Geophysical Research Abstracts
Vol. 16, EGU2014-10153-1, 2014
EGU General Assembly 2014

Martian Landscapes in Motion

Sarah Mattson (1), Alfred McEwen (1), Randolph Kirk (2), Elpitha Howington-Kraus (2), Matthew Chojnacki (1), Kirby Runyon (3), Gabriele Cremonese (4), and Cristina Re (4)

(1) Lunar and Planetary Laboratory, 1541 E. University Blvd., Tucson, Arizona, 85721, USA (smattson@pirl.lpl.arizona.edu), (2) Astrogeology Science Center, U.S. Geological Survey, Flagstaff, Arizona, USA, (3) Johns Hopkins University Earth & Planetary Sciences Dept., 3400 N. Charles St., Baltimore, Maryland, USA, (4) INAF-Osservatorio Astronomico di Padova, Padova, Italy

Stereo images from Mars Reconnaissance Orbiter's HiRISE camera with ~30 cm pixel scale are used to create high-resolution digital terrain models (DTMs), and orthorectified images. HiRISE DTMs have also been used for mapping structural geology (Okubo, 2010, Icarus), sedimentary structures (Metz et al., 2010, JGR), stratigraphy (Weitz et al., 2012, JGR), fluvial deposits (Lefort et al., 2012, JGR), volcanic terrains (Jaeger et al., 2010, Icarus), landing sites (Kirk et al., 2008, JGR), and other static landforms. But the surface of Mars is active today, and orthorectified images are being used to visualize and measure temporal changes. The HiRISE team has produced over 200 DTMs, most at 1 m grid spacing and vertical precision of 10s of cm (Kirk et al. 2008, JGR). To date, 169 DTMs and 400 orthoimages have been made publicly available, with more being added each month (http://uahirise.org/dtm). Three-band color (blue-green, red, and near infrared) orthoimages are also available in many cases.
A stereo pair consists of two images with similar lighting angles (to minimize surface differences) but different look angles with a convergence angle in the range of ~10-30º, depending on topography. Additional images to be orthorectified have no such lighting or geometric constraints – they must only have coverage over the area of the original stereo pair. A highly trained human operator works in an interactive digital system to tie surface features in each image to features in the original stereo pair. Orthorectification reprojects each controlled image to the high resolution DTM allowing from near pixel-to-pixel to sub-pixel matching of surface features, without topographic distortions. The main issue affecting the accuracy of HiRISE orthoimages is spacecraft jitter, which causes small-scale distortions. The HiRISE image processing pipeline employs a jitter correction routine that minimizes this problem (Mattson et al. 2009, EPSC) when necessary.
The availability of HiRISE orthorectified image sequences makes it possible to conduct accurate change detection studies of active processes on Mars. Some examples of studies of active landscapes on Mars using HiRISE DTMs and orthoimage sequences include: dune and ripple motion (Bridges et al., 2012, Nature), recurring slope lineae (RSL) (McEwen et al., 2011, Science; McEwen et al., 2013, Nature Geoscience), gully activity (Dundas et al., 2012, Icarus), and polar processes (Hansen et al., 2011, Science; Portyankina et al. 2013, Icarus,). These studies encompass images from multiple Mars years and seasons. Sequences of orthoimages make it possible to generate animated gifs or movies to visualize temporal changes (http://www.uahirise.org/sim/). They can also be brought into geospatial software to quantitatively map and record changes. The ability to monitor the surface of Mars at high spatial resolution with frequent repeat images has opened up our insight into seasonal and interannual changes, further increasing our understanding of Mars as an active planet.