The Quarterly Bulletin of the CEAS

COUNCIL OF EUROPEAN AEROSPACE SOCIETIES

3AF AIAE AIDAA AAAR CzAeS DGLR FTF HAES NVvL PSAA RAeS SVFW TsAGI

Issue 2 - 2017
2nd Quarter

Aerospace Europe 2017 Conference

(6th CEAS Air & Space Conference)

Organized by AAAR - The Aeronautics and Astronautics Association of Romania on behalf of CEAS
PARLIAMENT of ROMANIA, 16th-20th October 2017
with the contribution of ECCOMAS, EUROMECH, EUROTURBO, ERFCOTAC, ACARE, EREA, EDA, EASA, EUROCONTROL, EASN

COMOTI ROMANIAN RESEARCH & DEVELOPMENT INSTITUTE FOR GAS TURBINES

rosa

INCAS - NATIONAL INSTITUTE FOR AEROSPACE RESEARCH "ELIE CARAFOLI"

ORGANISED AND HOSTED BY THE AERONAUTICS AND ASTRONAUTICS ASSOCIATION OF ROMANIA (AAAR), THE CEAS AEROSPACE EUROPE 2017 CONFERENCE WILL TAKE PLACE FROM 16 TO 20 OCTOBER IN BUCHAREST

► WITH 40 TECHNICAL SESSIONS, 7 SPECIAL SESSIONS AND 6 WORKSHOPS, IT WILL COVER A BROAD SPECTRUM OF AERONAUTICS AND SPACE CURRENT ADVANCES AND FUTURE CHALLENGES

CEAS

WHAT IS CEAS ?

The Council of European Aerospace Societies (CEAS) is an International Non-Profit Association, with the aim to develop a framework within which the major Aerospace Societies in Europe can work together.

It presently comprises thirteen Full Member Societies: 3AF (France), AIAE (Spain), AIDAA (Italy), AAAR (Romania), CzAeS (Czech Republic), DGLR (Germany), FTF (Sweden), HAES (Greece), NVvL (Netherlands), PSAA (Poland), RAeS (United Kingdom), SVFW (Switzerland), TsAGI (Russia); and six Corporate Members: ESA, EASA, EUROCONTROL, LAETA, VKI and EUROAVIA..

Following its establishment as a legal entity conferred under Belgium Law, this association began its operations on January 1st, 2007.

Its basic mission is to add value at a European level to the wide range of services provided by the constituent Member Societies, allowing for greater dialogue between the latter and the European institutions, governments, aerospace and defence industries and academia.

The CEAS is governed by a Board of Trustees, with representatives of each of the Member Societies.

Its Head Office is located in Belgium:
c/o DLR – Rue du Trône 98 – 1050 Brussels.
www.ceas.org

WHAT DOES CEAS OFFER YOU ?

Knowledge transfer:

- A well-found structure for Technical Committees

High-Level European Conferences:

- Technical pan-European events dealing with specific disciplines and the broader technical aspects
- The CEAS European Air and Space Conferences: every two years, a Technical oriented Conference, and alternating every two years also, a Public Policy & Strategy oriented Conference

Publications:

- Position/Discussion papers on key issues
- CEAS Aeronautical Journal
- CEAS Space Journal
- CEAS Quarterly Bulletin

Relationships at a European Level:

- European Commission
- European Parliament
- ASD (AeroSpace and Defence Industries Association of Europe), EASA (European Aviation Safety Agency), EDA (European Defence Agency), ESA (European Space Agency), EUROCONTROL
- Other European organisations

European Professional Recognition:

- Directory of European Professionals

Honours and Awards:

- Annual CEAS Gold Medal to recognize outstanding achievement
- Medals in technical areas to recognize achievement
- Distinguished Service Award

Young Professional Aerospace Forum

Sponsoring

THE CEAS MANAGEMENT BOARD

It is structured as follows:

- General Functions: President, Director General, Finance, External Relations & Publications, Awards and Membership.
- Two Technical Branches:
  - Aeronautics Branch
  - Space Branch

Each of these two Branches, composed of specialized Technical Committees, is placed under the authority of a dedicated Chairman.

