Creating a Digital Surface Model from Airborne LIDAR ASCII Coordinate 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 has been written into the PCI Geomatica GDB for Geomatica version 10 and is covered in a different tutorial.

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 LIDAR ASCII files that were between 80 mb and 450 mb on a Pentium IV desktop computer with 1 GB RAM. The performance times ranged and were often between 25 minutes and just over an hour for the import process of ASCII data to PIX format, the digital surface process was much quicker. 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.

Geomatica version 9.1 has two different methods that allow tabular ASCII data to be imported into points so that a digital surface model (DSM) can be interpolated: the ‘Import ASCII Table/Points Wizard’ and the ‘Generic ASCII Vector’ (GAV) format, which allows users to define an ASCII vector database. This tutorial only covers the ‘Import ASCII Table/Points Wizard’ method located in Focus; however details regarding the GAV method can be located on our FAQ section of the PCI website and also in the PCI help documentation that is included with Geomatica.

The Import ASCII Table/Points Wizard allows ASCII data files to be converted into GIS vector point data. In the wizard, selecting the delimited option from the data format area allows you to specify the formatting character that separates the columns of data in the table (e.g. comma, tab, space etc). The Data Preview area will display an updated version of information reflecting the delimiter option that you chose. Tabular ASCII data does not require georeferencing to be converted with the wizard. Also degrees, minutes, and seconds cannot be imported as coordinates but as fields only.

Convert the ASCII tabular data to point data

The Import ASCII Table/Points Wizard has three main steps:

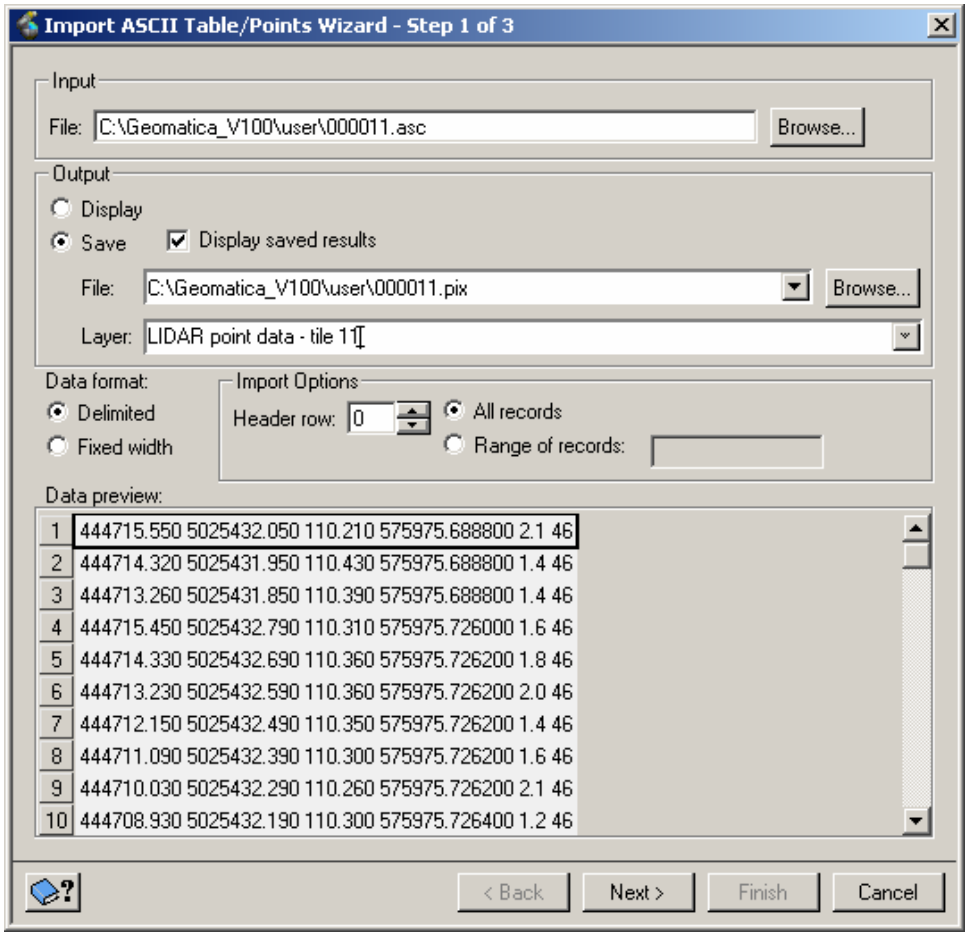
1. Select the ASCII file to import, specify the format of the delimited tabular data and specify the details for your output file.

