HiSEAS: A Tool for Planning HiRISE Stereo Pairs

C. Schaller* and M. Milazzo

Presenting and Corresponding Author: schaller@lpl.arizona.edu

One of the top priorities of HiRISE operations during the Mars Reconnaissance Orbiter's primary mission was the acquisition of roughly 1000 stereo pair observations of Mars[1], and the effort to acquire additional pairs continues into the extended mission. These pairs are used to produce digital elevation models (DEMs) and red/blue anaglyph images (Figure 1). In either case, the quality of the end product is dependent on the quality of the input stereo pair. Aside from the requirements on each half of the pair as an image on its own (e.g., clear atmosphere, using the same imaging modes, etc.), the pair itself has two important requirements: The stereo convergence angle must be around 20°, and the shadows in the two images must be of similar length and direction.

HiSEAS, the HiRISE Stereo Effect Analysis Software, is a tool for evaluating the stereo convergence angle and lighting conditions of a proposed stereo pair. Its input is a list of candidate stereo pairs, each defined by an already-acquired first-half stereo observation and a set of candidate second-half observations. The convergence angle for each candidate pair is computed, and those observations with convergence angles outside the allowed range are discarded.

For each remaining candidate pair, the change in lighting conditions between the first- and second-half observations is evaluated. This change is the distance between the tips of the shadows cast by a hypothetical unit-length pole oriented perpendicular to the Mars reference ellipsoid, ignoring local terrain, for each half (Figure 2). The final candidates are ordered by priority based on the lighting conditions—with smaller changes in shadow position receiving a larger priority—providing an easy metric for the targeting specialist to use in deciding which stereo pairs to pursue immediately and which to leave until a later time.

HiSEAS currently requires the first-half observation to have been already acquired when used. Efforts are underway to enable it to be used to plan both halves in the same two-week planning cycle. Doing so results in optimal lighting conditions, since the sun's position won't have changed very much in such a short time. It also minimizes changes in surface features and atmospheric characteristics between the two halves.

HiSEAS is also currently limited to HiRISE observations of Mars. This limitation is also being removed, enabling the software to be used with any similar instrument and any target body with minimal adaptation.

Links: HiRISE stereo pairs are available here: http://hirise.lpl.arizona.edu/stereo_pairs.php. HiRISE anaglyphs are available here: http://hirise.lpl.arizona.edu/anaglyph/.

References: [1] McEwen, A. S., et al. (2007), Mars Reconnaissance Orbiter's High Resolution Imaging Science Experiment (HiRISE), J. Geophys. Res., 112, E05S02, doi:10.1029/2005JE002605.

Acknowledgements: HiSEAS is adapted from code written by Shane Byrne; Drew Davidson wrote our initial adaptation.

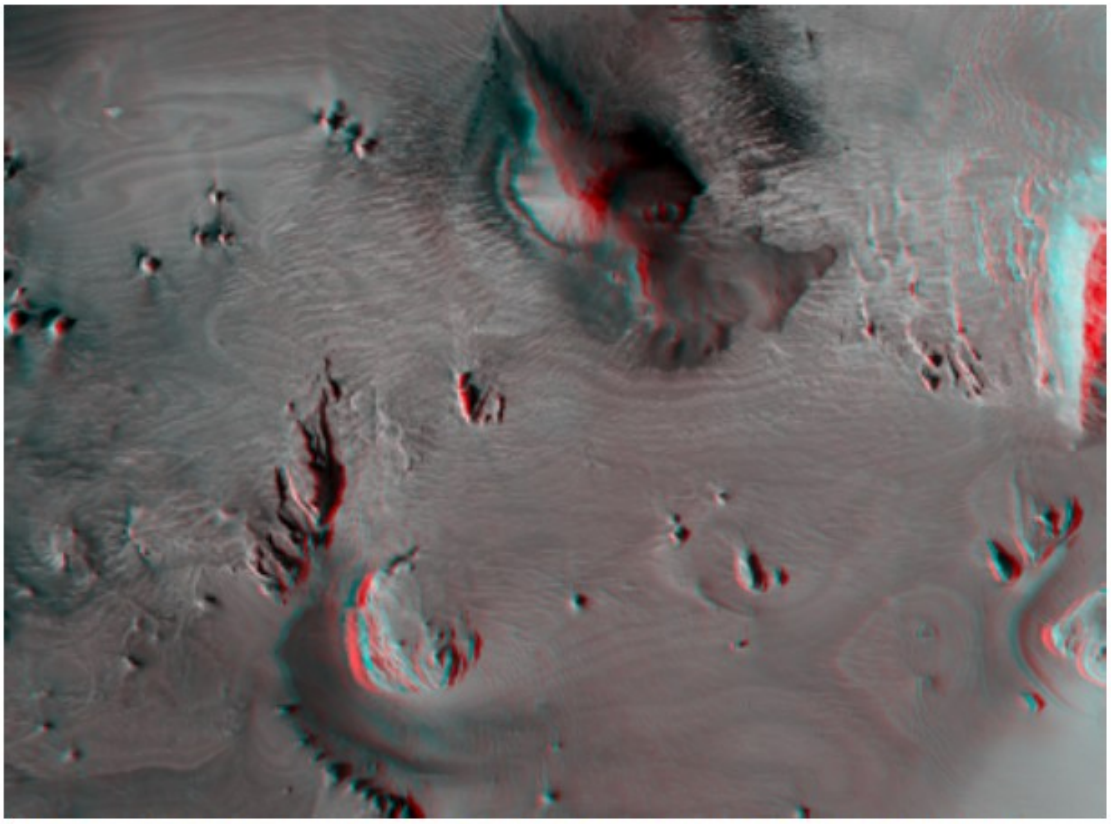

Figure 1: Part of HiRISE anaglyph PSP_003450_1975_ESP_012060_1975.

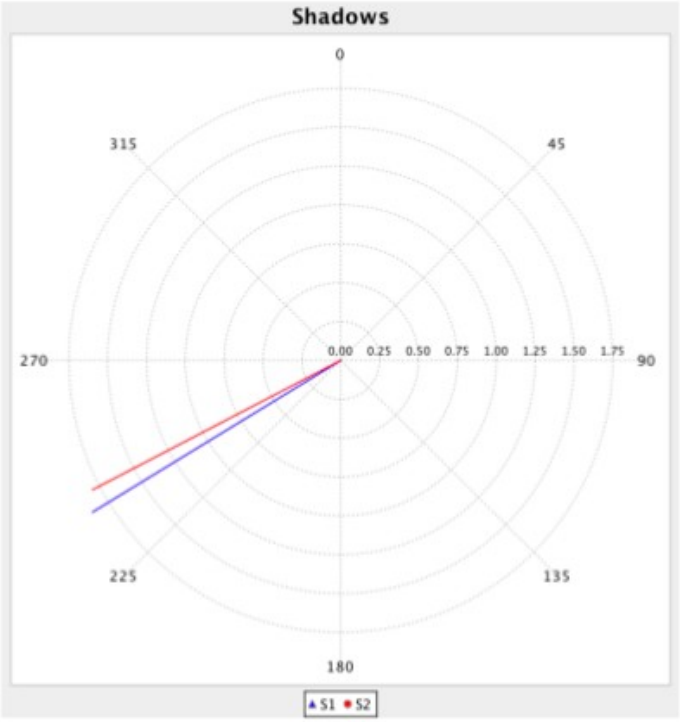

Figure 2: Shadows cast by a vertical, unit-length pole on Mars for PSP_003450_1975 (blue) and ESP_012060_1975 (red). The difference between the two is very small, making the second-half observation a very good match to the first half.