The officers of the Board in 2017:

Quarterly Bulletin, Design & Page Setting: Sophie Bougnon
sophie.bougnon1@sfr.fr

CEAS MEMBERS AND PARTNERS

Full Members:

Association Aéronautique et Astronautique de France (3AF)
6,rue Galilée – F-75016 Paris
Tel.: + 33 (0) 1 56 64 12 30 – www.3af.fr
President: Michel Scheller
Corporate Partners Director: Elisabeth Dallo
elisabeth.dallo@aaaf.asso.fr
Secretary General: Bernard Vivier
bernard.vivier@gmail.com
CEAS Trustees: Pierre Bescond
pierre.bescond@laposte.net and Elisabeth Dallo
Executive Secretary : Anne Venables
secr.exec@aaaf.asso.fr
Event Coordination: Anne Venables

Asociación de Ingenieros Aeronáuticos de España (AIAE)
COIAE. Francisco Silvela 71, Entreplanta
28250 Madrid (Spain) – Tel.: + 34 91 745 30 30
CEAS@coiae.es - www.coiae.es
President: Mrs Estefanía Matesanz Romero
CEAS Trustees: Mrs Mercedes Oliver Herrero
Mercedes.oliver-herrero@airbus.com
Mrs Estefanía Matesanz Romero
Secretary: info@coiae.es

Associazione Italiana di Aeronautica e Astronautica (AIDAA)
Casella Postale 227 – I-00187 Roma V.R.
Tel / Fax : +39 366 144 21 31
info@aidaa.it – www.aidaa.it
President: Prof. Leonardo Lecce
Universita di Napoli Frederic II
Via Claudio 21 – 80125 Napoli
leonardo.lecce@unina.it
Secretary General: Prof. Cesari Cardani
info@aidaa.it / cesare.cardani@polimi.it
CEAS Trustees: Prof. Leonardo Lecce
and Prof. Amalia Ercoli Finzi
amalia.finzi@polimi.it
Secretary: Daniela Vinazzza – daniela@aidaa.it

Aeronautics and Astronautics Association of Romania (AAAR)
220D Iuliu Maniu Ave - 061126 Bucharest 6 – Romania, P.O. 76, P.O.B. 174 – www.aaar.ro
President: Prof. Virgil Stanciu
vvirgilstanciu@yahoo.com
Vice-President and CEAS Trustee: Dr Eng. Valentin Silivestru – valentin.silivestru@comoti.ro
CEAS Trustee: Prof. Ion Fuiorea
ion.fuiorea@comoti.ro

Czech Aerospace Society (CzAeS)
Novotneho lavka 200/5
110 00 Prague, Czech Republic
oslcr@csvts.cz - www.czaes.org
President and CEAS Trustee:
Assoc. Prof. Daniel Hanus, CSc, EUR ING, AFAIAA
Vice-President and CEAS Trustee:
Assoc. Prof. Jan Rohac, PhD

Deutsche Gesellschaft für Luft-und Raumfahrt Lilienthal-Oberth e.V. (DGLR)
Godesberger Allee 70 – D- 53175 Bonn
Tel.: + 49 228 30 80 50
info@dglr.de – www.dglr.de
President: Prof. Rolf Henke: rolf.henke@dlr.de
CEAS Trustees: Dr Cornelia Hillenherms
cornelia.hillenherms@dlr.de
and Philip Nickenig - philip.nickenig@dglr.de
Secretary General: Philip Nickenig
Executive and Team Assistant: Susanne Frank
Susanne.frank@dglr.de
Conference Manager: Torsten Schilling
torsten.schilling@dglr.de

Flygtekniska Föreningen (FTF) – Swedish Society for Aeronautics and Astronautics
Anna Rathsman - SSC c/o Rymdbolaget
Box 4207 – SE-171 04 Solna
Tel: +46-8-627 62 62
anna.rathsman@sscspace.com
President: Captain Roland Karlsson
St - Persgatan 29 5tr, SE - 602 33 Norrköping
Tel.: + 46(0)11 345 25 16 /+ 46 (0)705 38 58 06
rkrolandk@gmail.com
CEAS Trustees: – Kaj Lundahl
Wiboms väg 9 • SE - 171 60 Solna
klundahl@bredband.net
+46 8 270 264 – +46 703 154 969 (mob)
– Prof. Petter Krus : Linköping University
SE - 58183 Linköping – petter.krus@liu.se
+46 13 282 792 – +46 708 282 792 (mob)
Secretary: Björn Jonsson – FMV AL Flyglogistik
SE-115 88 Stockholm, Sweden
bjorn.jonsson@fmv.se

