RELIABLE MARS TOPOGRAPHIC SURFACES FOR FUTURE LANDING SITES. A. F. Elaksher New Mexico State University (ETSE Department, 1060 Frenger Mall - Room 130 Las Cruces, NM 88003 elaksher@nmsu.edu)

Introduction: For many years, Mars surface has been a mystery for scientists. Lately with the help of geospatial data and photogrammetric procedures researchers were able to capture some insights about this planet. Two of the most imperative data sources to explore Mars are the HiRISE stereo images and MOLA data. The photogrammetric processing of these data sources enables scientist to accurately explore the planet surface for different tasks particularly those related to safely landing future robotic spacecraft. This poster outlines the photogrammetric processing of HiRISE and MOLA data to generate reliable 3D surface information.

Methodology: We start by processing one stereo pair collected by the HiRISE pushbroom sensor for a pilot site on Mars. First, we corrected for the jitter, i.e. geometric distortions due to spacecraft motion as proposed by different studies [1]. Next, point correspondence between conjugate points is established through the Scale Invariant Feature Transform (SIFT), [2]. A pushbroom mathematical model, [3], is then utilized to build a relatively oriented object model. After executing the model for the image stereo pair, an automated image matching algorithm is utilized to create a Digital Elevation Model (DEM) for the overlapping area in the stereo pair [4]. These DEMs although accurate still are not complete and exhibit some blunders due to false matching, occlusion, and smooth texture. Therefore, it has been strongly recommended to fuse these DEMs with laser-based DEMS, [5]. To merge these DEMs, we implement an automated algorithm to search and locate close by MOLA ground point and combine their elevations with values from the closest optical DEM.

The MOLA data is ranging laser elevations. Data is archived by the PDS Geosciences Node. Geodetic corrections have already been applied to the published data and topographic models are generated, [6]. Data is downloaded and proceeded to create a mosaic DEM covering the test area using the nearest-neighbor interpolation method. Finally, the optical and laser DEMs is combined to create a more accurate and comprehensive global DEM for Mars. To co-register both optical and range data before they are merged, trustworthy correspondence between both data is determined via the affine transformation model and rsults are assessed through control points. Most available methods for fusion these data are based on Earth-based laser and imagery, [7]. Orthophotos for the same areas are then generated using the HiRISE images, the generated DEMs, and the image orientation parameters defined by the photogrammetric solution. Finally, we utilize geospatial analysis tools to assess the topography, slopes, and roughness of the generated surfaces. Results are then compared with those found by commercial software packages.

References:

[1] Tong, X., Ye, Z., Xu, Y., Tang, X., Liu, S., Li, L., ... & Hong, Z. (2014). Framework of jitter detection and compensation for high resolution satellites. Remote Sensing, 6(5), 3944-3964.

[2] Lowe, D. G. (2004). Distinctive image features from scale-invariant keypoints. International journal of computer vision, 60(2), 91-110.

[3] Gupta, R., & Hartley, R. I. (1997). Linear pushbroom cameras. IEEE Transactions on pattern analysis and machine intelligence, 19(9), 963-975.

[4] Re, C., Roncella, R., Forlani, G., Cremonese, G., & Naletto, G. (2012). Evaluation of area-based image matching applied to DTM generation with Hirise images. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 4.

[5] Elaksher, A. F. (2016). Co-registering satellite images and LIDAR DEMs through straight lines. International Journal of Image and Data Fusion, 7(2), 103-118.

[6] Smith, D. E., Zuber, M. T., Frey, H. V., Garvin, J. B., Head, J. W., Muhleman, D. O., ... & Banerdt, W. B. (2001). Mars Orbiter Laser Altimeter: Experiment summary after the first year of global mapping of Mars. Journal of Geophysical Research: Planets, 106(E10), 23689-23722.

[7] Mastin, A., Kepner, J., & Fisher, J. (2009). Automatic registration of LIDAR and optical images of urban scenes. Institute of Electrical and Electronics Engineers.