UNIVERSITY OF MARYLAND

ENME 489Y – Remote Sensing: Spring 2018
Department of Mechanical Engineering

Due Date	Friday, April 20th, 2018
Submission Information	• Compile links to each YouTube video into a single .pdf file and upload the .pdf to Gradescope by 11:59pm

Completed 3D point cloud of lidar data

***General Reminder*: continue recording pictures & videos of your project to edit/stitch together in your semester project video (due May 15th) and final project presentation (begins May 1st)!**
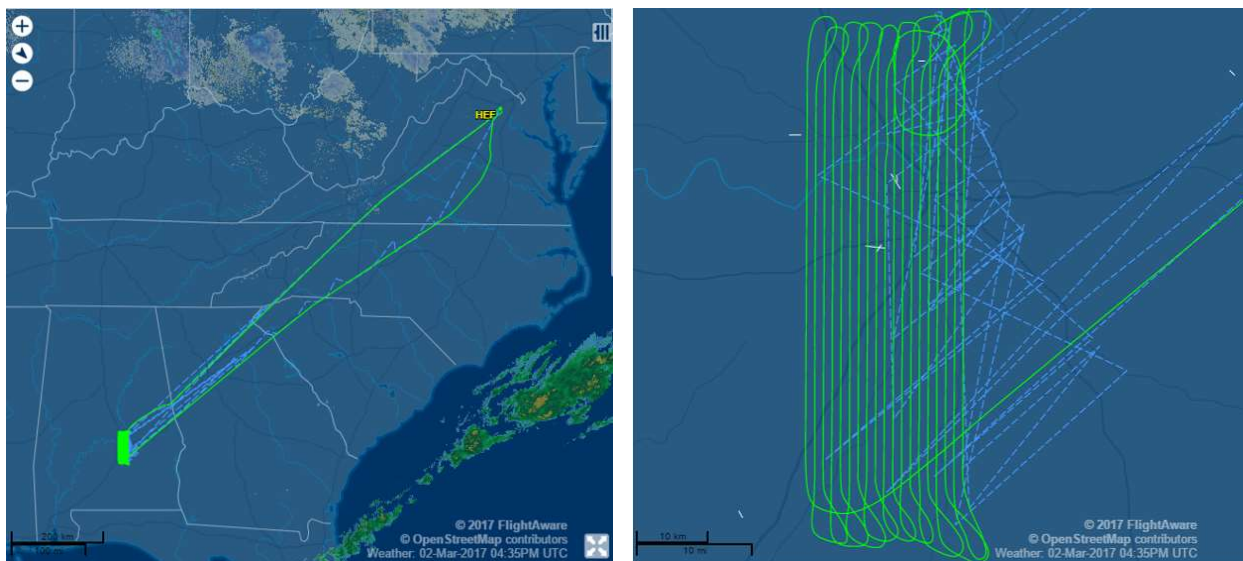
In Assignment #5 we integrated, aligned, and calibrated our field deployable lidar systems. In Assignment #6 we recorded a preliminary dataset in a controlled environment to ensure our lidar systems were functioning as intended, then headed out on campus to begin mapping our targets.

In this assignment we head back out into the field to record all of the data required to construct a 3D point cloud of our target, then process the data into a final point cloud.

Question #1 (40 points)

The goal of this assignment is to collect and process the lidar data required to construct our completed 3D point cloud. Let's begin by asking: "what is the optimum approach to collecting our data?"

