Lab 8
ESRM430
Instructor: Dr. L. Monika Moskal

Lab Objective:

- LiDAR Visualization

Tools:

- FUSION Software version 3.42
- Arboretum aerial and terrestrial LiDAR data
  - Aerial is from 2006
  - Terrestrial is from 2007
- Olympia, WA digital imagery and LiDAR data
  - Date: August 2008
  - Imagery is true color
  - LiDAR is at least 8 points per m^2 with 4 returns per pulse

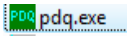
What you will hand in:

- This lab will be submitted in a digital format using the Lab8 drop box on the course website, note that you will hand in a write up **and an AVI file**.

Task 1:

- Set up a directory on the computer to work from. I suggest using …ESRM430/Lab8
- Copy Lab8 materials to your computer
- Do not work from your flash drive, but do back up the lab folder you have been working with to the flash drive at the end of the lab
- NOTE: I have placed additional files, tutorials and data in the Lab 8 folder that you can use if you would like to learn more about FUSION and LiDAR.

Task 2:

- Open the pdq.exe file 

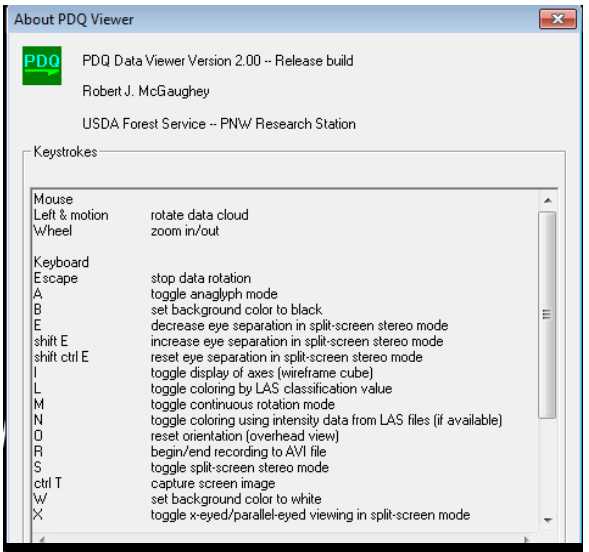
in the C:\FUSION installation folder.

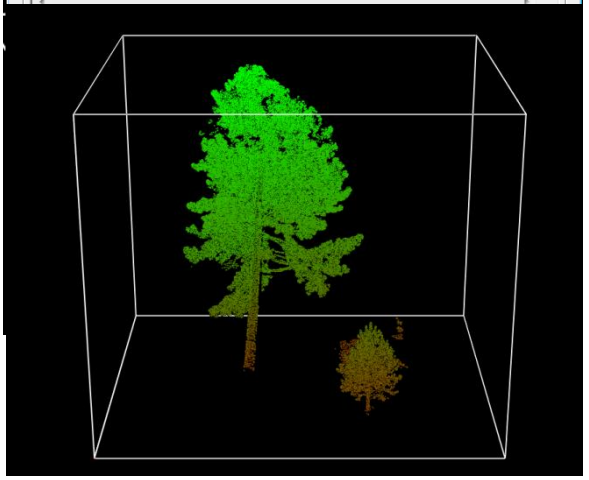
This will open a very simple visualization software for point data.

- Drag and drop the arboretum aerial LiDAR data file (aerialLiDAR.lda) into the visualization box, explore the data.
- Repeat with the arboretum terrestrial LiDAR data file (terrestrialLiDAR.lda).

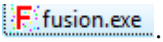
Both datasets are from the same geographical location.
You can also open the ../Lab8/data/Olympia, WA/ lidar/04406110.las (but it will take quite some time to load and is not necessary to answer questions 1 and 2).

- Answer the following question(s):
  1. What is the type (conifer or broad leaf) tree in the center of both the aerial and terrestrial LiDAR data?
  2. Discuss the differences between the two LiDAR datasets.





Task 3:

- Now open the FUSION software from the Start menu or the .exe file also located in C:\FUSION 

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FUSION relies on co-registered imagery to assist in visualization of LiDAR data, in this lab we will use the true color image of Olympia, WA that we have worked with in the past, you can also create intensity imagery out of the raw LiDAR data if you have no other co-registered imagery to work with.

