

The Photogrammetry Cube



Spaceport/Range
Situational
Awareness

We can determine distances between objects and points of interest in 3-D space to a useful degree of accuracy from a set of camera images by using multiple camera views and reference targets in the camera's field of view (FOV). The core of the software processing is based on the previously developed foreign-object debris vision trajectory software (see *KSC Research and Technology 2004 Annual Report*, pp. 2–5).

The current version of this photogrammetry software includes

- the ability to calculate distances between any specified point pairs,
- the ability to process any number of reference targets and any number of camera images,
- user-friendly editing features, including zoom in/out, translate, and load/unload,
- routines to help mark reference points with a “Find” function, while comparing them with the reference point database file, and
- a comprehensive output report in HTML format.

In this system, scene reference targets are replaced by a photogrammetry cube whose exterior surface contains multiple predetermined precision 2-D targets. Precise measurement of the cube's 2-D targets during the fabrication phase eliminates the need for measuring 3-D coordinates of reference target positions in the camera's FOV, using for example a survey theodolite or a Faroarm.

Placing the 2-D targets on the cube's surface required the development of precise machining methods. In response, 2-D targets were embedded into the surface of the cube and then painted black for high contrast. A 12-inch collapsible cube was developed for room-size scenes. A 3-inch, solid, stainless-steel photogrammetry cube was also fabricated for photogrammetry analysis of small objects.

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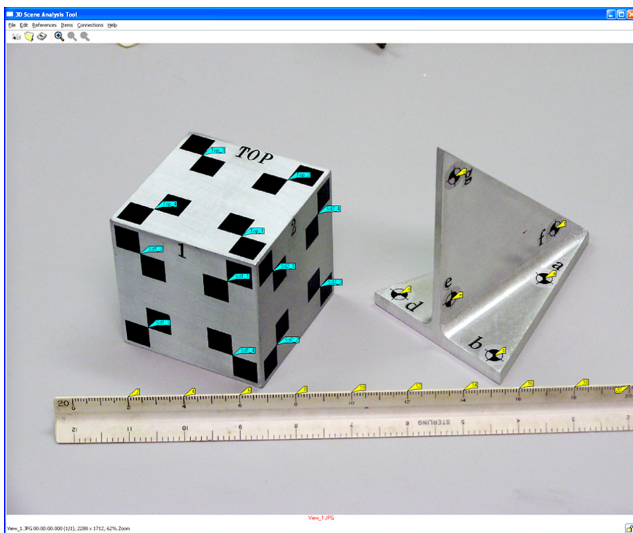


Figure 1a. A 3-in by 3-in photogrammetry cube and test object. The ruler is used to estimate the degree of lens distortion.

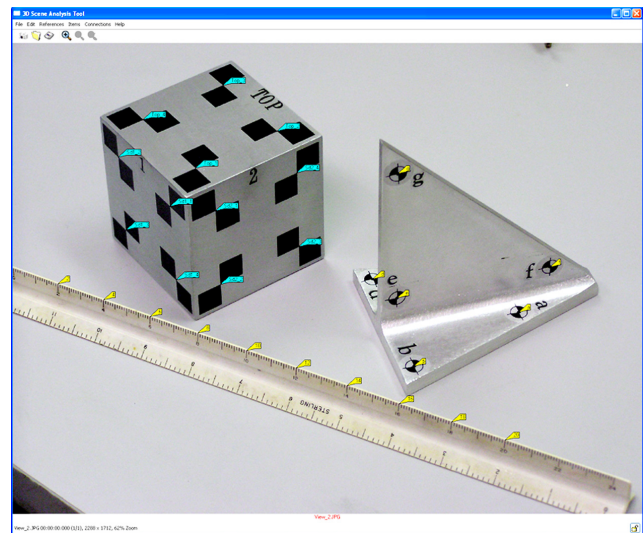


Figure 1b. The 3-in by 3-in photogrammetry cube and a test object, from a different viewpoint.

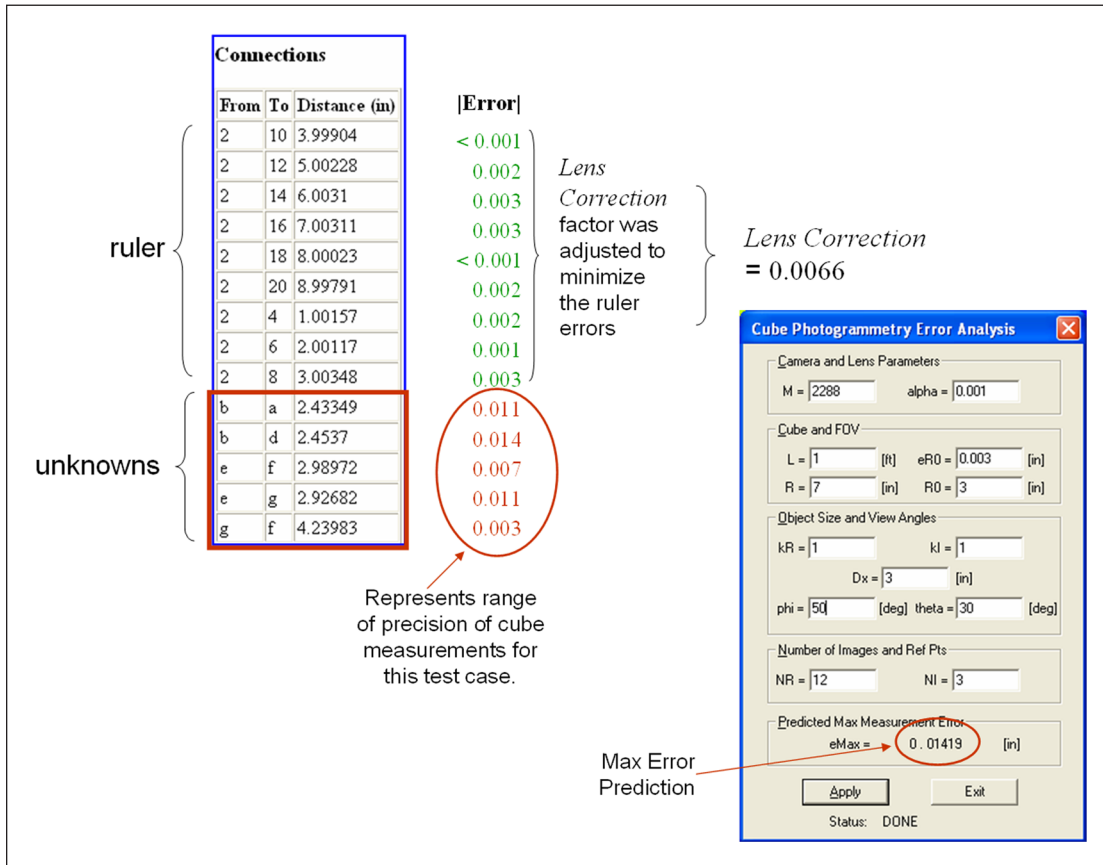


Figure 2. A demonstration of accuracy using the test images from Figures 1a and 1b. In this case, a lens correction factor was used to improve the results. The errors are compared to the Cube Photogrammetry Error Analysis model.