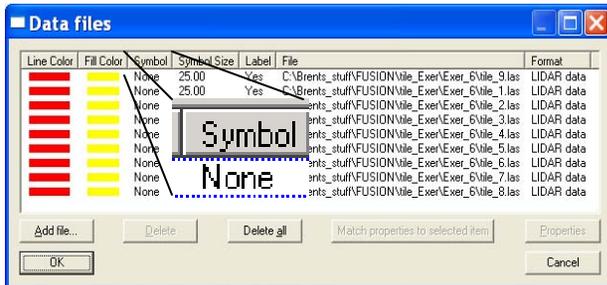




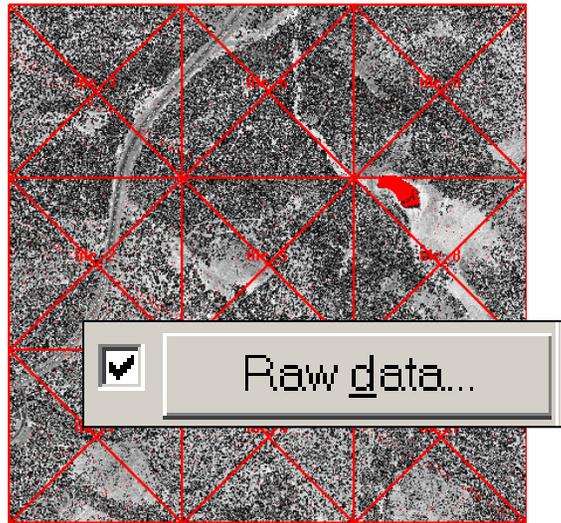
# EXERCISE 7: CREATING A FUSION PROJECT—PART 2



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Fusion ver2.65



*Important: leave the symbol set to none.*



## Introduction

This exercise continues with the creation of a Fusion project. In the last exercise you: examined the raw data, created and loaded the reference image from the raw data and explored the catalog command. In this exercise you will:

1. Load the lidar data,
2. Filter the data for bare earth points, and,
3. Create the bare earth surface.

## 1. Load the Lidar Data

As we mentioned in the last exercise: a georeferenced image is a critical requirement for exploring LIDAR data in Fusion—it provides the coordinate system and visual reference for the LIDAR data. The image has to be loaded before the data (and you've done that). If you just opened fusion, load **lub\_ref.bmp** as your reference image. Now it is time to Load the data...

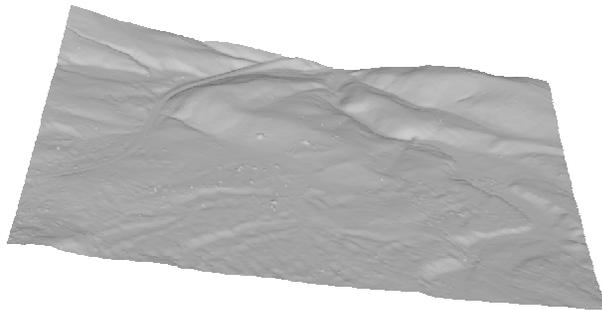
1. **Select** the **Raw data...** button in the left menu, navigate to the subdirectory where the **lub\_tileX.las** files are stored, select all of them and **Click, Open**. The **Data files** window will pop up (see sidebar graphic). **Click, OK** to load the data.
2. Ensure that **'none'** is specified under the symbol column. Usually you'll want to keep this set to **none** so that no raw LIDAR data will be displayed in the FUSION window. NORMALLY, YOU DO NOT WANT TO DISPLAY THE LIDAR DATA IN THE FUSION WINDOW. If you decide to display the lidar data, you would select a symbol type other than none, and then check the **Raw data...** checkbox. The data points are then drawn on the screen. This might be fun to watch once but not every time you zoom or redraw the screen. Watching several million points appear on the screen takes a loooooong time (fortunately, you can press the Esc key to stop the drawing). So, keep the symbol set to none unless you really have to check the data.
- When the symbol is set to none but the 'raw data' box is checked the screen will look



as shown in the sidebar graphic (previous page).

- Note: the 'raw data' box does not need to be checked to start working with the data in the next steps.

Now that we have the reference imagery and the lidar data loaded, we can begin creating the other surfaces...



Example Bare Earth Surface.

### Creating the Bare Earth Surface

The Bare Earth surface is important in its own right, but it also provides the reference elevation for measuring the heights of features in the data (i.e. we are usually more interested in the heights of features above ground level than we are interested in the elevation of features above sea level). Creating the Bare Earth Surface is a two step process—first we will filter the data to remove the above-ground LIDAR returns, then we will create the Bare Earth Surface from the remaining (ground) lidar returns.

