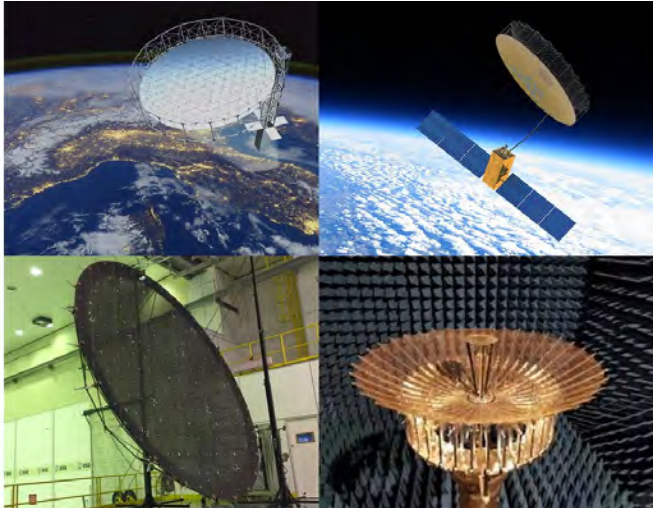


41st ESA Antenna Workshop

Workshop on Large Deployable Antennas

25 – 28 September 2023
ESTEC, Noordwijk, The Netherlands



Organised by the European Space Agency (ESA) Antenna and Sub-millimetre
Waves Section and the Structures Section



TABLE OF CONTENTS

Word of Welcome 3

Introduction 4

Committees..... 5

Map of ESTEC 6

Map of Exhibition area 7

Exhibitors 7

Sponsors..... 8

Programme at a glance..... 9

Programme

 Monday 25 September 10

 Tuesday 26 September 14

 Wednesday 27 September..... 18

 Thursday 28 September 23

WORD OF WELCOME

Dear colleagues, dear friends,

On behalf of the organizing committee of the 41st ESA antenna workshop, we are honoured and pleased to welcome you to this Workshop on Large Deployable Antennas taking place at ESTEC, the technical heart of the European Space Agency, at Noordwijk in the Netherlands.

The technical program of the workshop is very rich and diverse. It covers a wide variety of space applications such as Telecommunication, Earth Observation and Science that require large deployable antennas. Furthermore, it provides a good overview of the current state-of-the-art, highlighting the latest developments and innovations in the different fields, in Europe and all around the world.

As part of the organizing committee, we know that the success of a workshop is a subtle alchemy of several factors, but ultimately, it depends on the people who have worked with us in planning and organizing both the technical program and supporting social arrangements. We are particularly grateful to the Steering Committee for all the valuable and constructive comments we have received. We sincerely thank the Technical Committee for their meticulous and timely reviewing of the abstracts. Last but not least, we wish to express our gratitude to the ESA Conference Bureau who helped us with the organization and planning of this workshop.

Now, it is time to learn, exchange ideas and enjoy.
Have fun during these 4 days of workshop!

Paul Moseley & Erio Gandini

INTRODUCTION

INTRODUCTION

The European Space Agency (ESA), Antenna and Sub-millimetre Waves Section and the Structures Section organize the 3rd workshop on Large Deployable Antennas.

The Workshop will be held from **25th to 28th September 2023** at European Space Technology Centre, ESTEC, Noordwijk, The Netherlands.

OBJECTIVES OF THE WORKSHOP

The workshop will present the progress of activities related to the ESA Large Antenna Working Group and the working plans established by the European Space Agency in cooperation with industry, research institutes and with support of ESA member states.

The workshop will also present the state of the art and explore innovative approaches for large deployable antennas. It will embrace all antennas that require their RF radiating aperture to be unfurled in space. The aperture of these antennas is typically above 4 meters with applicability from VHF to V-band. The workshop will also cover deployable antennas for cubesats and small satellites.

COMMITTEES

ORGANIZING COMMITTEE

Paul Moseley (ESA-ESTEC, The Netherlands)

Erio Gandini (ESA-ESTEC, The Netherlands)

TECHNICAL COMMITTEE

Cecilia Cappellin (TICRA, Denmark)

Jean Christophe Angevain (ESA-ESTEC, The Netherlands)

Graham Coe (ESA-ESTEC, The Netherlands)

Leri Datashvili (LSS, Germany)

Alexander Ihle (ESA-ESTEC, The Netherlands)

Peter de Maagt (ESA-ESTEC, The Netherlands)

Paul Greenway (ESA-ECSAT, United Kingdom)

Patrick Klenk (DLR, Germany)

Cyril Mangenot (API-Space, France)

Alberto Meschini (Thales Alenia Space, Italia)

Jose Nieto (Comet Ingenieria, Spain)

Baptiste Palacin (CNES, France)

Ernst Pfeiffer (HPS GmbH, Germany)

Amool Raina (Oxford Space Systems, United Kingdom)

Nicolas Renaudin (ArianeGroup, France)

Juan Fayos Sancho (Comet Ingenieria, Spain)

Sebastian Schwarz (Airbus DS, Germany)

Martin Suess (ESA-ESTEC, The Netherlands)

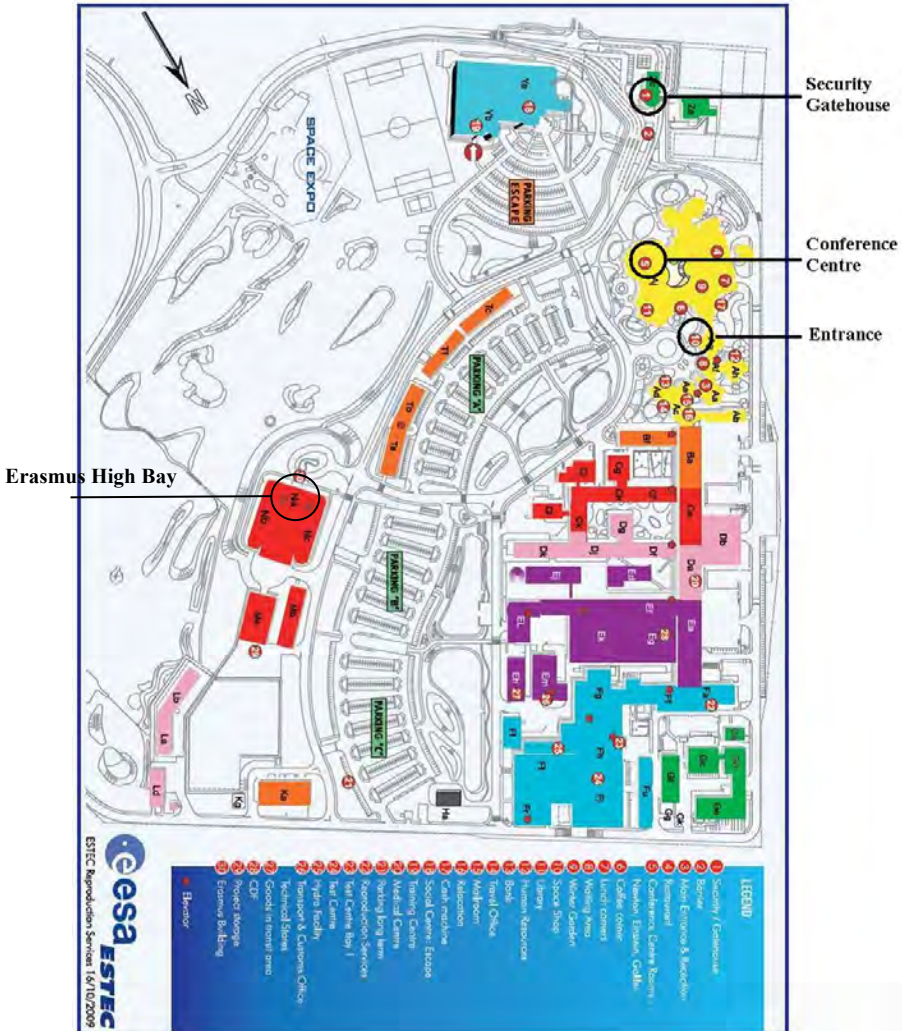
Tom Sproewitz (DLR, Germany)

