EXERCISE 2: GETTING STARTED WITH FUSION

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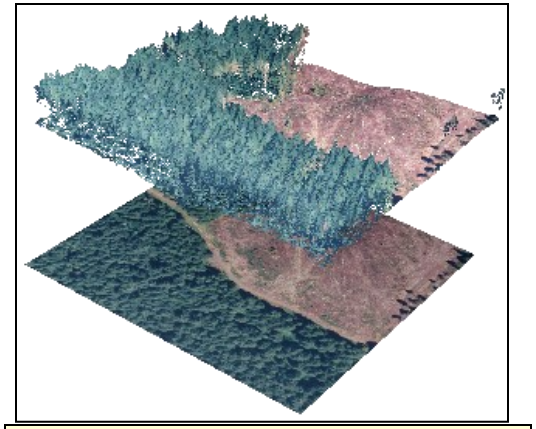
Fusion v2.8



Example of lidar data points (top layer) colored by the corresponding reference image (bottom layer)—in LDV.

If you change the Symbology by setting a Symbol other than None and you click the check box next to the **Raw data…** button, all of the data points will display in the Fusion window. This may be entertaining and educational once but you won't want to do it often—and it is not necessary in order to use FUSION.

Introduction

In this exercise, you'll be using the fully-prepared example data to explore the basics of FUSION.

Prerequisites

- Successful completion of Exercise 1 (Download and Install FUSION and the Example Data set)

Overview of Major Steps

1. Start Fusion and Load the Example Lidar Data
2. Load a Reference Image
3. Select a Sample to View in LDV
4. Add a Bare Earth Model
5. Explore FUSION's Sampling and Display Options

Procedure

Part 1: Start Fusion and Load the Example Lidar Data

1. Start Fusion: *Click,* **Start | Programs | FUSION | FUSION**
2. ***Click*** the **Raw Data button** on Fusion toolbar to display the **Open** dialog box.
3. Navigate to your data folder (**C:\lidar\SampleData**) and *Select* the sample dataset (**lda_4800k_data.lda**) and ***Click,* Open**. This will open the **Data Files** dialog.
4. The **Data Files** dialog allows you to change the display Symbology of the lidar data in the Fusion window—but, we strongly recommend that you accept the defaults (especially the Symbol set to None) for now, *Click,* **OK** (read the sidebar before making any changes).
5. Save your Fusion project by *Clicking* the Save icon or **File| Save As**.
6. Name the project **exer02.dvz** and *Save* it in a new folder named **C:\lidar\Fusion_Projects**.

FUSION Tip-Fusion requires a reference image before you can view your lidar data in LDV. If you don't have a reference image available you can create an intensity image from the raw lidar data to use as your reference image. This capability can be accessed through the FUSION interface: **Tools | Miscellaneous Utilities | Create an image using LIDAR point data..**

Basic LDV Navigation Tips

(Note: LMB = Left Mouse Button, RMB = Right Mouse Button)

LMB + move mouse: "Grab" and rotate the displayed data (rotation can be up/down and left/right)

It may be easiest to imagine that the data is contained in a glass ball. To rotate the data, use the mouse to roll the ball and thus manipulate the data.

LMB + ctrl + move mouse down: Zoom in

LMB + ctrl + move mouse up: Zoom out

RMB: Activate pop-up options menu for LDV

For a complete list of LDV keystrokes *Click* the **About LDV and Keystroke guide** button in the bottom left corner of the LDV, highlighted in red in the graphic to the left.

Part 2: Load a Reference Image

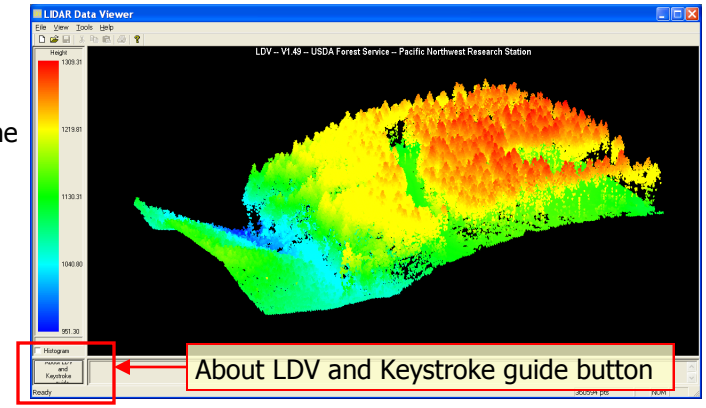
1. *Click* the **Image button** (located on Fusion toolbar). *Select* the sample orthophoto (**orthophoto_4800k.jpg**) from the sampledata folder and *Click*, **Open**. The image will automatically display in the Fusion viewer. If you want to **zoom-in** to any part of the image, *Right Click* on the location you want to zoom to. **Zoom-out** by *Clicking* the **Zoom to extents** button.
2. You're now ready to view the lidar data in the **Lidar Data Viewer (LDV).**

