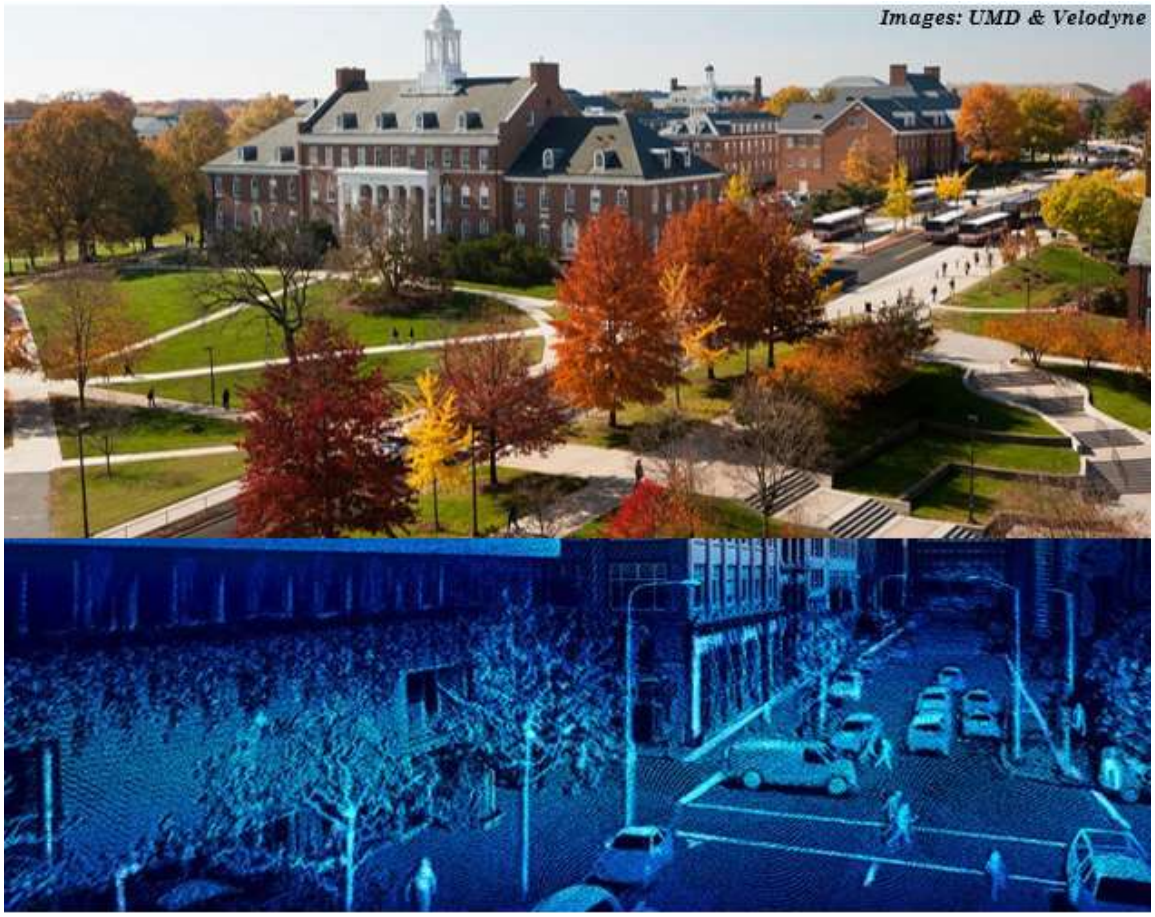
ENME 489Y – Remote Sensing: Spring 2018 Project Requirements

Department of Mechanical Engineering



This course explores the fundamentals of remote sensing techniques including light detection and ranging (lidar), radar, and digital image processing in the context of emerging technologies such as autonomous navigation and terrain modelling. The course requires completion of a semester-long project employing the course material, computer-aided analysis and design tools, rapid prototyping, and data collection & processing.

This semester, each student is required to design, integrate, and test their own lidar sensor, the architecture for which is based on the Raspberry Pi and OpenCV platforms. Each student is required to identify a target of interest on the campus of the University of Maryland and deploy their lidar sensor to collect 3D measurements of the target. Each student will process their 3D data to generate a point cloud of the target. In time, each student's point cloud will be compiled into an ever-evolving 3D map of campus. Finally, each student is required to create a solid model file of the target, derived from the 3D point cloud, and may 3D print a physical copy of the model for potential extra credit.

Specific project details are provided in the following pages. As always, please do not hesitate to contact Dr. Mitchell as questions or concerns arise and please: **have fun**!

Due: Tuesday 5/14/18 via email submission to Dr. Mitchell, NLT COB (**5pm** local time). Include in the email a link to your YouTube video, and attach to the email a single .ppt file (or provided a link for download). Name your .ppt file *lastname_firstname_ENME489Y.ppt*.

