IMPLEMENTATION OF A SELF-CONSISTENT STEREO PROCESSING CHAIN FOR 3D STEREO RECONSTRUCTION OF THE LUNAR LANDING SITES

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ABSTRACT:

The department for Planetary Geodesy at Technical University Berlin is developing routines for photogrammetric processing of planetary image data to derive 3D representations of planetary surfaces. The ISIS software [1], developed by USGS, Flagstaff, is readily available, open source, and well documented. Hence, ISIS was chosen as a prime processing platform and tool kit. However, ISIS does not provide a full photogrammetric stereo processing chain. Several components like image matching, bundle block adjustment (until recently) or digital terrain model (DTM) interpolation from 3D object points are missing. Our group aims to complete this photogrammetric stereo processing chain by implementing the missing components, taking advantage of already existing ISIS classes and functionality. With this abstract we would like to report on the development of our stereo processing chain and its first application to image data from the Lunar Apollo landing sites. To compute accurate 3D models and subsequently ortho-image maps several methods and software were developed. At the current stage this includes the software for automated matching and a 3D interpolation tool. The matcher integrates different matching approaches including a feature based (FB) and an area-based (AB) matching algorithm. With the help of Speeded Up Robust Features (SURF) the geometrical relations of the input images are determined to minimize disparities. AB matching techniques like normalized cross-correlation (NCC) and least-squares matching (LSM) are used to realize a dense matching. Due to the FB capability, the software can handle uncompressed, radiometrically corrected and non-rectified images. Thus a pre-rectification and a pre-existing DTM of the study area are not necessary. Based on the matching results and forward ray intersection techniques large clouds of 3D object point coordinates are derived and provided to the DTM interpolation tool. The object coordinates are map-projected into a pre-defined cube file, with different interpolation methods like mean, median, inverse distance weighting (IDW), nearest neighbor (NN), intersection accuracy weighting (IAW). For our test case of the Lunar Reconnaissance Orbiter (LRO) Narrow Angle Camera (NAC) DTMs we found that these benefit from the very good internal consistency. However, small offsets and possible distortion between neighbouring surface models remain due to the uncertainties of camera orientations. While a bundle block approach to correct for these small misalignments is currently under development, we have studied a different approach using Lunar Orbiter Laser Altimeter (LOLA) data as reference. The resulting DTMs are co-registered to LOLA tracks that intersect the study area. A grid search and a subsequent least square fit is performed to find the best fit between the LOLA profile and the DTM heights on sub-pixel accuracy level [2].

References:

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