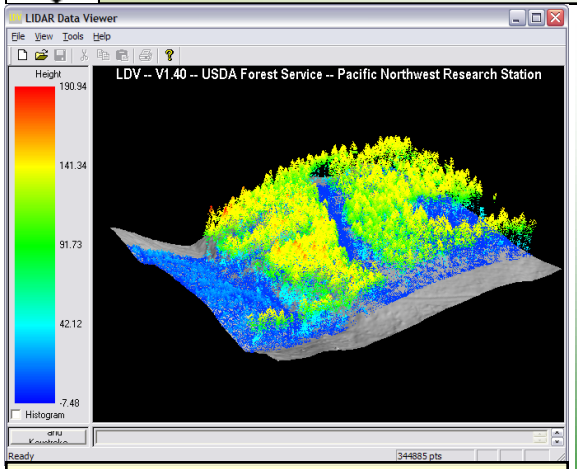
The stroked-box sample selection is highlighted in the Fusion window...

Part 3: Select a Sample to View in LDV

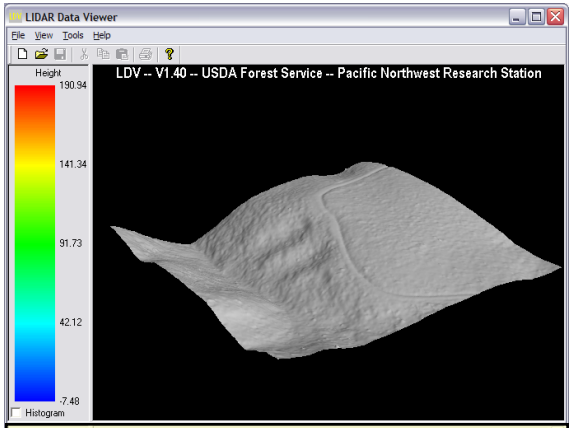
To create a sample and view the corresponding Lidar data in 3D:

1. Position the cursor over an area of interest in the orthophoto, ***Left Click*** and drag a smallbox (called a stroked box) over the area and release the left mouse button—this is your sample. Note: a small sample works better (faster) than a large sample.
2. The sample box will be highlighted in the Fusion viewer and LDV, Fusion's 3D viewer, will automatically appear and load the Lidar data within your sample boundary, as in the figure to the right.
3. Use the **Basic LDV Navigation Tips** (sidebar) until you are comfortable with your ability to





Once the Bare Earth model is specified in Fusion, it can be toggled in LDV via the right-click menu (Surfaces) or typing Alt-U.



The lidar data can be toggled via the right-click menu (Data) or typing Alt-D.

control the data cloud.

Part 4: Add a Bare Earth Model

1. *Close* the **LDV** and return to **FUSION** (it will still be running & your last sample will be displayed).
2. *Click* the **Bare earth** button (located on the Fusion toolbar).
3. *Select* the sample terrain model (**4800K_ground_surface.dtm**) from the sampledata folder and *Click,* **Open.**
4. Within the **Surface model options** window, you can accept the defaults or define contour intervals and line colors. Once you have chosen intervals and colors or accepted the defaults, *Click,* **OK**. The terrain model will be displayed in the Fusion viewer as a contour map over the orthophoto.
5. *Click* the **Repeat last sample…** button (located on the Fusion toolbar). This will display the same lidar data cloud as before—but in a moment we will also view the bare earth surface…
6. *Right Click* within the LDV viewer to access the "**Right Click Menu"**.
7. *Click* on **Surfaces** (or use the Alt-U keyboard option). The bare earth surface will automatically display with your lidar data cloud.
8. Access the right-click menu again and *Click* on **Data** to toggle the data off (or type Alt-D). This will allow you to inspect the bare earth surface without the data cloud. To turn the data back on use the right click menu and *Click* on **Data** again.

This exercise continues on the next page…

Note: See the last page of this document for an appendix describing the Sample Options dialog box.

FUSION Tip - Some of the sampling and display options can be very computer intensive and are appropriate only with a fast computer and a small sample area. You will have to be the judge of what your computer is capable of handling. A class 3 computer is recommended for **general** lidar data exploration and analysis.