To successfully complete the course project, each student is required to complete and submit the following:

-One (1) Interim Project Presentation, in the form of a .ppt file
-One (1) Final Project Presentation, in the form of a .ppt file
-One (1) YouTube video
-Three (3) Monthly Progress Reports

Each student will be graded out of a maximum of 100 points, allocated as follows:

Interim Project Presentation (10 pts)

1. Due the week of March 13th.
2. Maximum 5 slides permitted per student.
3. Presentation should cover (at a minimum):
    a. Description of target and motivation for selection
    b. Lidar sensor design and integration
    c. Sensor calibration
    d. Preliminary range data

Final Project Presentation (24 pts)

1. Delivered the week of May 1st.
2. Maximum 5 minutes permitted per student.
3. Presentation should cover (at a minimum):
    a. Brief description of target and lidar sensor design
    b. Collection and processing of range data
    c. Generation of 3D point cloud and 3D mesh

YouTube Video (60 pts)

A key component of the engineering practice, admittedly often insufficiently addressed in undergraduate curricula, is the link between technical activities and communications/marketing. Often the most successful engineers are those who not only design and deliver cutting edge technologies, but perhaps more importantly effectively communicate technical ideas and relevant financial/societal impacts to larger audiences. In this spirit, each student is required to create and upload a video to your individual YouTube account and provide the link to it (the video can remain unlisted, which means only people with the link can see it, if you wish). Your video (in its entirety, or a portion)

may be showcased on the monitor near the DeWalt Seminar & Conference rooms in Martin Hall. So, spend some time on the video and show off your work! **If nothing else, have fun with the filming process!**

The video must be no less than five (5) minutes in length and cover the following:

1. Overall
    a. Minimum five (5) minutes in length.
    b. Visual and audio clarity.
2. Introduction
    a. Background of the project.
    b. Description of your target of interest, including motivation for selection.
3. Sensor Design
    a. Summary of the key technical aspects of the lidar sensor.
    b. This section should demonstrate your understanding of the fundamentals of remote sensing, as applied to your lidar sensor and selected target.
    c. Sensor test/calibration activities.
4. Sensor Deployment
    a. Collection of range data using your lidar sensor at the target of interest.
    b. Description of any challenges encountered (e.g. technical, weather-related, etc.) and how you overcame those challenges to acquire data.
5. Data Processing
    a. Processing of lidar range data and creation of 3D point cloud and mesh.

Suggestion: use your phone to record 30-60 second video clips throughout the semester, then stitch them together towards the end of the semester. *General theme of engineering documentation*: take images and video all the time, as you go, then edit as desired later on. Always better to cut out extra material than to say "I wish I had an image of that…!" at the conclusion of the project.

Examples of previous student videos:
https://www.youtube.com/channel/UCS06KXwLJU6nicU4abtU9Kg

*Please watch immediately: **Vertical Video Syndrome - A PSA**
https://www.youtube.com/watch?v=Bt9zSfinwFA

<u>3D Printed Model</u> (Maximum 5 pts extra credit)

Each student may 3D print a solid model of their target (derived from the 3D point cloud of your collected lidar data), to be delivered to Dr. Mitchell for a maximum of 5 pts extra credit.

Students are encouraged to consult with the folks at Terrapin Works (https://terrapinworks.umd.edu/) throughout the semester, who provide a fantastic resource for students both in terms of design for 3D printing as well as a variety of 3D printing services.

Monthly Progress Reports (6 pts)

In professional engineering practice, it is commonplace for employees to generate Monthly Progress Reports (MPR) for the tasks they are supporting. These reports are a means of communicating technical challenges and accomplishments, schedule impacts, and overall progress to the customer. They also serve to time-stamp project progress and are often referred to down the road when questions arise.

In this spirit, students are required to complete the ENME 489Y version of Monthly Progress Reports during the semester project. Each report should be delivered to Dr. Mitchell as a single email. Include in the email:

1. 1-2 paragraphs briefly describing overall progress, any obstacles/issues encountered and how Dr. Mitchell can help to resolve, and planned work for the next reporting period.
2. One (1) hashtag-worthy image highlighting a key aspect of your project experience for the month.

Monthly Progress reports are due via Gradescope by COB on the deadlines listed below:

MPR #1 due February 28
MPR #2 due March 31
MPR #3 due April 30

Ground Rules for Semester Projects

So that everyone is on the same page from the beginning, please understand that:

1. Students are encouraged to work together and collaborate on their semester projects; however, each student must integrate **their own** lidar sensor, map their own target of interest, and produce their own 3D point cloud and mesh.

2. Your work this semester will live on at the University after you graduate. Take ownership of and pride in your work! Feel encouraged to continually offer feedback to Dr. Mitchell on how any/all aspects of the project could be improved in future semesters.

3. One of the primary motivations for this class is to have a **positive experience** and gain **hands-on experience** in a new, innovative area of engineering. If you find yourself struggling or not having a positive experience, talk with Dr. Mitchell asap. You are his #1 priority and he will work to see to it that you have a good time!