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Geological mapping from macroscopic and quantitative texture analysis of Mars Express HRSC data: a first contribution to the study of lobate craters

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Fluvial, aeolian or glacial activity, impact cratering and landslides are among various geological processes which produce different surface textures at the macroscopic scale (few tens of meters). The quantitative measurement of surface textures could provide valuable insights into the description of and discrimination between some of these geological processes. Furthermore, quantitative texture studies of the Martian surface are now feasible given the very high resolution of the HRSC instrument onboard Mars Express. We introduce here a method, developed in the context of image classification and segmentation, to quantify the "macroscopic texture" of a planetary surface. It is based on a filtering process as described in [1, 2] and consists of a convolution of an image with a set of Gabor filters, followed by a local energy function evaluation.

The sequence of operations described in [2] is applied to high resolution images from HRSC. We first demonstrate the potential of this method for the identification of geological features. Wrinkle ridges or fractures are highlighted by this algorithm and could be used for a detailed mapping of such features, given the coverage of HRSC data. Regarding lava flows, our initial results indicate a diversity of textures which could be related either to differing states of degradation (evolution from fresh lava flows to sandy areas) or to the type of lava itself.

We focus on selected morphologies of lobate craters according to the nomenclature defined in [3]. We show that the textural quantities derived can be related to the state

of degradation of the ejecta material. In particular we demonstrate that our texture analysis is a good indicator of the amount of the dust mantling on the contiguous ejecta layer [2].

The pristine morphologies of ejecta are sometimes accessible. For instance, in Syrtis Major, a recent analysis of THEMIS IR data shows that size distribution of particles related to the ejecta emplacement processes have not been totally erased by the post-impact modification history [4] or in Lunae Planum where high thermal inertia values indicate the absence of dust mantling. The lobate ejecta investigated in these regions show a strong diversity of surface textures at the scale of a few pixels. In particular, for double-lobe craters, we show the textural properties variations between the inner lobe and outer lobe and compare the results to the thermal properties of ejecta. Our results are in good agreement with the recent work of Mouginis-Mark [5] on the ejecta materials at Syrtis Major that emphasized differences in thermal properties, morphologies and surface textures between the inner and outer lobes. We thus provide a quantitative and statistical analysis of this observation which is thought valuable for the understanding of the particularity of double-lobe ejecta.

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