### 2. Filter the data for bare earth points

This procedure is performed from the DOS command prompt using the **Groundfilter** program. The algorithm the executable is based on is described in: *'Determination of terrain models in wooded areas with airborne laser scanner data'* by K. Kraus and N. Pfeifer (1998, ISPRS).

The Syntax for the **Groundfilter** command is:

**GroundFilter** [switches] outputfile cellsize datafile1 datafile2 ...

1. Open a DOS command window: (**Start** | **Run...** | type "**cmd**" and click **Okay**)
2. Navigate to the Fusion program directory.
3. **Type "GroundFilter"** to get the full syntax description.
4. Use the **groundfilter** utility to create a data file with only ground points from the **lub\_tile#.las** files.



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Use the following parameters:

- Add these Switches (with a single space between each switch):
  - /gparam:-1
  - /wparam:2
  - /tolerance:0.1
  - /iterations:10
- And add these parameters (again with single spaces between):
  - **<out\_path>\lub\_groundpoints.lda** (this is the output file)
  - **2** (this is the cell size in the same units as the lidar data)
  - **<in\_path>\ lub\_tiles.txt** (this is a text file containing the file paths for the input data files)

### Syntax:

```
Groundfilter /gparam:-1 /wparam:2 /tolerance:0.1 /iterations:10 <out path>\lub_groundpoints.lda 2 <in path>\lub_tiles.txt
```

*Consider putting the command (including switches and parameters) in a batch file—despite being only a single command.*

Load **lub\_groundpoints.lda** into Fusion (Raw data... button) and inspect the results (see examples on the following page).

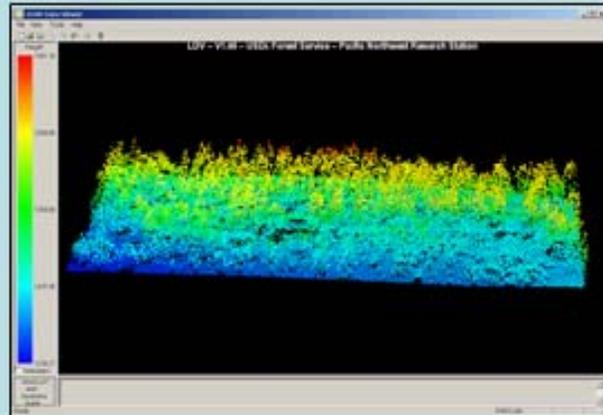
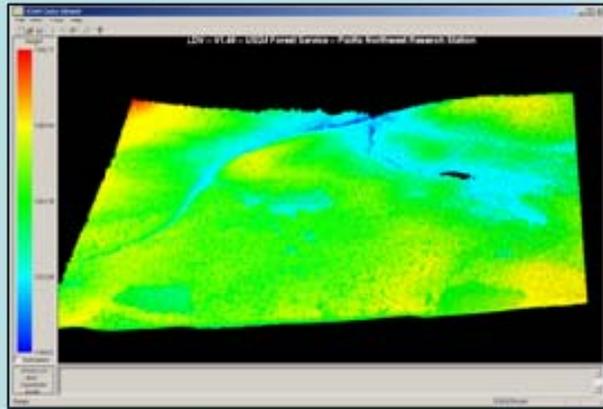
*Exercise 7 continues on page 5...*



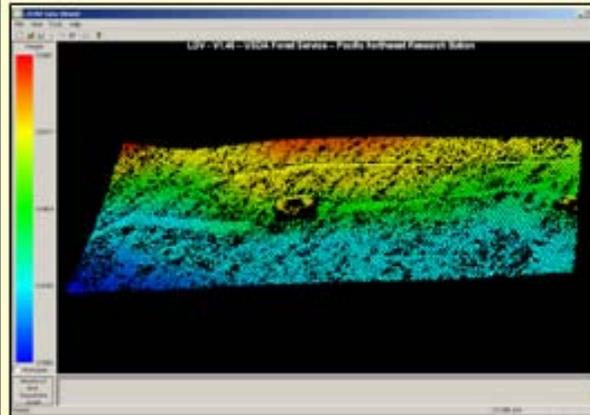
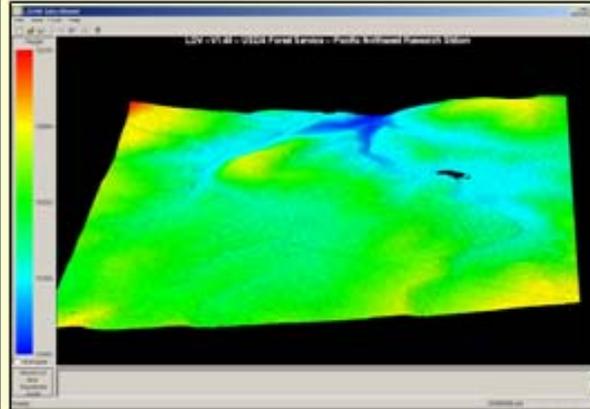
## EXERCISE 7: CREATING A FUSION PROJECT—PART 2