Roger Walker (ESA-ESTEC, The Netherlands)

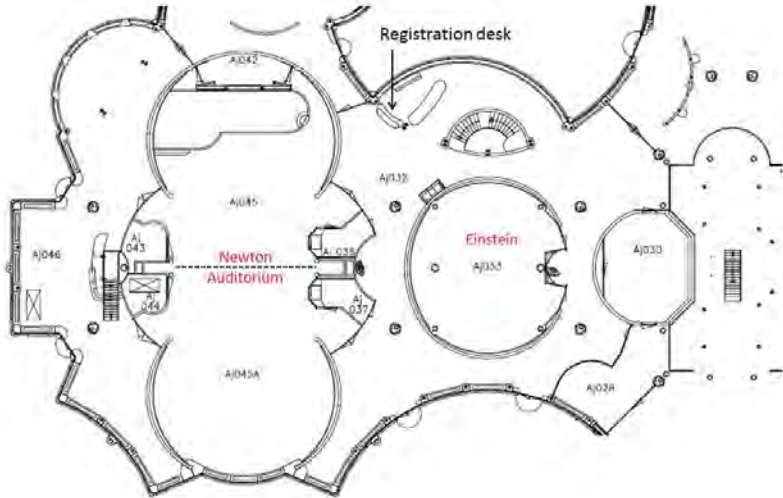
Paolo Zolla (HPS GmbH, Germany)

41st ESA Antenna Workshop

MAP OF ESTEC



MAP OF EXHIBITION AREA



EXHIBITORS

The following exhibitors can be found in Einstein:

- Airbus**
- Anyfields**
- Glenair**
- Ommatidia LiDar**

SPONSORS

We are very grateful for the following sponsors of the 41st ESA Antenna Workshop:

HPS

High Performance Space
Structure Systems GmbH

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<https://www.largespace.de/>

41st ESA Antenna Workshop

PROGRAM AT A GLANCE

Monday 25/09	Tuesday 26/09	Wednesday 27/09	Thursday 28/09
Registration 08:00 – 10:00			
Opening session 10:00 – 11:00	Novel manufacturing and assembly technologies for large deployable antennas 09:00 – 10:40	EuRAAP convened session: Advances on large deployable reflector antennas for small sats 09:00 – 10:40	In-orbit assembly and formation flying 09:30 – 10:50
Coffee break 11:00 – 11:20	Coffee break 10:40 – 11:00	Coffee break 10:40 – 11:00	Coffee break 10:50 – 11:20
Mesh design, manufacturing and characterization 11:20 – 13:00	Large deployable reflectors 1 11:00 – 13:00	Large deployable reflectors 2 11:00 – 13:00	Deployable antennas for small satellites 11:20 – 13:00
Lunch break 13:00 – 14:00	Lunch break 13:00 – 14:00	Lunch break 13:00 – 14:00	Lunch break 13:00 – 14:00
Copernicus Imaging Microwave Radiometer - CIMR 1 14:00 – 15:40	Copernicus Imaging Microwave Radiometer - CIMR 2 14:00 – 15:40	Copernicus Imaging Microwave Radiometer - CIMR 3 14:00 – 15:20	Deployable arrays 14:00 – 15:40
Coffee break 15:40 – 16:10	Coffee break 15:40 – 16:10	Coffee break 15:20 – 15:50	Coffee break 15:40 – 16:00
Low frequency deployable antennas 16:10 – 17:30	Reflecting and transmitting surface technologies 16:10 – 17:50	Testing and Verification of Large Deployable Antennas 15:50 – 17:30	Large reflect arrays 16:00-17:40
Welcome reception 17:30 – 20:00		Bus departure for dinner 18:00	Closing ceremony 17:40 – 18:00
		Workshop dinner 18:30 – 22:30	

PROGRAMME

Monday 25 September

08:00 – 10:00 Registration	
10:00 – 11:00 Opening Session <i>Chairs: Erio Gandini, Paul Moseley</i>	
10:00	Introduction and Welcome
10:15	In memoriam of Julian Santiago Prowald: The Julian Santiago Prowald Large Deployable Reflector System A. Ihle ¹ <i>⁽¹⁾ European Space Agency, ESTEC, NOORDWIJK, The Netherlands</i>
10:30	Plenary talk: The Copernicus Imaging Microwave Radiometer (CIMR): Instrument Overview and Performance <u>R. Midthassel</u> ¹ , B.Fiorelli ¹ , C. Galeazzi ¹ , M. Sallusti ¹ , C.Donlon ¹ <i>⁽¹⁾ European Space Agency, ESTEC, Noordwijk, The Netherlands</i>
11:00 – 11:20 Coffee Break	
11:20 – 13:00 Mesh design, manufacturing and characterization <i>Chairs: Paul Moseley, Satoru Ozawa</i>	
11:20	Advanced RF reflective metal mesh for high frequency deployable reflector antennas <u>Mr. Michael Decius</u> ¹ , Mr. Pietro Salvini ² , Mr. Sebastian Hoeck ¹ , Mr. Emanuele Marotta ² , Mr. Paul Moseley ³ , Mr. Alexander Ihle ³ , Mr. Goncalo Rodrigues ³ , Mr. Martin Suess ³ , Mr. Jean-Christophe Angevain ³ <i>¹TEC-KNIT CCTT GmbH, ²University of Rome "Tor Vergata", ³ESA/ESTEC</i>
11:40	Development and Standardization of Testing Methods for 2D and 3D Fabrics and the Relevance of the Tests to Predict the Behaviour of Mesh Reflector Surfaces

41st ESA Antenna Workshop

	<p><u>Ms. Isa Bettermann</u>¹, Amanda Kulesa¹, Henning Löcken¹, Thomas Gries¹ ¹<i>RWTH Aachen University</i></p>
12:00	<p>Structural Modelling of knitted Wire Meshes through an original Curvilinear Beam Finite Element <u>Mr. Christian Iandiorio</u>¹, Mr. Emanuele Marotta¹, Prof. Pietro Salvini¹ ¹<i>University Of Rome "Tor Vergata"</i></p>
12:20	<p>Electrical and mechanical properties of metal mesh for Ka-band using zirconium copper wire <u>Dr. Satoru Ozawa</u>¹, Kazuyuki Nakamura², Daisuke Matsumoto³, Naokuni Muramatsu⁴, Hidehiko Fujii⁵, Masatoshi Mori⁶ ¹<i>Japan Aerospace Exploration Agency</i>, ²<i>Technosolver Corporation</i>, ³<i>Taiyo Wire Cloth Co.,Ltd.</i>, ⁴<i>NGK Insulators, Ltd.</i>, ⁵<i>Keycom Corporation</i>, ⁶<i>Koyo Materica Corporation</i></p>
12:40	<p>Constructing Warp Knitted Structures for Metal Based Large Deployable Reflector Surfaces <u>Ms. Isa Bettermann</u>¹, Henning Löcken¹, Christoph Greb¹, Thomas Gries¹ ¹<i>RWTH Aachen University</i></p>
13:00 – 14:00 Lunch break	
14:00 – 15:40 Copernicus Imaging Microwave Radiometer - CIMR 1	
<i>Chairs: Salvatore Contu, Benedetta Fiorelli</i>	
14:00	<p>CIMR Antenna Sub-System: An Overview, Key Requirements & Challenges <u>Eng. Salvatore Contu</u>¹, Eng. Vincenzo Lubrano¹, Eng. Silvio Varchetta¹, Dr. Roberto Mizzoni², Dr. S. Endler³, Dr. L. Datashvili⁴, Eng. Marco Grilli⁵, Eng. Benedetta Fiorelli⁶ ¹<i>Thales Alenia Space Italy S.p.A.</i>, ²<i>Independent Consultant for TASI on CIMR</i>, ³<i>High Performance Space Structure Systems GmbH</i>, ⁴<i>Large Space Structures GmbH</i>, ⁵<i>OHB Italia</i>, ⁶<i>ESA/ESTEC</i></p>
14:20	<p>CIMR ANTENNA SUB-SYSTEM OVERALL DESIGN AND MODELLING <u>Eng. Vincenzo Lubrano</u>¹, Eng. Riccardo Rigato¹, Eng. Salvatore Contu¹, Eng. A. Montani¹, Dr. Roberto Mizzoni², Dr. Giuseppe Addamo³, Dr. Oscar Antonio Peverini³, Dr. Giuseppe Virone³, Dr. Cecilia Cappellin⁴, Eng. Pasquale Giuseppe Nicolaci⁴, Eng. Benedetta Fiorelli⁵</p>

