Tools, Tips, and Workflows

Testing the LP360 Volumetric Analysis Tool

LP360, versions 2014.1 and above

BSAU | AWG

Support
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In previous articles of GeoCue News we covered how the Volumetric Analysis Tool within LP360 works, and how it can be used within a project, LP360 Under the Hood: Volumetric Analysis and Volumetrics – Do it Right!, respectively. We're often asked how accurate or reliable the volumetric results can be expected to be. In this article we explain the testing that was completed in order to estimate the overall error of the tool.

Testing Theoretical Shapes

In order to test LP360's volumetric calculations it was necessary to have known volumes. For this portion of the testing two synthetic geometric LAS files were used. The first LAS file contains synthetic points laid out in the shape of a pyramid. The second LAS file uses a rectangular prism, which in this instance represents a building. To determine theoretical volume of each shape the geometrical equations for the volume of a pyramid and the volume of a rectangular prism, respectively, were used.

Pyramid

The first synthetic file that was generated was in the form of a pyramid and had a ground sample distance (GSD) equal to 0.5. All points within the file were marked as unclassified. The pyramid was 200 meters wide by 200 meters in length by 50 meters high.

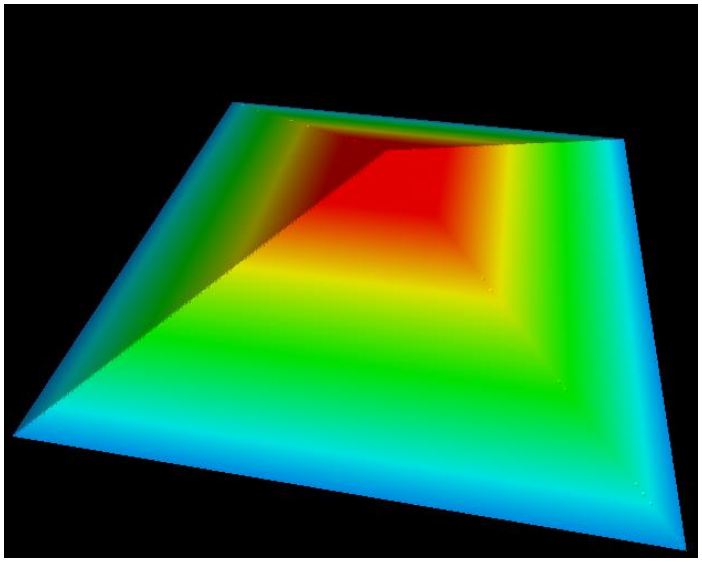

Figure 1 – Synthetic Pyramid (200x200x50)

QCoherent Software LLC
www.LP360.com
256-461-8289 (phone)
256-461-8249 (fax)

The following geometric equation for the volume of a pyramid was used to determine the theoretical, or control volume for the pyramid:

$$V = \frac{\mathrm{L} * \mathrm{W} * \mathrm{H}}{3}$$

Figure 2 – Equation for Volume of a Pyramid

Rectangular Prism

The second synthetic file that was generated was in the form of a rectangular prism and had a GSD equal to 0.5. The prism is centered in the middle of flat ground. The flat area is classified using classes 1 and 2, while the prism is classified using class 6. The prism was 50 meters wide by 50 meters in length by 10 meters high.

