

Creating a Digital Surface Model from LIDAR LAS Data



TUTORIAL

Light Detection and Ranging (LIDAR) techniques use similar principles to those of Radio Detection and Ranging (RADAR) with the exception that it utilizes a laser beam instead of radio waves. Airborne systems typically collect topographic elevation measurements of the surface in the form of positional X, Y, Z coordinates at pre-defined intervals.

The data produced from a LIDAR sensor in its most common form, is often represented by a series of spatial coordinates in an American Standard Code for Information Interchange file (ASCII). The data in the file is recorded in a tabular format where each line has coordinate information separated by a common delimiter. The data can include other attribute information for each point as well. There are additional ways to represent LIDAR data such as LAS format, which is an alternative to the generic ASCII file format used by many companies. . This newer format is now supported for read access by the GDB library in version 10.

What is the LAS Format?

The LAS file format is a public file format for the interchange of LIDAR data between vendors and customers. This binary file format is an alternative to proprietary systems or a generic ASCII file interchange system used by many companies. The problem with proprietary systems is obvious in that data cannot be easily taken from one system to another. There are two major problems with the ASCII file interchange. The first problem is performance because the reading and interpretation of ASCII elevation data can be very slow and the file size can be extremely large, even for small amounts of data. The second problem is that all information specific to the LIDAR data is lost. The LAS file format maintains the information specific to the LIDAR nature of the data while not being overly complex. (Source: <http://www.lasformat.org>)

The added read support for the LAS format now allows users to skip the Import to ASCII process and either import it into PIX format or create a surface model directly from the LAS file.

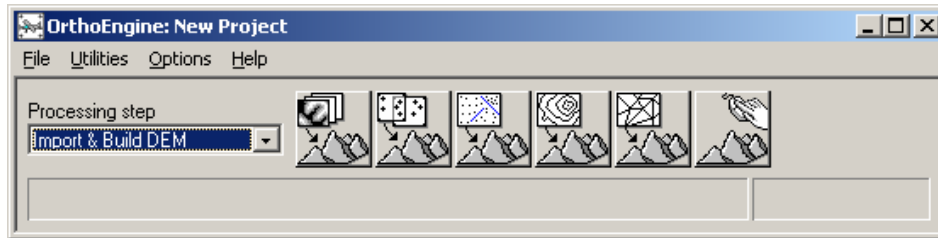
Resultant LIDAR data is usually a very dense network of coordinate points and can often contain millions of measurements for a given area. This can result into large file sizes, depending on the collection area and data resolution, which has been known to be difficult to handle with the majority of common off the shelf software packages. The procedures defined in this tutorial were tested with a LIDAR LAS file (Source: <http://www.optech.ca>) that was approximately 90 mb in size on a Pentium IV desktop computer with 1 GB RAM. The performance times ranged but were usually between 5 and 10 minutes. It would only be logical to expect that much larger files would involve much longer time periods for the computation process and results may vary.

Interpolate a Digital Surface Model from the imported LIDAR points

Geomatica OrthoEngine can interpolate elevations from the LIDAR data in LAS format directly to generate a continuous raster digital surface model. In this example we only use 1 input LAS file, but if you had several adjacent LAS vector files then you could use them together in this step to generate a seamless surface. This is an important feature with LIDAR data because most often the data will be split into tiles to prevent the datasets from becoming too large in file size.