41st ESA Antenna Workshop

	<i>¹Thales Alenia Space Italy S.p.A., ²Independent Consultant for TASI on CIMR, ³CNR-IEIT c/o Politecnico di Torino, ⁴TICRA, ⁵ESA/ESTEC</i>
14:40	The LDRS on CIMR – Architecture and Design Status <u>Mr. Stephan Endler</u> ¹ , Mr. Marco Fischer ¹ , Dr. Leri Datashvili ² , Mr. Nikoloz Maghaldadze ² , Mr. Salvatore Contu ³ , Mr. Riccardo Rigato ³ , Ms. Benedetta Fiorelli ⁴ , Mr. Alexander Ihle ⁴ ¹ HPS - High Performance Space Structure Systems GmbH, ² LSS - Large Space Structures GmbH, ³ Thales Alenia Space Italia S.p.A., ⁴ ESA - European Space Agency
15:00	Architectures, Technologies and Performance Enhancement of Large / Small Space Deployable Reflectors at LSS GmbH <u>Dr. Leri Datashvili</u> ¹ ¹ Large Space Structures GmbH
15:20	Design, Development and Verification Challenges for the Deployable Arm as Subassembly of CIMR’s Large Deployable Reflector Subsystem <u>Mr. Stephan Endler</u> ¹ , Mr. Marco Fischer ¹ , Mr. Mariusz Kosmalski ¹ , Mr. Ricardo Lopes ² , Ms. Benedetta Fiorelli ³ , Mr. Alexander Ihle ³ ¹ HPS - High Performance Space Structure Systems GmbH, ² INEGI - Instituto de Ciência e Inovação em Engenharia Mecânica e Engenharia Industrial, ³ ESA - European Space Agency
15:40 – 16:10 Coffee break	
16:10 – 17:30 Low frequency deployable antennas <i>Chairs: Ronan Le Letty, Aitor Martinez Agoues</i>	
16:10	Deployable Loop Antenna Array Based on a Scissors Mechanism <u>Mr. German Ramirez Arroyave</u> ¹ , Prof. Javier Araque Quijano ² ¹ EPFL, ² UNAL
16:30	Accurate VHF Satellite Antenna Measurements in Electrically Small Environments with the Synthetic Probe Array Technique Mr. Francesco Saccardi ¹ , Mr. Andrea Giacomini ¹ , Mr. Enrico Tartaglino ¹ , Mr. Paul Moseley ² , Mr. Luis Rolo ² , <u>Mr. Lars Foged</u> ¹

41st ESA Antenna Workshop

	¹ Mvg, ² ESA
16:50	<p>Deployable wideband and directive dual circularly polarized VHF antenna for remote radar sensing application (Version 2)</p> <p>Mr. Aitor Martínez¹, Mr. Rubén Caballero¹, Mr. Mikel Goñi¹, Mr. José Nieto², Mr. Guillermo González², Mr. Víctor Ortega², Mr. Jorge Daniel Martínez³, Mr. Vicente Enrique Boria-Esbert³, Mr. Oriol Aragon⁴, Mr. Nicholas Hwang⁴, Mr. Torsten Fritzel⁵, Mr. Hans-Jürgen Steiner⁵</p> <p>¹GRUPO EOSOL SL, ²COMET INGENIERÍA SL, ³Universidad Politécnica de Valencia (UPV), ⁴OPEN COSMOS LTD, ⁵aeroXess GmbH</p>
17:10	<p>The successful recovery of the JUICE RIME antenna deployment</p> <p>R. Le Letty¹, D. Escolar¹, C. Erd¹, B. Doll², S. Pfohl² G. Chambon³, Th. Blais³ F. Faye³</p> <p>¹ESA-ESTEC, ²Spacetech (STI), ³Airbus Defence and Space, Toulouse</p>
17:30 – 20:00 Welcome reception Winter Garden	

Tuesday 26 September

<p>09:00 – 10:40 Novel manufacturing and assembly technologies for large deployable antennas <i>Chairs: Farzaneh Gholami, Maarten van der Vorst</i></p>	
09:00	<p>GRADEL Robotic Additive Manufacturing (GRAM) Unique Solution for Manufacturing Large Deployable Antennas <u>Mrs. Farzaneh Gholami</u>¹, Mr. Marco Marques¹ ¹GRADEL</p>
09:20	<p>Antenna Fabrication and Assembly by using Lunar Regolith <u>Dr. Ayaka Takahashi</u>¹ ¹Teikyo University</p>
09:40	<p>An optical attitude gauge for locking the pointing of large antennas to the satellite reference system <u>Dr. Carlo Sasso</u>¹, Massimo Zucco¹, Luciana Bonino², Jessica Girella², Iain McKenzie³, Marco Pisani¹ ¹Istituto Nazionale di Ricerca Metrologica (INRIM), ²Thales Alenia Spazio - Italy, ³ESTEC-European Space Agency</p>
10:00	<p>CFRP struts using aluminium sleeves with CMT-pins for load transfer: mechanical and thermo-stability tests <u>Dr. Stephan Ucsnik</u>¹ ¹LKR Light Metals Competence Centre Ranshofen</p>
10:20	<p>Extension of reference materials for standardization in the production of large deployable antennas <u>Mr. Lukasz Nowicki</u>¹, Malgorzata Celuch¹, Marzena Olszewska-Placha¹, Janusz Rudnicki¹ ¹Qwed Sp. Z O. O.</p>
<p>10:40 - 11:00 Coffee Break</p>	
<p>11:00 – 13:00 Large Deployable Reflectors 1 <i>Chairs: Greg Apotsos, Peter de Maagt</i></p>	
11:00	<p>Development of High-Precision Fan-fold Reflectors</p>

