REMOVE PRESUMABLE SPACECRAFT JITTER OF THE CONTEXT IMAGER (CTX) INSTRUMENT USING "JITTER_SOLVE" FROM THE NASA AMES STEREO PIPELINE SOFTWARE TO CREATE A CTX DEM FOR A CRATER IN TYRRHENA TERRA

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Introduction: The "jitter_solve" program was recently introduced by NASA Ames Stereo Pipeline (ASP) software [1] as a possible solution "to reduce the effect of unmeasured perturbations in the linescan sensor as it acquires the data" [2]. "Jitter_solve" program reminds the work of the "bundle_adjust" program, but it adjusts each individual camera position and orientation in the linescan model instead of the only single one when using the CSM camera model. We present our implementation of the DEM generation and provide it to the public as a basis for discussion. The aim is to create an example dataset which helps fine-tuning the parameters for the software. Our Bash code is available under the permanent DOI http://dx.doi.org/10.17169/refubium-38637 (for long-term availability) and under the GitHub repository https://github.com/planetary-fub/asp-jitter_solve-example (for public discussion by pull-requests, issues, etc.).

The study area is the unnamed crater located within highlands of Tyrrhena Terra on Mars. The crater is assumed to be an open-basin paleolake as there are channels looking like inlet and outlet; the high-quality DEM is needed to study possible fluvial activity in this crater.

Data: The CTX images for the stereopair were located using the Mars Orbital Data Explorer (https://ode.rsl.wustl.edu/mars/index.aspx) and downloaded from the PDS Geoscience node in IMG format. Among 4 swaths 2 images were chosen with the highest convergence angle of approx. 20°: G02_018948_1749 and G22_026873_1771.

Methods: The general workflow is based on the steps described in the ASP Documentation [2] following the example from section 14.23.3 (page 249).

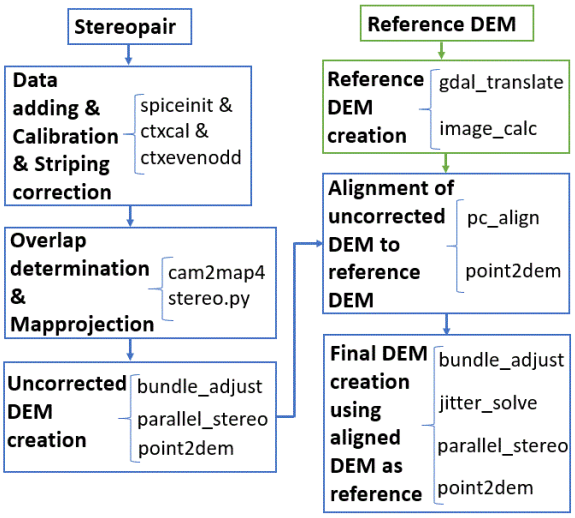

Fig. 1 – The workflow used in this study

The idea of this workflow (Fig. 1) is to first create an "uncorrected" DEM and a reference DEM separately, and then align the uncorrected DEM to the reference DEM. Then the recently added "jitter_solve" command (since ASP version 3.2.0) is applied on the aligned cameras constrained to the reference DEM to solve for jitter. We try our processing with various values for the num-lines-per-position and the num-lines-per-orientation parameters. For the final DEM creation, the stereo matching is re-run using the cameras solved for jitter.

For the pre-processing under ISIS3 [3], we have included the recently introduced in-flight calibration files as published in [4] and available for download at http://dx.doi.org/10.17169/refubium-37236.

Results and Discussion: Adjusting the parameters showed that it is possible to decrease the intersection errors and get rid of the missing lines on the colorized rasters of the intersection errors if the interpolations of samples and lines are removed (the parameters "--num-lines-per-position 1000" and "--num-lines-per-orientation 1000") – Fig. 2. Although an improvement is clearly visible, a remaining striping effect is still visible on the resulting DEM (Figs. 3 and 4). The open question remains: is it possible to completely get rid of the striping effects on the DEM if the algorithm is optimizing for the intersection error?

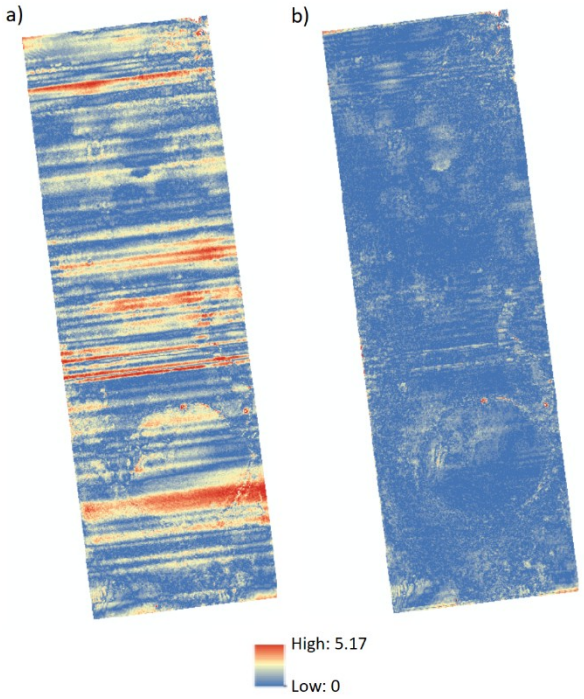

Fig. 2 - Intersection error for DEMs: a) without jitter correction; b) with jitter correction

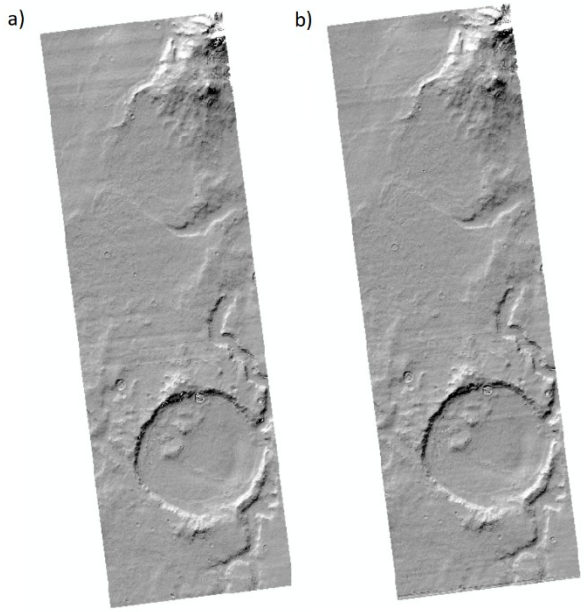

Fig. 3 Hillshaded DEMs: a) without jitter correction; b) with jitter correction

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References: [1] Beyer R. A., Alexandrov O., and McMichael S. (2018) *Earth and Space Science*, 5. https://doi.org/10.1029/2018EA000409. [2] Beyer R. A., Alexandrov O., McMichael S., and the ASP contributors (Jan 1, 2023), Ames Stereo Pipeline Documentation, Release 3.2.0. [3] Edmundson, K. L., Cook, D.A., Thomas, O.H., Archinal, B.A., Kirk, R.L. (2012) Jigsaw: the ISIS3 Bundle Adjustment for Extraterrestrial Photogrammetry, ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., Volume I4. [4] Walter, S.H.G, Munteanu, R.R.C, Aye, K.-M. (2023) LPSC 54, abstract #2806.