T3 drone lidar plots

Bob McGaughey

The UAS lidar data, in LAS format, was clipped to the plot size (17.68m radius) plus a 3m buffer around the plot. The ground models, created using the lidar data, were clipped to the buffered plot extent. The field trees, with distance and azimuth, were used to create tree models that can be displayed in the point cloud. I also included the field data for each plot as it contains additional details for the measured trees. Tree height was not measured in the field so the height for the tree models was predicted based on species-specific DBH-height relationships. For some plots, the predicted heights seem good but for others, heights are overestimated. FUSION project files are provided to make it easy to load data into FUSION for further exploration. All data products are in UTM zone 10 (EPSG: 26910).

The drone lidar data covering some of the T3 units was collected by West Fork Environmental, LLC. The data are very high density (1000-1500 returns-m^{-2}). Even though the individual plots are small (about 0.10 hectare or 0.25 acre), the point data files are quite large and contain 1-2 million points.

This document is intended to help you get started with FUSION and the T3 drone lidar data. It does not describe everything that you can do with FUSION.

Installing FUSION

FUSION is freely available from this link: FUSION Version Check (uw.edu). FUSION was last updated in May 2022. If you have an older version, you should download and install the latest version.

The link near the bottom of the page has a link to the installer. If you have trouble running the installer, there is also a link for a simple zip archive containing all the program and auxiliary files needed for FUSION. Usually, such problems are related to administrative controls on computers. If the installer doesn't work, figuring out why and correcting the problems may require support from your system administrator.

The installation includes a comprehensive manual covering all the command line tools available in FUSION as well as instructions for using FUSION to visualize and explore lidar data. For this exercise, we will be using the FUSION and LDV programs to visualize the UAS lidar data and field measured trees.

Getting started

Data for the plots are available here: forsys.sefs.uw.edu - /transfer/T3Plots/. The files (one for each plot) range from 15 to 30 Mb. These need to be unzipped once downloaded. Each zip file contains five files (point data, ground model, FUSION tree list, field tree data, and FUSION project file). All plots can be unzipped into the same folder. There is also a shapefile containing the plot locations (http://forsys.sefs.uw.edu/transfer/T3Plots/plot_centers.zip). This file is not needed to explore the lidar data but is useful in GIS to better understand the relationship between the plots and the T3 treatment units.

The normal mode of operation for FUSION requires you to find and load point and ground data for your area of interest. For point data, FUSION requires data in LAS format. Compressed data in LAZ will work but sample extraction will be EXTREMELY slow. For the T3 plots, I have created FUSION project files (extension ".dvz") to make it easy to load data for each plot. Once you have FUSION running, select

File…open and navigate to the folder containing the data for plots. Load the project file for the desired plot and you should see a screen like the image in Figure 1.

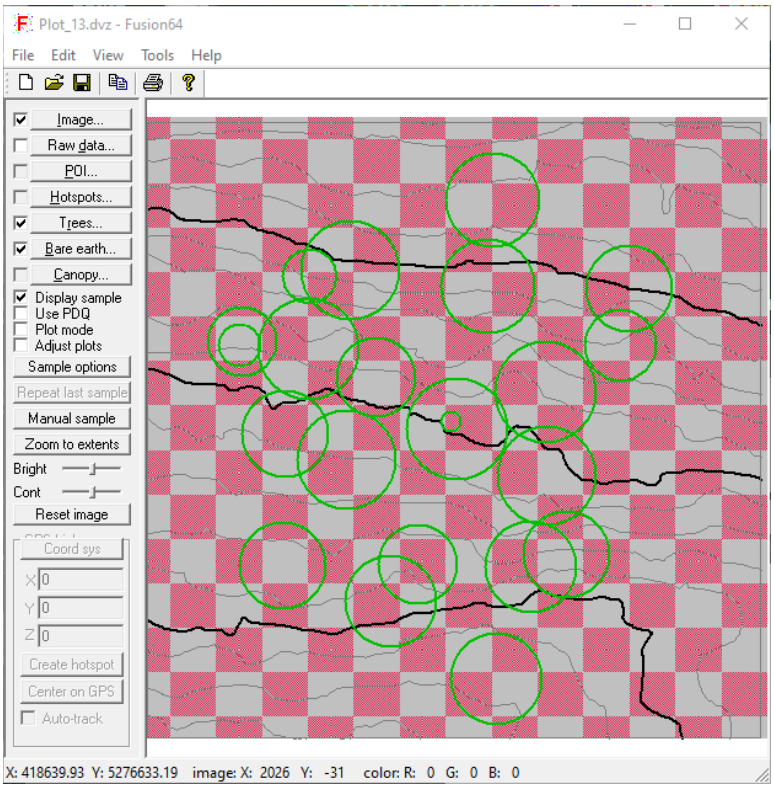

Figure 1. FUSION screen image for plot 13.