41st ESA Antenna Workshop

	<p><u>Mr. Takahiro Kuhara</u>¹, Mr Kazuyuki Nakamura¹, Mrs Nobuko Nakamura¹, Mr Yuji Yamagata¹, Mr Satoru Ozawa², Mr Tadashi Masuoka² ¹<i>Technosolver Corporation</i>, ²<i>Japan Aerospace Exploration Agency</i></p>
11:20	<p>Simulation driven Design and Optimization of electrically large Reflector Antennas <u>Dr. Christoph Mäurer</u>¹ ¹<i>Altair Engineering GmbH</i></p>
11:40	<p>HE-R1000 LURA Antenna System developed by Thales Alenia Space in Italy <u>Mr. Giuseppe Orlando</u>¹, Mr. Fabio Castelli¹, Mr. Luigi Di Cicco¹, Mr. Alberto Meschini¹, Mr. Claudio Pellegrino¹, Mr. Riccardo Rigato¹, Mr Gianfranco Sirocchi¹, Mr. Marcello Zolesi¹ ¹<i>Thales Alenia Space Italy</i></p>
12:00	<p>Contact Modelling among Wires in the Mechanical Characterization of Mesh Reflectors <u>Emanuele Marotta</u>¹, Christian Iandiorio¹, Pietro Salvini¹ ¹<i>University Of Rome "Tor Vergata"</i></p>
12:20	<p>SEGMENTED HEXAGONAL ANTENNA REFLECTOR CONCENTRICALLY STACKED USING SHAPE MEMORY COMPOSITE TUBULAR HINGES <u>Juan M. Fernandez</u>¹, Andrew F. Paddock¹, Jin Ho Kang¹, Joshua E. Salazar¹, Kevin O'Neal², Kevin Demarco² ¹<i>NASA Langley Research Center</i>, ²<i>Analytical Mechanics Associates, Inc. NASA LaRC</i></p>
12:40	<p>In-Orbit Correlation Results of a 5m Deployable Reflector <u>Mr. Rolf Kluge</u>¹, Mr Sebastian Schwarz¹ ¹<i>Airbus Defence And Space</i></p>
13:00 – 14:00 Lunch Break	
14:00 – 15:40 Copernicus Imaging Microwave Radiometer - CIMR 2 <i>Chairs: Rolf Midthassel, Davide Maiarelli</i>	
14:00	<p>Reflective Mesh Developments for Large Deployable Reflector Subsystem Applications</p>

41st ESA Antenna Workshop

	<p><u>Mr. Peter Lindenmaier</u>¹, Dr. Martin Loesch¹, Mr. Benjamin Kolodziej², Mr. Thomas Hagen², Mr. Maurizio Lori¹, Dr. Ernst Pfeiffer¹</p> <p>¹HPS - High Performance Space Structure Systems GmbH, ²HPtex - High Performance Textiles GmbH</p>
14:20	<p>CIMR ANTENNA MESH RF MODELLING AND CHARACTERIZATION</p> <p><u>Eng. Pasquale Martinelli</u>¹, Eng. Pierluigi Cecchini¹, Eng. Vincenzo Lubrano¹, Eng. Davide Maiarelli¹, Dr. Roberto Mizzoni², Dr. Cyril Mangenot³, Dr. M. Kosmalski⁴, Eng. Benedetta Fiorelli⁵</p> <p>¹Thales Alenia Space Italy S.p.A., ²Independent Consultant for TASI on CIMR, ³Api-Space, ⁴High Performance Space Structure Systems GmbH, ⁵ESA/ESTEC</p>
14:40	<p>Radiometric Characterisation of the Transmission and Reflection Losses of Deployable Reflectors for Spaceborne Microwave Radiometers</p> <p><u>Dr. Axel Murk</u>¹, Alexandra Brönnimann¹, Roland Albers¹</p> <p>¹University Of Bern</p>
15:00	<p>RF DESIGN AND VALIDATION OF THE FOCAL PLANE FEED-ARRAY SUB-SYSTEM OF THE CIMR REFLECTOR ANTENNA</p> <p><u>Eng. Pierluigi Cecchini</u>¹, Eng. Vincenzo Lubrano¹, Eng. Davide Maiarelli¹, Dr. Roberto Mizzoni², Dr. Oscar Antonio Peverini³, Dr. Giuseppe Addamo³, Dr. F. Paonessa³, Dr. Giuseppe Virone³, Dr. Mauro Lumia³, Dr. M. Ohgren⁴, Eng. Benedetta Fiorelli⁵</p> <p>¹Thales Alenia Space Italy S.p.A., ²Independent Consultant for TASI on CIMR, ³CNR-IEIT c/o Politecnico di Torino, ⁴Beyond Gravity Sweden, ⁵ESA/ESTEC</p>
15:20	<p>UNCERTAINTY QUANTIFICATION FOR CIMR ANTENNA REFLECTOR</p> <p><u>Dr. Tonny Rubæk</u>¹, Dr. Mustafa Murat Bilgic¹, Dr. Roberto Mizzoni², Mr. Vincenzo Lubrano³, Dr. Benedetta Fiorelli⁴</p> <p>¹TICRA, ²Independent Consultant for TASI on CIMR, ³THALES ALENIA SPACE ITALIA S.p.A., ⁴ESA/ESTEC</p>
<p>15:40 – 16:10 Coffee Break</p>	

41st ESA Antenna Workshop

16:10 – 17:50 Reflecting and transmitting surface technologies	
<i>Chairs: Carolina Tienda</i>	
16:10	<p>Novel Design of Lens and Polarizer Combination with Jerusalem Crosses for Radar Antennas. <u>Mr. Niels de Jong</u>¹ ¹<i>CHL Netherlands B.V.</i></p>
16:30	<p>Tolerance analysis method for a radio telescope <u>Dr. Hiroaki Imada</u>¹ ¹<i>National Astronomical Observatory Of Japan</i></p>
16:50	<p>Design, Manufacture, and RF Testing of a Frequency Selective Surface Sub-reflector for Telecom Applications <u>Dr. Min Zhou</u>¹, Dr. Andreas Ericsson¹, Dr. Stig Busk Sørensen¹, Dr. Tonny Rubæk¹, Dr. Mathieu Riel², Dr. Nelson J. G. Fonseca³ ¹<i>TICRA</i>, ²<i>MDA</i>, ³<i>ESA-ESTEC</i></p>
17:10	<p>Preliminary Design of RF Antenna for Space Missions <u>Dr. Dimitrios Mazarakos</u>¹, Dr. Dimitrios Vlachos¹, Mr Dimitrios Zacharakis¹, Dr Antonios Vavouliotis¹, Dr Antonios Alexandridis², Dr Aris Tsoilis², Mr Vasileios Vlachodimitropoulos², Mr Stefanos Lampiris², Mr Georgios Moraitis³, Prof. Vassilis Kostopoulos³ ¹<i>Adamant Composites Ltd</i>, ²<i>Institute of Informatics & Telecommunications, NCSR Demokritos</i>, ³<i>University of Patras</i></p>
17:30	<p>Adaptive radiating surface reflector technology development for antenna reflector precision improvement <u>Dr. Aitor Erenchun</u>¹, Mr. Alvaro Pipó¹, Mr. Benjamín Pinazo¹ ¹<i>Prosix Engineering</i></p>

