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Quantitative analysis of lunar crater's landscape: automatic detection, classification and geological applications

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Lunar craters are the most important geological tectonic features on the moon; they are among the most studied subjects when it comes to the analysis of the surface of the moon since they provide us with the relative age of the surface unit and more information about lunar geology. Quantitative analysis of landscape on lunar crater is an important approach in lunar geological unit dating which plays a key role in understanding and reconstruction of lunar geological evolution. In this paper, a new approach of automatic crater detection and classification is proposed based on the quantitative analysis of crater's landscape with different spatial resolution digital terrain models. The approach proposed in this paper includes the following key points: 1) A new crater detection method which selects profile similarity parameters as the distinguishing marks is presented. The new method overcomes the high error defect of former DTM based crater detection algorithm; 2) Craters are sorted by the morphological characteristics of profiles. The new quantitative classification method overcomes the subjectivity of the previously descriptive classification method.

In order to verify the usefulness of the proposed method the pre-selected landing area of China's Chang'e-III lunar satellite-Sinus Iridum is chosen as the experimental zone. DTM with different resolutions from the Chang'e-I Laser Altimeter, the Chang'e-I Stereoscopic Camera and the Lunar Orbiter Laser Altimeter (LOLA) are used for crater detection and classification. Dating results of each geological unit are gotten using crater size-frequency distribution method (CSFD). By comparing the former dating and manual classification data, we found that the results obtained by our method and the former results have the strong consistency. With the combination of automatic crater detection and classification, this paper basically provided a quantitative approach which can analyze the lunar crater's landscape and get geological information from it. And the approach can be widely used on other planets like Mars.