### Unfiltered Data



### Filtered Data



*The entire Lubrecht data set.*

*A subset of the entire Lubrecht data set.*

The images show the difference between the data points of the original data file (all nine tiles with more than 5 million data points) and the remaining filtered bare earth points of the ground filtered output file (~2.4 million points). The subsets show the difference in greater detail. The difference in height can be seen from the elevation data in the left colored bar of each image.



### 3. Create Bare Earth (BE) DTM surface

Once again, we'll be working from the DOS command prompt, this time using the **GridSurfaceCreate** command to create a **BE** surface from the **BE** points we just created.

The **groundfilter** executable (which you just finished using) provides a switch to generate a surface from the filtered points—however, this is a diagnostic output and should not be used for the **BE** surface. The **BE** surface should be created with **GridSurfacecreate** (you get more control over the output with **GridSurfacecreate**). This command can also be used if filtered data were provided as part of the deliverables.

**Syntax:** **GridSurfaceCreate** [/switches] surfacefile cellsize xyunits zunits coordsys zone  
horizdatum vertdatum datafile1 datafile2 ... datafile10

1. As you've done before, open a DOS command window and examine the full syntax of the **GridSurfaceCreate** command.
2. Use the **Gridsurfacecreate** utility to create the DTM surface from **lub\_groundpoints.lda** (the ground-filtered point data set). Use the following parameters:
  - **<out\_path>\lub\_surface.dtm** (this is the output file)
  - **2** (this is the cell size in the same units as the lidar data)
  - **M** (xy units are meters)
  - **M** (z units are meters)
  - **1** (coordinate system is UTM)
  - **12** (coordinate system zone)
  - **2** (horizontal datum is NAD83)
  - **2** (vertical datum is NAVD88)
  - **<in\_path>\ lub\_groundpoints.lda** (this is the input data file)

**Note:** *FUSION currently does not use the projection information BUT (according to Bob McGaughey—FUSION's developer) it will/might in the future. The projection information is stored in the header and thus provides a way to keep track of the projection info. It is best if you input this information correctly but if you don't know the projection or datum, you can use the unknown options.*



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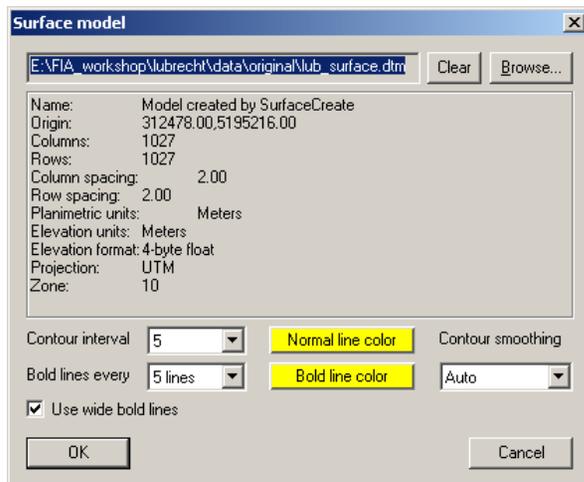


The syntax should look similar to:

### Syntax:

```
gridsurfacecreate <out_path>\lub_surface.dtm 2 M M 1 12 2 2 <in_path>\ lub_groundpoints.lda
```

*Consider putting the command in a batch file—despite being only a single command.*



### Notes:

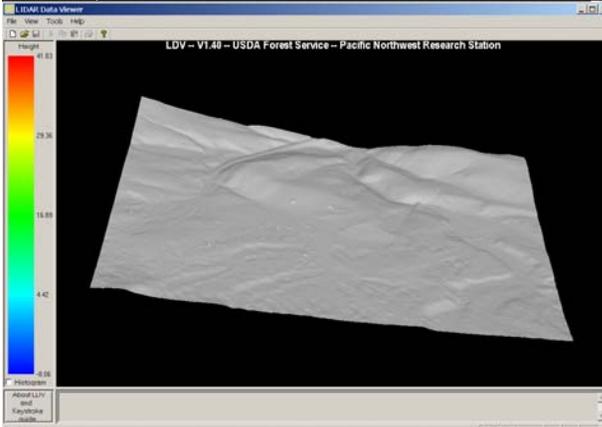
- *The contour interval is in the same units as the elevation data.*
- *It's best not to change the "contour smoothing" option. The auto setting is scale sensitive. If you set this to anything else, you can get into trouble with very large surface models.*
- *Using "1 by1" cell option with a large DTM will be very slow. You can stop the drawing of contours with <Esc> but its best to leave this on "auto".*