Wednesday 27 September

<p>09:00 – 10:40 EurAAP convened session: Advances on large deployable reflector antennas for small sats</p> <p><i>Chairs: Cecilia Cappellin, Stefania Monni</i></p>	
09:00	<p>Solid Under-Constrained Multi-Frequency (SUM) Deployable Antenna <u>Dr. Jonathan Sauder</u>¹, Dr. Nacer Chahat¹, Dr. Raquel Rodriguez Monje¹, Dr. Juan Mejia-Ariza¹, Dr. Shannon Brown¹ ¹<i>Jet Propulsion Laboratory, California Institute of Technology</i></p>
09:20	<p>DEVELOPMENT OF A DEPLOYABLE REFLECTOR ANTENNA FOR CUBESAT MISSIONS Dr. Juan Fayos¹, <u>Mr. Jose Nieto</u>¹, Mr. Jorge Pinazo¹, Dr. Aitor Erenchun², Mr. Álvaro Pipó², Mr. Xabier Zubeldia², Mr. Aitor Martínez³, Dr. Sebastián Blanch⁴ ¹<i>Comet Ingeniería S.L.</i>, ²<i>Prosix Engineering S.L.</i>, ³<i>Eosol Engineering</i>, ⁴<i>Universitat Politècnica de Catalunya</i></p>
09:40	<p>Development of a modular deployable mesh reflector scalable from 1 to 6 m <u>Dr. Aitor Erenchun</u>¹, Mr. Alvaro Pipó¹, Dr. Juan Fayos², Mr. Carlos Montesano³ ¹<i>Prosix Engineering</i>, ²<i>Comet Ingeniería</i>, ³<i>Airbus Ds Space Systems</i></p>
10:00	<p>MilliWave: a Millimeter-Wave Deployable Antenna for CubeSat <u>Mr. Tao Luo</u>¹, Louis Dufour¹, Nikoloz Maghaldadze¹, Christoph Zauner¹, Leri Datashvili¹, Pasquale Giuseppe Nicolaci², Stig Busk Sørensen², Cecilia Cappellin², Benedikt Byrne³, Shumit Das³ ¹<i>Large Space Structures GmbH</i>, ²<i>TICRA</i>, ³<i>ESA - ESTEC</i></p>
10:20	<p>Deployable Antenna Structures for Small Satellite <u>Ing. Claudio Ferrara</u>¹ ¹<i>Progetti Speciali Italiani</i></p>

41st ESA Antenna Workshop

10:40 – 11:00 Coffee Break	
11:00 – 13:00 Large deployable reflectors 2 <i>Chairs: Jean Christoph Angevain, Rolf Kluge</i>	
11:00	DESIGN, DESIGN FEATURES, ASSEMBLY AND BENCH TESTS OF THE DEPLOYABLE SPACE REFLECTOR Prof. Elguja Medzmariashvili ¹ , Dr. Oleksandr Sushko ² , Prof. Serhii Khoroshylov ³ , Dr. Serhii Martyniuk ⁴ , Prof. Shota Tserodze ⁵ , Prof. Mikheil Janikashvili ⁶ , Researcher Malkhaz Nikoladze ⁷ , Dr. Guram Bedukadze ⁸ <i>¹Transformable Structures Georgia T.S. Georgia" Ltd company, ²"EOS Ukraine" Foreign Company, ³"EOS Ukraine" Foreign Company, ⁴"EOS Ukraine" Foreign Company, ⁵Transformable Structures Georgia T.S. Georgia" Ltd company, ⁶Transformable Structures Georgia T.S. Georgia" Ltd company, ⁷Transformable Structures Georgia T.S. Georgia" Ltd company, ⁸Transformable Structures Georgia T.S. Georgia" Ltd company</i>
11:20	Cable and mesh management techniques in Large Unfurlable Antenna <u>Mr. N S Murali</u> ¹ , Mr Undale Milind ¹ , Mr Yadav Subash ¹ , Dr B P Nagraj ¹ <i>¹U R Rao Satellite Centre</i>
11:40	LARGE DEPLOYED REFLECTOR DEVELOPED BY THALES ALENIA SPACE ITALY Eng. Pasquale Capece ¹ , Eng. Alberto Meschini ¹ , Eng. Davide Maiarelli ¹ , Eng. Mario Lanuti ¹ , Eng. Fabrizio Poscente, <u>Eng. Marco Lapi</u> ¹ , Eng. Davide Scarozza ¹ , Eng. Riccardo Rigato ¹ , Dipl. Fabio Castelli ¹ <i>¹Thales Alenia Space Italy</i>
12:00	Development and Qualification of the L3Harris Perimeter Truss Reflector <u>Mr. Greg Apotsos</u> ¹ , Mr John Howard ¹ <i>¹L3Harris</i>
12:20	Design and Performance of The first European Shaped Mesh Reflector Antenna Leri Datashvili ¹ , Nikoloz Maghaldadze ¹ , Tao Luo ¹ , Cecilia Cappellin ² , Jakob Rosenkrantz de Lasson ² , Rolf Jørgensen ² , Marzia Migliorelli ³ , Lorenzo Scialino ³ , Alexander Ihle ⁴ , Goncalo Rodrigues ⁴ , Luis Rolo ⁴ , Maarten Van der Vorst ⁴ , Luca Salghetti Drioli ⁴ , Jean-Christophe Angevain ⁴ <i>¹LSS, ²TICRA, ³Space Engineering (Airbus Italia), ⁴ESA/ESTEC</i>

41st ESA Antenna Workshop

12:40	<p>SEGMENTED, PLEAT-FOLDED AND RIB-SUPPORTED THIN-SHELL COMPOSITE ANTENNA REFLECTOR</p> <p>Juan M. Fernandez¹, Andrew F. Paddock¹, Kevin Roscoe¹, Kevin Demarco²</p> <p><i>¹NASA Langley Research Center, ²Analytical Mechanics Associates, Inc. NASA LaRC</i></p>
13:00 – 14:00 Lunch Break	
<p>14:00 – 15:20 Copernicus Imaging Microwave Radiometer - CIMR 3</p> <p><i>Chairs: Leri Datashvili, Stephan Endler</i></p>	
14:00	<p>CIMR Antenna Sub-System: Verification Approach and Challenges</p> <p><u>Mr. Giovanni Rosati</u>¹, Eng. Eva Trippanera¹, Eng. Pasquale Martinelli¹, Eng. Salvatore Contu¹, Dr. Karol Tomczyk², Eng. Nikoloz Maghaldadze³, Eng. Marta Belló Escribano³, Eng. Ricardo Lopes⁴, Dr. Roberto Mizzoni⁵, Eng. Benedetta Fiorelli⁶</p> <p><i>¹Thales Alenia Space Italy S.p.A., ²HPS - High Performance Space Structure Systems GmbH, ³LSS - Large Space Structures GmbH, ⁴INEGI - Institute of Science and Innovation in Mechanical and Industrial Engineering, ⁵Independent Consultant for TASI on CIMR, ⁶ESA/ESTEC</i></p>
14:20	<p>Environmental testing campaign of a Large Deployable Mesh Reflector</p> <p><u>Mr. Nikoloz Maghaldadze</u>¹, Mrs. Marta Belló Escribano¹, Mr. Salvatore De Lellis¹, Mr. Atin Aggarwal¹, Mr. Christoph Zauner¹, Mr. Julian Dominic Pauw¹, Mr. Leri Datashvili¹, Mr. Stephan Endler², Mr. Mariusz Kosmalski², Mr. Max Oswald³, Mr. Ricardo Lopes⁴, Mr. Graciano Martinez Fuente⁵, Mr. Alexander Ihle⁶, Mr. Gonçalo Rodrigues⁶, Mr. Martin Suess⁶, Mrs. Benedetta Fiorelli⁶, Mr. Salvatore Contu⁷</p> <p><i>¹LSS, Large Space Structures GmbH, ²HPS, High Performance Space</i></p>
14:40	<p>Thermal Modelling and Correlation of Reflective Meshes</p> <p><u>Mr. Javier Garcia Garrido</u>¹, Mr. Enrico Friso¹, Mr. Alberto Franzoso², Ms. Irma Torresani², Mr. Marco Grilli², Ms. Paula Prado Montes³, Mr. Vito Laneve³, Ms. Benedetta Fiorelli³</p> <p><i>¹HPS GmbH, ²OHB Italia SpA, ³ESA - European Space Agency</i></p>

