

Schedule 2021

Electromagnetic sensor systems (RRY 057)

Location:

Monday 13:15-17: <https://chalmers.zoom.us/j/69219304175>

Thursday, 10-11.45: <https://chalmers.zoom.us/j/68677872849>

Friday, 15:15-17: <https://chalmers.zoom.us/j/68209689840>

Password: EMSS

Note on physical meeting on January 29 and the 2 laboratory exercises

Resp teacher: Johan Mellqvist (johan.mellqvist@chalmers.se)

WEEK 1	
Course introduction 2021-01-18 (Mon), 13:15 – 15:00 All Course overview and practicalities. Presentation of involved teachers	Lecture ALL
Basic concepts and considerations 2021-01-18 (Mon), 15:15 – 17:00, What is it all about Reading instruction: Chapter 1	Lecture <i>Johan Mellqvist</i>
Electromagnetic waves 2021-01-21 (Thu), 10:00 – 11:45, Polarisation and coherence. Flux and radiance. Blackbody and solar radiation. Reading instruction: Chapter 2.1, 2.2 2.5, 2.6	Lecture Patrick Eriksson
Interaction between EM waves and matter 2021-01-22 (Fri), 15:15 – 17:00 Complex refractive index and absorption length. Surface reflections and BRDF. Attenuation and the Beer-Lambert law. Reading instruction: Chapter 3.1, 3.2, 3.3, 3.6	Lecture Patrick Eriksson
WEEK 2	
Remote sensing, radiation and complex refractive index 2020-01-25 (Mon), 13:15 – 15:00	Problem solving Franz Kanngiesser
Properties of the atmosphere 2021-01-25 (Mon), 15:15 – 17:00 Structure and composition of the atmosphere. Impact of molecules, aerosols, clouds and precipitation. Refraction and turbulence. The ionosphere. Book section 3.4 and 4 (3.4.2 and 4).	Lecture Johan Mellqvist
Data retrieval 2021-01-28 (Thu), 10:00 – 11:45 The observation system. Least squares and the Bayesian approach. Machine learning. Reading instruction: Lecture slides, Sec 6.7 (6.5)).	Lecture Patrick Eriksson
Optical remote sensing systems	Lecture

2021-01-29 (Fri), 15:15 – 17:00, Physical. Meeting. room ES51	Johan Mellqvist
Hardware used for optical remote sensing (ORS) measurements. This includes photomultipliers, diodes, CCDs, prisms and diffraction gratings used. Parts of book section 6 (6) + extra material.	
WEEK 3	
Radiative transfer 2021-02-01 (Mon), 13:15 – 15:00	Problem solving Franz Kanngiesser
Spectroscopic measurements in IR and UV 2021-02-01 (Mo), 15:15 – 17:00	Lecture Johan Mellqvist
Principle, applications ranging from industrial measurements of petrochemical flares to volcanic ash in volcanoes to gas measurements from planets in space. Reading instruction: Parts of book section 6 (6) + extra material.	
Application of lasers for distance, speed and concentration.	
2021-02-04 (Thu), 10:00 – 11:45 LIDAR, DEMO of LIDAR sensor, wind LIDAR, topography, bathymetry, DIAL. Reading instruction: Lecture slides and extra material (Lecture Johan Mellqvist
Automotive LIDAR 2021-02-05 (Fri), 15:15 – 17:00	Guest Lecture Henrik Eliasson, Volvo Cars AB
A walkthrough of the use of sensors for active safety and autonomous driving applications at Volvo Cars. There will be a general overview for automotive sensing applications and a deep dive into lidar technology." Reading instruction: Extra material and slides	
WEEK 4	
Optical systems 2021-02-08 (Mon), 13:15 – 15:00	Problem solving Franz Kanngiesser
Satellite Imaging systems 2021-02-08 (Mon), 15:15 – 17:00	Lecture Johan Mellqvist
Satellite and airborne surveillance, spectral and spatial resolution Reading instruction: slides	
Passive infrared measurements Group I exercise 2021-02-09 (Tue) 9-12 ORS laboratory	Lab Johan Mellqvist
Passive infrared measurements exercise Group 2 2021-02-09(Tue) 13-16 ORS laboratory	Lab exercise Johan Mellqvist
Passive infrared measurements exercise Group 3 2021-02-10 (We) 9-12 ORS laboratory	Lab exercise Johan Mellqvist

