Abstract

Images obtained by the High Resolution Stereo Camera (HRSC) during the Phobos flybys in March 2010 were used to study the proposed new landing site area of the Russian Phobos Sample Return Mission (PhSRM), scheduled for launch in 2011 [1]. From the stereo images (resolution of up to 4.4 m/pixel), a digital terrain model (DTM) with a lateral resolution of 100 m per pixel and a relative point accuracy of ±15 m, was determined. Images and DTM were registered to the established Phobos control point network [8]. A map of the landing site area was produced enabling mission planners and scientists to extract accurate body-fixed coordinates of features in the Phobos-Grunt landing site area.

Introduction

The European Mars Express spacecraft is currently the only spacecraft orbiting Mars to carry out Phobos flybys on a regular basis. The HRSC successfully imaged Phobos during three very close passes (orbits 7915, 7926, and 7937) with the nadir, stereo and photometric channels. Image resolutions were between 4.4 m/pixel to 19 m/pixel in the nadir and stereo channels. Further observations during the orbits 7948 and 7959 were dedicated to color imaging at reduced resolution. Images of these flybys cover the proposed landing site for the PhSRM. The previously available digital terrain model for Phobos [7] was derived from low resolution Viking Orbiter images only and was interpolated over large parts.

Data processing

Prior to the matching process orientation parameters of the camera were adjusted [6] and tied to the control point network [8]. This adjustment included data of 20 flybys to tie all data suitable for a DTM generation to the same reference. An a priori rectification of the image data onto a shape model derived from spherical harmonic functions was performed to minimize parallaxes between them, thus reducing search areas for the automated matching process [2].

Table 1: Estimated coordinates for the proposed landing sites [1] based on image data obtained during MER orbit 7915 orthorectified onto the new DTM. The coordinate reference is the frame defined by the control network published in [7].

<table>
<thead>
<tr>
<th>Landing Site</th>
<th>Longitude</th>
<th>Latitude</th>
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<tbody>
<tr>
<td>1</td>
<td>217.7° W ±/ ±0.1°</td>
<td>15.5° N ±/ ±0.1°</td>
</tr>
<tr>
<td>2</td>
<td>212.0° W ±/ ±0.1°</td>
<td>21.5° N ±/ ±0.1°</td>
</tr>
</tbody>
</table>

Results

We derived a DTM with a resolution of 100 m per pixel (Fig 1). The relative height accuracy, representing the remaining uncertainty of the ray intersections, is on average 10 m, but not higher than 20 m. The ortho-rectified images of the MEX orbit 7915 were used to determine accurate body fixed coordinates of Phobos-Grunt landing sites (Fig 3 & Table 1). Different representations, such as perspective views (Fig. 2), allow us to judge the overall topography and to study the safety of the proposed Phobos-Grunt landing site area. The geometry suggests for both proposed landing sites a smooth area without steep slopes. Variations of the dynamic heights in this area also appear to be of small magnitudes [5].

References