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Improvements to Color HRSC+OMEGA Image Mosaics of Mars

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1. Introduction

The High Resolution Stereo Camera (HRSC) on the Mars Express (MEx) orbiter has acquired 3640 images (with 'preliminary level 4' processing as described in [1]) of the Martian surface since arriving in orbit in 2003, covering over 90% of the planet [2]. At resolutions that can reach 10 meters/pixel, these MEx/HRSC images [3-4] are constructed in a push-broom manner from 9 different CCD line sensors, including a panchromatic nadir-looking (Pan) channel, 4 color channels (R, G, B, IR), and 4 other panchromatic channels for stereo imaging or photometric imaging.

In [5], we discussed our first approach towards mosaicking hundreds of the MEx/HRSC RGB or Pan images together. The images were acquired under different atmospheric conditions over the entire mission and under different observation/illumination geometries. Therefore, the main challenge that we have addressed is the color (or gray-scale) matching of these images, which have varying colors (or gray scales) due to the different observing conditions. Using this first approach, our best results for a semi-global mosaic consist of adding a high-pass-filtered version of the HRSC mosaic to a low-pass-filtered version of the MEx/OMEGA [6] global mosaic.

Herein, we will present our latest results using a new, improved, second approach for mosaicking MEx/HRSC images [7], but focusing on the RGB color processing when using this new second approach. Currently, when the new second approach is applied to Pan images, we match local spatial averages of the Pan images to the local spatial averages of a mosaic made from the images acquired by the Mars Global Surveyor TES bolometer. Since these MGS/TES images have already been atmospherically-corrected, this matching allows us to bootstrap the process of mosaicking the HRSC images without actually atmospherically correcting the HRSC images. In this work, we will adapt this technique of MEx/HRSC Pan images being matched with the MGS/TES mosaic, so that instead, MEx/HRSC RGB images will be matched with specially-constructed MEx/OMEGA RGB mosaics.

2. HRSC Preprocessing

We perform a photometric correction (using a Lambertian model, by dividing by the cosine of the incidence angle). The main portion of the photometric-correction effort involves the determination of the illumination and observation angles with respect to the digital elevation model [8].

3. OMEGA Preprocessing

The MEx/OMEGA RGB mosaics have been produced as a special product by integrating the atmospherically-corrected reflectance of the narrow-band OMEGA channels over the spectral band-passes for each of the three broad-band HRSC color channels, using the measured filter functions for HRSC as weighting functions for this integration.

Based on prior experience when producing the HRSC Pan mosaic with our first approach [5], there will be additional gaps in the resulting HRSC+OMEGA RGB mosaic caused by gaps in OMEGA coverage and/or by gaps in high-quality atmospheric correction of the OMEGA data.

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