Recall from lecture that, for airborne lidar systems, the sensor is flown onboard an aircraft traversing parallel North-South lines. The swath of the lidar scans typically has 10-20% overlap, which assists in the process of stitching the data together.
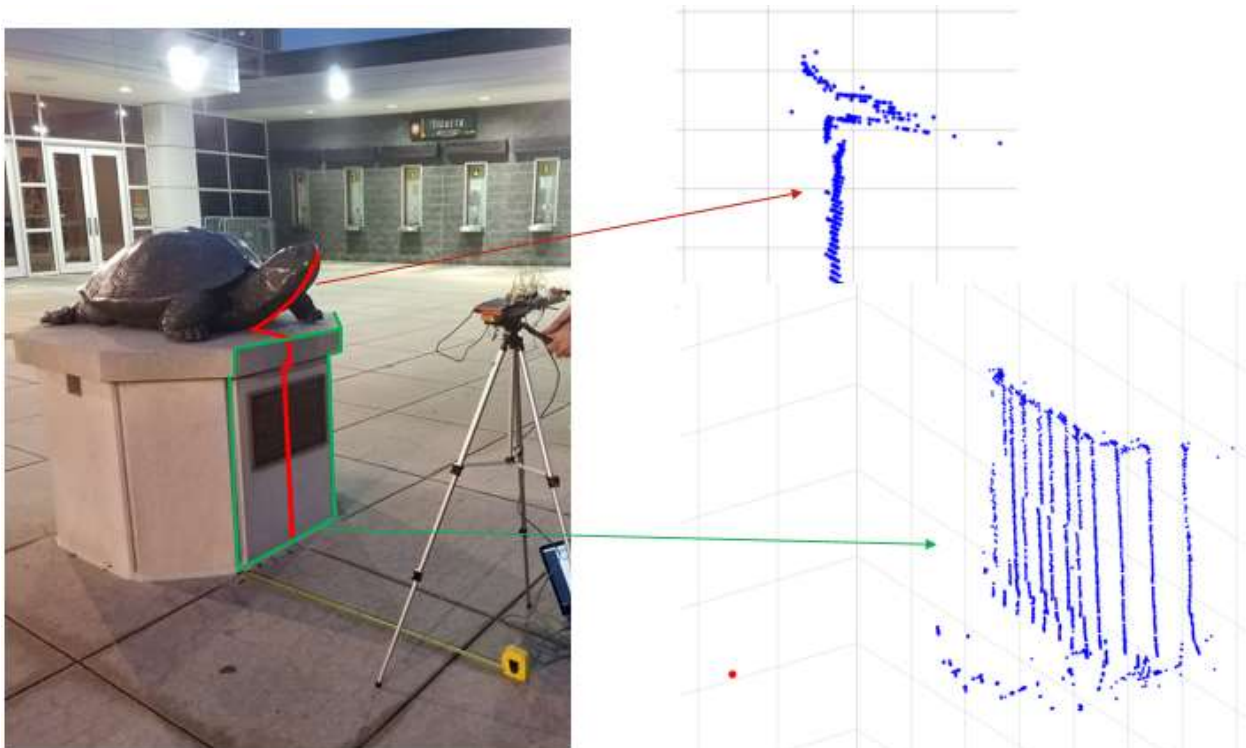

For airborne lidar systems, range data is typically collected while "mowing the lawn," or flying a series of parallel North-South lines above the target of interest

Based on the size and geometry of your target, you may need to collect data in a similar fashion – scanning the lidar up/down, moving the lidar a few inches/feet in one direction or the other, scanning the lidar up/down, etc. Thus it is important to give proper thought and attention to the question of "what is the optimum approach to collecting my data?" prior to heading back on campus.

Note 1: since everyone in 489Y has a different target on campus, the answer to "**how *much* data** is required to make a complete 3D point could?" is subjective. The spirit of the course project is to create a full (all sides) 3D point cloud of your target. In this sense, the more data in the point cloud, the better…but Dr. Mitchell understands you may be limited by restricted access from one side or another, bright lighting from one side or another, etc. Such limitations should be clearly addressed in this assignment as well as your **final project video (due 5pm May 15th)**.

Note 2: Depending on ambient lighting conditions at your target, you may be required to create multiple *colorpicker.py* color masks, one for each angle/swath.

A 489Y student "mowing the grass," i.e. scanning Testudo at Xfinity in Spring 2017, here using the single-beam version of the lidar system

Head out on campus and fully map your target, then process the data from each scan in Python. The *datacollection.py* and *datageneration.py* scripts required to complete the acquisition and processing are available on the course GitHub:
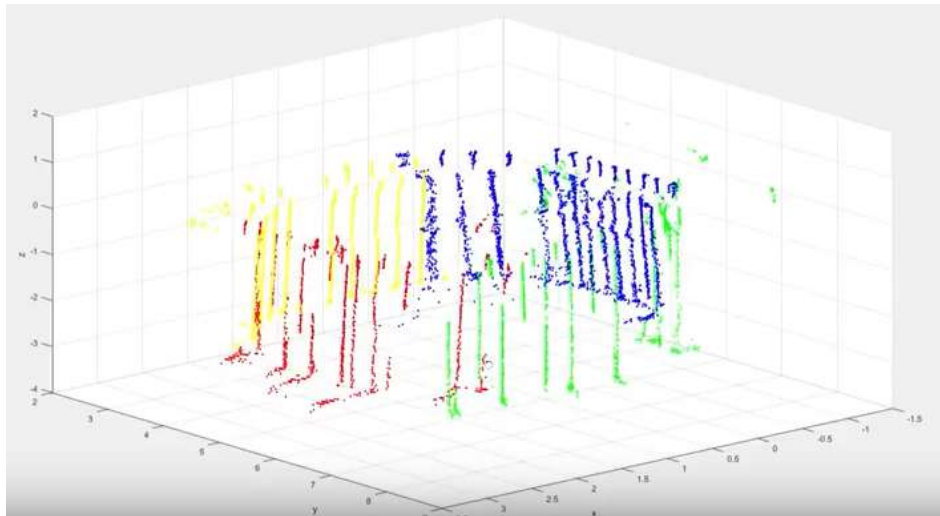
https://github.com/oneshell/enme489y

