SVT 532 Survey strategies in use of Lidar

Number of credits: 3

Syllabus Spring 2020

Instructor: Raymond J. Hintz
316 Boardman Hall
207-299-5572 (ray.hintz@maine.edu)
office hours: 11:30-12:30T,12:00-1:00W,11:00-12:00R (or email questions or to set an appointment – email and you get your answers fast)

Prerequisites: prior coursework in photogrammetry/remote sensing and GPS

Required Texts:

(1) Renslow, Michael, ed. 2012. *Airborne Topographic Lidar Manual.* Bethesda, MD. American Society for Photogrammetry and Remote Sensing. ISBN 1-57083-097-5. (only suggested)
(2) Course Handouts (provided on internet)

Reference Texts:

(1) McGlone, J. C., ed. 2004. *Manual of Photogrammetry.* 5th edition. Bethesda, Md.: American Society for Photogrammetry and Remote Sensing. ISBN 1-57083-071-1.
(2) Shan, J. and C. Toth, ed. 2008. *Topographic Laser Ranging and Scanning, Principles and Processing*. Boca Raton, FL. Taylor & Francis Group. ISBN 9781420051421.
(3) Wolf, P. and B. Dewitt. ed. 2000. *Elements of Photogrammetry*, 3rd edition. Boston. McGraw-Hill. ISBN 0-07-292454-3.
(4) Van Sickle, J., ed. 2008. *Practical GPS for Surveyors,* Taylor and Francis Group, ISBN 0849391954

Student Learning Outcomes
At the end of SVT 532 students can
(1) understand the differences in current Lidar sensing devices and how to apply them to various survey situations.
(2) determine the control requirements of various Lidar applications.
(3) integrate both ground and airborne GPS-IMU to enhancing Lidar solutions.
(4) optimize identification of invalid Lidar observations.
(5) optimize break line extraction from Lidar information.
(6) utilize .las format across industry standard software.
(7) utilize Lidargrammetry as an alternative to stereo vision in photogrammetry.
(8) develop accuracy standards for Lidar data.
(9) apply return number to effective feature extraction.
(10) optimize corridor mapping project field collection.

Course overview: Lidar (Light Detection and Ranging) is an optical remote sensing technology that uses laser pulses to determine distance between the sensor and a surface or object. In the last 10 years, lidar has emerged as one of most important sources of data for topographic mapping, vegetation analysis, and 3D modeling of urban infrastructure. Course topics will include types of Lidar sensors and their applications; integration of GPS-IMU with Lidar; calibration; algorithms for elimination of non ground Lidar shots; automated break line extraction processes; ground based mobile Lidar survey issues;

Integration of survey control into Lidar data sets; accuracy assessment of overlapping scanned data; understanding the industry standard .las format; integration with other types of survey information; Lidargrammetry; classifying Lidar data by return number and layer; procedures for accuracy assessment; corridor mapping

Course Delivery: Lectures On-line via **https://bb.courses.maine.edu/**; lectures are captured and can be replayed; all other material is on Blackboard (syllabus, handouts, exams, etc.)

Measurement of outcome: Examination and completion of homework

Course Grading:

3 exams @ 100 pts. each	300
10 homework @ 30 pts. each	300
TOTAL	600

Generally A is 90%+, B is 80-89, C is 70-79, and D is 60-69.
Each exam is 20 multiple choice questions that will be taken via the Internet outside of class time in a designated 3 hour time frame. No final exam is given.

NOTE: Lateness on homework is not allowed unless prior arrangements have been made. If homework is turned in late it receives no credit.

Week #Topic

1 Basic Lidar concepts; different type of Lidar sensors and their applications
Homework #1: Lidar sensor types and applications

2 Control requirements of Lidar; Integration with GPS-IMU; types of targets for corridor projects; GPS-IMU processing; Mathematical models for fitting external control
Homework #2: GPS-IMU and external control for Lidar applications

3 Lidar calibration; elimination of artifacts and anomalies in Lidar data
Homework #3: Calibration of Lidar

4 Key design components of lidar sensors, including single-return, multi-return, waveform, photon-counting, multispectral, and hyperspectral
Homework #4: Applying sensor type to application

5 Manual classification of Lidar data; hydrologic enforcement; automated terrain model extraction
Exam #1

6 Lidargrammetry (courtesy Cardinal Systems http://www.cardinalsystems1.net/#!vrlidar/csgh)
Homework #5 Lidargrammetry

7 Static ground based Lidar applications
no homework

8 Aerial Lidar applications
Homework #6: static vs. dynamic Lidar

9 Mobile Ground based Mapping
Homework #7: Corridor Mapping

10 Forestry applications
Exam #2

11 USGS Lidar specifications, CALTRANS Lidar specifications
Homework #8: Lidar standards

12 Data format standards - .las; .las into a CAD and GIS environment
Homework #9: Use of .las in surveying related softwares

13 Lidar image registration

Homework #10: Image registration
14 Review of the extended world of Lidar theory and applications; evidence of future advances in Lidar; Multiray photogrammetry as a Lidar alternative
Exam #3

- **Academic Honesty Statement:** Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

- **Students Accessibility Services Statement [This should be customized to include the instructor's name]:** If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with me (the instructor of the course) privately as soon as possible.

- **Course Schedule Disclaimer (Disruption Clause):** In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Observance of Religious Holidays/Events: The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from the class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.

Sexual Discrimination Reporting

The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell any of your teachers about sexual discrimination involving members of the campus, **your teacher is required to report** this information to Title IX Student Services or the Office of Equal Opportunity.

Behaviors that can be "sexual discrimination" include sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct, and gender discrimination. Therefore, all of these behaviors must be reported.

Why do teachers have to report sexual discrimination?

The university can better support students in trouble if we know about what is happening. Reporting also helps us to identify patterns that might arise – for example, if more than one victim reports having been assaulted or harassed by the same individual.

What will happen to a student if a teacher reports?

An employee from Title IX Student Services or the Office of Equal Opportunity will reach out to you and offer support, resources, and information. You will be invited to meet with the employee to discuss the situation and the various options available to you.

If you have requested confidentiality, the University will weigh your request that no action be taken against the institution's obligation to provide a safe, nondiscriminatory environment for all students. If the University determines that it can maintain confidentiality, you must understand that the institution's ability to meaningfully investigate the incident and pursue disciplinary action, if warranted, may be limited. There are times when the University may not be able to honor a request for confidentiality because doing so would pose a risk to its ability to provide a safe, nondiscriminatory environment for everyone. If the University determines that it cannot maintain confidentiality, the University will advise you, prior to starting an investigation and, to the extent possible, will share information only with those responsible for handling the institution's response

The University is committed to the well-being of all students and will take steps to protect all involved from retaliation or harm.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For **confidential resources on campus**: **Counseling Center: 207-581-1392** or **Cutler Health Center: at 207-581-4000**.

For **confidential resources off campus**: **Rape Response Services:** 1-800-871-7741 or **Partners for Peace**: 1-800-863-9909.

Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

For **support services on campus**: **Title IX Student Services: 207-581-1406**, **Office of Community Standards: 207-581-1409**, **University of Maine Police: 207-581-4040 or 911**. Or see the OSAVP website for a complete list of services.