41st ESA Antenna Workshop

15:00	<p>CIMR ANTENNA SUB-SYSTEM BREAD-BOARD RF MODELING AND VALIDATION</p> <p><u>Dr. Cecilia Cappellin</u>¹, Pasquale Giuseppe Nicolaci¹, Roberto Mizzoni², Cyril Mangenot³, Vincenzo Lubrano⁴, Eva Trippanera⁴, Benedetta Fiorelli⁵</p> <p>¹TICRA, ²Independent Consultant for TASI on CIMR, ³Api-Space, acting as consultant for HPS, ⁴THALES ALENIA SPACE ITALIA S.p.A., ⁵ESA/ESTEC</p>
15:20 – 15:50 Coffee Break	
<p>15:50 – 17:30 Testing and Verification of Large Deployable Antennas</p> <p><i>Chairs: Marco Righero, Elena Saenz</i></p>	
15:50	<p>Lubrication for Deployment without heating - Advanced Testing and ongoing Developments towards bearings and gears for LDAs</p> <p><u>Dr. Andreas Merstallinger</u>¹</p> <p>¹AAC - Aerospace And Advanced Composites GmbH</p>
16:10	<p>An antenna measurement system with a large range of motion based on a cable-suspended dolly</p> <p><u>Dr. Marco Righero</u>¹, Dr Giorgio Giordanengo¹, Dr Giuseppe Musacchio Adorisio¹, Mr Michael Maurer², Mr Frederick Meyer², Mr Georg Peters², Dr Ines Barbay³, Mr Eric Van Der Houwen³, Dr Luis Rolo³, Dr Giuseppe Vecchi⁴</p> <p>¹Fondazione Links, ²Spidercam Robotics GmbH, ³ESA, ESTEC, ⁴Politecnico di Torino</p>
16:30	<p>Verification of the Biomass Large Deployable Reflector</p> <p><u>Mr. Greg Apotsos</u>¹, Mr. Stefan Kiryenko², Mr. Oscar Liddiard³, Mr. Brian Smith¹, Mr. Massimo Palladino², Mr. David Boveda³</p> <p>¹L3Harris, ²European Space Agency, ³Airbus Defence and Space</p>
16:50	<p>In-orbit metrology instrument for surface monitoring</p> <p><u>Dr. Iván Bravo</u>¹, Dr. Eduardo Margallo¹, Dr. José Luis Rubio¹, Mr. Jorge Pinazo², Dr. Grégory Pandraud¹</p> <p>¹Ommatidia Lidar, ²COMET Ingeniería</p>
17:10	<p>HERTZ 2.0 as a Multi-Purpose Test Facility for European Large Antennas</p> <p><u>L.Rolo</u>¹, A. Riccardi¹, D. Trenta¹, P. Moseley¹, P. Angeletti¹</p> <p>¹ESA/ESTEC, NOORDWIJK, The Netherlands</p>

41st ESA Antenna Workshop

18:00 Bus departure for workshop dinner
18:30 – 22:30 Workshop dinner

41st ESA Antenna Workshop

Thursday 28 September

09:30 – 10:50 In-orbit assembly and formation flying	
<i>Chairs: Gwenaelle Aridon, Advenit Makaya</i>	
09:30	Guidance, Navigation, and Control of In-Orbit Assembly of Large Antennas – technologies and approach for IOANT <u>Eng. Jose Francisco Briz Valero</u> ¹ ¹ <i>Gmv Aerospace And Defense</i>
09:50	The TriHex Antenna <u>Dr. Manuel Martin-Neira</u> ¹ , Dr. Francesca Scala ² , Mr. Albert Zurita ³ , Mr. Berthyl Duesmann ¹ , Ms. Alexandra Bulit ¹ , Dr. Erio Gandini ¹ , Dr. Camilla Colombo ² , Mr. Josep Closa ³ , Mr. Iain Mckenzie ¹ , Mr. Michal Miler ¹ ¹ <i>ESA</i> , ² <i>Polimi</i> , ³ <i>Airbus Defence and Space</i>
10:10	Concept for In-Space Assembly of Large Reflector Antennas <u>Prof. Sergio Pellegrino</u> ¹ , Mr Jong-Eun Suh ¹ , Ms Sahangi Dassanayake ¹ , Mr Mark Thomson ² ¹ <i>Caltech</i> , ² <i>Tendeg</i>
10:30	In-Orbit Assembled Reflectors: the Future of Telecommunications to Enhance Global Connectivity <u>Dr. Gwenaelle Aridon</u> ¹ , <u>Simon Le Duc</u> ¹ , Jeremie Hausseguy ¹ , Anaïs Ardan-Ejarque ¹ , David Marote Alvarez ¹ ¹ <i>Airbus Defence & Space</i>
10:50 – 11:20 Coffee Break	
11:20 – 13:00 Deployable antennas for small satellites	
<i>Chairs: Benedikt Byrne, Paolo Focardi</i>	
11:20	Dual-Circularly Polarized Reflectarrays as Standardized Antenna Solutions for CubeSats Ms. Blanca Valencia ¹ , Mr. Borja Imaz-Lueje ² , <u>Dr. Daniel Martinez-de-Rioja</u> ¹ , Dr. Manuel Arrebola ² , Dr. Marcos R. Pino ² , Dr. Jose A. Encinar ¹

41st ESA Antenna Workshop

	¹ Universidad Politécnica De Madrid, ² Universidad De Oviedo
11:40	Design and RF Testing of Reflectarray for CubeSat at X-band <u>Dr. Min Zhou</u> ¹ , Dr. Tonny Rubæk ¹ , Dr. Andreas Ericsson ¹ , Dr. Mustafa M. Bilgic ¹ , Dr. Erik Jørgensen ¹ ¹ TICRA
x12:00	Deployable VHF helix antenna with isoflux radiation pattern <u>Mr. Aitor Martínez</u> ¹ , Dr. Amagoia Tellechea ¹ , Mr. Rubén Caballero ¹ , Mr. Víctor Sesma ¹ , Ms. Leire Vigor ¹ , Mr. Víctor Ortega ² , Mr. Guillermo González ² , Mr. Jose Nieto ² ¹ EOSOL SL, ² COMET INGENIERÍA SL
12:20	Dynamics modelling and analysis of the deployable reflector antenna for SAR mini-satellites <u>Prof. Serhii Khoroshylov</u> ¹ , Vladislav Shamakhanov ¹ , Viktor Beitsun ¹ , Prof. Elguja Medzmariashvili ² , Prof. Shota Tserodze ² , Dr. Serhii Martyniuk ¹ , Dr. Oleksandr Sushko ¹ ¹ "EOS Ukraine" Foreign Company, ² Transformable Structures Georgia T.S. Georgia" Ltd company
12:40	Uncertainty Quantification of the Gain Budget for the Ka-Band Deployable Mesh Reflector Antenna for INCUS <u>Dr. Paolo Focardi</u> ¹ ¹ Jet Propulsion Laboratory, California Institute of Technology
13:00 – 14:00 Lunch Break	
14:00 – 15:40 Deployable arrays <i>Chairs: Giovanni Gasparro, Erio Gandini</i>	
14:00	Compact L-band phased array system. <u>Mr. Jacobus A Kegel</u> ¹ ¹ Eindhoven University Of Technology
14:20	TASI heritage and new developments in Active Antennas for SAR