Passive infrared measurements exercise Group 4		Lab exercise
2021-02-10 (We) 13-16 ORS laboratory		Johan Mellqvist
Passive satellite and ground based measurements of surface properties		Lecture
2021-02-12 (Fri), (Fri), 15:15 – 17:00		Johan Mellqvist
Main optical, IR and applications. Atmospheric correction. Reading instruction: Extra material Book sections 3.6, 6.1.5, 6.3, 6.4.5, 6.6 and parts of 11.2.3 (3.5, 6.2.5, 6.2.6, 6.3.6, 6.4 and 11.3.3).		
WEEK 5		
Optical system II		Problem solving
2021-02-15 (Mon), 13:15 – 15:00, Room ES51 Franz Kanngiesser		
Microwave radiometers		
Lecture		
2021-02-15 (Mon), 15:15 – 17:00		Patrick Eriksson
The components of a microwave radiometer. Calibration and noise. Scanning approaches. Reading instruction: Chapter 7.1 and lecture slides		
Microwave imaging		Lecture
2021-02-18 (Thu), 10:00 – 11:45		Patrick Eriksson
Radiative transfer with emission. Applications of microwave imagers. Reading instruction: Chapter 3.5, 7.2 7.4		
Precipitation radars		Lecture
2021-02-19 (Fri), 15:15 – 17:00		Patrick Eriksson
Ground- and satellite based precipitation radars. Particle scattering and attenuation. Reading instruction: Chapter 3.4 and lecture slides		
WEEK 6		
Microwave measurement and Radiative transfer		Microwave
2021-02-22 (Mon), 13:15 – 15:00		Problem solving
		Franz Kanngiesser
Basic Radar systems		Lecture
2021-02-22 (Mo), 15:15 – 17:00		Leif Eriksson
principles, radar cross section, radar equation, range resolution. Scatterometry. Introduction scattering lab. Book sections 9.2-9.3 (9.3-9.4).		
Short range Radar		
Lecture		
2021-02-25(Thu), 10.00 – 11:45		Albert Monteith
Preparation for lab exercise and description of short range radar for autonomous vehicles. Reading instruction:		
Radar in industry applications		Guest Lecture
2021-02-26 (Fri), 15:15 – 17:00,		Christoffer Widahl, Emerson
How Radar is used for level, distance, volume and other measurements in industry applications. Basic principles, signal processing, industry specific challenges and future applications. Reading instruction: Lecture slides		

WEEK 7	
Radar 2021-03-01(Mon), 13:15 – 15:00	Problem solving Franz Kanngiesser
Imaging radar 2021-03-01 (Mon), 15:15 – 17:00, Speckle. Range ambiguity. SAR Interferometry. SAR applications. Reading instruction: . Book sections 9.4-9.5 (9.5-9.6).	Lecture Leif Eriksson
Radar, Group I 2021-03-02 (Tue) ORS garage	Lab exercise Albert Monteith
Radar, Group 2 2021-03-02 (Tue) ORS garage (TBC)	Lab exercise Albert Monteith
Radar, Group 3 2021-03-03 (We) ORS garage (TBC) Monteith	Lab exercise Albert
Radar, Group 4 2021-03-03 (We) ORS garage (TBC) Monteith	Lab exercise Albert
	Synthetic Aperture Radar Lecture 2021-03-04 (Thu), 10:00 – 11:45, Real aperture radar, imaging geometry, geometric distortions, azimuth resolution. SAR principles.
Sensor system in automotive and other industry and data retrieval 2020-03-05 (Fri), 15:15 – 17:00, Sensor and data algoritms.	Guest Lecture Ole Martin Christensen QamCom
WEEK 8	
Radar and SAR 2020-03-08 (Mon), 13:15 – 15:00,	Problem solving Franz Kanngiesser
Wrapup 1 2020-03-08 (Mon), 15:15 – 17:00 Repetition of radar. Repetition of main theory and microwave sounding ..	Lecture Leif Eriksson, Patrick Eriksson Leif Eriksson Patrick Eriksson
Wrapup 2 2020-03-11 (Thu) 10-11:45	Lecture Johan Mellqvist

Repetition of optical measurements and general overview of course.
Exam 2021-03-20 Morning
Notes:
Feb 11: No lectures due to Personal development
Course book, Literature: W,G, Rees, 2013, Physical principles of Remote Sensing , 3 rd edition (available at Cremona, Chalmers store) handouts and compendia that are provided free of charge.