FUSION Tip - you can only use the **Subtract ground elevations** option if you've loaded a Bare Earth Surface (which you've done).

FUSION Tip - you can only use the **Bare Earth filter** options if you've loaded a Bare Earth Surface (which you've done).

Part 4: Explore Fusion's Sampling and Display Options

Fusion offers a number of ways to sample and view lidar data. We'll explore several of these options in this section and you'll use many of the remaining options in subsequent exercises.

1. In the FUSION window *Click* the **Sample options** button to open the Sample Options dialog (see Appendix 1).
2. Under the **Sample shape** section, *Select,* **Stroked circle** (the default is Stroked box) and *Click,* **OK**.
3. *Select* a **small stroked-circle sample** in the Fusion window and view the results in the LDV.
4. *Close* the **LDV**.
5. Return to the Sample options and change the sample shape back to **Stroked box**.
6. In the **Decimation** section, increase the value to **200** and *Click*, **OK**.
7. In the Fusion window *Select* a **large stroked-box sample** (suggestion: make the stroked box cover about 1/2 the size of the reference image). It may take a few minutes to extract the sample but the results display very fast in LDV. Please notice that the ground is not flat within the sample area as you view the data in LDV—you'll make it flat in the next sample.
8. Return to the Sample options and *Select* (check) the **Subtract ground elevations from each return** in the **Options section** and *Click,* **OK**.
9. *Click* the **Repeat Last Sample** button. This will repeat the last sample area but now the data will appear in LDV on flat terrain—this is very useful for comparing heights above ground level.
10. Return to the Sample options and change the **Decimation value** back to **1** and *de-select* the **option to subtract ground elevations.**
11. *Select* the **Bare Earth Filter option** to **Exclude points close to surface** and increase the tolerance to **2**.
12. *Click,* **OK** to close the sample options dialog.

13. *Select* a small **stroked box sample** in the Fusion window. Note that the points close to the ground have been excluded from displaying in LDV.
14. Return to the Sample options and *Select* the **Include all points** option under **Bare Earth Filter**.
15. In the Sample options window, under the **Color** options *Select,* **Color using image** and *Click,* **OK**.
16. *Click* the **Repeat last sample** button. You should notice that each lidar return is now painted the color of the corresponding reference orthophoto image. Keep LDV open.

To this point, you've been controlling the display and sample options from Fusion's Sample Options dialog box. Now, we'll explore a few of the display options within LDV…

17. Access the right-click menu and ***Toggle*** (either on or off) the **Draw all points when moving** option. ***Click-and-drag*** to move the data sample. If you've toggled the Draw all points… option **on**, the responsiveness of your display may be sluggish (but it looks good) and if you toggle the option **off**, the LDV display will be very responsive (but it won't look as good).
18. Set the **Draw all points…** option to suit your computer and your preferences.
19. Access the right-click menu again and *Click* the **Marker…** option.
20. Experiment with the **Marker Type** and **Marker Size** options—however, be aware that the sidebar note is particularly applicable to some of the Marker Types. If in doubt, keep the marker type set to **Points**.
21. Back in the Fusion window, *Click* the **Sample Options** button.
22. *Enable* the **Color by Intensity** option.
23. *Click,* **OK** and then *Click,* **Repeat Last Sample**. The LDV viewer will display returns according to their intensity value (or the near-infrared spectral value). The intensity information can be helpful to interpret ground features. However, because the intensity information of the ground features are clustered on only a small portion of the displayed intensity range, the default display parameters make the data difficult to interpret. Let's adjust the

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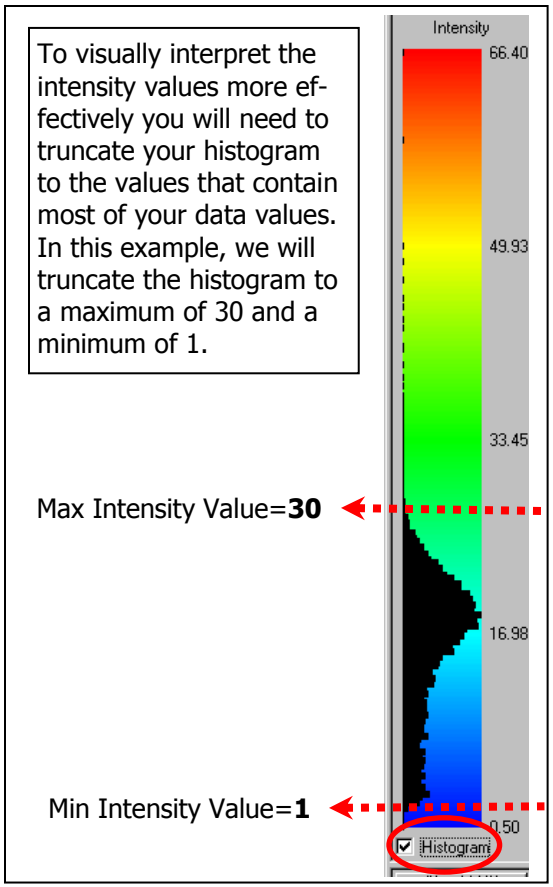
intensity display parameters to improve interpretation.

