

Mapping Matters

By Qassim A. Abdullah, Ph.D., PLS, CP

Your Questions Answered

The layman's perspective on technical theory and practical applications of mapping and GIS

Q: When shopping for digital terrain model data, how do we decide between lidar and conventional stereo-compilation?

Anonymous, Rapid City, SD

Dr. Abdullah: The answer to the question depends on a combination of the following factors:

- The type of application -- The type of application will determine the accuracy level and contour interval required. From lidar acquisitions with a fairly reasonable budget, we usually can extract contours, with intervals up to a maximum of 2' with acceptable Root Mean Square Errors (RMSE) of vertical accuracy equal to 20 cm that can be guaranteed to meet commonly accepted accuracy standards (supplemental 3D breaklines may be required for some projects). Although at very low altitudes, with dense collection of points cloud, lidar is capable of collecting data suitable for the generation of 1 ft. contours (RMSE = 10 cm), conventional-stereo compilation remains the most practical method of obtaining such high accuracy.
- The size of the area to map -- If the area to be mapped is large, then lidar may represent a more time- and cost-effective alternative to conventional stereo compilation.
- The user's budget -- Lidar is generally less expensive and less time consuming to process than conventional aerial photography due to the reduced manual labor involved when compared to manual 3D stereo compilation.
- The type of terrain -- Depending on the type of terrain, obtained accuracies may differ between stereo compilation and lidar. In other words, in heavily vegetated areas, lidar may prove to be less effective due to the poor number of points cloud that reach the ground underneath the tree canopy. However, the new generation of lidar, with a repetition rate of 150 MHz (150,000 laser points per second) and faster scanning frequency (up to 90 Hz), will significantly improve the terrain modeling quality and accuracy.
- Aesthetic preference -- From a purely aesthetic point of view, contours obtained from stereo compilation are generally smoother than those obtained from lidar acquisitions and, unlike lidar-derived contours, have clear breaklines and transitions. For familiarity and aesthetics, some users may prefer contours generated from stereo compilation, while other users who need the data only for 3D modeling could care less about the smoothness of the contours.

Q: I recently learned about many state-wide mapping projects that were flown during the last few years with digital cameras. Could you elaborate on the reliability of such systems and the advantages of using these cameras versus the long-trusted film aerial cameras? In addition, are these digital cameras suitable for the production of large engineering-scale map products?

Anonymous, Frederick, MD

Dr. Abdullah: This is a very interesting question as I am always faced with it on all new technologies that have appeared during the last decade, such as Airborne GPS and Inertial Navigation (INS/MU). The new digital cameras, whether they are based on framing, such as the DMC from Intergraph and UltraCAM from VEXCEL, or pushbroom concepts, such as the ADS40 from Leica,, just to mention few, all share common advantages over existing film cameras. These advantages include the following:

- Superior dynamic range as all of these digital cameras capture 12 bits worth of information versus the 8 bits we customarily obtain from scanned film. This characteristic makes the digital camera unique in its ability to widen the flying window as it can handle less favorable weather and light conditions. In addition, this capability provides more options for the user to extract lost information in shadow and dark areas.
- Faster turn around as it eliminates the film processing and the scanning processes.
- All of these cameras can simultaneously collect multiple products and also can serve as a multi-spectral sensor. In one flight, the digital camera collects black & white, natural colors (RGB), and false color infrared (CIR). For a film camera to obtain these lines of products, we would have to fly the camera three times. This would be costly and impractical, especially when considering the limited flying window in many regions of the country.
- Some of these cameras provide multiple stereo look angles which, when utilized in the process of aerial triangulation or DEM correlation, provide enhanced quality products as compared to the single look of the film camera.

Finally, I personally participated in the evaluation of the products for many state-wide projects and I would like to note here that all products met or exceeded the horizontal and vertical mapping standards published by NMAS, ASPRS, and NSSDA for the corresponding scale. The geometric accuracy of the derived products from these cameras is as good if not better than the products generated from conventional scanned films. Some of these cameras provided very high resolution imagery with pixel ground coverage of 5 cm, and all of the major metric digital cameras in the market are utilized for large-scale mapping.

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