



Antennas for Space Applications

4th Edition - 12 - 16 March 2012

Course summary

Luca Salghetti Drioli

luca.salghetti.drioli@esa.int

Keplerlaan, 1
2201 AZ Noordwijk
The Netherlands

Noordwijk, 12-16 March 2012



The European Space Research and Technology Centre (ESTEC) is the largest site and the technical heart of ESA.

Course coordinator:



Dr. L. Salghetti Drioli

ESA-ESTEC,

Antenna and sub-mm wave section

luca.salghetti.drioli@esa.int



© distribution forbidden without written consent of the author

The course has covered one topic of about 34 hours of lectures, all concentrated in a week. The aim of the antennas for space applications course was to give an overview of design approaches, constraints and technical solutions for space antennas, addressing both theoretical and technological issues. The course focused on the main space applications such as telecommunication, earth observation and science but also addressed other uses of antennas for space. The lectures covered radiofrequency, mechanical and thermal design, material technology and test aspects, ending with a visit to the satellite and antenna test facilities at the European Space Research and Technology Centre (ESTEC).

Following topics, classified by applications, were addressed at the course:

1. Types of antennas: - Applications - Characteristic parameters - Categories of antennas
2. Fixed telecommunications systems: - Design parameters for multiple-beam antennas - The transform-chain model - Passive intermodulation products - Re-configurable antennas - Beam-forming networks - Selective surfaces
3. Mobile telecommunication and multimedia systems: - Satellite constellations - High-efficiency feeds - Array antennas and magnified array antennas - Microstrip and multiple-layer antennas - Antennas for fixed and mobile terminals
4. Direct broadcast by satellite: - Shaped-beam antennas - Double reflector antennas - Degrees of freedom of an antenna - Meteorological attenuation and reconfigurability - Small receiving antennas
5. Remote sensing: - Radar systems - Degrees of freedom of array antennas - Array synthesis - Radiating elements for arrays - Synthetic aperture radars - Active array antennas
6. Science instruments . Radiometers and imagers in Millimetre and sub-millimetre waves. Associated ground segment
7. Other applications: TTC and data transmission antennas – Navigation antennas - Data relay - Service antennas

Speakers		
<i>Name</i>	<i>Organization</i>	<i>Title</i>
L. Salghetti Drioli	ESA-ESTEC	Antenna Engineer / Course coordinator
C. Mangenot	ESA-ESTEC	Head of Antenna and sub-mm wave section
K. Van 't Klooster	ESA-ESTEC	Antenna Engineer
J.C. Angevain	ESA-ESTEC	Antenna Engineer
G. Toso	ESA-ESTEC	Antenna Engineer
A. Martin Polegre	ESA-ESTEC	Antenna Engineer
M. Paquay	ESA-ESTEC	Antenna Measurement Engineer
J. Santiago Prowald	ESA-ESTEC	Structural Engineer
M. Lumholt	TICRA	TICRA Managing Director
P. de Maagt	ESA-ESTEC	Antenna Engineer
P. M. Besso	ESA-ESOC	Head of Ground Station Antenna section
G. Guida	IDS	System Analyst

© distribution forbidden without written consent of the author

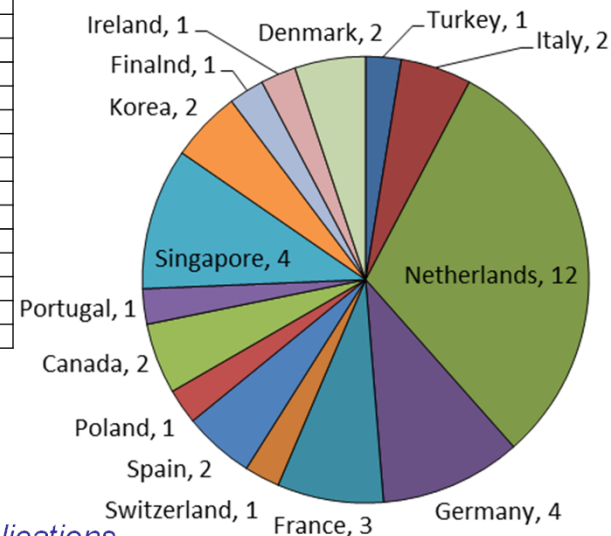
Monday 12 March	Tuesday 13 March	Wednesday 14 March	Thursday 15 March	Friday 16 March
<u>Fundamentals:</u> <ul style="list-style-type: none"> • Overview of Space Missions; • Space antenna types and design constraints; • Basics of antennas; • Radiators and reflectors; 	<u>Service antennas:</u> <ul style="list-style-type: none"> • Space/Ground TTC antennas; • User segment antennas; <u>Science mission antennas:</u>	<u>Telecom antennas:</u> <ul style="list-style-type: none"> • Fixed; • Broadband; • Mobile; <u>Practical exercise</u>	<u>Mechanical/Thermal design of space antennas</u> <u>Earth Observation antennas:</u> <ul style="list-style-type: none"> • Synthetic Aperture Radars; • Altimeters; • Scatterometers; • Radiometers; <u>Practical exercise</u>	<u>Navigation antennas</u> <u>Antenna testing:</u> <ul style="list-style-type: none"> • RF Testing; • High power testing; • Mechanical/Thermal testing. <u>Future trends</u>