41st ESA Antenna Workshop

	<p>applications Eng. Giovanni Gasparro¹, Eng Pasquale Capece¹, <u>Eng Mario Lanuti</u>¹, Eng Paolo Campana¹, Eng Alberto Meschini¹ ¹<i>Thales Alenia Space in Italy</i></p>
14:40	<p>Towards planar scanning antenna arrays at ONERA: a review <u>Dr. Aurélie Dorlé</u>¹, Dr. Cédric Martel¹, Dr. André Barka¹, Loïc Castanet¹, Dr. Hervé Jeuland¹ ¹<i>Onera</i></p>
15:00	<p>ACTA-UHTS project – Overview of challenges and enablers for the development of very large DRA for telecom satellites in Ka band <u>Dr. Jean-Philippe Fraysse</u>¹, Hervé Legay¹, Julien Hugon¹, Stéphane Vezain¹, Michel Sotom¹, Etienne Girard¹, Benoit Benazet¹, Yann Oster¹, Jean-Didier Gayraud¹, Mikko Karppinen², Mikko Harjanne², Cherchi Matteo², Nikolaos Karafolas³, Emmanuel Caplanne³, Benedicte-Marie Folio³, Bingen Cortazar³, Ashley Roach³, Giovanni Toso³ ¹<i>Thales Alenia Space - France</i>, ²<i>VTT</i>, ³<i>ESA</i></p>
15:20	<p>Hybrid beamformed direct radiating Ka-band arrays for Multibeam Coverage with Frequency Reuse <u>Miss Margaux Pellet</u>^{1,2}, Mr Hervé Legay¹, Mr George Goussetis², Mr Joao Mota², Mr Giovanni Toso³, Mr Piero Angeletti³ ¹<i>Thales Alenia Space</i>, ²<i>Herio-Watt University</i>, ³<i>European Space Agency</i></p>
15:40 – 16:00 Coffee Break	
16:00 – 17:40 Large reflect arrays <i>Chairs: Giovanni Toso, Min Zhou</i>	
16:00	<p>Design and Deployment Feasibility study of 1 m x 1 m Ka-band reflect-array Antenna Mr. Alok Lenka¹, <u>Mr. Mayank</u>¹, Mr. Antonio Pedivellano², Mr. Martin Wantoch von Rekowski⁴, Ms. Ravneet Kaur³, Mr. Johannes Schumacher¹, Ms. Laura Schmitz², Mr. Joram Gruber², Mr. Thomas Sinn² ¹<i>Celestial Space Technologies GmbH</i>, ²<i>DCUBED (Deployables Cubed GmbH)</i>,</p>

41st ESA Antenna Workshop

	³ German Orbital Systems GmbH, ⁴ Blackwave GmbH
16:20	Design and direct optimization of spatially fed metasurfaces: software defined highly shaped coverage Reflectarray antenna <u>Dr. Andrea Guarriello</u> ¹ , Daniele Bresciani ² , Renaud Loison ¹ , Hervé Legay ² ¹ Institut National Des Sciences Appliquées De Rennes (IETR), ² Thales Alenia Space
16:40	MASKARA: Large Reflectarray at Ka-band: From Design to Manufacturing and Testing <u>Dr. Min Zhou</u> ¹ , Dr. Pasquale G. Nicolaci ¹ , David Marote ² , Javier Herreros ² , Dr. Niels Vesterdal ¹ , Dr. Michael F. Palvig ¹ , Dr. Stig B. Sørensen ¹ , Dr. Jakob R. de Lasson ¹ , Dr. Giovanni Toso ³ ¹ TICRA, ² Airbus Defence and Space SAU, ³ ESA-ESTEC
17:00	Evaluation of Large Deployable Reflectarray Antennas in Multiple Flat and not Aligned Panels Mr. Borja Imaz-Lueje ¹ , Dr. Daniel Martinez-de-Rioja ² , Dr. Marcos R. Pino ¹ , <u>Dr. Manuel Arrebola</u> ¹ ¹ Universidad De Oviedo, ² Universidad Politécnica de Madrid
17:20	Large Deployable ReflectArray for a S band mission - Accomodation, deployment and performances. <u>Eng. eric Labiole</u> ¹ , Eng Olivier Bardel ¹ , Eng Daniele Bresciani ¹ , Eng Céline Leclerc ¹ , Eng PhD Renaud Chiniard ¹ , Eng Willy Wintgens ² , Philipp Heck ² , Eng PhD Andréa Guarriello ³ ¹ Thales Alenia Space, ² Euro-Composites S.A. , ³ INSA RENNES
17:40 – 18:00 Closing ceremony	



CIMR Satellite by ESA/TAS

Large Deployable Reflector Subsystems

LDRS for Earth Observation, Telecommunication, Defence and Science



Driven by ESA technology & flight programs, HPS delivers, as consortium lead, complete deployable antenna-/reflector-subsystems. Most prominent example is the LDRS for the Copernicus CIMR Mission, developed together with our main partner and subcontractor LSS for the reflector assembly.

CIMR LDRS key characteristics are:

- 8 m deployable arm
- 8 m deployable reflector
- 0.3 mm RMS
- up to Ka-band applications
- gold plated Molybdenum mesh
- subsystem is rotating with 8 RPM
- direct customer: Thales Alenia Space, Italy.

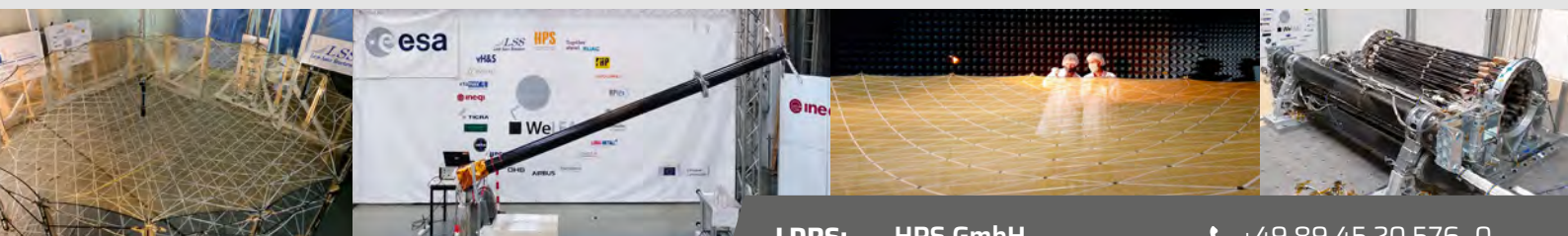
Our subsystems comprise:

- ▶ System Engineering and Accommodation
- ▶ Reflector Assembly
- ▶ Arm Assembly
- ▶ HDRMs
- ▶ Thermal Hardware
- ▶ Feeds on demand
- ▶ Deployment Electronics
- ▶ Harness
- ▶ MGSE
- ▶ Zero-g Deployment Test
- ▶ Qualification.

Reflective Mesh as self-standing product:

- ▶ Continuous Mesh production by our Joint Venture HPTex (DE)
- ▶ Various Mesh densities available.

WeLEA - the Consortium for the European Solution of LDRS:



Contact



Homepage



Flyer

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Reflective Meshes:

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Heritage

About us

Large Space Structures GmbH (LSS GmbH) was founded in 2012 as a spin-off from the Technische Universität of München (TUM), Munich, Germany. Our focus lays in Large Deployable Antennas/Reflectors (LDA/LDR) development. Over the past decade, we have extended knowledge and experience of 30 years, to get to where we are today: a team of over young 40 individuals from 15 different nationalities working as a unite motivated and passionate towards one goal, which currently is an EQM and two flight models of 8 m LDR for the Copernicus Expansion Mission CIMR.

Our first successful project was SCALABLE, a European Space Agency (ESA) funded R&D project: a 5m deployable double-pantograph ring, which supports a reflecting surface formed by a cable network with a knitted metal mesh. Many further ESA and other projects over the last years, like AMPER, LEA, LEOB, LABUM, TALDES, REVOLVE, SUTRA, each for LDA / LDR technologies, have led us to the worldwide recognized success.

Working experience with the European Space Agency and numerous European industrial partners in these projects is a valuable asset of our company and its staff in developing LDA / LDR technologies primarily for the European market needs.