2. Identify delimiters that separate your ASCII data before converting into vector format.

3. Select data types for the fields in your table, specify the coordinate fields and convert the values to vector points.

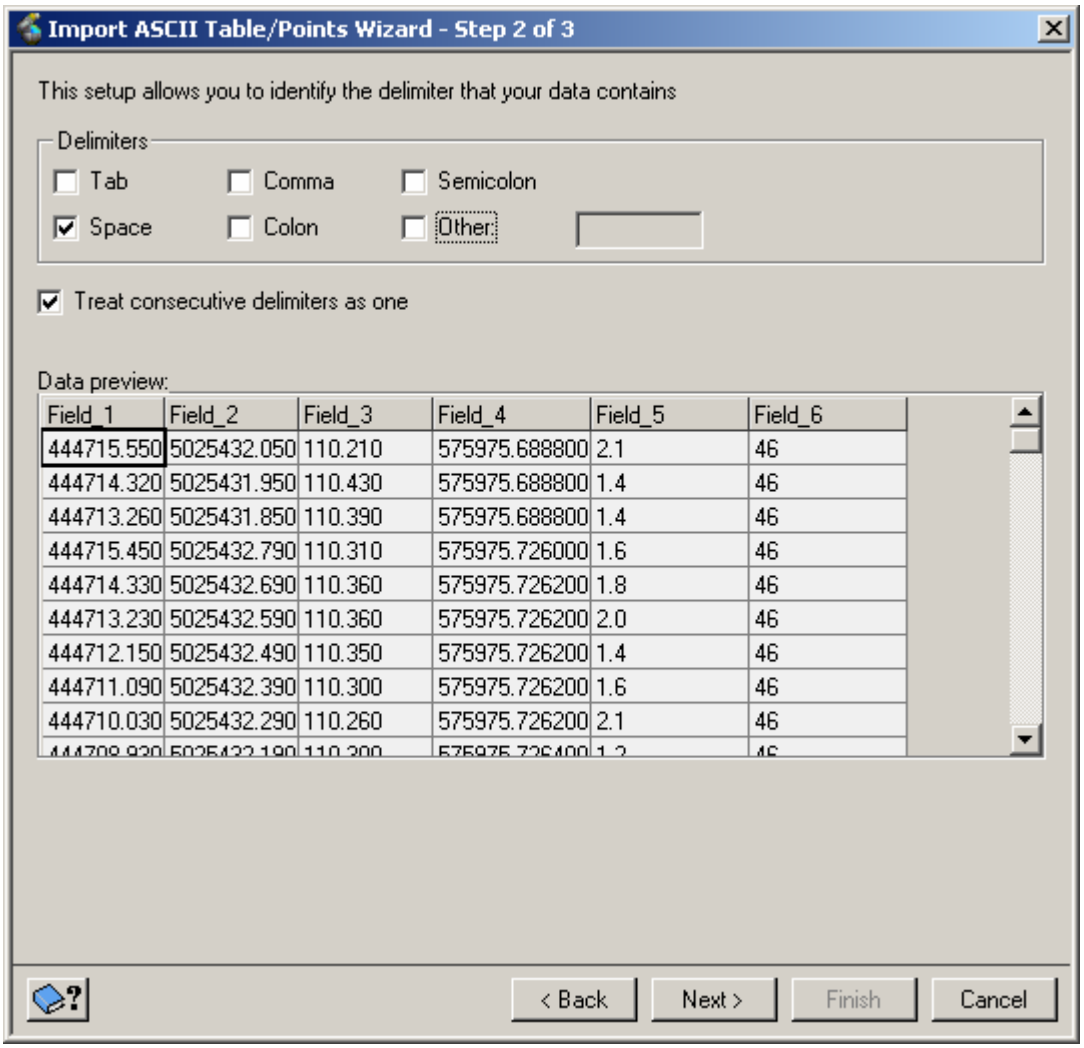
Step 1

- Select **File** from the main menu in Focus, next select **Utility** and then **Import ASCII Table/Points** to open the 'Import ASCII Table/Points Wizard window'.
- In the Input area of the Import ASCII Table/Points Wizard, click the **Browse** button, locate the ACSII-format file to input and then click the **Open** button. If the ASCII file does not have a TXT extension then you will need to switch the Files of type selection at the bottom of the File Selection window to All files (*) to make your file visible.
- In the output area, select the radio button beside the **Save** option and then enter in the destination and the name for new output file (Note: checking the display saved results option will also load the imported data into the Focus viewer). Enter a description for the new point layer in the Layer input box. Using the Display option will import the data to a point format as well but it will be imported and displayed only into the Focus viewer and not saved to a PIX file.
- Enable the Delimited option in the **Data Format** area.
- In the Import Options section enter a number of 1 or higher in the Header row box, if you want the first line of data displayed as a header row. Note: It is often a good idea when working with extremely large files that you use the **Range(s) of Records** option instead of **All Records** option. This option will allow you to split up the ASCII input data into 1 or more output point files. You can then still use these multiple files that you create to create 1 seamless digital surface.
- Click the **Next** button to continue.