Hellenic Aeronautical Engineers Society (HAES)
3, Karitsi Str. 10561 – GR-10561 Athens
Phone & Fax (HAES): +30-210 - 323 - 9158
Working hours Phone:+30 22620-52334
Mob.:+30 697 997 7209
E-mail (HAES): admin@haes.gr
President: Ioannis Vakrakos –
vakrakos@otenet.gr
CEAS Trustees: Triantafyllos (Akis)
Tsitinidis ttsitinidis@haicorp.com
Tony Economopoulos – ae@otenet.gr

Nederlandse Vereniging voor Luchtvaart-techniek (NVvL)
c/o Netherlands Aerospace Centre
Anthony Fokkerweg 2
NL- 1059 CM Amsterdam
Tel.: + 31 88 511 3055 (secretariat)
nvvl@nlr.nl – www. nvvl.org
President: Christophe Hermans
CEAS Trustee: Christophe Hermans
christophe.hermans@dnw.aero
Secretary General and CEAS Trustee:
Paul Eijssen – paul.eijssen@nlr.nl

Polish Society of Aeronautics and Astronautics (PSAA)
Nowowiejska 24 – 00-665 Warsaw – Poland
Phone : +48 660 009 804
President: Pawel Stezycki
pawel.stezycki@ge.com
Vice-President: Miroslav Rodzewicz
miro@meil.pw.edu.pl
CEAS Trustee: Miroslaw Rodzewicz
miro@meil.pw.edu.pl
General Secretary: Andrzej Zyluk
Treasurer: Jacek Szumbarski
Coordinator for Foreign Relations : Zdobyslaw Goraj - goraj@meil.pw.edu.pl
Administrative Officer: Agata Wierzbinska

Royal Aeronautical Society (RAeS)
No.4 Hamilton Place – London
W1 J 7 BQ – United Kingdom
Tel.:+ 44 (0)20 76 70 4300
raes@aerosociety.com – www.aerosociety.com
President: ACM Sir Stephen Dalton FRAeS
CEAS Trustees: Emma Bossom and David Chinn
emma.bossom@aerosociety.com
Chief Executive: Simon Luxmoore
simon.luxmoore@aerosociety.com
Governance and Compliance Manager:
Saadiya Ogeer – saadiya.ogeer@aerosociety.com
Head of Conference: Richard Nicholl
conference@aerosociety.com

Schweizerische Vereinigung für Flugwissenschaften/Swiss Association of Aeronautical Sciences (SVFW)
RUAG/Aviation – Seetalstrasse 175
PO Box 301 – CH-6032 Emmen
Tel.:+41 79 239 22 36 – www.svfw.ch
President and CEAS Trustee: Dr Jürg Wildi
juerg.wildi@ruag.com
CEAS Trustee: Dr Georges Bridel
a/o ALR – Gotthardstr. 52 – CH-8002 Zurich
georgesbridel@aol.com

Central Aerohydrodynamic Institute Russian Aerospace Society (TsAGI)
1, Zhukovsky St. – Zhukovsky, Moskow region, 140 180, Russian Federation
Chief Executive and CEAS Trustee:
Sergey L. Chernyshev, D.Sc.
ved@tsagi.ru – www.tsagi.com
CEAS Trustee: Evgeni Andreev – andreev@tsagi.ru

Corporate Members:

ESA
8-10, rue Mario Nikis - F-75015 Paris
CEAS Representative: Torben Henriksen
www.esa.int

EASA
Konrad - Adenauer - Ufer 3
D-50542 Cologne (Germany)
Tel.: +49 (221) 8999 0000 - http://easa.europa.eu

EUROCONTROL
Rue de la Fusée 96 - Brussels 1130
CEAS Representative: Philippe Merlo
http://www.eurocontrol.int