In Figure 1, the checkerboard background indicates that we don't have imagery to serve as a background so FUSION generated a simple, synthetic image to provide some orientation information. The green circles represent tree crowns derived from the field data (distance and azimuth from reference point was recorded for each tree) and the black/gray lines represent contour lines generated from the ground model. Colors for the trees and contour lines can be changed if desired.

The default sampling mode in FUSION uses a stroked rectangle. Other sample modes are available and may be more useful in certain situations. With the relatively (relative to the entire UAS lidar data for a treatment unit) small point files, you can stroke the entire area to display the full plot. **Note:** The first time a sample is taken for a data set, there is an indexing operation that takes place that can take a few minutes. Once the indexing is complete, subsequent samples will be faster. If you find that performance is still too slow for your liking, stroke a smaller box to reduce the area and number of points in the sample. Figure 2 shows the point data for plot 13. Once the point data area displayed, you can manipulate the data view. It helps if you think of the data being inside a glass ball sitting on a table. Use your mouse with the left button pressed to roll the ball to move the data. You can zoom in and out on the points using the moue wheel. Point size can be increased or decreased by pressing ctrl-plus and ctrl-minus (this can get a bit complicated if you don't have a numeric keypad). The LDV viewer offers a menu of options when you click the right mouse button. This allows you to turn on the ground surface and change several viewing options.

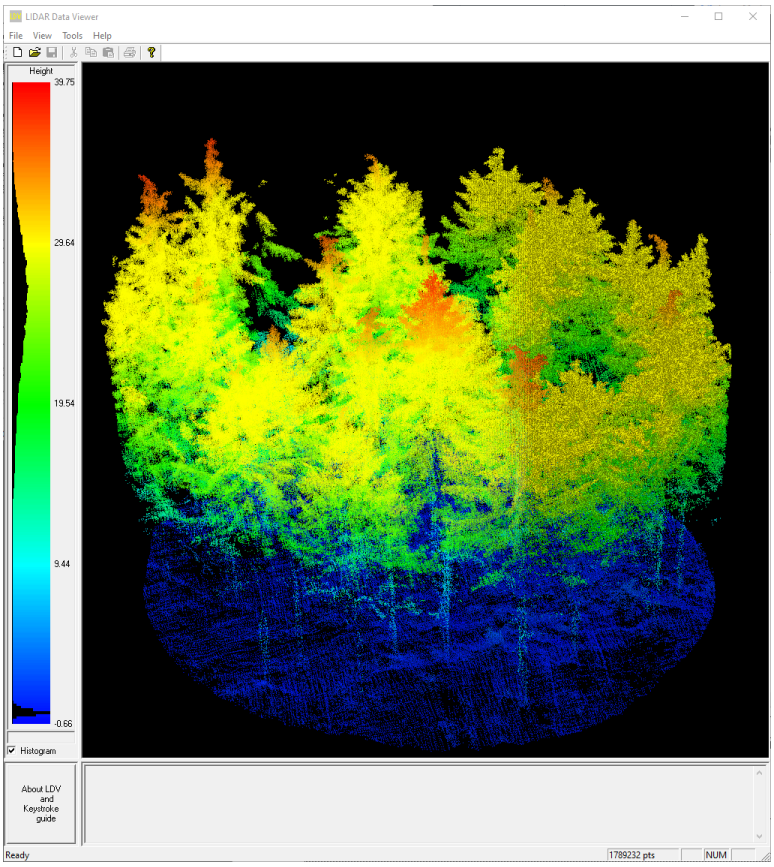

Figure 2. LDV screen image showing point data for plot 13.

FUSION offers a variety of controls over the sampling process. Clicking the **Sample options** button in the FUSION program presents the interface to control sampling and viewing options shown in Figure 3. For starters, check the box next to "Include tree models in data sample". Then click **Ok** to close the dialog. In FUSION, click the **Repeat last sample** button to use the same sample area but apply the new options. You should see the tree models and the point data. Notice that the trees do not align perfectly with the point data. This is due to error in GPS positions and errors in field measurements (azimuth and distance from reference point to trees). I have tried to adjust: the GPS locations for a few plots to produce better alignment but found that there is no simple offset that works for all trees on a plot. There is work underway to adjust the location of individual trees and the lean of individual trees to better match the point data. If you want to inspect the tree alignment, go to the sample options and check **Subtract ground elevation from each return** and **Include points close to the surface**. Then change the **Tolerance** value to 5 (point elevations/heights are in meters). Close the **Sample Options** dialog and click **Repeat last sample** to regenerate and display the data sample. You should be able to see only the point data representing the lower part of tree stems. Notice that some tree locations are close while others are not. **Note:** If any part of your sample area extends beyond the area covered by the ground model, all point data will be shown.

