Automatic Crater Detection Algorithm based on spatial distributions of slope azimuth and concavity of terrain derived from Lunar Digital Elevation Model

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We develop a new automatic crater detection algorithm (CDA) based on digital elevation model (DEM) of the Moon and suggest morphological parameters that effectively filter out false or unsuccessful detections. Using SELENE/LRO Digital Elevation Model (SLDEM, Haruyama et al., 2014), our CDA finds crater candidates whose diameter ranges from 500 m to 8 km. Then we acquire first and second order derivative images for each candidate using Sobel and Laplacian filters, respectively. Using the first order derivative image, we parameterize the degree of spatial concentration of surface normal vectors pointing toward inside of the candidate. From the second derivatives, we calculate standard distances from the candidate center weighted by concavity of the terrain for concave-up and concave-down regions individually. Making use of these three parameters that are directly derived from morphology, our CDA effectively separates genuine craters and false detections.

In this work, we investigate the performance of our DEM-based CDA and its screening efficiency for three regions on the Moon that show typical topographic characteristics of mare, highland, and composite area. We select 6˚ ×6˚ regions near the lunar equator and compare our results to LU78287GT, the lunar impact crater catalog of Salamunićcar et al. (2014). In the selected regions, our CDA identifies over 98% of 873 craters listed in LU78287GT whose diameter ranges from 500 m to 8 km. We also detect ~5,000 more candidates in those regions that are not listed in the previous catalog but regarded as genuine craters. We note that thresholds of the morphological parameters used in this work should be adjusted in accordance with the topography because the gap among the parameters between true and false detections becomes ambiguous when it comes to highland region. We will also discuss on fine-tuning of the criteria regarding the morphological parameters suggested in this work.

References: Haruyama et al. (2014), 45th Lunar and Planetary Science Conference, #1304; Salamunićcar et al. (2014), Advances in Space Research, 53, 1783-1797

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