Once you've successfully run the above command, you've fulfilled the stated objectives of this exercise. The remainder of this exercise will explore some ways you might want to examine the bare earth surface... Before loading the just generated surface, make sure:

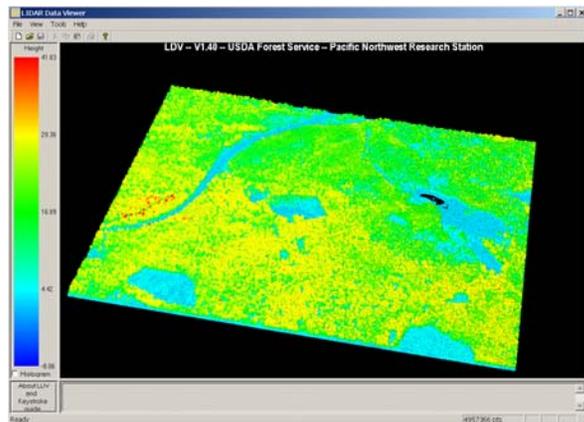
- the reference image is loaded,
    - If you want to display the data **points** along with the surface load the 9 **lub\_tile#.las** files to view the surface in combination with all returns.
3. **Select the Bare earth...** button and navigate to and select **lub\_surface.dtm**.
  4. **Click, Open.** This will open the **Surface model** dialog:
    5. Change the **Contour interval** to **5** (since this is a relatively flat area)
    6. **Click** the **Use wide bold lines** checkbox
    7. **Click** the **Normal line color** and **Bold line color** buttons and change both to a bright yellow (or some color that will contrast with the greyscale image)
    8. **Click, OK**—the **lub\_surface.dtm** file will display as contour lines within the Fusion display window.
  9. **Click** and drag in the Fusion viewer to create a stroked-box sample of the data to view in **LDV**.
  10. Notice that the colored bar on the left shows heights above the bare earth surface (this happens automatically when a Bare earth model is loaded).
  11. **Right Click** within the LDV viewer to access the right-click menu and select the **Marker...** menu item.
  12. Ensure that the **Marker type** is set to **Points** and set the **Marker size** to **Miniscule**.



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*The surface model displayed without the lidar data. Note: the surface model will not display if you have selected the **Subtract ground elevation...** Sample option.*



13. **Click, OK.**
14. Again, access the right-click menu but this time **Select Surfaces** (or **Alt-U**)
15. Access the **right click** menu again and **uncheck** the **Data** option (**Alt-D**)—this will turn the lidar data off and only the surface will be visible. If the surface is not visible it likely means that you have **Subtract ground elevation from each return** checked in the **Sample options**—Uncheck that option and **Click** the **Repeat last sample** button.

At this point, we haven't finished creating all of the data analysis layers for our Fusion project; however, we can start interrogating the data. Going back to the fusion window...

18. Select the **Sample options** button to open the Sample options dialog:
  19. Ensure that **Stroked box** is the **Sample shape**,
  20. Under the **Options** section, check only **Subtract ground elevation from each return**,
  21. Under the **Bare earth filter**, check the **Exclude points close to the surface**,
  22. Set the **Tolerance** to **1**,
  23. Within the **Decimation** section, increase the value to Include every **200** data points (this will significantly speed up the display for large areas—which we'll do in a moment).
24. **Click, OK.**
25. In the Fusion display window, click-and-drag a stroked box that covers most or all of the data extent to view in LDV (see sidebar). By selecting the **Subtract ground elevation** from each return option, the data will be normalized against the ground surface—you should notice that the trees appear to be on a flat plane across the sample area.



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Feel free to explore the results by changing the **Sample options**—for example:

- Alter the **Decimation** value (if your computer is slow, increase the value; if fast, decrease the value; if you're sampling a small area, decrease the value).
- Alter the **Bare earth filter tolerance**: increase to 5 to remove the ground and shrub layer or include all points to show everything.
- Uncheck the **Subtract ground elevation from each return**.

After each alteration, either *Click* the **Repeat last sample...** button or select a new sample area.

Before moving on to the next exercise, reset your sampling options such that:

- No **options** are checked.
- Choose, **Include all points** for the Bare Earth and Canopy Surface filters.
- Reset the **Decimation** to something close to 1 (depending on how fast things display).
- **Select, Color by height** under color options.

*End of Exercise 7*