24. *Click* the **Histogram** checkbox on the left side of the LDV viewer (**see graphic to left**). The histogram will display (black) along the color legend.

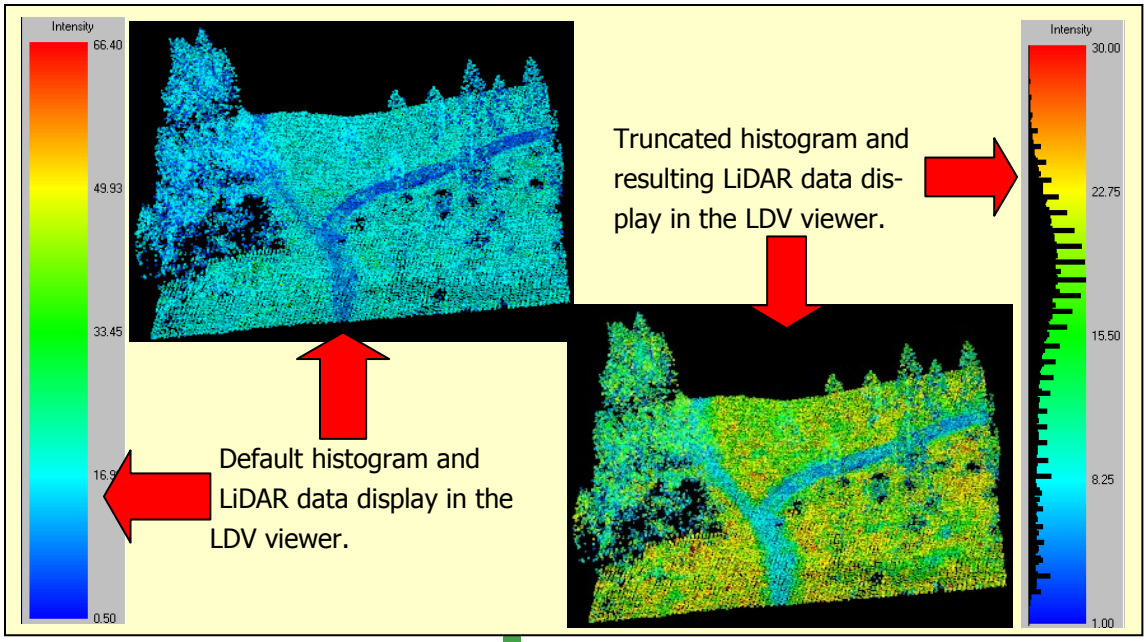
<u>You should see that most of the intensity values are clustered in the lower half of the available intensity range. Let's truncate the available range to the approximate range of the intensity values (so that we can interpret the LiDAR data better).</u>

25. Write down the approximate low and high intensity values that capture most of the histogram (**<u>see graphic to left</u>**).
26. *Click* the **Sample Options** button in the Fusion window.
27. *Enable* **Truncate Attribute Range** (in the Color section).
28. Enter your approximate **minimum** and **maximum** histogram values.
29. *Click,* **OK** and then *Click,* **Repeat Last Sample**.

To visually interpret the intensity values more effectively you will need to truncate your histogram to the values that contain most of your data values. In this example, we will truncate the histogram to a maximum of 30 and a minimum of 1.



Exercise 2 continues on the next page……



Now that you've effectively stretched your intensity data to cover the full color legend for improved interpretation (see figure to the left). High intensity values (or high near-infrared values) for natural communities most likely represent photosynthetically active vegetation, and in some cases may represent dry bare soil. Lower intensity values likely represent: 1) wet, bare soil, 2) water, or 3) less photosynthetically active vegetation. The figure to the left illustrates how the data and histogram changes with truncation.

FUSION Tip– Note: Lidar intensity values are not normalized. The lidar sensor will change its gain or pulse strength during the acquisition, which changes the return intensity of the pulses/returns. The same feature can have different intensity values in different flight lines. Hence, the intensity values can be used for interpretation but it is not advisable to use the values for spectral analysis.