EUROAVIA
Kluyverweg 1 - 2629 HS, Delft, NL
President and CEAS Trustee: Horatiu Goanta
CEAS Representative: Nicola Cimmino
nicola.cimmino@euroavia.eu
Phone: +40 743 00 1578 – www.euroavia.eu

LAETA (Portugal)
CEAS Representative: Pr L.B. Campos
Ave Rovisco Pais - Lisboa
www.idmec.ist.utl.pt/laeta/

VKI (Belgium)
Chaussée de Waterloo,
72 - B- 1640 Rhode-St-Genèse
CEAS Representative: Jean Muylaert
www.vki.ac.be

Societies having signed a MoU with CEAS:

Académie de l'Air et de l'Espace (AAE)
1, avenue Camille Flammarion – F-31500 Toulouse
www.academie-air-espace.com

American Institute of Aeronautics and Astronautics (AIAA)
1801 Alexander Bell Drive, Reston, VA 20191
megans@aiaa.org – www.aiaa.org

Chinese Society of Astronautics (CSA)
PO Box 838 – 10830 Beijing, China (PRC)
Pr Wang Jia – csa_space@yahoo.com.cn
www.csaspace.org.cn/

European Aeronautics Science Network (EASN)
President: Prof. Spiros Pantekalis
Rue du Trône 98 – 1050 Brussels, Belgium
www.easn.net

Association of European Research Establishments in Aeronautics (EREA)
Chairman: Bruno Sainjon – ONERA
EREA Secretary: Uwe Moeller – DLR
Uwe.Moeller@dlr.de

International Council of the Aeronautical Sciences (ICAS)
President: Dr-Ing. Detlef Müller-Wiesner
Executive Secretary: Axel Probst
c/o DGLR – Godesberger Allee 70 – D- 53175 Bonn
icas@icas.org – www.icas.org

Korean Society for Aeronautical and Space Sciences (KSAS)
Prof. Seung Jo Kim – Prof. In-Seuck Jeung
enjis@snu.ac.kr – sjkim@snu.ac.kr

EDITORIAL

Jean-Pierre Sanfourche
Editor-in-Chief,
CEAS Quarterly Bulletin

“Dear readers,

The front page of this bulletin highlights the important objective to be reached by the CEAS in this year: the full success of its sixth biennial conference which will be held in Bucharest from 16 to 20 October 2017, organised and hosted by the Aeronautics and Astronautics Association of Romania (AAAR). For the first time it will be supported by several European Science & Technology associations, which justified its new title: **CEAS AerospaceEurope Conference**. The preparation status report here after presented clearly shows that all necessary efforts are converging towards the achievements of this target.

You may observe that the editorial volume of our bulletin is slightly growing: this is difficultly avoidable if we wish to continuously improve its quality by regularly covering Aeronautical Sciences, Defence and Space.
Concerning Aeronautical Sciences, two articles are published, both oriented towards the future:

- *The endless runway*, a study conducted by an industrial consortium, analysing in detail the advantages and disadvantages of the circular runway concept, as well as the main technical obstacles to be overcome;

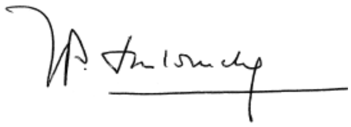
- SOLAR-JET *Zero-Carbon Jet Fuel*, the EU-FP7 research project whose aim is to demonstrate the possibility to produce carbon-neutral kerosene from CO_2 captured from air, water and solar energy.

The Aerospace Defence and Security section presents two papers: on the one hand an article relating to the Integrated Air and Missile Defence (IAMD), and on the other hand the welcome words of the EDA 2016 Annual Report by Jorge Domecq, EDA Chief Executive.

As regards Space, four subjects are covered:

- ExoMars 2020, ambitious mission jointly developed by ESA and ROSCOSMOS, the Space Agency of Russia;
- The ESA recent advancements in the manufacturing technologies for the space sector;
- Sentinel IIB and its successful launch on 7 March;
- An interview with Marc Picher, former Head of CNES Toulouse Centre, about “Climate Needs Space”, the theme of the Air and Space Academy Conference to be held in Toulouse on 10 and 11 October.