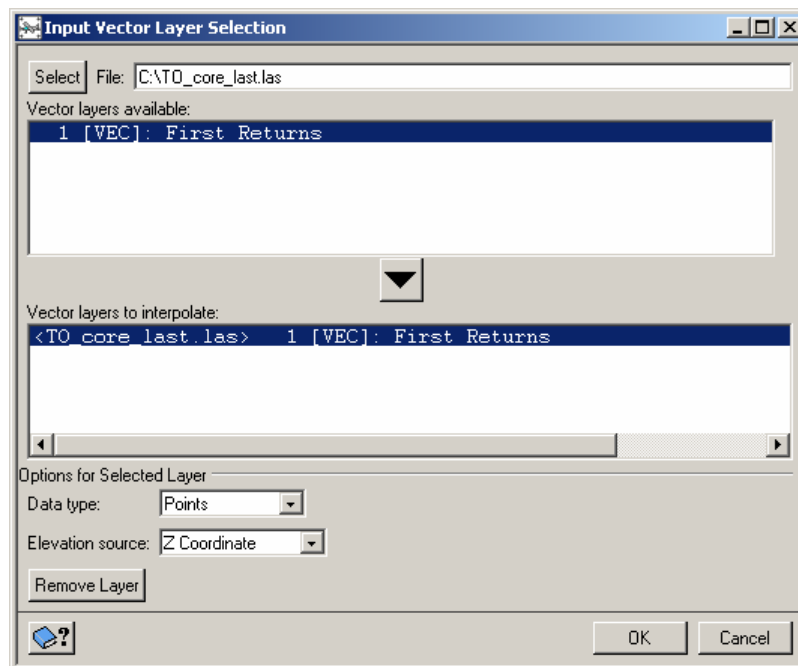
Step 1

- On the **OrthoEngine** tool bar in the **Processing step** list, select **Import & Build DEM**.
- Select **DEM from vectors/points**



Step 2

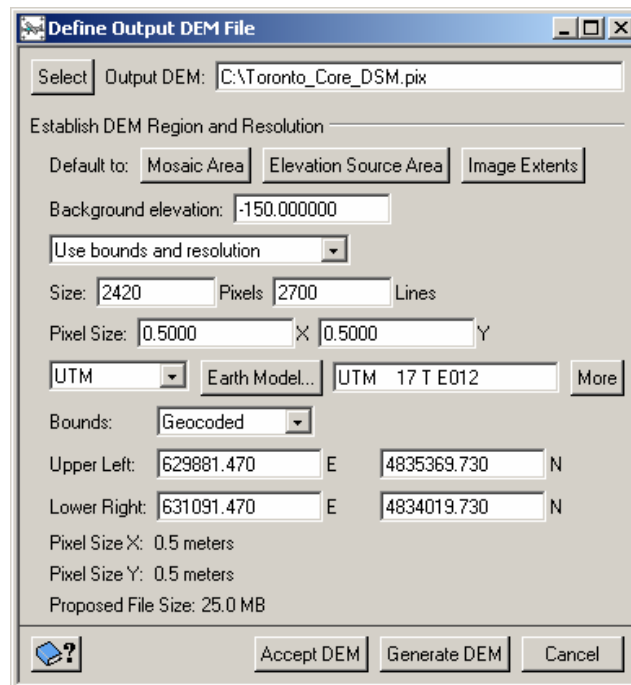
- Click **Select** to choose the input LAS file. Available vector layers from the file will appear in the **Vector layers available** list. Select the layers from the file that you wish to include and then click the arrow to add the layers to the Vector layers to interpolate. If more than one layer or file is to be included with the DSM then continue this step until all input data has been selected.
- Select the vector segment in the **Vector layers to interpolate** box to activate the **Options for Selected Layer** section.
- In the **Data type** list, select Points and in the **Elevation source** list, click the attribute where the elevation value is stored.



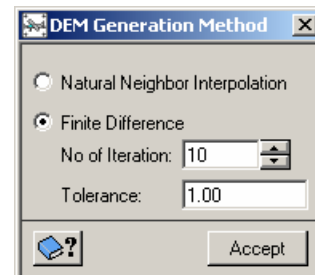
- Click the **OK** button to continue.

Step 3

- In the **Define Output DEM file** window, With the **Select** button give the path to where you want to save the file and then give the output file a new name.
- Click **Elevation Source Area** to generate a DEM that covers all of the area where elevation data exists.
- In the **Background elevation** box, type the value to represent the background or “No Data” pixels of the DSM.
- Three parameters determine the final output of the DEM: the size, the resolution, and the bounds of the DEM. You can specify two out of the three, and OrthoEngine will calculate the third.
- Select **Use bounds and resolution** option and then enter the desired pixel size
- In the **Bounds** list, click **Geocoded** to enter the georeferencing information. And then click the **Generate DEM** button to initiate the interpolation process.



- In the subsequent dialog box, select **Finite difference** to use the Distance Transform and Finite Difference algorithm to interpolate the DSM from your points. This method is recommended for files that contain evenly distributed points because it can rapidly process an unlimited number of points.
- In the **No of iteration** list, type the maximum number of times that the DEM is smoothed.
- In the **Tolerance** box, type the minimum difference in value required during smoothing to warrant another application.



Click the **Accept** button and a DSM will be generated and displayed.

Results

When the DEM interpolation process is complete, you will have a PIX file containing a continuous raster surface interpolated from all of the points created from the LIDAR data in the LAS format. You can open the DSM file in Focus with your LAS file to validate the resultant raster surface.

The output data can then be used to create other terrain models such as Shaded Relief, create slope and aspect maps, generate 3D perspective images, simulate fly-overs, integrate with other imagery and much more.

