AUTONOMOUS ROCK DETECTION FROM MARS EXPLORATION ROVER IMAGERY AND 3-D POINT CLOUD DATA. K. Di, Z. Yue, Institute of Remote Sensing Applications, Chinese Academy of Sciences, P. O. Box 9718, Datun Rd, Chaoyang District, Beijing 100101, P.R.China. (kcdi@irsa.ac.cn)

Rocks are one of the major features seen from images of Mars Rover Exploration (MER) rovers. The distribution and shape properties of rocks have important significance for studying a variety of processes, including impact, aeolian, volcanic, fluvial, and others that have shaped the surface of Mars. Rocks can become obstacles for rover traversing and can also be used as tie points for vision-based rover localization and navigation. Thus, autonomous rock detection will be very helpful for both scientific investigations and engineering operations in a Mars rover mission.

We have developed a new algorithm that autonomously detects the locations and extracts the shapes of rocks from optical images and 3-D point cloud data. The optical images can be from navigation or science camera of a rover, e.g., Navcam or Pancam of the MER rovers, while the point cloud data are the derived XYZ data from the stereo images. The basic idea is that the 3-D point cloud data gives good separation of ground (soil) and above-ground (rock) features while rover imagery provides more accurate boundaries of the rocks; by using image and 3-D point cloud data together the rocks can be detected more reliably and accurately.

The procedure of autonomous rock detection algorithm includes: mean-shift segmentation of rover imagery, above-ground object identification through local plane fitting of 3-D point cloud data, grouping and merging adjacent image segments with the help of the distances of the segments to the fitted planes, and final rock detection and boundary delineation. We tested the developed algorithm using MER Spirit's Navcam data acquired at sites 1600, AK00, AQJI, ATAC, AVKC and, which were acquired on Sols 65, 692, 803, 1184 and 1348 and respectively. The data were downloaded from the MER Analyst's Notebook website (http://an.rsl.wustl.edu/mer/). The test results show that most medium and large rocks are successfully detected. The algorithm is especially effective for the regions where rocks are not densely distributed. We will further enhance robustness and efficiency of the algorithm and validate it using more data sets.

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