UNIVERSITY OF MARYLAND

GEOG660 - Advanced Remote Sensing Using LiDAR

Winter 2021

Course Dates:	**11/30/2021 to 2/19/2021**	**Lecturer:**	**Rejanne Le Bivic, Ph.D (she/her)**
TA:	Xueyuan Gao	**Email:**	rlebivic@umd.edu
Lectures:	Monday, 5:30-8p	**Office Hours:**	Friday, 3-4pm
Lab Sessions:	Tuesday, 5:30-7:30p	**Classroom:**	Online (WebEx)

1 Course Contents

Description:

This course will expand on remote sensing concepts with a focus on light detection and ranging (Lidar) technology. Lidar, also known as laser scanning, is an active remote sensing tool that produces high-resolution point clouds. It is widely used today in many different fields, ranging from archeology and urban management to forestry. Lidar is being applied to problems such as terrain modeling, biomass estimation, change detection, feature extraction, and measuring tree canopy. This course will cover the fundamentals of Lidar, explore current developments in Lidar technology, and discuss different applications where Lidar is being used. Students will get hands-on learning about Lidar data management, processing, and analysis.

The format of this course will consist of lectures, lab assignments, readings, and a final project. In regards to the current outbreak situation, the lectures will be presented online via Google Meet. All lectures involve the interaction between students and instructor in real-time. Lectures will be archived into videos which will be made available on ELMS. Please note that video archives are only intended for occasional or backup use in case students have to miss lectures due to personal, business, or medical reasons. Real-time, online participation is strongly recommended. The Lab assignments will also be posted on ELMS.

Objectives:

1. Understand the theory of Lidar technology
2. Know all the platforms used with Lidar sensors
3. Discover several applications of Lidar
4. Being able to download Lidar and process it using ArcGIS and LAStools
5. Have a critical mind regarding the data
6. Being able to formulate a scientific question and answer to it using Lidar data
7. Being able to communicate scientific results

Prerequisites: Students should be **proficient in GIS** and have taken at least an introductory course in remote sensing (GEOG652: Digital Image Processing and Analysis). It is also helpful to have some background in modeling (GEOG654: Spatial Modeling) and programming using Python (GEOG656: Programming and Scripting for GIS) but those are not mandatory.

Main References: There is **no required textbooks**. The following is a list of useful resources, additional readings will be posted on ELMS:

- Pinliang Dong, Qi Chen 2018, *LiDAR remote sensing and applications.*
- Heritage, G. and A. Large. 2009, *Laser Scanning for the Environmental Sciences.*
- Shan, J. and C. K. Toth. 2008, *Topographic Laser Ranging and Scanning.*
- Keranen, K. and R. Kolvoord. 2015, *Making Spatial Decisions Using GIS and Lidar: A Workbook*.

Other Information on the course contents:

- During the first Lecture we will have a look at the ELMS platform to make sure that you make the most of the platform, but I encourage you to get accustomed to it the few days before the first Lecture.

2 Assignments

Grading Structure:

Assignment:	Percentage %
Lab	70
Final Project:	20
- proposal	(5)
- poster and discussion	(15)
Participation	5
Weekly quizzes	5

Lab Assignments: There are a total of seven (7) lab assignments. The due date will be specified in the lab document and will usually be the Friday the week after the lab, 10 full days after the Lab. Late submission of lab reports may result in a deduction of points. However, in some situations (e.g. medical or family emergency), extension is possible if you contact the instructor before the due date.**All labs must be completed by the end of the quarter**.

Final project: A final project is required to complete this course. It will provide students an opportunity to work on a small project involving Lidar that is closely related to their area of study. The project must be carried out individually and independently. The project will consist of a (1) proposal, (2) poster, and (3) presentation. Examples:

- Using Lidar data as high-resolution input for a spatial model
- Producing digital surface models or digital terrain models
- Creating canopy height models or other forestry metrics
- Comparing Lidar data to other remotely sensed data

- Extracting height and boundary information to create a 3-D city model
- Calculating the change in elevation before and after an event

Quizzes: There will be one quiz for each Lecture, it will be available the day of the Lecture and all the quizzes will have to be completed by the end of the Term. Those quizzes are questions related directly to the Lecture, you will be able to find the solutions in the Lectures slides. Their purpose is to ensure that you follow the Lectures, either live or in an asynchronous way. You will have three attempts for each quiz and the best grade will be automatically kept.

Participation: The Participation grade will reflect on your general participation during the term. In particular, you will have two (2) occasions to participate:

- All the students will have to post the Poster of their Final Project in the Discussion boards and you will be given time to comment on each other's work
- At the end of the Term I will ask you to complete a short assignment about what you learned during the course.

Grading Scale:

Range:	100%	92-100%	87-92%	80-87%	77-80%	70-77%	67-70%	61-67%	<61%
Grade:	**A+**	**A**	**B+**	**B**	**C+**	**C**	**D+**	**D**	**F**

Grading Details: For each Lab, the breakdown of the grading will be explicit. You will usually receive the grade for your Lab Assignment one (1) week after the due date for this assignment. Due to the circumstances I will be more flexible than usual on the due date for the assignment but I encourage you to stay on track and submit them regularly. For any work you can't submit on time you should send me an email prior to the due date so we can discuss it. Any formal grade disputes must be submitted in writing (email) and within one week of receiving the grade.