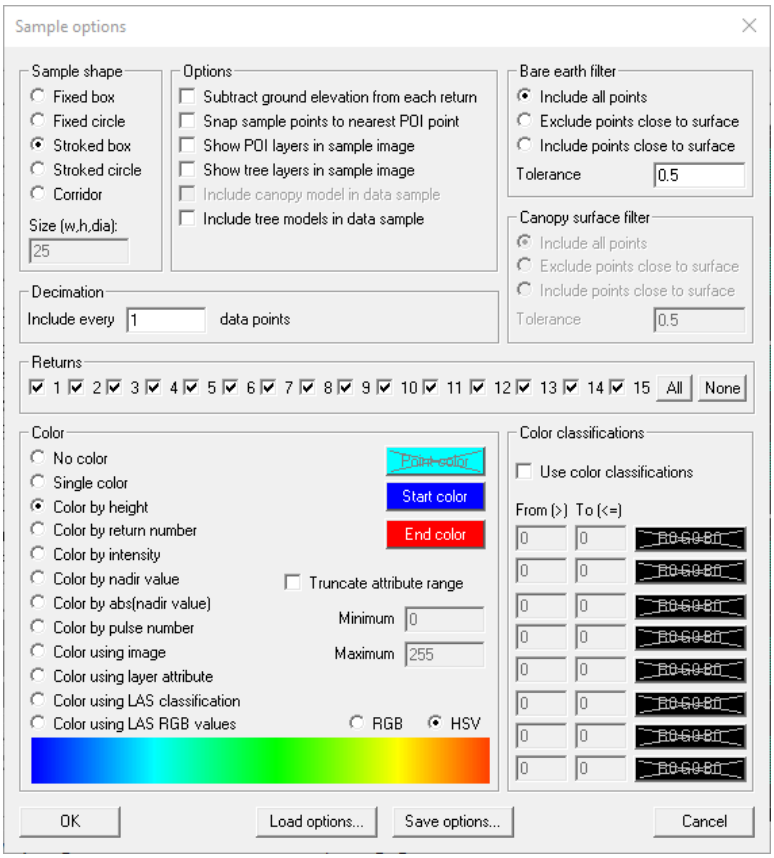

Figure 3. Sample options dialog in FUSION.

FUSION offers a transect (corridor) sampling shape that is particularly useful for evaluating stand structure. On the **Sample options** dialog, select **Corridor** and change the size to 5 (5m wide corridor). Then select **Ok** to close the **Sample options** dialog. On the main FUSION display, stroke a line from one side of the plot to the opposite side. Keep the line within the area covered by the checkered image. Figure 4 shows an example of a transect. Depending on the orientation of your sample line, you may have to manipulate the view to see the vegetation profile.

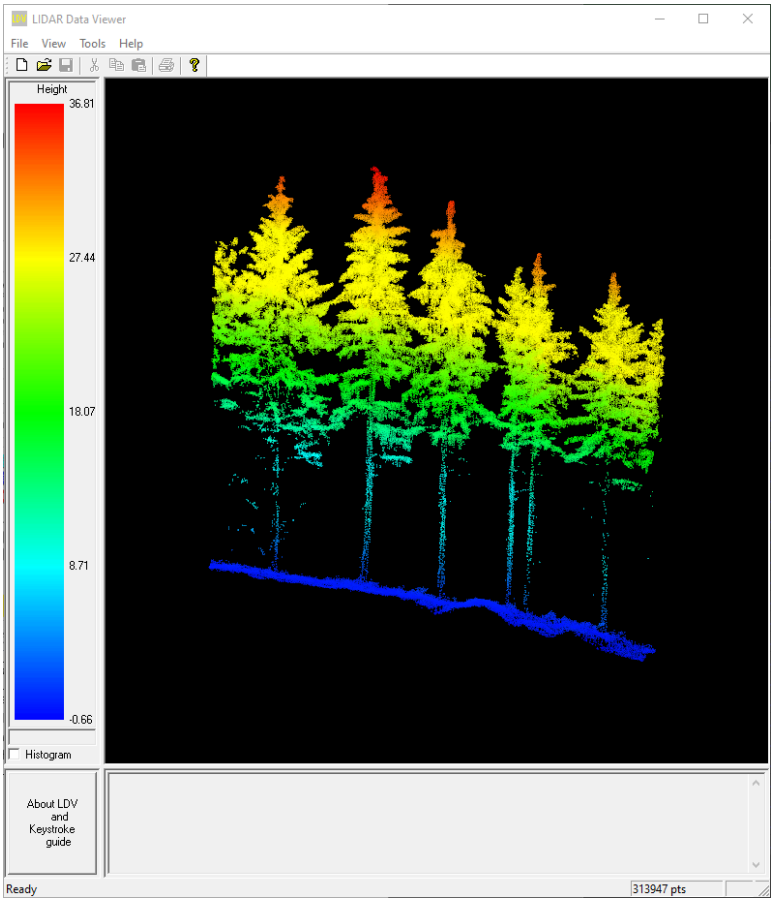

Figure 4. Transect of points through plot 13.

The FUSION sampling options can help you highlight specific features in the data. In addition, options in the LDV data viewer can also help highlight or even make measurements within the point cloud. Explore the options on your own but be warned, you can spend lots of time exploring the data!!