



GSForest PhD course

Physical models in remote sensing (1.5 ECTS)

October 9-11, 2007, Gardenia at the University of Helsinki Viikki campus, Koetilantie 1, Helsinki

Teachers: Dr., Senior Research Associate Tiit Nilson, Tartu Observatory, Estonia; Prof., Senior Research Associate Andres Kuusk, Tartu Observatory, Estonia; Research Prof. Jouni Pulliainen, Finnish Meteorological Institute; Doc., Special Research Scientist Sanna Kaasalainen, Finnish Geodetic Institute

Description and Timetable

(lectures daily 9:15 - 16:15, lunch 12:00-13:00):

Tuesday and Wednesday, October 9 – 10

Physical basis of optical remote sensing and characterizing vegetation, especially forests, Tiit Nilson and Andres Kuusk

- Physical basis and concepts used in remote sensing. Radiative transfer problem.
- Solar radiation and its transfer through the atmosphere.
- Radiative transfer in vegetation. Geometric-optical characterization of vegetation. Gap probability and clumping. Bidirectional gap probability and the hot spot. Phase function of elementary layer.
- Leaf optical models.
- Soil reflectance models.
- Ground and canopy reflectance models.
- Direct and inverse problem.
- Demonstration and practical work.
- Radiative transfer and reflectance models in forests.
- Kuusk-Nilson forest reflectance model. Demonstration and practical work.
- Measurements techniques and sensors.

Thursday, October 11

Physical basis of microwave remote sensing, Jouni Pulliainen

- Theoretical background of microwave remote sensing is presented starting from fundamental theories of the propagation and scattering of electromagnetic waves and from the radiative transfer theory. The practical application of these theories to the problem of forest remote sensing is discussed. This focuses on (a) theoretical models, (b) semi-empirical model and (c) empirical approach to describe microwave remote sensing observations of forested terrain. An introduction to model-based data inversion algorithms is also given.

Physical basis of laser scanning, Sanna Kaasalainen

- The lectures of laser basics will deal with topics such as fundamentals of laser light (e.g., stimulated emission and the amplification of light), lasers (laser basic elements and components), and laser applications, especially in active remote sensing. There will also be an introduction to the physics and applications of laser scanning (overview of LIDAR applications and physical parameters).



Literature for the course:

Shunlin Liang, 2004. Quantitative Remote Sensing of Land Surfaces. Wiley, New Jersey, 534 pp. Description of FRT (forest reflectance model).
<http://www.aai.ee/bgf/frt/frtman0807.pdf>

Other books / articles (further info from the teachers):

E. Hecht: Optics. Addison Wesley.

J. B. Campbell: Introduction to remote sensing. Taylor & Francis.

H. Kogelnik and T. Li: Laser beams and resonators, Applied Optics vol 5 no 10, 1966.

Fujii and Fukuch: Laser remote sensing. Taylor & Francis. New book.

Registration: CLOSED. The course is open for all PhD students and researchers interested in remote sensing of forests (no course fee, but travelling and accommodation expenses must be covered by themselves). GSForest covers travelling and accommodation costs to GSForest funded PhD students. Fill in the registration form [HERE](#).

Ask **further information** about the GSForest course from Professor Pauline Stenberg (pauline.stenberg@helsinki.fi).