Generate a unique .txt file for each scan (scanning the lidar up/down), then in MATLAB manipulate and combine the .txt files into a single 3D point cloud. Since each student's target is different, **there is no central MATLAB script for this assignment**; each student must manipulate and combine their .txt files.
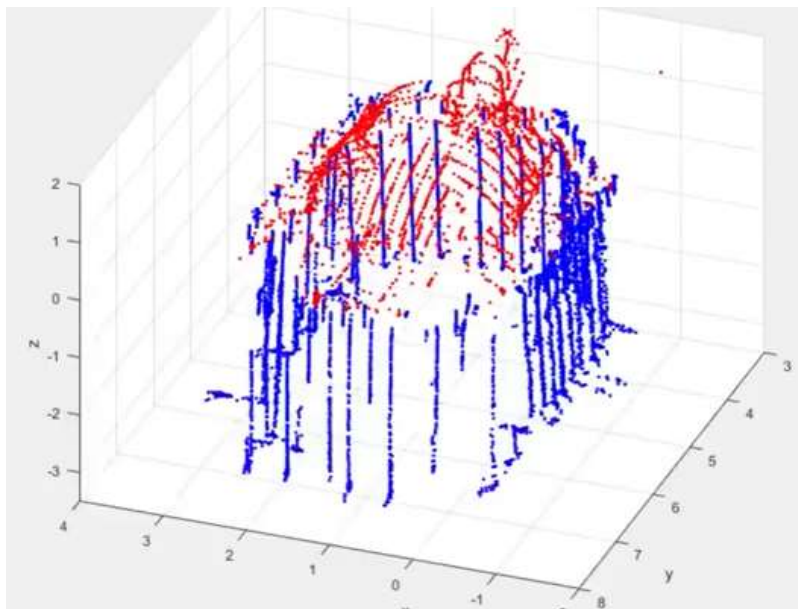
Note 3: **Feel welcome and encouraged to modify** any/all of the Python scripts used for data collection.

To view an example of a previous 489Y student scanning their target and creating a 3D point cloud, zoom to the 5:35 minute mark of the following video:

https://www.youtube.com/watch?v=xOO9d_6w2PE&index=7&list=PLekqOMAzgrTRP6Ms7wl37-2lKjU92tqnL

Plot of four .txt files representing scans of Xfinity Testudo, one from each side of the statue, combined into a single 3D point cloud. Each color (R, G, B, Y) represents a different scan and corresponding .txt file

Final 3D point cloud of Xfinity Testudo, color-coded to distinguish Testudo (red) from the base (blue)

Feel encouraged to **play around with filtering of the data** as well in an attempt to "clean up" your final 3D point cloud. Ambient light can often make its way through the color mask and will manifest itself as noise in the 3D point cloud. This filtering can be accomplished in a variety of ways. For example, passing your data through a for() loop that only plots those points with proper [x ,y, x] coordinates.

To complete Question #1, perform the following:

1. Using your field deployable lidar system, head out to your target and **record all data images required to generate a full 3D point cloud**. The more data, the better! **Data from as many sides of the target as possible need to be processed and submitted with 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. **Be sure to discuss any limitations on data acquisition**, such as limited access to one side of the target, significant ambient lighting, etc. 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, along with any modifications to the scripts you deem necessary, process the data recorded at your target and plot the [x, y, z] points as a completed 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, in particular **how you stitched together all of the scans**, 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.

Finally, to complete Assignment #7:

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.

Looking Ahead: Final Project Presentations will begin on Tuesday May 1st. While the order of presentations will be randomly selected and posted on ELMS, **all students are required to attend all four presentation lectures** (May 1, 3, 8, 10). Additional information will be posted on ELMS in the coming days regarding requirements for the presentations.