- Use the "Image…" button on the top of the box to the left to load the 04406110.TIF image in the ../Lab8/data/Olympia, WA/ tc/ folder.

You can use the mouse wheel + the CTRL button on your keyboard to zoom in and out, keyboard arrows will move you up, down, left, and right. Additional navigation in FUSION and keyboard shortcuts are listed on the last 3 pages of the lab.

- Next use the "Raw data…" button to open the LiDAR data in the the ../Lab8/data/Olympia, WA/ lidar/ folder.
- Select the 04406110.las file; use the defaults in the Data file menu and click OK.
- Click and drag to draw a small box (stroke box) on top of the imagery, you will notice that the area of the box will be used to sample and display the LiDAR data. The LiDAR point cloud is colored by height. Repeat this process for multiple locations in the imagery. View water, a swimming pool, houses, vegetation, and dense tree canopy. Make sure that you are drawing all points while moving by right mouse clicking in the LiDAR data viewer and selecting this option.
- In the LiDAR Data Viewer window right mouse click in the middle of the viewer area and select Anaglyph as your viewing option (or alternatively Alt+G on the keyboard), put on the blue/red 3D glasses and explore the data. The data will no longer be colored by height but you will see the LiDAR data in true stereo.

- Answer the following questions:
  3. What happens to water when you look at the water areas (swimming pool and lake) in the LiDAR data? Discuss why this occurs.
  4. Why are there very few and sometimes no LiDAR return points under dense vegetation canopy?

Task 4:

Now you will color the LiDAR point cloud using other information.

- Return to the main FUSION program and select the "Sample options" button midway down the window on the left.
- In the Color section select:
  - "Color by return number" and click OK.
  - Hit the Repeat last sample button on the main FUSION screen.
- Go back to the "Sample options" button, and now, in the Color section select:
  - "Color by intensity" and click OK.
  - Hit the Repeat last sample button on the main FUSION screen.
- Go back to the "Sample options" button, and now, in the Color section select:
  - "Color by pulse number" and click OK.
  - Hit the Repeat last sample button on the main FUSION screen.
- Go back to the Sample options button, and now, in the Color section select:
  - "Color using image" and click OK.
  - Hit the Repeat last sample button on the main FUSION screen.
- Now select your favorite view location and coloring option, draw the data in the LiDAR data viewer, right mouse click and select Wiggle-Vision (Alt+W). Once you are satisfied, turn Wiggle-Vision off.
- Finally, right mouse click on the view again and select "Save wiggle-vision AVI file…", you will submit this file as part of your lab submission. Make sure your last name and coloring option for the LiDAR point cloud are used in the AVI file name.

In the last viewing option you are using the colors from the aerial true color photograph to color the LiDAR point cloud.

- Answer the following question:
  5. What do the last return pulses correspond to (most of the time)?
  6. Discuss the intensity values of the various land use/land cover themes you are familiar with in this location.
  7. How well do the imagery and LIDAR point data match up, how can you test this?

Keyboard commands for FUSION and LDV

Command	Context	Description
Up arrow 8 on numeric keypad	Viewing	Rotate around screen X axis (away from viewer)
Down arrow 2 on numeric keypad	Viewing	Rotate around screen X axis (toward viewer)
Right arrow 6 on numeric keypad	Viewing	Rotate around screen Y axis (away from viewer)
Left arrow 4 on numeric keypad	Viewing	Rotate around screen Y axis (toward viewer)
Page up 9 on numeric keypad	Viewing	Rotate around screen Z axis (counter-clockwise)
Page down 3 on numeric keypad	Viewing	Rotate around screen Z axis (clockwise)
Home 5 on numeric keypad 7 on numeric keypad	Viewing	Reset rotation to original state
Shift & left arrow	Measurement marker on	Move marker in negative direction along the X axis of the data (not X axis of screen)
Control & left arrow	Measurement marker on	Rotate marker 1 degree in positive direction
Shift & control & left arrow	Measurement marker on	Rotate marker 10 degrees in positive direction
Shift & right arrow	Measurement marker on	Move marker in positive direction along the X axis of the data (not X axis of screen)
Control & right arrow	Measurement marker on	Rotate marker 1 degree in negative direction
Shift & control & right arrow	Measurement marker on	Rotate marker 10 degrees in negative direction
Shift & up arrow	Measurement marker on	Move marker in positive direction along the Y axis of the data (not Y axis of screen)
Control & up arrow	Measurement marker on	Increase long axis of marker making the marker more elliptical (small step)
Shift & control & up arrow	Measurement marker on	Increase long axis of marker making the marker more elliptical (large step)
Shift & down arrow	Measurement marker on	Move marker in negative direction along the Y axis of the data (not Y axis of screen)
Control & down arrow	Measurement marker on	Decrease long axis of marker making the marker more elliptical (small step)
Shift & control & down arrow	Measurement marker on	Decrease long axis of marker making the marker more elliptical (large step)
Escape	Wiggle-vision on Scan-vision on Measurement marker on	Stop motion or stop scanning of clipping planes Clear marks and measurement points

