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Create Accurate Orthophotos with Softcopy Photogrammetry

Continued ...

Input Imagery

A full featured, recent release of most of the Windows NT/2000 or UNIX software programs will be able to import the following types of imagery and data. More importantly, does the software program you are considering for purchase support a wide variety sensors, cameras, and triangulation options?

- **Aerial and Terrestrial Metric Photographs: scanned or digital**
  These cameras are the most common type of aerial photo camera. Several older reconnaissance satellites that used film also have known camera calibrations. Each camera and lens combination should have a bi-annual calibration performed that is provided to the photogrammetric technician. Generally, the first generation of film is scanned on a special, geometrically calibrated scanner at high resolution. A few all digital metric systems are on the market that deliver 1 foot pixels without the expense and time of film processing.
- **Aerial and Terrestrial Non-Metric Photographs: scanned or digital**
  A non-metric camera system could be identical to a metric system except for the lack of a certified camera calibration report. However, these cameras, while of high quality, may not have the necessary known geometric qualities. Of primary importance is a precisely measured focal length, locations of fiducials, and the principal point of the focal plane. These items essentially form the interior orientation of the photogrammetric model. Modern triangulation software will, if given enough ground control, calculate an approximation of the camera model, sufficient to allow precise photogrammetric measurements to be made. Therefore, the much lower cost of these camera systems makes them attractive to many organizations given their utility for stereo modeling and photogrammetry.
- **Digital 35mm Cameras and Video Cameras**
  The same caveats as above apply to these cameras except that even more ground control will be required to obtain good results and overall image quality will be lower.
- **Satellite Imagery, RADAR, LIDAR, and other push-broom and across track scanners**
  The advantages of digital satellite scanners are that large areas are covered at a resolution from 20 meters to 1 meter in a single scene. Minimizing the number of stereo models greatly reduces the labor involved and allows for the rapid collection of photogrammetric information for military and mission-critical applications. These systems have very complicated geometry and camera models due to the nature of the motion of the sensor during the acquisition of the imagery. Imagine a constantly moving perspective center versus the near instantaneous exposure by a standard aerial camera. Novel approaches must be used to create a valid sensor model for these satellites. Verify that the sensor you are selecting for a mission can generate true stereo imagery and that some type of camera model has been developed.

Advantages of photogrammetric techniques over standard geometric corrections

In the case of aerial metric cameras, a desktop scan at 600 dpi of the image that is georeferenced using a 1st or 2nd order polynomial transformation will be accurate to within 3 or 4 pixels on flat terrain. Hilly and steep terrain quickly degrades the accuracy to 10's of pixels and with 1 foot pixels the accuracy may be unacceptable in most GIS applications. By systematically removing the distortion from the camera, film and lens, and correcting for terrain using a DEM, it is possible to achieve accuracies across large areas of around 0.5 pixels. Single frame rectification using a camera calibration report, 4 control points, and a good DEM can achieve accuracies of around 1 pixel. The strength of the softcopy photogrammetry system is the ability to georeference 10's to 100's of photos at a time with only 1 surveyed ground control point per photo. The distribution of the points is critical to success in aerial triangulation, but by using tie points, it is possible to analytically build accurate control networks of hundreds of points.

Scanning of Imagery

If you are utilizing traditional aerial photography as the input into your software, you will first have to make high resolution scans of the frames. This can be done on desktop scanners that are large enough to fully accommodate a 9 inch by 9 inch frame, with varying results.. However, the usual method is to have the original roll film scanned on a photogrammetric scanner. These expensive ($50,000 and up) scanners have very precise internal geometry and produce detailed scans from 300 dpi up to 2000 dpi. Cost depends on the media (color or panchromatic), the resolution, and the volume you are doing but will range between $20 to $70 per frame, of which 60% is overlap from the stereo-mate. The quality of the original film, scene exposure and scan can directly impact the results of your project, particularly DEM extraction. Work closely with your scanning contractor to obtain the price and service you need and pick one vendor that can archive all your film properly. www.imagescans.comand www.pre-phot-img.com are reputable firms.

Scan resolution greatly effects file size and ground pixel spacing as shown in the chart below.

Photo Scale 1:X	12 microns 2117 dpi pixel size in m	25 microns 1016 dpi pixel size in m	85 microns 300 dpi pixel size in m
4800	0.058	0.120	0.408
9600	0.115	0.240	0.816
24000	0.288	0.600	2.040
File Size Mb/B&W	363	84	7
File Size Mb/Color	1089	252	21

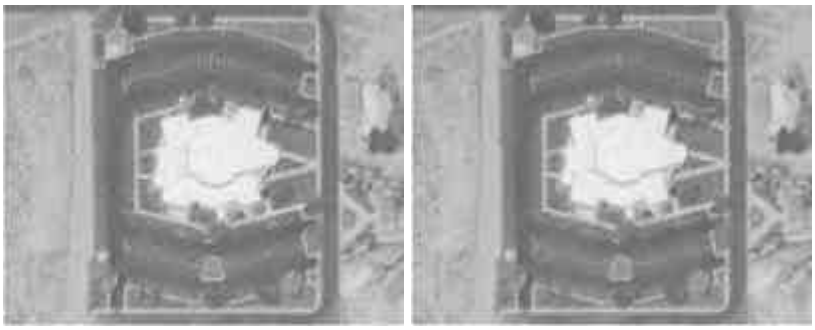

Figure 1. 12 micron scan (left) and 25 micron scan (right) on 1:24000 photography.

Note file size difference in the above table. Is this worth the extra data cost?

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