCET SET has been successfully used to derive DTMs using stereo-imagery from several NASA missions. These methods are well described in the literature [1].

PhotoScan, on the other hand, is a relatively new software package. The literature only describes the applications of PhotoScan for aerial imagery [4-6] and close-range 3D object reconstruction (archaeology) [6-7].

Unlike traditional photogrammetry tools PhotoScan is well suited for deriving 3D information from oblique imagery. PhotoScan achieves this by using the scale-invariant feature transform (SIFT) algorithm [8] for automated tie-point detection in both nadir and oblique imagery. Using SIFT, PhotoScan is able detect tie-points (keypoints) more rapidly than other techniques (including human decision making). SIFT keypoints are used to align the photos in a first step to produce a sparse point cloud. After measuring the ground control points, a bundle adjustment is performed to produce a dense point cloud [6]. Photoscan will refine the solution by calculating the reprojection error of a SIFT keypoint [6].

Results: Using MESSENGER MDIS images of Mercury, we have generated DTMs from the same set of stereo-images using both SOCET SET and PhotoScan. We co-register these DTMs and re-sample to ensure a common domain. We then determine the absolute difference and root-mean square difference between the datasets. We report the results of this comparison, highlight areas of significant difference between each DTM, and account for these differences in terms of the merit of each technique.

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