©

39 students of which:

- 33 paying;
- 6 grants (2 from ESoA, 3 from NEWFOCUS, 1 from ESA)
- 16 from Universities;
- 8 from Industries;
- 13 from Space Agencies (including ESA);
- 2 from Research centres.

Family Name	First Name	Company	Country
1Akan	Volkan	TUBITAK Space Technologies Research Institute	TR
2Ali	Haider	Politecnico di Torino	IT
3Balme	Francois	ESA-ESTEC	NL
4Bauer	Jan	Fraunhofer IIS	DE
5Boscagli	Giovanni	ESA-ESTEC	NL
6Budianu	Alexandru	University of Twente	NL
7Darde	Bruno	INTESPACE	FR
8DONADIO	Roberto	ESA-ESTEC	NL
9Dutto	Valerie	ESA-ESTEC	NL
10Esquius Morote	Marc	EPFL	CH
11Faroogui	Muhammad Zunnoorain	CNR-IEIIT c/o Politecnico di Torino	IT
12Fernandez	Jean Raphael	Universidad Politecnica de Madrid	ES
13Garcia	Pierre-Antoine	IETR	FR
14Gasztold	Michal	Przemyslowy Instytut Telekomunikacji S.A.	PL
15Gebert	Nico	ESA-ESTEC	NL
16Geneste	Xavier	ESA-ESTEC	NL
17Ghiotto	Anthony	Ecole Polytechnique de Montreal	CA
18Glogowski	Rafal	IST/EPFL	PT
19Heliere	Florence	ESA-ESTEC	NL
20Le Lepvrier	Benoit	IETR/INSA	FR
21Lee	Wee Liang Cedric	DSO National Laboratories	SG
22Lee	Kyoil	Korea Aerospace University	KO
23Lim	Zi Wei	DSO National Laboratories	SG
24Lim	Wai Yean	DSO National Laboratories	SG
25Lizaraga Cubillos	Juan	ESA-ESTEC	NL
26Modrzewski	Rafal	Aalto University	FI
27Narbudowicz	Adam	Dublin Institute of Technology	IE
28Pelorossi	Fabio	Serco Services GmbH	DE
29Pfützenreuter	Lysan	German Aerospace Centre- Space Administration	DE
30Porciani	Massimiliano	ESA-ESTEC	NL
31Rocio	Martin	INSA	ES
32Shafai	Leili	Canadian Space Agency	CA
33Smith	Thomas	Technical University of Denmark	DK
34Van Es	Jan-Joris	National Aerospace Laboratory NLR	NL
35Vanin	Felice	ESA-ESTEC	NL
36Yoon	Seong Sik	Korea Aerospace University	KO
37Zander	Martin E.	Technische Universität Braunschweig (University of	DE
38Zhang	Xianzhong	DSO NATIONAL LABORATORIES	SG
39Zhou	Min	Technical University of Denmark	DK



© distribution forbidden wi

The different backgrounds of the attendees lead to lively exchanges during the whole week and all gave very positive feedback about the unique set of information and know-how provided on space antennas (RF and thermo/mechanical design as well as testing).

The standard ESoA evaluation form was distributed to the students; all 39 students completed the evaluation form. After the outcome of the evaluation form and after discussion and interaction with the students, we have noticed a global satisfaction; however, the following weak points have been detected, which will be useful to be considered for improving the next edition of the course.

- Too many concepts have been transmitted, without having time enough to assimilate them;
- Too many examples (and we have already reduced them from the past editions !);
- Students would like to see even more technology aspects (e.g. materials, manufacturing techniques, etc.);
- For some lectures, less text more synoptic, sketches, diagrams;
- Need for address micro and nano satellites.

With respect with the past editions, practical sessions were included where students were able to ‘play’ with modelling tools especially designed for antenna for space applications (TICRA GRASP and IDS ADF EMS). These hours have enlighten a bit the heavy program and were positively perceived by the students.

