



<div>Coordinator</div> <div></div>	<div><div><div><div>A</div><div>”</div></div><div>Aalto University</div><div>School of Electrical Engineering</div></div></div> <div>Antti V. Räisänen (Aalto)</div>	<div></div>								
Involved institutions	<div>Aalto, UPM, ASYSOL, Virginia Diodes</div> <div>The course is sponsored by ASYSOL, CST and European Microwave Association</div>									
Name of the course	<div>Antenna measurements at millimetre and submillimetre wavelengths</div>					Type				
	M	D	A/D	A						
	■									
Place	<div>Aalto University School of Electrical Engineering, Dept. of Electronics and Nanoengineering</div> <div>Maarintie 8, Espoo</div>					Date: 8-12 May, 2017				
Summary (2000 words)	<div>Testing of large (high-gain) satellite antennas as well as that of small integrated antennas at millimetre and submillimetre wavelengths is a difficult task.</div> <div>In case of large antennas, the classical far-field method has two major obstacles at mm and submm wavelengths: impractically large measurement distance and high atmospheric loss.</div> <div>The planar near-field scanning method has been used up to 1 THz. The applied near-field methods give useful information only on the main beam and its vicinity, because the field-sampling is typically very sparse. Reflector-based compact antenna test range (CATR) measurements have been carried out up to 500 GHz. Hologram-based CATR measurements have been carried out at 650 GHz.</div> <div>In case of small integrated antennas, various techniques for on-wafer measurements have been developed. This short course discusses the techniques and limitations of the various test methods, such as the planar near-field scanning and CATR as well as on-wafer measurements. Also antenna pattern correction techniques are discussed. Lectures are accompanied by laboratory demonstrations/exercises.</div> <div>The participants have a choice to study a related specific topic prior to the short course, write a brief report and present that to other participants during the course.</div> <div>The lectures include the following: introduction, mm- and submm-wave instrumentation, near-field scanning, near-field to far-field transformation, compact antenna test range (CATR), CATR based on reflectors, a lens, or a hologram, construction of a hologram based CATR, quiet-zone testing and antenna testing in a CATR, antenna pattern correction techniques, testing of small integrated antennas.</div> <div>The laboratory demonstrations (exercises) include the following:</div> <div><ul style="list-style-type: none">- vector measurements at 1THz- scanning of near-field – computation of the far-field pattern- antenna measurement in a hologram CATR- elimination of disturbing scatterer effect in a CATR – application of the APC method- on-wafer antenna measurement through reflection coefficient measurement</div>									
Structure of the course	Lectures	Experimental labs.	Computer exercise	Total	Credits	Assessment typology				
	22	7	2	31	2 - 4	Attendance plus exercise – 2 cr special assignment - 2 cr				
Teachers	Name			Organization			Title			
	Antti Räisänen			Aalto			Dr, Prof.			
	Sergiy Pivnenko			ASYSOL			Dr			
	Manuel Sierra Castañer			UPM			Dr, Assoc. Prof.			
	Eric Bryerton			Virginia Diodes			Dr			
	Ville Viikari			Aalto			Dr, Assoc. Prof.			
	Juha Ala-Laurinaho			Aalto			Dr, Staff Scientist			
	Aki Karttunen (laboratory exercise)			Aalto			Dr			
	Jianfang Zheng (laboratory exercise)			Aalto			M.Sc.			
Availability of dedicated structures	College rooms		Dedicated Labs		Classrooms		Computer rooms		Canteen	
	yes	not	Yes	not	yes	not	yes	not	yes	not
	■		■		■		■		■	

ESoA short course: Antenna measurements at millimetre and submillimetre wavelengths

SCHEDULE:

Monday 8 May 2017: Introduction to mm- and submm-wave measurements, hall AS3

Hour	Topic	Teacher
9-10	Presentation and introduction	Antti Räisänen
10-11	Antenna measurements; general	Antti Räisänen
11-12	Specific aspects at mm- and submm-wavelengths	Antti Räisänen
12-13	Lunch	
13-14	Submm-wave instrumentation	Eric Bryerton
14-16.30	Introductory lecture, laboratory demonstration: Vector measurements at 1 THz	Eric Bryerton

Tuesday 9 May 2017: Near-field measurement, hall AS3

Hour	Topic	Teacher
9-10	Near-field measurements; general	Sergiy Pivnenko
10-12	Planar near-field scanning and transformation from near-field to far-field	Sergiy Pivnenko
12-13	Lunch	
13-14	Instrumentation aspects in near-field measurements	Juha Ala-Laurinaho
14-16.30	Laboratory & computer demonstration: Near-field measurement	Aki Karttunen, Juha Ala-Laurinaho

Wednesday 10 May 2017: Compact antenna test ranges (CATR), hall T6

Hour	Topic	Teacher
9-11	Anechoic chambers and CATR in general; reflector and lens CATR	Manuel Sierra Castañer
11-12	Antenna (and RCS) measurements in CATR	Manuel Sierra Castañer
12-13	Lunch	
13-14	Introduction to hologram CATR and RCS measurement in a phase-hologram CATR	Juha Ala-Laurinaho
14-15	Hologram CATR, QZ testing, and antenna measurement	Juha Ala-Laurinaho
15-16.30	Laboratory: Antenna measurement in a hologram CATR	Aki Karttunen, Juha Ala-Laurinaho
17-22	“Kyykkä”-game and dinner	

Thursday 11 May 2017: Hologram CATR, hall 1521-22

Hour	Topic	Teacher
9-10	Antenna pattern correction techniques	Ville Viikari
10-11	Antenna range evaluation techniques	Ville Viikari
11-12	Laboratory & computer exercise: Elimination of disturbing scatterer effect in a CATR	Ville Viikari
12-13	Lunch	
13-14	Measurement of small integrated antennas	Ville Viikari
14-16.30	Laboratory: On-wafer antenna measurements	Jianfang Zheng, Juha Ala-Laurinaho

Friday 12 May 2017: Student seminar and exam, hall AS3

Hour	Topic	Teacher
9-10	Exam	Antti Räisänen
10-12	Seminar with student presentations	Antti Räisänen
12-13	Lunch	
13-15	Conclusions and diplomas	Antti Räisänen

Special assignment

Topics for special assignment:

- 1) Antenna measurement campaigns at frequencies above 100 GHz
- 2) On-wafer antenna measurements at mm-wavelengths
- 3) Effects of atmosphere in THz antenna testing
- 4) Mechanical problems in near-field scanning
- 5) Comparison between different near-field facilities
- 6) Horn antennas at submm-wavelengths
- 7) Antenna elements for antenna arrays at mm and submm-wavelengths
- 8) Suggest your own topic!

If a student is interested in a special assignment worth of extra ECTS points, he/she must select a topic from the list above or suggest his/her own topic to the course coordinator, and write a report of 5-15 pages (based on the available literature), and make a PowerPoint presentation of 20 minutes in the seminar on Friday, 12th of May. The report and PowerPoint presentation must be submitted to the course coordinator through email by Wednesday, 3rd of May.