

ENME 489Y – Remote Sensing: Spring 2018
Department of Mechanical Engineering**Due Date** Thursday, April 12th, 2018**Submission Information**

- Compile links to each YouTube video into a single .pdf file and upload the .pdf to Gradescope by 930am

*Initial collection of lidar data & initial 3D point cloud***General Reminder: keep recording pictures & videos of each aspect of your project to edit/stitch together in your semester project video and final project presentation!**Question #1

In Assignment #5 we integrated, aligned, and calibrated our field deployable lidar system. In Question #1, we record a preliminary data set in a controlled environment to ensure our lidar systems are functioning as intended before heading out on campus to begin mapping our targets.

Begin by identifying a target of interest in your home/apartment. This could be just about anything, but preferably a target with a known geometry. A box, chair, your roommate, etc. will suffice. To see an example of the process, head to the 1:00 minute mark of the following video (*Note: your lidar likely scans up/down, not left/right as shown here*):

<https://www.youtube.com/watch?v=dQlkwxSn5IU&list=PLekqOMAzgrTRP6Ms7wl37-2IKjU92tqnL&index=14&t=71s>

To understand the spirit of Question #1, recall in Week 8 we scanned The Digital Mr. Raymond during lecture. You will essentially repeat the process here, but with a target of interest in your home/apartment. Refer to ELMS > Modules > Week 8: Lidar Demonstration for details.

To begin the scanning process, head to GitHub and download *datacollection.py* to your Raspberry Pi:

<https://github.com/oneshell/enme489y>

Let's explore this script, which will be **executed on the Raspberry Pi**. The *datacollection.py* script asks the user to input an IMU angle and stores the angle as a variable. The script then opens the RPi camera feed and collects a frame, on top of which OpenCV plots crosshairs for alignment along with the IMU angle in the upper right-hand portion of the frame. See example .jpg data files on the following page.

When the operator is ready to **save an image**, press the "m" key. This creates a .jpg image file, the name of which is stored as the IMU angle.

The script then asks the user to input a new IMU angle. This process is repeated until the operator has recorded all data (i.e. image files), at which point the "q" key can be pressed to **break out of the script**.

Thus, the output of *datacollection.py* is a series of .jpg images, each with a filename corresponding to an IMU angle.

Use your field deployable lidar to scan the target of interest in your home/apartment. **Collect a minimum of 20 data images**, i.e. collect range data for a minimum of 20 different IMU angles.

Recall that **all IMU angles must be entered as values from 0 to 360 degrees**, as the Python script used to process the data will not account for negative numbers.



Scanning The Digital Mr. Raymond using the datacollection.py script

Record a minimum 60 second video clip of yourself describing and mapping the target inside your home/apartment. Demonstrate any pertinent features or geometries of the target. Upload the video to your YouTube account, then insert the link in a .pdf file to be uploaded to Gradescope (Question #3).

Question #2

With all 20 images recorded on your Raspberry Pi in Question #1, transfer the image files from your RPi to your laptop. Then head over to GitHub and download *datageneration.py* to your laptop:

<https://github.com/oneshell/enme489y>

Let's explore this script, which will be **executed in PyCharm**. Begin by ensuring all of the images recorded in Question #1 are in a proper folder on your laptop. Run *colorpicker.py* to **set the correct lower and upper bounds of the HSV mask** applied to the images.