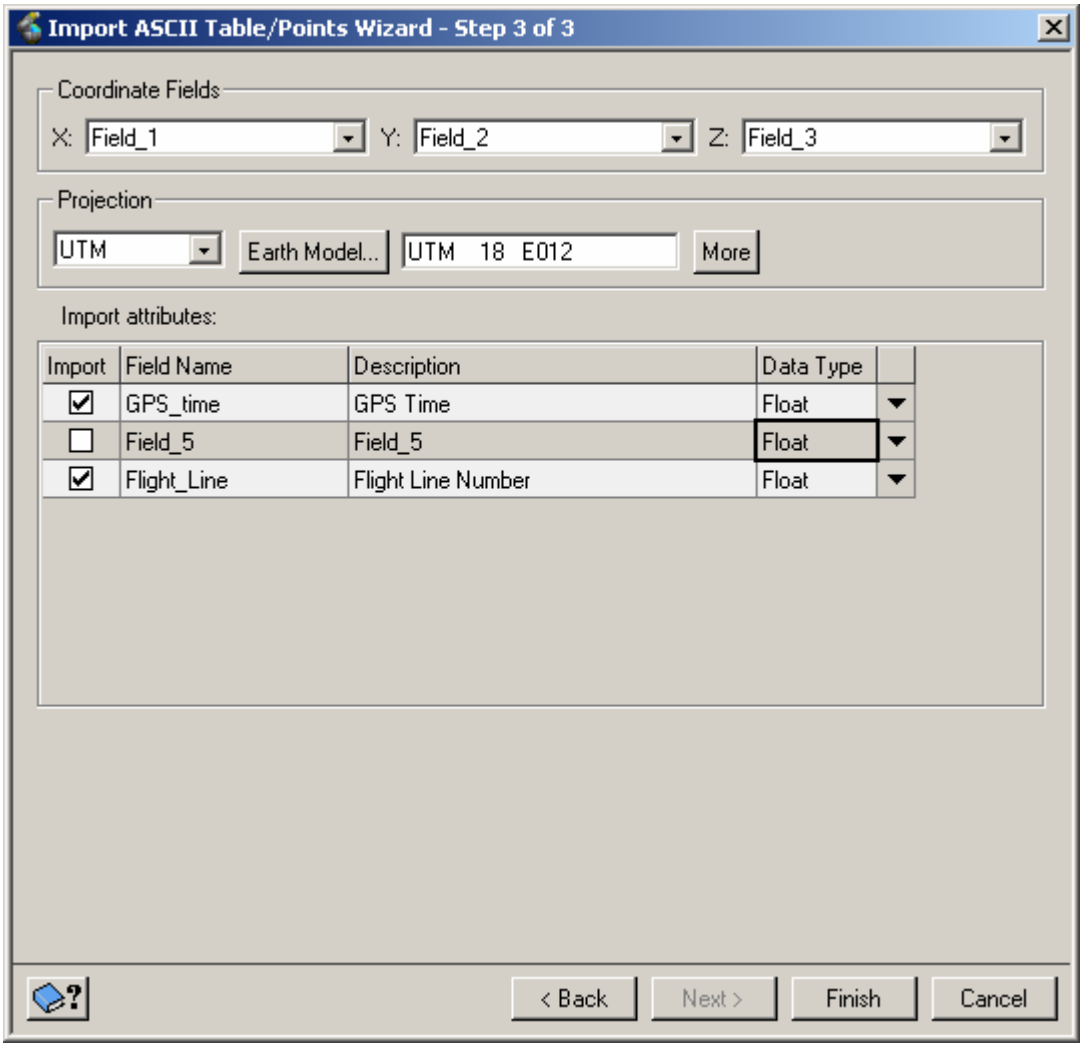
Step 2

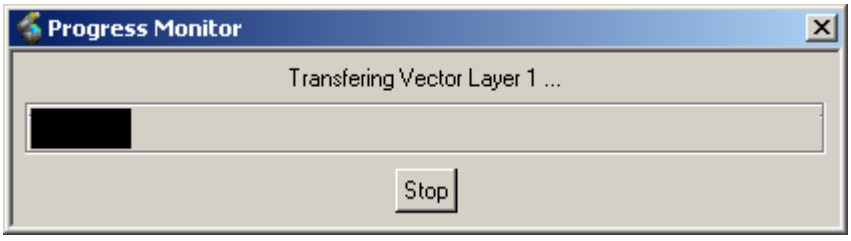
- In the **Delimiters** area, enable a check box next to the correct delimiter type that your ASCII file data is separated with. You can see the required delimiter in the preview area between each record.
- The **Data preview** area should change to table format matching your data fields when you have chosen the correct option. Then click the **Next** button to continue to step 3.



Step 3

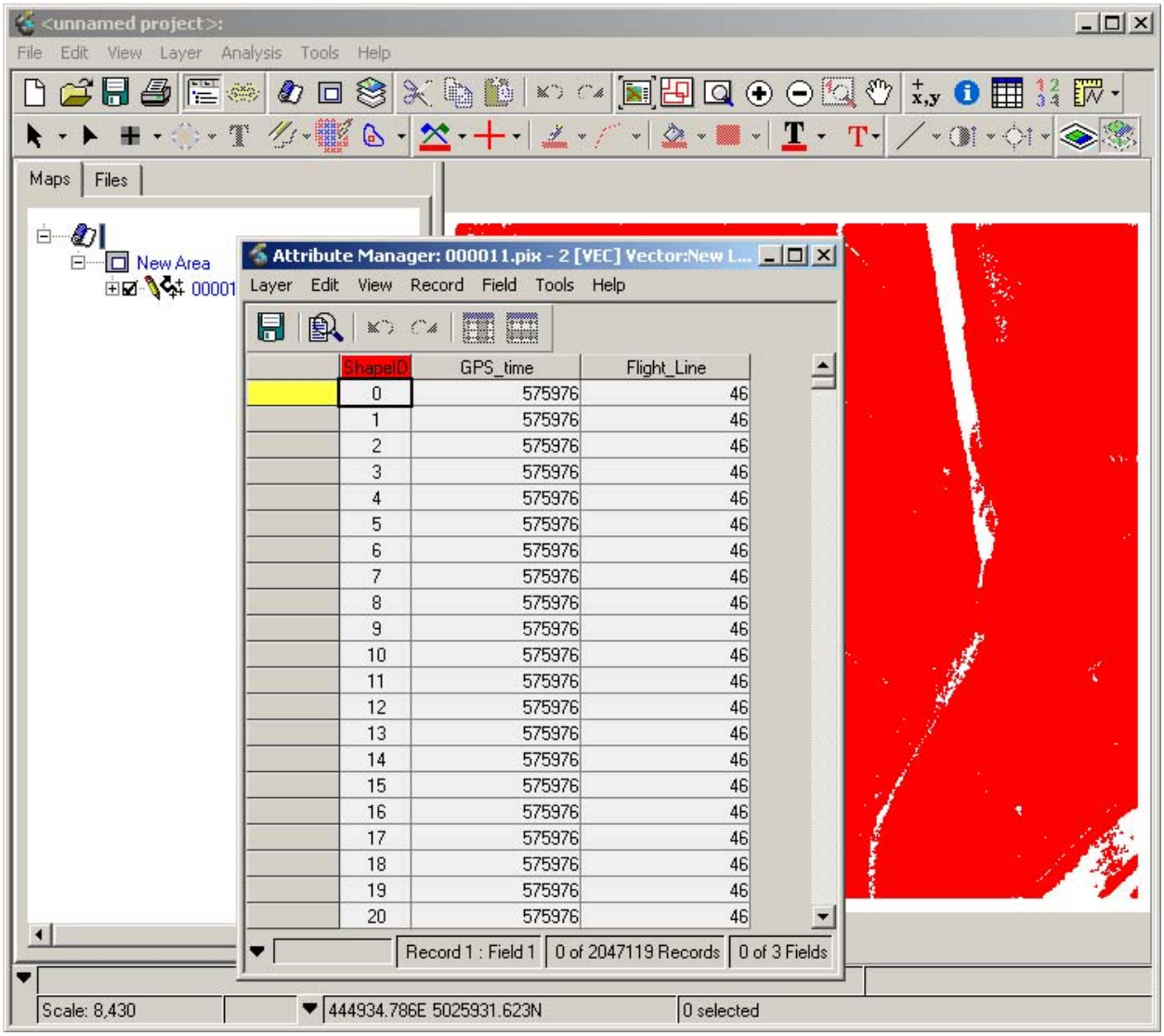
- First. ensure that the Data Type of the **X**, **Y**, and **Z** attributes have been switched from default Text to Float in the **Import attributes** section.
- In the **Coordinate Fields** area, select the values from the **X**, **Y**, and **Z** list boxes that contain your coordinate and elevation data.
- Enter in the **Projection** information for the output file.
- Update the **Field Names**, **Description** and **Data Types** of the remaining attribute columns of data (if available). You can choose to include or exclude the other columns of data into your vector file with the Import check boxes.
- Click the **Finish** button to initiate the importing from ASCII to PIX.





