Mapping Matters

Your Questions Answered

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

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

Q: When shopping for lidar data, how do I know what point density I need for my project and whether I need breaklines to support the terrain modeling?

Dr. Abdullah: The subject of point density in lidar datasets and the resulting accuracy of derived products are of great importance, both to users and providers of lidar data. Unfortunately, there are no set rules to govern this topic, leaving many users to establish their own guidelines when requesting lidar data acquisitions. This fact becomes very obvious when studying the point density requirements specified by different requests for proposals (RFPs). At a loss in this ever confusing topic, many users request lidar data with sub-meter post spacing to achieve an accuracy that is easily obtainable with less dense lidar datasets. Unless the task calls for 3D modeling and above-ground, manmade or natural features, asking for highly dense lidar data may harm the budget with very little accuracy benefits, especially when the collection of breaklines is requested.

During the Second National Lidar Meeting held recently at the USGS headquarters in Reston, Virginia, speakers presented a variety of views and levels of understanding as to what constitutes a reasonable and practical lidar dataset. The most misleading approach is the one calling for a lidar database to fit the broad needs of ***all users***, and here I mean all users, including those whose applications require 10 points or more per square meter! An advocacy call like this not only wastes valuable taxpayer money, but also makes for an impossible task as there is very little capital available for such an expensive undertaking…unless you live in the UAE, that is.

With the above phrases, I have made my political statement clear, so now let us get to the technical heart of the matter. Lidar data specifications should be tagged with user-specific needs and specifications. In order to address the issues adequately, my response will span the next few issues of the column due to the limited space allocated for each article.

The following sections represent different user communities' requirements and the recommended data specifications:

1. Terrain Modeling Applications: Terrain modeling is a requirement of nearly all lidar projects, spanning a wide range of uses and specifications. The most common terrain modeling applications requested by lidar users follow.
   a. **Contours generation:** The dwindling use of paper (hard-copy) maps combined with advancements in 3D terrain modeling software capabilities have driven down the need for traditional contour generation. The demand for contours and contour specifications in RFPs involving lidar data collection continues, however, despite availability of new terrain modeling and viewing methods, such as 3D rendering and shaded relief maps. To create lidar-based contours that meet cartographic and geometric qualities, lidar data with modest post spacing of around 2 to 4 meters can be augmented with breaklines derived from image-based photogrammetry. If imagery is not available for breakline production, then a "lidargrammetry" approach is possible. In this method, very dense lidar datasets with post spacing of around 1 meter are used to create detailed stereomates by draping the lidar intensity image over the lidar DEM; these stereomates are then used to generate breaklines using any stereo-softcopy system. Once the breaklines are collected, either through photogrammetry or lidargrammetry, the lidar points can be thinned to a great degree, depending on the complexity of the terrain. The thinned dataset is then merged with the breaklines to create a digital terrain model (DTM), required for modeling the contours. In addition, all lidar points within a buffered distance around the breaklines should be removed to achieve acceptable contours without sacrificing accuracy. This process makes sense, as that is how we have always modeled contours from a DTM. The issue of utilizing breaklines in modeling contours from lidar data often gets confused, however, as service providers attempt to mix very dense and accurate lidar data with manually collected and possibly less accurate breaklines. Without buffering or thinning the lidar points close to the breaklines, the contours will appear problematic whenever a lidar point appears right next to a breakline. The last statement is true even with a photogrammetrically collected and modeled DTM. In constructing lidar-derived DTMs, we should consider all the best practices previously developed and utilized for modeling photogrammetric DTM during the past decades. A good quality DTM is achieved by having accurately modeled breaklines and minimum mass points outside the breaklines when necessary. Lidar indiscriminately collects dense mass points throughout the project area, including on and around the later collected breaklines. Unless lidar data is thinned and breaklines are buffered and cleared from the lidar points around it, it will be very difficult, if not impossible, to achieve cartographically acceptable contours.

"The subject of point density in lidar datasets and the resulting accuracy of derived products are of great importance, both to users and providers of lidar data. Unfortunately, there are no set rules to govern this topic, leaving many users to establish their own guidelines when requesting lidar data acquisitions."

"The issue of utilizing breaklines in modeling contours from lidar data often gets confused, however, as service providers attempt to mix very dense and accurate lidar data with manually collected and possibly less accurate breaklines."

   b. **3D Terrain Modeling:** Most modern lidar data users and providers are equipped with 3D modeling software that allows them to model lidar data for different applications, such as flood and environmental hazard, watershed management, etc. Depending on the required vertical accuracy of

continued on page 956