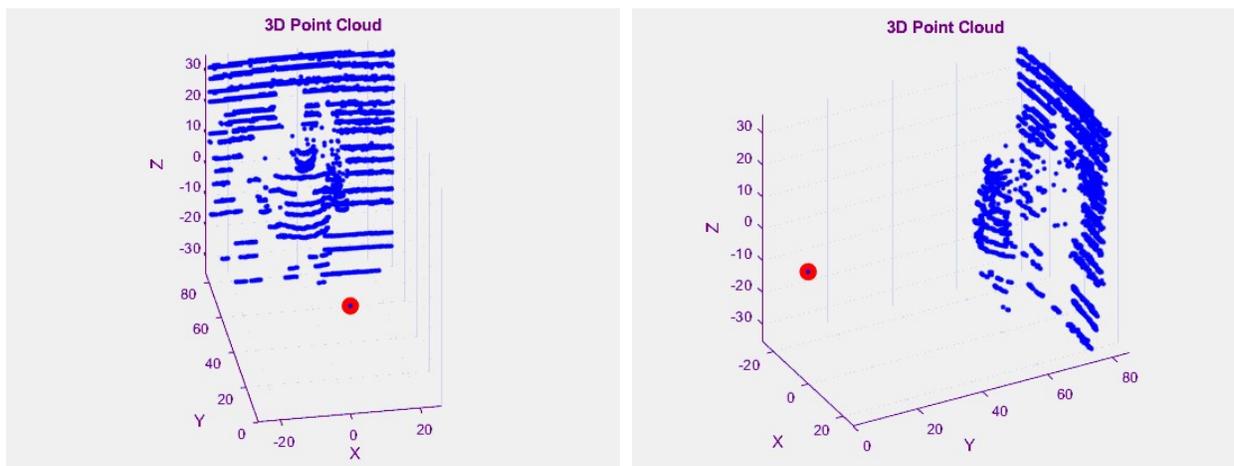
Ensure the values of *ro*, *rpc*, and *H* are correctly identified for your lidar, as evaluated in Assignment #5.

Using the *glob* function, the *datageneration.py* script identifies all files ending with *.jpg* in the allocated folder. The script then opens a *.txt* file, which will be used to store the processed *[x, y, z]* coordinates of each range measurement.

The script enters a *for()* loop to process each image indexed in *files* via the *glob* function, then writes the *[x, y, z]* coordinates to a *.txt* file.

Finally, the *datageneration.py* script plots the *[x, y, z]* data as a 3D point cloud using Matplotlib.

For an alternate (and, typically, better-looking) view of the 3D point cloud, head over to GitHub and download *3dcloud.m* to your laptop. This MATLAB file reads in the *.txt* file created by *datageneration.py* and plots the 3D point cloud using the *pcshow()* function. (Note: this script was originally written to use MATLAB via the **Virtual Computing Lab** on campus)



3D point cloud of *The Digital Mr. Raymond* as viewed in MATLAB using the *pcshow()* function

Record a minimum 60 second video clip of yourself demonstrating the process of translating *.jpg* image files into a 3D point cloud. This should be recorded via your laptop and appropriate software (see Piazza post for suggestions) Be sure to highlight any interesting qualities of the 3D point cloud. Upload the video to your YouTube account, then insert the link in a *.pdf* file to be uploaded to Gradescope (Question #3).

Question #3

With your field deployable lidar operating as desired (i.e. successful completion of Question #1 and #2), head out on campus to **record initial data at your target**. Here we repeat the processes outlined in Question #1 and Question #2 at your target.

For this assignment, students are **required to map only one side of their target**, although you are encouraged to map as much of the target as possible. (A full map and corresponding 3D point cloud will be submitted with Assignment #7)

Once finished collecting data images, process the images and create a 3D point cloud of your target, as in Question #2.

To complete Question #3, perform the following:

1. Using your field deployable lidar system, head out to your target and **record a minimum of 20 data images for a minimum of 20 different IMU angles**. Feel free (and encouraged!) to record more than 20 data images/scans of the target, although **only one side of the target needs to be processed and submitted for this assignment**.
2. **Record a minimum 60 second video clip** of yourself at the target demonstrating the data acquisition process with your lidar. This should include video of you describing key features/attributes of the target, then of you scanning the target, recorded either via your cell phone camera, GoPro, and/or your RPi camera. Upload the video to your YouTube account, then insert the link in a .pdf file to be uploaded to Gradescope.
3. Using the *datageneration.py* and *3dcloud.m* scripts, process the data recorded at your target and plot the [x, y, z] points as a 3D point cloud. **Record a minimum 60 second video clip** of yourself demonstrating the process of translating .jpg image files into a 3D point cloud, recorded via your laptop. Be sure to highlight any interesting qualities of the 3D point cloud. Upload the video to your YouTube account, then insert the link in a .pdf file to be uploaded to Gradescope.

Note 1: consider using the video clips for your semester project video!

Note 2: food for thought: how well does your lidar data align with reality? Consider bringing a ruler/tape measure with you to your target to compare measurements: lidar data vs. hand measurements.

Finally, to complete Assignment #6:

Upload a **single page .pdf** to Gradescope with the links to each YouTube video recorded within this assignment. Label each link such that Dr. Mitchell understands which videos correspond to which questions.