Mission:

DEPLOYMENT of the team and expertise - on ground, LDAs / LDRs - in space



Services

LDA / LDR development:

- Design, Analysis & Optimization
- Manufacturing, Assembly & Testing



Facilities

- MAIT Clean room with Deployment MGSE
- Thermal-Vacuum Chamber
- Tensile machine with thermal chamber
- Laser Cutting,
- Laser Tracker
- Mechanical workshop



Product:

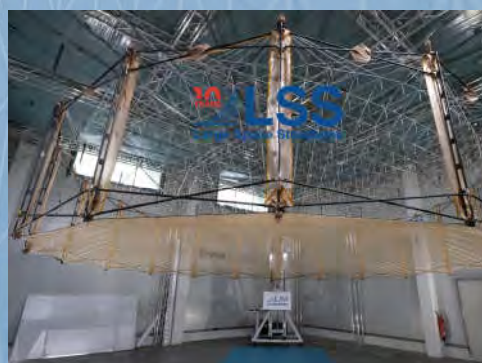
- Deployable Antennas / Reflectors 0.5 m to 30 m
 - With Flexible Shell Membranes (FlexRS®-I, OriFlex®)
 - With Cable Network Structures with Mesh (FlexRS®-II)
- Deployable Structures (e.g., flexible deployable solar arrays) and MGSEs



Contact

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Call for Papers

Glasgow

UK

17 – 22 March 2024

18th European Conference on Antennas and Propagation

THE CONFERENCE

EuCAP is Europe's largest and most significant conference on antennas and propagation attracting more than 1500 participants from academia and industry, and more than 50 industrial exhibitors worldwide. It is an excellent forum for exchanging new technical-scientific achievements, demonstrating state-of-the-art technology, and establishing and strengthening professional networks.

EuCAP 2024 will give the opportunity to address some of the main challenges of our time for technical-scientific research in Antennas, Electromagnetics, Propagation and Measurements.

FORMAT OF THE CONFERENCE

The conference will comprise:

- Plenary sessions with invited and keynote speakers
- Oral and Poster sessions
- Short courses
- Industrial and scientific workshops
- Industrial exhibition

APPLICATION TRACKS

Aiming at increasing the interaction between academia and industry, the conference will feature session tracks focused on front-line applications.

BEST PAPER AWARDS

A Best Student Paper Award, and Best Paper Awards in the five categories: Antenna Theory and Design, Antenna Applied Technology, Electromagnetics, Propagation, and Measurement are planned.

GRANTS

A number of grants covering travel and registration will be offered to selected authors. Please see the conference homepage for more information (www.eucap2024.org).

AMTA EUROPE

The Antenna Measurement Techniques Association (AMTA) is strongly involved in the conference. AMTA will contribute with invited speakers, provide special sessions, cooperate in the application tracks, and sponsor the technical tours.

AUGMENTED PAPERS PUBLICATION

Authors can apply for publication in a special issue of the International Journal of Microwave and Wireless Technologies (EuMA) during the submission process.

EXHIBITION AND SPONSORSHIP

The conference will provide numerous opportunities for exhibitors and sponsors, according to their strategic visibility and publicity targets. Coffee breaks and lunches will be served in the exhibition area to increase the interaction between participants and exhibitors. Please see the conference homepage for more information.

GLASGOW, SCOTLAND

As the birthplace of James Clerk Maxwell, Scotland has a long history relating to Electromagnetism that derives from the early days marked by theoretical foundations, throughout the years of radar technology development and more recently complemented by a flourishing New Space sector.

Scotland's largest city, Glasgow, is home to one of the most collaborative and dynamic innovation economies in Europe, with outstanding partnerships between the public, private and academic sectors. It is home to the largest academic community in the UK outside London and the city in Europe that manufactures most satellites. Glasgow is excellently connected with the World and easily accessible by train, sea, road, and three airports. Glasgow boasts beautiful architecture, excellent venues and world-class museums and galleries offering visitors a vibrant arts scene.

Information for Authors

Authors are invited to submit papers in PDF format, with a minimum length of two and a maximum length of five A4 pages.

The paper must contain enough information for the Technical Programme Committee and reviewers to assess the quality of the work in a single acceptance/ rejection review process. It will be possible to revise accepted papers in line with the reviewers' comments.

Submit your paper online at www.eucap2024.org no later than **13 October 2023**. The submission requires an EDAS® account, which is free.

Presented papers will be included in IEEE Xplore, if the authors choose this option during the submission process. Compliance with the IEEE format is mandatory in this case.

At least one of the authors of each paper must register as a delegate attending the conference. Each delegate can register a maximum of two papers in her/his name as "presenting author".

Important Dates

Deadline: 13 October 2023
Notification: 18 December 2023
Revised paper: 09 Feb. 2024

Firm Deadline

For EuCAP 2024, there will be no extension of the paper submission deadline; late or updated submissions will not be accommodated after the deadline.

Conference Topics and Application Tracks

Antenna Topics	
A01	Antenna theory, analysis and design
A02	Antenna technologies (including additive manufacturing)
A03	Active and passive arrays
A04	Mm-wave, sub mm-wave, THz and nano-optical antennas
A05	Multiband, wideband (incl. UWB) and multifunctional antennas
A06	Electrically small antennas
A07	Wearable and implantable antennas
A08	Lens antennas, reflectors, feed systems and components
A09	Reflectarrays and transmitarrays
A10	Slotted-waveguide & leaky-wave antennas
A11	Adaptive and reconfigurable antennas
A12	In-package and on-chip antennas
A13	MIMO, diversity, smart antennas & signal processing
A14	Antennas for RFID/sensors, wireless power transmission and harvesting
A15	Other antenna topics

Propagation Topics	
P01	Propagation theory and deterministic propagation modelling
P02	Empirical and statistical propagation modelling
P03	Channel sounding and parameter estimation techniques
P04	Propagation measurements
P05	Mm-wave, THz and UWB propagation
P06	Machine learning and artificial intelligence for propagation
P07	Propagation for vehicular communications
P08	Body propagation, effects of biological tissues on propagation
P09	Radar, localization, and sensing
P10	Other propagation topics

Measurements Topics	
M01	Material characterizations and non-destructive testing
M02	Near-field, far-field, compact and RCS measurement and calibration techniques
M03	Data acquisition, imaging algorithms and measurement post-processing
M04	Measurement range evaluation and EMI/EMC/PIM instrumentation
M05	UAV- and robotic based measurements
M06	Dosimetry, exposure and SAR assessment
M07	Satellite and aerospace antenna characterisation
M08	Mm-wave, THz and quasi-optical antenna measurements
M09	MIMO, OTA and 6G antenna testing
M10	General antenna measurements and other topics

www.eucap2024.org

Electromagnetics Topics	
E01	Electromagnetic theory
E02	Computational and numerical techniques
E03	Optimisation methods and machine learning in EM and antenna design
E04	Imaging and inverse scattering
E05	Scattering, diffraction and high frequency techniques
E06	Frequency/polarization selective surfaces and periodic structures
E07	Metamaterials and metasurfaces
E08	Electromagnetic education
E09	Other EM topics

Application Tracks	
T01	Sub-6 GHz for terrestrial networks (5G/6G)
T02	Mm-wave for terrestrial networks 5G/6G
T03	Aerospace, new space and non-terrestrial networks
T04	RF sensing for automotive, security, IoT, and other applications
T05	Positioning, localization, identification & tracking
T06	Biomedical and health
T07	THz and high frequency technologies
T08	EM modelling and simulation tools
T09	Novel materials, metamaterials, metasurfaces and manufacturing processes
T10	Fundamental research and emerging technologies

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