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Automatic Multiple-Expert Quality Assessment for Batch Processed Martian DTMs

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Digital Terrain Models or DTMs (sometimes called Digital Elevation Models or DEMs) are a gridded representation of elevation to represent the "bare earth" terrain surface, where each point is referenced by its position in x, y, and z (represented often by greyscale intensity or via a pseudo-coloured look-up table or CLUT. As an important tool for planetary research, Mars DTMs have been produced from HRSC (30-150m), CTX (18m), and HiRISE (0.75-1m) stereo images. Producing good Martian DTMs is not an easy process, resulting in low number in currently available DTMs.

To solve this problem, fully automated DTM processing chain based on the open-source NASA Ames Stereo Pipeline (ASP)[1] called CASP-GO (Co-registration ASP-Gotcha Optimised)[2] Using this approach, more than 4,000 CTX DTMs have been processed over a short time period[3], with similar production parameters resulting in varying qualities in the produced DTMs. Because of the number of produced DTMs, it is difficult to assess the quality of the products manually.

Training data are needed to produce a classifier that can correctly classify the DTM products. Three different volunteers classified 1300 DTMs out of the total of around 4,000. Manual assessment were done separately three times (for 800+, 700+, 700+ DTMs, with 300+ overlapping data) to classify DTM products into 5 different classes. Although assessment criteria have been defined as well as possible, different assessment results occurred between these volunteers. Using a multiple-expert classifier trained with manually assessed DTMs, features such as image completeness, local feature and surface roughness are used as input to automatically classify CTX DTMs. This classifier is tested for other Martian DTM products and the results will be shown.

[1] Moratto, Z. M., Broxton, M. J., Beyer, R. A., Lundy, M., & Husmann, K. 2010. Ames Stereo Pipeline, NASA's open source automated stereogrammetry software. In Lunar and Planetary Science Conference (Vol. 41, p. 2364).
[2] Tao, Y., Muller, J. P., Sidiropoulos, P., Veitch-Michaelis, J., & Yershov, V. 2016. An Optimised System for Generating Multi-Resolution DTMs using NASA MRO Datasets. International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences, 41.
[3] Tao, Y., & Muller, J. P. 2017. Automated Planet-Wide DTM Generation from NASA MRO Data—A Status Report. In Lunar and Planetary Science Conference (Vol. 48).