Results

When the import process is complete, the new PIX file containing all the points created from the coordinate ASCII data will be loaded into the Focus viewer and the Attribute Manager will be opened displaying the attribute data (if available) that is associated with the points.

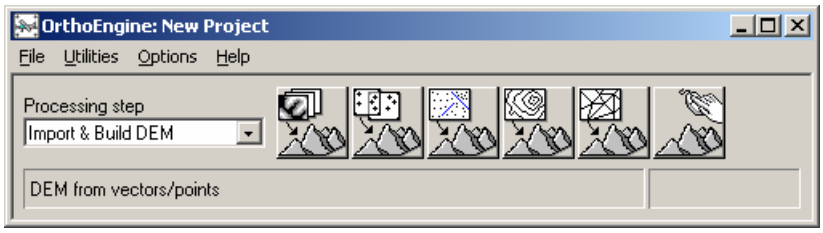


Interpolate a Digital Surface Model from the imported LIDAR points

Geomatica OrthoEngine can interpolate elevations from the points created from the raw ASCII LIDAR data to generate a continuous raster digital surface model. You can combine several different vector layers and files to generate a seamless surface. This is important with LIDAR data because most often the ASCII data will be split into tiles to prevent the datasets from becoming too large in file size.

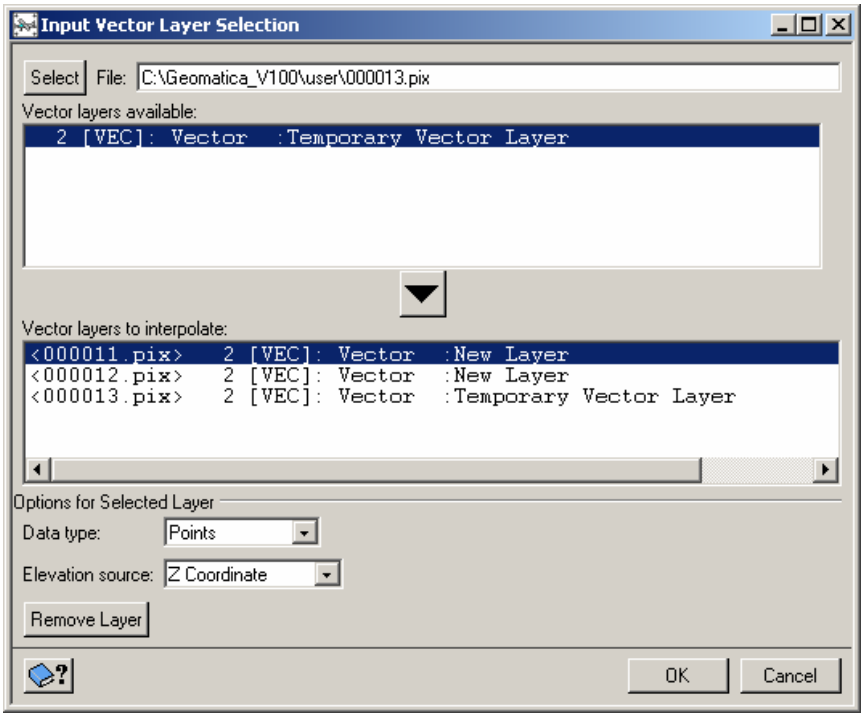
Step 1

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



Step 2

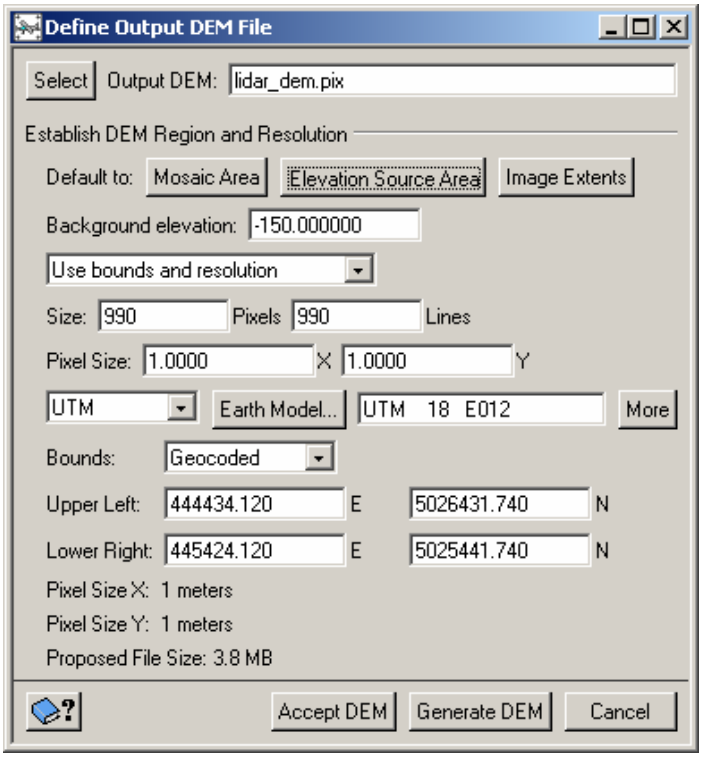
- Click **Select** to choose the input vector file. Available vector layers from the file will appear in the **Input File Vector Layers**. Select the layers from the file that you wish to include and then click the arrow to add the layers to the Vector layers to interpolate. If more then one layer or 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 **Set of Vector Layers to Interpolate** box to activate the **Options for Selected Layer s**ection.
- In the **Data type** list, select Points and in the **Elevation source** list, click the attribute where the elevation value is stored.



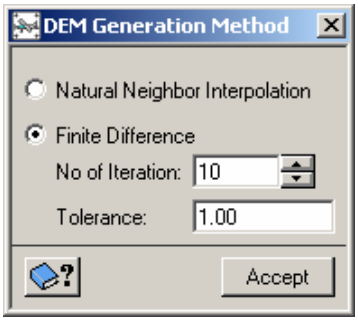
- Click the **Accept** button to continue.

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 bounds and resolution option and then enter the desired pixel size for the DSM
- 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 raw ASCII data. You can open the file in Focus with your LIDAR points 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.