



# 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\*\*

### QUESTION:

**Question:** I'm conducting an experiment to see how different methods of surveying vary when used to estimate volumes. Does ASPRS put out standards of accuracy for using photogrammetry to determine volumes? I'm also trying to determine if there's a way to truly test the accuracy of these data. On another note, to your knowledge, is there a smartphone application that uses photos to determine volume? I know Pix4D has an application for such a thing, but it requires a smartphone with lidar capability, such as the iPhone 12 and 13. I am trying to find one that does not require the lidar capability, only a camera, to estimate volume. What are your thoughts?

Jordan Aikins, Lumos & Associates, Carson City Nevada

**Dr. Abdullah:** The simple answer to your question about whether ASPRS has a standard for volume computation accuracy is no, we do not have one. However, we are considering developing a standard for 3D modeling and oblique imagery that will touch on the topic you raised. As for volume computations, there are a few parameters that contribute to the quality of volume assessment besides positional accuracy. Those that come to mind are point cloud density and the different methods of modeling terrain, such as the more widely used, polygon-based Regular Triangulated Networks (RTNs) and Triangulated Irregular Networks (TINs), versus options like Voxel-based networks. Terrain modeling and volume computation quality are sensitive to whether the software represents the point cloud as a TIN, a gridded surface or an RTN. If it is an RTN, then you must consider what post spacing that grid needs to be created with. Here, I would like to elaborate on point density, since it is the most important contributor to

**"Point density is the most important contributor to the quality of modeling terrain."**

the quality of modeling terrain. In many instances, users of lidar data for example focus on point cloud accuracy as specified by sensor manufacturers, ignoring an important aspect of the terrain modeling quality: the data density and how it varies according to the terrain smoothness. Figure 1 clearly illustrates this problem. While the point cloud was acquired to a positional vertical accuracy of 10cm, the lack of

point density caused the modeling software to estimate the vertical position of Point A to be at Position A', resulting in a vertical error in the digital terrain model (DTM) of 2m or even more depending on the terrain undulation. To remedy this situation and obtain an accurate representation of the terrain, the point cloud needs to be acquired at a higher

**"Totally smooth or flat terrain can be accurately modeled using a point cloud with nominal post spacing (NPS) of a few meters or coarser."**

density. In the case of the terrain in Figure 1, higher point cloud density is the only way to accurately represent the terrain shape. If the terrain contains a high-frequency undulation, using a low-density point cloud results in substantial inaccuracy in the volume estimation no matter what software or modeling algorithms are used. This high-density requirement is not necessary if the terrain does not fluctuate rapidly and is flat or smooth. Totally smooth or flat terrain can be accurately modeled using a point cloud with nominal post spacing (NPS) of a few meters or coarser.

Lidar point cloud that are accurate to 10cm, not necessarily result in accurate DTM

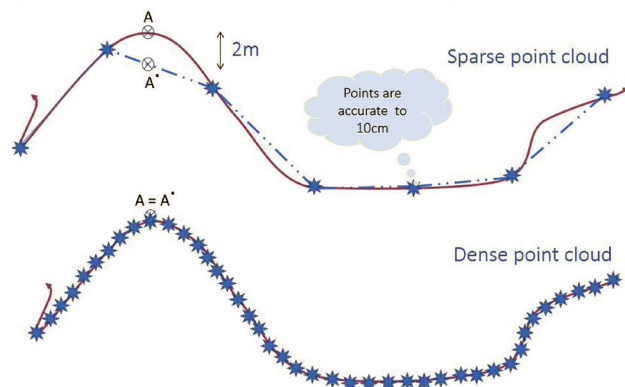


Figure 1: Terrain roughness and point cloud density.

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As for processing software, you should be able to do photogrammetric computations in Pix4D using smartphone imagery. I am not sure that you can run Pix4DMapper on a smartphone, but you can import and process imagery acquired by a smartphone into a desktop or cloud processing engine of Pix4DMapper. Using smartphone imagery, Pix4DMapper can generate a point cloud, perform feature removal to create a DTM, compute volume and export contours. Other software on the market, such as SimActive's Correlator3D, Agisoft Metashape, Trimble UASMaster and others, can perform similar processing.

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