Backspace	Measurement marker on with measurement line	Deletes last measurement point
Enter	Measurement marker on	Save measurement point
Space	Viewing	Activate right-mouse-button menu
+ (plus key)	Viewing with image plate active	Increase transparency of the image plate
+ (plus key)	Viewing with surface active	Increase transparency of the surface model
Control & + (plus key)	Viewing using fixed size markers	Increase size of point markers
- (minus key)	Viewing with image plate active	Decrease transparency of the image plate
- (minus key)	Viewing with surface active	Decrease transparency of the surface model
Control & - (minus key)	Viewing using fixed size markers	Decrease size of point markers
Letter A	Measurement marker on	Turn on display of points within measurement area and above current marker height
Shift & letter A	Viewing	Turn on display of all data points
Letter B	Measurement marker on	Turn on display of points within measurement area and below current marker height
Letter C	Measurement marker on	Move marker to the height of the closest point within the measurement area
Shift & letter C	Measurement marker on	Center the measurement area on the closest point and move the marker to the height of the closest point within the measurement area
Letter G	Measurement marker on and surface display enabled	Move measurement marker to ground elevation
Letter H	Measurement marker on	Move marker to the height of the highest point within the measurement area
Shift & letter H	Measurement marker on	Center the measurement area on the highest point and move the marker to the height of the highest point within the measurement area
Letter I	Image plate enabled	Lower image plate (small step)
Shift & letter I	Image plate enabled	Raise image plate (small step)
Control & letter I	Image plate enabled	Lower image plate (large step)
Shift & letter I	Image plate enabled	Raise image plate (large step)
Letter L	Measurement marker on	Move marker to the height of the lowest point within the measurement area
Shift & letter L	Measurement marker on	Center the measurement area on the lowest point and move the marker to the height of the lowest point within the measurement area
Letter O	Measurement marker on	Reset measurement marker to a circle

Letter R	Measurement marker on	Turn off display of points within measurement area
Letter S	Measurement marker on	Move measurement area to the current marked point (indicated with a 3D "+")
Letter T	Measurement marker on	Toggle display of points within measurement area
Letter X	YZ clipping enabled	Lower clipping plane (small step)
Shift & letter X	YZ clipping enabled	Raise clipping plane (small step)
Control & letter X	YZ clipping enabled	Lower clipping plane (large step)
Shift & letter X	YZ clipping enabled	Raise clipping plane (large step)
Letter Y	XZ clipping enabled	Lower clipping plane (small step)
Shift & letter Y	XZ clipping enabled	Raise clipping plane (small step)
Control & letter Y	XZ clipping enabled	Lower clipping plane (large step)
Shift & letter Y	XZ clipping enabled	Raise clipping plane (large step)
Letter Z	XY clipping enabled	Lower clipping plane (small step)
Shift & letter Z	XY clipping enabled	Raise clipping plane (small step)
Control & letter Z	XY clipping enabled	Lower clipping plane (large step)
Shift & letter Z	XY clipping enabled	Raise clipping plane (large step)
F4	Viewing	Open bare ground model dialog*
F5	Viewing	Open segmentation dialog*
F7	Viewing	Open plot location dialog*
F8	Viewing	Open attribute clipping dialog
F9	Viewing	Open tree measurement dialog

*features not available in demo version