3 Technical Details

Software: You can use either a PC or Mac to access ELMS. Whichever you choose, it should be equipped with headphones and microphone. You should also have the following plug-ins installed: Java, Real Media, Flash Player, and Quicktime.
The following software will be utilized during this course:

- ESRI ArcGIS 10.X
- Python 2.7
- LAStools (https://rapidlasso.com/lastools/)
- CloudCompare (http://www.danielgm.net/cc/release/)

The software required for this class is ESRI ArcGIS 10.X (ArcInfo) which is available in the open lab (located in 1136 and 1138 LeFrak Hall) and in the VMWare. If you need a personal copy of ArcGIS for your computer, please contact me by e-mail before class. Note: The free software that comes in books and other venues does not have the ArcInfo license and cannot be used to complete most labs.

Copyright: Within our class, students may work together to review class notes and lab assignments. However, **labs must be done individually**. Students must turn in their own work without assistance from another student. When refering to, summarizing, paraphrasing or quoting a source, please refer to them properly by adding a reference list to your assignment. Don't copy paragraphs of your sources but rephrase any information that is important for your assignment.

Class Attendance and Environment: You are strongly recommended to attend every lecture in real time. Our class will meet using **WebEx** and the lecture will be recorded and archived on the ELMS-Canvas platform. During the live lecture you will be able to ask questions. You can either participate using your webcam or not, this totally is up to you. I will encourage you to turn on your webcam if you are willing to do so, to create a more welcoming and cordial environment. Just remember that the lecture will be recorded (and only use for the purpose of this class). I will remind you those details at the beginning of each lecture. You will usually receive the link/invitation for the next Lecture the day before the lecture at the latest.

Due to the circumstances, the Lab session will be shorter than the 2h, because it is expected that you use those two hours to complete the lab on your own. For each lab you will have a demonstration that will last between 15 and 30 min.

It is important to recognize that the classroom is an environment that requires respect for all participants. Therefore, students are expected to conduct themselves in a considerate manner.

Disabilities and Religion: Any student with a disability is encouraged to meet with the instructor privately during the first week of class to discuss accommodations. I will make every effort to accommodate students who are registered with the Disability Support Services (DSS) Office and provide a DSS accommodation form.

Please refer to the Online Undergraduate Catalog Policy on Religious Observance.

Academic Integrity: The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets the standards for academic integrity at Maryland for all undergraduate and graduate students. As a student, you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

Names/Pronouns and Self-Identifications The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Course Evaluation: Please submit a course evaluation through CourseEvalUM in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to CourseEvalUM is confidential. Campus will notify you when CourseEvalUM is open for you to complete your evaluations for fall semester courses. Please go directly to the Course Eval UM website to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

4 Communication

Communication:

Email Since the course is now fully online, the emails will be our main way to communicate. You can either email me directly at rlebivic@umd.edu or use the email link in the sidebar in your ELMS platform. I usually reply within 24h.

Online Office Hours and Appointments I will have online Office Hours on Fridays, 3-4pm. I will be available and will send you the link every Friday. In addition to those Office Hours, I encourage you to reach out and request an individual appointment if you have specific questions about the Labs or the Lecture. I am very flexible on the timing of those appointments and can meet from 7am to 10pm depending on your needs.

Discussion Board The discussion board is a place on the ELMS site for you to visit your classmates. This is an open forum for discussion about course material and for casual conversation. We encourage any general questions about the course material or lab assignments to be posted here so that students can help learn from each other. We will try to help answer any course-related questions that are posted here.

5 Course Schedule:

This schedule may be adjusted. Changes will be announced and posted on ELMS and an updated version of this Syllabus will be poster on ELMS as well.
All work must be submitted by February 19th., 2021.

Week	Date	Topics	Lab #	Lab due	Final project
1	**11/30**	Introduction to Lidar Lidar Data Formats	**1**	**12/11**	-
2	**12/7**	Lidar Data collection Lidar Data processing ArcGIS Tools and LAStools	**2**	**12/18**	
3	**12/14**	Digital Elevation Models Digital Terrain Models Digital Surface Models	**3**	**1/1**	
4	**12/21**	Bathymetric Lidar Alternative Lidar platforms Lidar data fusion	**-**		Proposal out
5	**12/28**	Winter break			
6	**1/4**	Lidar accuracy: change detection	**4**	**1/15**	Proposal due
7	**1/11**	Lidar classification; Feature extraction ArcGIS tools and LAStools	**5**	**1/22**	
8	**1/18**	Applications I: hydrology ecology, forestry	**6**	**1/29**	
9	**1/25**	Application II: urban studies Drone laser scanning Atmospheric Lidar	**7**	**2/5**	
10	**2/1**	Full waveform Lidar Lidar processing pipelines			
11	**2/8**	Multispectral Lidar Photon counting Lidar; Flash Lidar			Posters online
12	**2/15**				Presentations