Automatic Extraction of Planetary Image Features

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***Abstract*—With the launch of several Lunar missions such as the Lunar Reconnaissance Orbiter (LRO) and Chandrayaan-1, a large amount of Lunar images will be acquired and will need to be analyzed. Although many automatic feature extraction methods have been proposed and utilized for Earth remote sensing images, these methods are not always applicable to Lunar data that often present low contrast and uneven illumination characteristics. In this paper, we propose a new method for the extraction of Lunar features (that can be generalized to other planetary images), based on the combination of several image processing techniques, a watershed segmentation and the generalized Hough Transform. This feature extraction has many applications, among which image registration.**

I. Introduction

The Lunar Reconnaissance Orbiter (LRO) is a NASA mission, aimed at creating a comprehensive atlas of the moon features and resources to aid in the design of a lunar outpost and to prepare exploration and scientific missions to the Moon. LRO will be launched in late 2008 and will spend at least one year in orbit collecting detailed information about the moon and its environment. Different types of data will be collected by LRO at different times, by different sensors, and from different view-points. Registration will be an essential task to jointly exploit, integrate, or compare these different data, and feature extraction is the first step to not only image registration but any further analysis of these data. Because planetary images typically exhibit lack of contrast, poor illumination and lack of good features, we propose a novel region-based approach for the extraction of Lunar (and planetary) features.

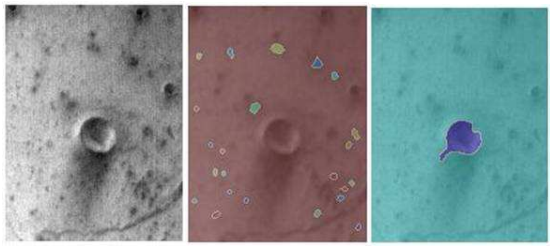
II. APPROACH

The features to be extracted are rocks (i.e., objects of small elliptical shape), craters (objects of elliptical shape with shadows), and ridges. In order to detect them, the image gradient is first computed by using the Canny edge detector [1]. Then, the watershed algorithm in [2] is applied to the Canny gradient, in order to segment regions in the gradient image, which appear as closed-contours in the gradient are segmented. Elliptical shapes are detected by a generalized Hough accumulator [3]. Furthermore, a standard Hough accumulator [4] can be applied to detect straight lines in the gradient image.

For the application of this method to registration, the features above are extracted from both images to be registered, and then matched in order to compute the geometric transformation required to achieve the registration.

III. Results

Since currently, LRO images are not yet available, experiments were carried out using similar data, collected during the mission Mars Global Surveyor. Preliminary results are shown in Fig.1.



(a) (b) (c)

Fig. 1. The original image (a), the close contour features (b) and the elliptic shape features (c) are shown.

IV. Benefits

The proposed approach will be used for many applications dealing with all the different data collected during the LRO mission (and other Lunar missions), among which image registration and image analysis, with the aim of selecting safe landing sites, identifying lunar resources, and studying how the lunar radiation environment will affect humans.

V. Conclusion

A novel approach has been proposed for feature extraction and matching in registration of planetary data. In planetary data, the features to be extracted are not as well-contrasted nor -defined as for Earth data. However, small rocks, which are not affected by uneven illumination, can easily be detected. An illumination correction will be necessary to detect all the craters, ridges and big rocks, which have shadows.

References

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