INVESTIGATING FLUVIAL TOPOGRAPHY FORMING PROCESSES OF THE MARTIAN SURFACE BY MEANS OF RASTER BASED GEOMETRY ANALYSIS

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ABSTRACT:

Mars Missions like ESA's Mars Express (MEX) and NASA's Mars Global Surveyor (MGS) provide results, which enable the geological analysis of the Martian surface at high resolution and in 3D. Area based image matching using images of the MEX instrument High Resolution Stereo Camera (HRSC) or the surface points acquired by the MGS instrument Mars Orbiter Laser Altimeter (MOLA) make the derivation of digital terrain models (DTMs) possible. Currently, geological investigations regarding the Mars are mostly based on the visual interpretation of images (e.g. HRSC and Super Resolution Channel of MEX, and Mars Orbiter Camera of MGS), photometry, measurements and 3D analysis within stereo models of images of the HRSC, and the analysis of profiles derived from DTMs from HRSC images or MOLA tracks.

Raster based geometry analysis allows fast, efficient and automatic mathematical analysis of terrain models (e.g. computation of curvature, exposition, or slope). Hydrological analysis methods such as detection of depressions, potential river lines and water sheds, or the derivation of catchment areas are predestined to be realized in a raster based manner as well. Such methods were implemented at the Institute of Photogrammetry of the Vienna University of Technology by Rieger (1992); improvements were done by Gajski (2005). The hydrological analysis methods are implemented as systolic processes. Thus, the conditions of the cells of a DTM are derived synchronously by taking only their neighbours into consideration. The visualisation of the results is prepared by means of special filtering operations.

According to the current standard of knowledge, the formation of large areas of the current Mars topography has been influenced by fluvial processes. Therefore, hydrological analysis has a high potential to support the derivation of models which can be applied to model the behaviour of possible former surface water or other flowing material on Mars in a plausible manner. Such raster based methods provide useful additional information to geological analysis. They were already applied to DTMs derived from MOLA tracks (Dorninger et al, 2004).

In this paper, raster based methods for the analysis of the Martian terrain will be discussed. Currently, the capabilities of these algorithms are increased in order to allow a more complex modelling of surface water behaviour. For instance, there will be considered the infiltration in soil (possibly different infiltration parameters for different soils) and the control of the amount of incoming water from specific points or areas (this can be used also to simulate volcanic eruption). Exemplary applications on high resolution HRSC DTMs, as derived for the HRSC DTM test (Heipke et al, 2006), will be presented.

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