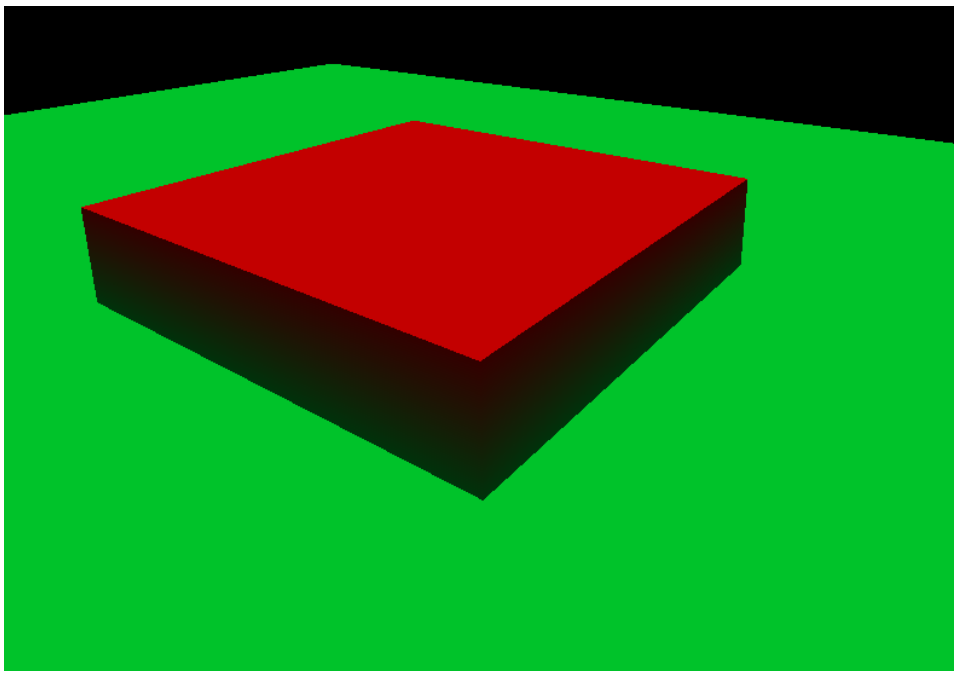

Figure 3 – Rectangular Prism (50x50x10)

The following geometrical equation for the volume of a rectangular prism was used to determine the control volume for the shape:

$$V = LWH$$

Figure 4 – Equation for Volume of a Rectangular Prism

LP360 Volumetric Analysis

Once the control volume was established the next step was to run the data through LP360's Volumetric Analysis Tool. This was accomplished using the pre-packaged Point Cloud Task: Volumetric Analysis, Digitized Input. The base of the pyramid was digitized using LP360's Tool Geometry and then conflated to determine the elevation values of the base surface. The conflation method used was Summarize Z calculating the Closest Z value.

The base surface that was used within the Volumetric Analysis was the previously digitized base polygon, with the hull surface being created based off the LAS data itself. The resulting information was then exported to a shapefile.

Results

After running the two synthetic LAS files through LP360 the results were compiled and compared against the control values. In Figure 5 each control volume is compared against the volume as computed by LP360. The end results show that LP360 has a Percent Error of 0.02.

Source Data	Dimensions	Theoretical Volume (m^3)	LP360 Volume (m^3)	Percentage Error
Pyramid (GSD: 0.5)	200 x 200 x 50	666,666.70	666,548.00	0.02%
Prism (GSD: 0.5)	50 x 50 x 10	25,000.00	24,997.22	0.01%

Figure 5 – Control and Testing Results

During the testing phase it was discovered that the volume does vary depending upon where the base is drawn. After some careful consideration we reached the conclusion that this is to be expected due to the nature of how the Volumetric Analysis works with respect to being a computation between two gridded surfaces. Therefore, it is important to make sure that the base polygon is being drawn in such a manner as to capture the points that are necessary during the conflation process (Figure 6).

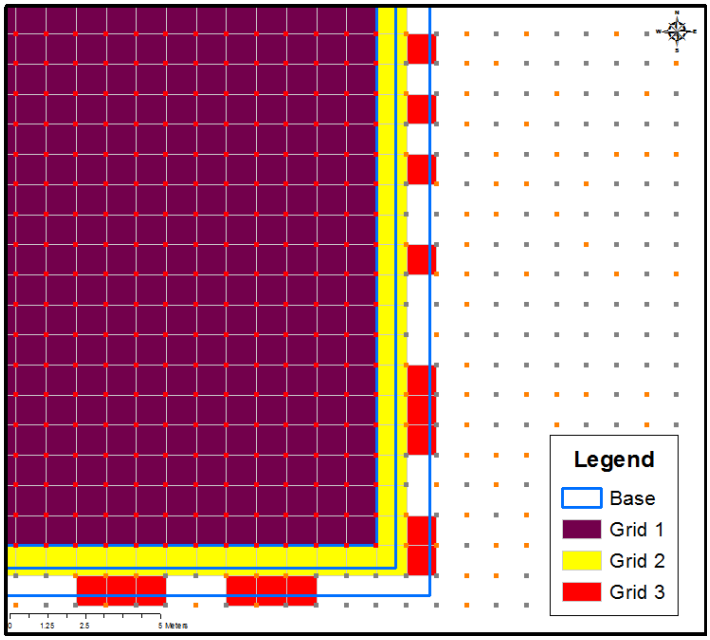

Figure 6 - Gridded Extents depending upon base

Understanding the ground sample distance (GSD) will make this process easier. Note that LP360 auto computes the GSD to use during the volumetric analysis based upon the point density, and hence, nominal point spacing of the dataset being used.

The question then comes about, “How would the percent error relate to an irregular pile, such as a stockpile?” Based upon the synthetic test results using the pyramid and the prism we would expect the percent error for an irregular pile should also fall within a similar result. Research has been conducted, both in the office and the field using the Metric Mapping Kit (MMK), which leads to a high level of confidence in LP360’s Volumetric Analysis Tool. For additional information concerning volumetric analysis of irregular piles please look for a future Newsletter Article detailing a field study using the MMK unit.