

FINDING STEREO PAIRS WITH THE PDS PLANETARY IMAGE LOCATOR TOOL (PILOT)

M. S. Bailen, K. E. Herkenhoff, E. A. Howington-Kraus, K. J. Becker. U. S. Geological Survey, Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ, 86001 (mbailen@usgs.gov).

Introduction: Creating a topographic model is often the first step in performing research such as slope and roughness analysis; landing site determination; wind, water, landslide and lava flow modelling; orthorectification for cartographic products, anaglyph creation, simulated 3D flyovers, and more [1]. Researchers in pursuit of topographic models have developed one-shot stereo-matching tools for specific targets, regions, instruments, and data sets; but as of yet, members of the planetary scientific community have not devised a flexible and comprehensive stereo-matching tool. The Planetary Image Locator Tool (PILOT) [2] aims to fulfill this need with its new stereo-matching feature. PILOT is equipped with a web-accessible easy-to-use interface to locate and evaluate stereo pairs, quickly performing evaluations that require instrument-dependent specifications for culling the data. The tool has the ability to search current data from mission archives, easily adjust constraints (including resolution, incidence angle, emission angle, intersect area, convergence angle and other photometric keywords), and allow further culling of the data through online visual assessment of imagery and geometry.

Background: PILOT is a web-based search interface (<http://pilot.wr.usgs.gov>) supported by the USGS Astrogeology Science Center and the NASA/USGS Planetary Data System (PDS) Imaging Node. PILOT provides access to NASA's largest archive of spacecraft imagery, the PDS Imaging Node. Searches performed through PILOT are simplified by a planetary mapping interface and an advanced constraint panel to allow easy and incisive culling of the archive data. Searches are further enhanced by sourcing the geospatial information, thumbnail and browse images, metadata and photometric keywords stored in the Unified Planetary Coordinates (UPC) database [3].

Usage: PILOT's stereo-matching tool was developed to locate stereo pairs over targeted regions, not entire planetary bodies. To maintain the speed and responsiveness of the tool,

accessing the tool is restricted to successful PILOT searches with less than 250 images. If an area of interest contains greater than 250 images, further restrictions can be set by defining a latitude/longitude bounding box (map tab) or setting limits for photometric values (advanced tab). To activate the stereo matcher, the user must select the tab marked *Stereo* at the top of the display. Once selected PILOT computes all possible spatial intersects for the search results. An interactive panel (Figure 1, lower half) slides open and displays the intersects along with options to select and map specific pairs. Information such as convergence angle, intersection area and the variance between photometric keywords (e.g. solar azimuth, emission angle, etc..) are provided through the interface.

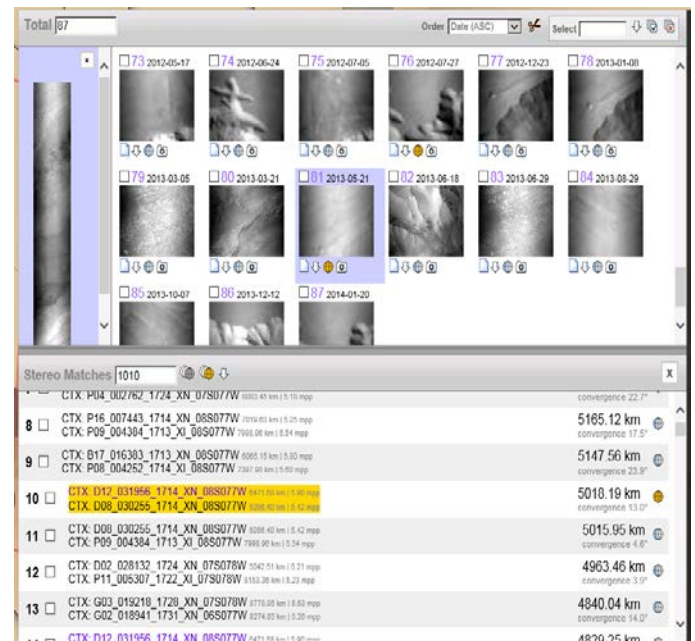


Figure 1: Example of the stereo matching interface in PILOT. The lower panel slides open to display possible stereo matches.

On-The-Fly Culling: Upon computing the spatial intersects, PILOT allows for on-the-fly culling of the result set through sliders and input boxes on the stereo tab (Figure 2). The culling

occurs in real time (computed by the browser), thus providing an immediate and interactive experience when adjusting stereo-specific parameters (e.g. resolution, incidence angle, emission angle, intersect area, base-height ratio, convergence angle and other photometric keywords). The flexibility provided by the stereo tab invites users who are familiar with specific instruments, targets, and regions on a planetary surface to quickly perform the necessary adjustments for their particular area of interest.

