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Mars, High-Resolution Digital Terrain Model Quadrangles on the Basis of Mars-Express HRSC Data

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Introduction: Since December 2003, the European Space Agency's (ESA) Mars Express (MEX) orbiter has been investigating Mars. The High Resolution Stereo Camera (HRSC), one of the scientific experiments onboard MEX, is a pushbroom stereo color scanning instrument with nine line detectors, each equipped with 5176 CCD sensor elements [1,2]. One of the goals for MEX HRSC is to cover Mars globally in color and stereoscopically at high-resolution. So far, HRSC has covered half of the surface of Mars at a resolution better than 20 meters per pixel. HRSC data allows to derive high-resolution digital terrain models (DTM), color-orthoimage mosaics and additionally higher-level 3D data products. Past work concentrated on producing regional data mosaics for areas of scientific interest in a single strip and/or bundle block adjustment and deriving DTMs [3]. The next logical step, based on substantially the same procedure, is to systematically expand the derivation of DTMs and orthoimage data to the 140 map quadrangle scheme (Q-DTM).

Methods: The division of the Mars surface into 140 quadrangles is briefly described in Greeley and Batson [4] and based upon the standard MC 30 (Mars Chart) system. The quadrangles are named by alpha-numerical labels. The workflow for the determination of new orientation data for the derivation of digital terrain models takes place in two steps. First, for each HRSC orbits covering a quadrangle, new exterior orientation parameters are determined [5,6]. The successfully classified exterior orientation parameters become the input for the next step in which the exterior orientation parameters are determined together in a bundle block adjustment. Only those orbit strips which have a sufficient overlap area and a certain number of tie points can be used in a common bundle block adjustment. For the automated determination of tie points, software provided by the Leibniz Universität Hannover [7] is used.

Results: For the derivation of Q-DTMs and ortho-image mosaics, the use of the improved data (single strips and also image blocks) is essential because, among other things, they adapt the HRSC-derived data to the global Mars-reference system very well. The Q-DTM quadrangles will be distributed to the community as files in VICAR as well as Geo-JP2000 format. The map projection of the Q-DTM quadrangles will be, however, slightly different from the MC 140 scheme in the way that all quadrangles will be released in equidistant cylindric map projection except for the polar areas which will be stereographically projected.

References: [1] Neukum, G., et al. (2004), ESA SP-1240, 17-35. [2] Jaumann, R., et al. (2007), Planet. Space. Sci. [3] Dumke, A. et al. (2008), IntArchPhRS, 37, Part B4, 1037–1042. [4] Greeley, R. and Batson, R. M. (1990), Planetary Mapping, Cambridge University Press, New York, 266. [5] Spiegel, M. (2007), IntArchPhRS, 36 (3/W49B), 161–166. [6] Spiegel, M. (2007), Dissertation, DGK C, 610, Verlag der Bayerischen Akademie der Wissenschaften, München. [7] Schmidt, R. (2008), Dissertation, DGK C, 623, Verlag der Bayerischen Akademie der Wissenschaften, München..

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