To conclude this exercise, continue to interact with the data in LDV and experiment with the following items on the right-click menu:

- Wiggle-vision (Alt-W)
- Overhead View (Alt-O)
- Reset Orientation (Alt-R)
- Reset Zoom (Alt-Z)
- Image Plate (Alt-P)

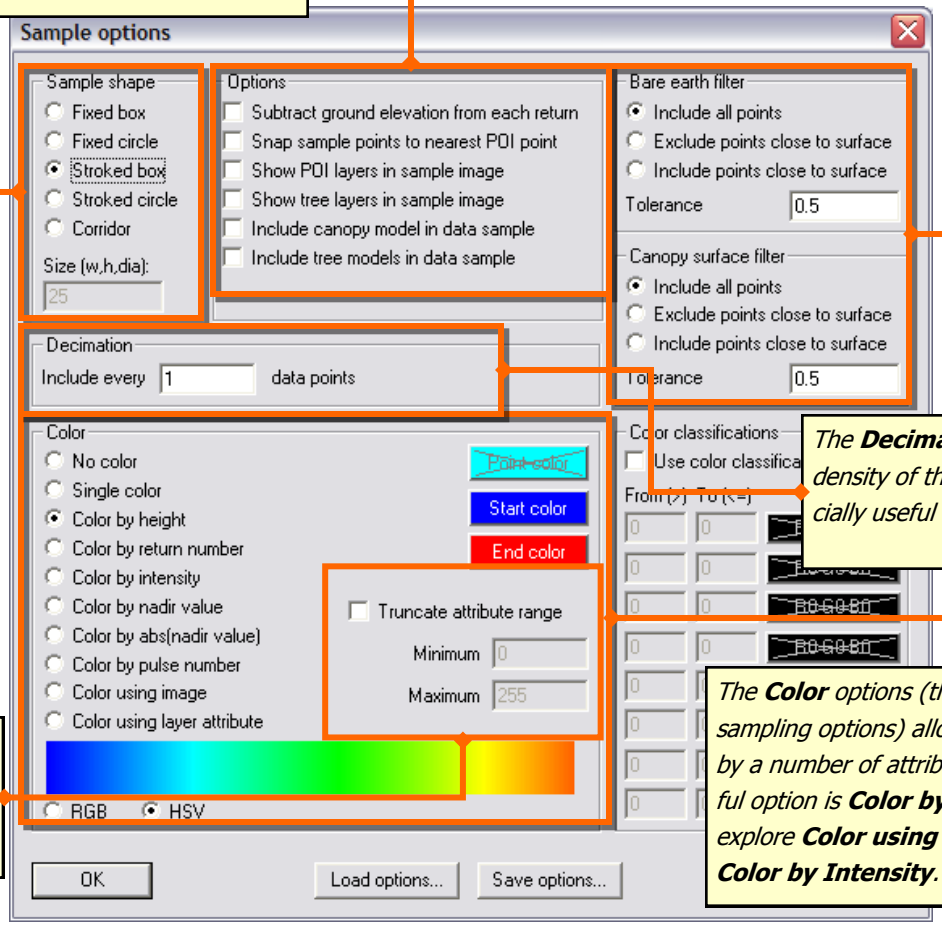
32. Turn the truncate function off and choose the color by option that seams most appropriate for general visualization (color by height is recommended).
33. Save the project: **File | Save**.

This concludes Exercise 2

APPENDIX 1: SAMPLE OPTIONS

*The only option in the **Options** section that we'll explore in this exercise is **Subtracting ground elevation from each return**. This essentially flattens the terrain so above-ground feature heights can be readily interpreted. Note this is where we can toggle the option to Snap our sample to a POI.*

Once we have specified a Bare Earth Model and/or a Canopy Surface Model, we can filter (include or exclude) lidar points at a user-defined distance from those surfaces.



*The default **Sample shape** is a Stroked box, but there are other options. Of particular interest: A Fixed circle is very useful for defining fixed radius plots (when choosing a fixed box or circle, you will have the option of specifying the size). The fixed circle can be snapped to the plot center by choosing the **Snap** option in the **Options** section...*

*The **Decimation** option allows you to reduce the density of the points being sampled. This is especially useful when you select a large sample area.*

Enabling this option can allow you to truncate (or stretch) your histogram so that your data display is more interpretable.

*The **Color** options (though they're not really sampling options) allow you to display the data by a number of attributes. Usually the most useful option is **Color by height** but we will also explore **Color using (reference) image** and **Color by Intensity**.*