I wish you a good reading and on behalf of the Board of Trustees, I thank you in advance for your contribution to the success of Bucharest Conference 2017. ”



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CEAS PRESIDENT'S MESSAGE

Christophe Hermans,
CEAS President 2017

CEAS @work

At the last General Assembly meeting Elisabeth Dallo (representing AAAF) and Paul Eijssen (representing NVvL) were elected as new Trustee Board members and Torben Henriksen (ESA) as branch chair Space.
On 21 March we had our first CEAS officers meeting in the PolSCA Brussels office. From 2017 onwards we will meet twice a year as trustees to discuss strategic matters and twice the officers will hold meetings dealing with the day-to-day business of the council.
Important points on the agenda of the officers meeting of course were the preparation of the CEAS/Aerospace Europe Conference 2017, nominations received for the CEAS awards, 25 years of CEAS and CEAS Aeronautical and Space Journals.

In the framework of our contribution to the EU ECAero-2 project together with sister societies ECCOMAS, ERCOFTAC, EUCASS, EUROMECH and EUROTURBO the Aerospace Europe platform has been established (http://aerospace-europe.eu/). The platform has been created with the aim of providing a central hub for professionals with an interest in the development and applications of technologies in all areas relevant to Aeronautics and Astronautics. Main focus is on the dissemination of information and the promotion of knowledge transfers at a European scale. CEAS is using the platform for publishing the papers presented at our conferences and thematic events, as far as not issued in our journals. The platform also contains a rich overview of all relevant aeronautical events.

CEAS is in contact with PEGASUS, the European network of aerospace engineering faculties, about setting up an EU quality system in the higher education in aerospace.

CEAS Aerospace Europe Conference in 2017: European Aerospace: Quo Vadis?

The preparations for our CEAS Aerospace Europe Conference from 16 – 20 October in Bucharest, organized by our Romanian society AAAR, are progressing well. The call for papers has been closed. The preliminary conference program contains 40 technical sessions, 7 special sessions and 6 workshops on interesting topics. Plenary sessions will deal with subjects like strengthening international collaboration, advances in aerospace sciences and the future of space exploration. Progress on the preparations and a first draft conference programme can be followed on the conference website (http://ceas2017.org/). We would like to welcome you all in the prestigious Palace of the Parliament that has been chosen as conference venue. The registration process has started and we still can accommodate companies and organizations to take part in the exhibition.

Cooperation

During a first joined meeting with EASN, represented by Spiros Pantelakis (as chairman of the European Aeronautics Science Network Association), we have signed a Cooperation Agreement. Both our organisations provide services and conduct activities some of which are quite similar, others are rather complementary. By joining forces in certain areas I'm convinced we can reach out to more professionals, increase our impact and be more efficient in organizing events. Traditionally EASN has strong links with universities and thus scientists, where we as CEAS reach out more to industry, applied research and thus engineers, it shows that we can reinforce each other. This is why we have agreed from 2019 onwards to jointly organize the biennial European aerospace conferences with a joined technical committee.

Aeronautical and Space journals

The first volumes of this year for both of our successful journals with 27 excellent scientific articles have been published in March. End of last year we have welcomed Hansjörg Dittus (DLR), who took over the position of Editor-in-Chief of the Space Journal succeeding Constantinos Stavrinidis. In addition Olga Trivailo (DLR) and Rafael Bureo Dacal (ESA) have joined the Managing Editor team of the Space Journal. We are very grateful for the effort and enthusiasm of Steve who significantly contributed to the success of the CEAS Space Journal from its first edition in 2011 onwards!

Christophe Hermans

AEROSPACE EUROPE CEAS CONFERENCE2017

By Leonard Trifu, Marketing Manager, COMOTI

DATE AND VENUE

THE CEAS WILL HOLD ITS 6th BIENNIAL CONFERENCE: 'AEROSPACE EUROPE CEAS CONFERENCE2017'

FROM 16 TO 20 OCTOBER 2017 IN BUCHAREST – PALACE OF THE PARLIAMENT – 2-4 IZVOR ST. (Sector 5, 050563 – Bucharest, Romania)
The Conference will take place in 7 rooms/halls.
A 300 m^2 space will be available for the exhibition.

