



Characterizing the surface rugosity of the asteroids using geostatistical approach and decomposition techniques

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Different processes, such as erosion, meteoritic bombardment, volcanic activities, isostatic compensation, have impacts on the rugosity of extra-terrestrial surfaces. Some of these processes tend to soften the topography, while others increase its rugosity but also leads to particular rugosity features (e.g. impact craters). Extra-terrestrial surfaces may be heterogeneous in their rugosity and exhibit different zones, on which there is more occurrence of either volcanic activity or meteoritic bombardment, for instance. The delimitation of these zones is generally manual and based on visual characterization.

In this work, we study the use of 3D surface decomposition techniques and spatial variability analysis for characterizing surface rugosity and as ultimate goal, for classifying their different types of outcrop surfaces. The first used approach relies on geostatistical tools, termed as variograms, in order to study the spatial topography variability. These approaches are very common in geological modelling but are few used in astronomy. The second category of approaches includes spherical harmonic decompositions as well as Fourier transforms. These approaches are well known techniques to decompose surfaces into frequency spectrum. The so-obtained spectrum is able to characterize and discriminate different kinds of rugosity. However, these techniques have number of drawbacks, respectively: necessity of spherical shapes and of initial non-multivalued surfaces. Recently, the more general Laplacian decomposition allows any kinds of 3D surfaces to be taken into account.

In this work, it is proposed to combine and compare these two kinds of techniques while applying them on different synthetic cases and celestial bodies. Interesting results are obtained using variogram analysis. The computed variogram parameters permits to estimate statistics on crater impact diameters. Finally, the different results obtained concerning the characterization of the surface rugosity will be also presented.