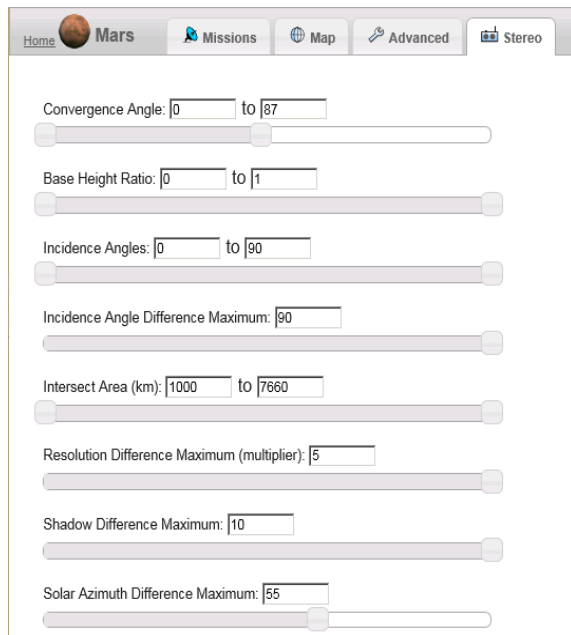


Figure 2: Stereo tab with sliders and input boxes to adjust stereo-specific parameters.

Stereo Coverage Mapping: Once the stereo matches have been selected and culled, PILOT's map tab can be used to examine the stereo coverage within the area of interest (Figure 3). The map tab is interactive, allowing selection, removal and further examination of the intersections. In addition, the individual footprints that make up stereo pairs can be mapped on top of an intersection to verify the coverage area.

Credit: The development of PILOT's stereo matching tool was supported by the MRO HiRISE Project and the USGS Astrogeology Science Center.

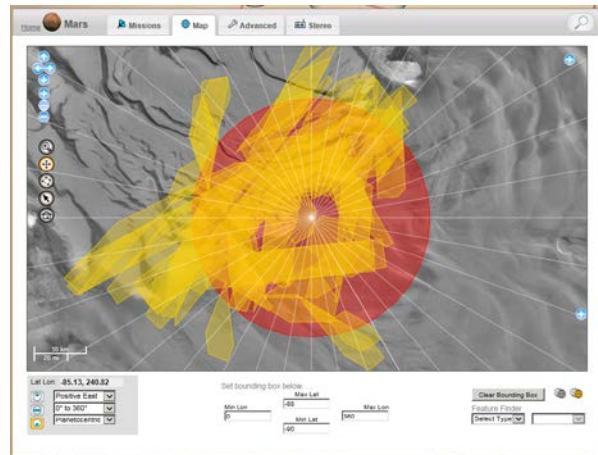


Figure 3: Example of a stereo coverage map for MRO CTX on the south pole of Mars.

Technical Details: By sourcing the UPC [3], the PILOT stereo-matching tool takes advantage of corrected geospatial and photometric details as generated by the USGS Astrogeology ISIS system [4], details that are typically not available through labels provided by the PDS. While some stereo-matching tools locate intersects by finding center points contained in mutual pairs, PILOT is able to perform more exact intersect searches by referencing the entire footprint geometry of images in a geospatially aware database, PostgreSQL/PostGIS [5]. Computing photometric keywords (e.g. incidence angle, emission angle, solar azimuth, etc.) and values derived from these keywords (convergence angle, base-height ratio), rely on maximum, minimum, and center values for these keywords. For many images, these values contain significant variance over the span of an image and a margin of error should be expected. To help determine the margin of error, a range of convergence angles is computed and displayed in the stereo panel. Intersect areas are computed using a geodesic formula with IAU accepted radii. Suggested stereo criteria are a result of cooperative mapping projects completed at the USGS Astrogeology Science Center. [6]

References: [1] Kirk, R. L et al, 2012 LPSC 43 abs. #4361. [2] Bailen, M. B. et al., 2013 LPSC 44 abs. #2246. [3] Akins, S. W., et al, 2009, LPSC 40, abs. #2002 [4] Sides S. et al., 2013, LPSC 44, abs. #1746 [5] <http://www.postgresql.org>, <http://postgis.net>. [6] Becker, K. J. et al, 2015 LPSC 46 this volume.