Course syllabus

Faculty of Technology
Department of Forestry and Wood Technology

4TS019 Skogsbrukets digitalisering, 15 högskolepoäng
Digitalisation in Forestry, 15 credits

Main field of study
Forest and Wood Engineering

Subject
Forest Science

Level
Second cycle

Progression
A1F

Date of Ratification
Approved 2022-12-19.
The course syllabus is valid from autumn semester 2024.

Prerequisites
General entry requirements for second-cycle studies and specific entry requirements:

4TS022 Forest Ecosystem Services or 4TS016 Silviculture or equivalent

English 6 The English language requirement is considered fulfilled for those who have a bachelor's degree of 180 credits from a Swedish institution or 120 credits of completed studies at Linnaeus University (LNU). English requirements can also be met through other specified means, as outlined on antagning.se or universityadmissions.se. For admission to the courses included in the program, the specific eligibility requirements stated in each individual course syllabus apply.

Objectives
Knowledge and Understanding

- Describe the theoretical and physical foundations of various remote sensing techniques such as satellite images (optical, radar), laser scanning, and digital photogrammetry.
- Explain the objectives and methods for data collection via remote sensing and field inventories to gather information on forest conditions and changes (in terms of ecosystem services, forest damage, traceability, and conservation considerations, etc.).

Skills and Abilities

- Apply the processing steps in remote sensing and field inventory in terms of data collection, processing, and analysis.
- Apply various methods for estimating forest variables, explain the methods' potential and limitations, and evaluate their estimation accuracy.
- Independently design and conduct an advanced forest inventory with related analysis for companies operating in the Swedish forestry sector (taking into account ecosystem services, forest damage, traceability, and conservation considerations, etc.).

Judgement and Approach

- Critically evaluate the forestry usefulness of remote sensing from various platforms (satellite, aircraft, helicopter, drone, ground-based systems) and sensor types (optical, laser, radar), individually and in combination, in terms of application, scale, data quality, and cost.
- Identify development trends in remote sensing and forest inventory in Sweden and internationally, in relation to the global sustainability goals concerning forests.

Content

The course focuses on theory through lectures and literature and provides practical skills through, for example, computer exercises within forest remote sensing and forest inventory. An important part concerns how different data sources are integrated for use in various forestry applications.

The course content includes both the individual company's need to estimate forest conditions and changes through remote sensing, and how remote sensing is used for global monitoring and assessment. The course also provides knowledge and skills to independently design and carry out an advanced forest inventory with related analysis for companies within Swedish forestry.

Through varied learning activities and contacts with representatives from the forest sector and international experts, the student develops skills in critical thinking, practical problem solving, and oral and written communication.

Themes addressed include:

- Introduction to forest remote sensing
- Theoretical/physical foundations of remote sensing
- Overview of platforms and sensors for remote sensing
- Methods for geometric correction and radiometric calibration of remote sensing data
- Methods for estimating forest variables

- Designing and conducting an advanced forest inventory
- Evaluation methods for remote sensin
- Traceability of forest raw materials and products
- Digital monitoring of environmental considerations in forestry

Type of Instruction

Teaching consists of lectures, seminars, learning activities (written assignments, production of information materials, discussions), and practical exercises involving representatives from the forest industry and authorities. The course includes guest lectures by international experts. Students work both individually and in groups. Mandatory elements are a final seminar and submission of assignments. The course is given in English, but elements and assessment can in some cases also be carried out in Swedish.

Examination

The course is assessed with the grades U, 3, 4 or 5.

Grading is based on results from submitted assignments (5 credits, U/G) and a project work (10 credits, U, 3, 4, 5).

Resit examination is offered in accordance with Linnaeus University’s Local regulations for courses and examination at the first- and second-cycle levels.
In the event that a student with a disability is entitled to special study support, the examiner will decide on adapted or alternative examination arrangements.

Course Evaluation

A course evaluation should be conducted during the course or in connection with its conclusion. The results and analysis of the completed course evaluation should be promptly communicated to students who have completed the course. Students participating in the next course instance should be informed of the results of the previous course evaluation and any improvements that have been made, no later than at the start of the course.

Required Reading and Additional Study Material

Bohlin, J., Wallerman, J., and Fransson, J.E.S. (2012). Forest variable estimation using photogrammetric matching of digital aerial images in combination with a high-resolution DEM. Scandinavian Journal of Forest Research, 27(7), 692-699. https://doi.org/10.1080/02827581.2012.686625

Ceccherini, G., Duveiller, G., Grassi, G., Lemoine, G., Avitabile, V., Pilli, R., & Cescatti, A. (2020). Abrupt increase in harvested forest area over Europe after 2015. Nature, 583, 72-77.

Nilsson, M. et al. (2017). A nationwide forest attribute map of Sweden predicted using airborne laser scanning data and field data from the National Forest Inventory. Remote Sensing of Environment, 194 (2017), 447–454.

Rodríguez-Veiga, P. et al. (2019). Forest biomass retrieval approaches from earth observation in different biomes. International Journal of Applied Earth Observation and Geoinformation, 77, 53-68. https://doi.org/10.1016/j.jag.2018.12.008

Santoro, M., Cartus, O., Fransson, J.E.S., and Wegmüller, U. (2019). Complementarity of X-, C-, and L-band SAR backscatter observations to retrieve forest stem volume in boreal forest. Remote Sensing, 11(13), 1-25. https://doi.org/10.3390/rs11131563

Santoro, M., Eriksson, L.E.B., and Fransson, J.E.S. (2015). Reviewing ALOS PALSAR backscatter observations for stem volume retrieval in Swedish forest. Remote Sensing, 7(4), 4290-4317. https://doi.org/doi:10.3390/rs70404290