AH2915 Laser Scanning Technologies, 7.5c

HT2019

Course PM

Topographic terrestrial and airborne lasers canning have become one of the most important geospatial data acquisition technologies. The laser scanning systems can collect accurate 3D data in large volumes in short time. Although the laser was invented in early 1960's, its use in for the mapping purposes was delayed several decades due to the lack of various supporting technologies. The present widespread use of laser scanning systems for topographic applications really began in mid 1990's.

This course gives you theoretical background about the data acquisition and processing procedures for terrestrial and airborne laser scanning, as well as practical experience with terrestrial laser scanning.

Intended learning outcomes

The overall goal is to give the students theoretical and practical knowledge about laser scanning measurement procedure, data processing and modelling. After the course the students should be able to:

1. Explain the principle for terrestrial and airborne laser scanning (TEN1)
2. Explain the principle of photogrammetric production of point clouds (TEN1)
3. Evaluate different methods for production of point cloud and choose an appropriate method for given application (TEN1, PRO3, LAB2)
4. Plan airborne laser scanning projects (TEN1)
5. Plan and perform terrestrial laser scanning projects (PRO3, LAB2)
6. Produce products from point cloud and assess their quality (LAB2, PRO3

Time schedule and content

(L – lecture, E – exercise)

	Date	Time	Room	Content	De
V35					
L1	26/8	8 - 10	BoraBora	Basic principles: laser, properties of laser beams, pulsed and continuous wave laser ranging, laser triangulation. Main parts of laser scanner instruments. Types of instruments.	
L2	27/8	10-12	Borabora	Transformations – direction cosine, Euler angles, quaternions.	
E1	29/8	13 - 17	M102	Determination of transformation parameters.	S
V36					
L3	2/9	10-12	Ocean	Surveying procedure for terrestrial laser scanning. Registration of multiple scans. Different methods for geo-referencing of terrestrial laser scanning data.	
L4	3/9	8 - 10	Pacific	Air-borne laser scanning. Principles, sensors and applications.	
E2	5/9	13 – 16	M102	Georeferencing of airborne laser scanning data	Sept
V37					
L5	9/9	10 - 12	Pacific	Inertial navigation and its application in georeferencing of laser scanning data.	
E3	10/9	9 – 12	M102	Introduction to Cyclone: Quick Start module (target based registration, modelling)	
E4	12/9	13 – 16	M102	Inertial navigation, help with home assignment	Sept 2
V38					

L6	16/9	10 - 12	Borabora	Point cloud from images	
E5	16/9	13 – 17	OUT	Data collection with drone	
E11	18/9	13 - 17	Arctic	Image segmentation using deep learning	
V39					
L7	23/9	10 – 12	Pacific	Georeferencing of ALS using GPS/INS combination	
E6	24/9	8 - 12 (group 1) 13 - 17 (group 2)	OUT	Terrestrial laser scanning - field measurements	
E7	26/9	13- 16	M102	Structure from motion, (software AGISOFT and Cloud Compare)	
V40					
L8	30/9	10 - 12	BoraBora	3D modelling: fitting geometric primitives, meshing, surface modelling	
L9	1/10	10 – 12	BoraBora	Visualisation of point clouds. Point cloud filtering and segmentation	
E8	3/10	13 - 16	M102	Project work	
V41					
E9	8/10	9 - 12	M102	Project work	
E10	10/10	13 - 17	Pacific	Project work presentations	

	18/10	14 - 18	Arctic	Exam	

Rooms Borabora and Pacific are located in Teknikringen 10B, ground floor, the corridor next to the lifts.

Structure of the course

The course is worth 7.5 credits, which corresponds to 5 weeks of work. During the course you will obtain both theoretical and practical knowledge and skills in laser scanning technology. The course activities consist of lectures (2 hours each), laboratory and project work – see the schedule above.

It is obligatory to attend the field measurements, other attendance in not obligatory. There are three computational laboratory works, for which you are supposed to write a report and one training exercise (Introduction to Cyclone) where you present the results on screen. You are supposed to write the reports and perform the training individually, but you are allowed to cooperate with your classmates.

The project work requires cooperation between the students, especially the field measurements. The data processing and project report writing can be done in groups of two students or individually.

The results of the project work will be presented orally. A part of project work is a seminar, where each student will prepare a presentation on a chosen topic. The students can pick a topic from the following list, but it is possible to choose a non-listed topic.

- Registration, georeferencing
- Instrument check and calibration
- Quality assessment of point clouds and 3D models
- Surface and 3D modelling
- Automatic feature identification and extraction
- Point cloud segmentation and classification
- Applications: tree detection, deformations monitoring …
- Photogrammetric methods of point cloud generation
- …

The presentation will be based on literature search and it should provide an overview of methods and solutions.

Deadlines

September 9: Submit report from E1 (Determination of transformation parameters)

September 19: Submit report from E2 (Georeferencing of airborne laser scanning data)

September 18: Choose a topic for seminar presentation

September 21: Submit report from E4 (Inertial navigation)

September 30: Submit report from E7 (Structure from motion)

October 20: Submit project report

October 25: Submit home assignment

Examination

To pass the course you must

- submit lab reports (and be approved)
- perform the project work, submit the project report and present the results
- prepare a presentation on a chosen topic. The presentation is based on research papers.
- to pass the examination, which consists of the home assignment and oral examination

Credits and grades

- LAB2 - Laboratory Work, 2.0 credits, grade scale: P, F
- PRO3 - Project, 3.0 credits, grade scale: P, F
- TEN1 - Examination, 2.5 credits, grade scale: A, B, C, D, E, FX, F

Grading criteria

A, B: submit all lab and project reports in time, No, or only minor corrections necessary. Answer correctly, or with minor uncertainties, all questions for written (home assignment) and oral examination.

C,D : submit most of the lab and project reports in time. Some corrections are necessary. Answer all questions for written (home assignment) and oral examination, several questions are answered

just partially or with uncertainties.

E, FX: submit all lab reports, larger corrections are necessary. Answer most of the questions just partially and or with greater uncertainty.

Literature

Jie Shan and Charles K. Toth (2009). Topographic Laser Ranging and Scanning Principles and Processing. (http://www.crcnetbase.com/isbn/978-1-4200-5142-1)

CRC Press 2009, Print ISBN: 978-1-4200-5142-1, eBook ISBN: 978-1-4200-5143-8 (http://www.crcnetbase.com/isbn/9781420051421?cookieSet=1)

HDS training manual. Leica Geosystems 2005.

Articles on laser scanning

http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XXXVIII-5-W12/ (http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XXXVIII-5-W12/)

Teacher

Milan Horemuz, PhD., **horemuz@kth.se** (mailto:horemuz@kth.se), 08-790 73 35