PROGRAMME

PLENARY SESSIONS – KEYNOTE SPEAKERS

- **Frank BRENNER**, EUROCONTROL, Brussels, Belgium
- **Christiane BRUYNOOGHE**, EUROCONTROL, Brussels, Belgium
- **Olivier CHAZOT**, "von Karman" Institute for Fluid Dynamics, , Belgium
- **Valentin CIMPUIERU**, Romanian Air Traffic Services Administration ROMATSA, Romania
- **Dominique COLLIN**, Safran Group – SNECMA, France
- **Mihnea COSTOIU**, "Politehnica" University of Bucharest, Romania
- **Delia DIMITRIU**, Manchester Metropolitan University, UK
- **Sergiy DMYTRIYEV**, SE Ivchenko-Progress, Ukraine
- **Cătălin FOTACHE**, United Technologies Research Center (UTRC), USA
- **Laszlo FUCHS**, Royal Technical University of Stockholm, Sweden
- **Rolf HENKE**, Advisory Council for Aviation Research and Innovation in Europe (ACARE), DLR, DGLR, Germany (final confirmation pending)
- **Christophe HERMANS**, CEAS, DNW, Netherlands
- **Charles HIRSCH**, NUMECA, Belgium
- **Laurent Leylekian**, ONERA, France
- **Cătălin NAE**, Romanian National Aerospace Research Institute "Elie Carafoli", Romania.
- **Guillermo PANIAGUA PEREZ**, Purdue University, USA
- **Florin PĂUN**, ONERA, France
- **Olivier PENANHOAT**, Safran Aircraft Engines, France
- **Marius Ioan PISO**, Romanian Space Agency ROSA.
- **Octavian Thor PLETER**, "Politehnica" University of Bucharest, Romania
- **Raoul POPESCU**, Pratt & Whitney Aeropower Rzeszow, Poland
- **Bruno SAINJON**, European Research Establishments in Aeronautics (EREA), ONERA, France
- **Valentin SILIVESTRU**, Romanian National Research and Development Institute for Gas Turbines COMOTI, Romania.
- **Virgil STANCIU**, Aeronautics and Astronautics Association of Romania (AAAR), „Politehnica" University of Bucharest, Romania.
- **Stefan Constantin VALECA**, Ministry of Research and Innovation. Romanian Government (final confirmation pending)
- **Michael WINTER**, Pratt & Whitney, USA
- **Sorin ZGURĂ**, Institute of Space Science, Romania
- European Space Agency (representative to be assigned)

TECHNICAL SESSIONS

- **40 ordinary technical sessions** on 23 topics, including an estimated number of 240 peer reviewed papers
- **7 special sessions** including an estimated number of 40 peer reviewed papers
  - "**Constant volume combustion**", organised by COMOTI and will gather presentation of the latest research results in the field. Some of the latest results obtained in the FP 7 project TIDE will be presented. A round table discussion at the end of the workshop will facilitate the free exchange of ideas between the participants.
  - **"Aircraft 3rd Generation MDO for Innovative Collaboration of Heterogeneous Teams of Experts"**. Three special sessions organised by DLR on the latest results from the AGILE Horizon 2020 project aimed at developing the next generation of MDO and aircraft design and on the exploitation activities dedicated to education, including the "AGILE design challenge", dedicated to the Academia and Research organizations.
  - **"Space Technology and Advanced Research"**. Three special sessions organized by the Romanian Space Agency ROSA to presents results obtained within the STAR research programme.

- **6 workshops including** an estimated number of 40 presentations:
  - **"Future Sky"**. Workshop organised by EREA, the asso-

ciation of European Research Establishments in Aeronautics on its Joint Research Initiative in which development and integration of aviation technologies are taken to the European level, and based on the alignment of national institutional research for aviation by setting up joint research programmes. The session will be chaired by Mr. Joseph KASPAR, General Manager at VZLU, Czech Republic, EREA Vice Chair and Chair of Future Sky Board.

- **"ACARE SRIA"** Workshop organised by the Advisory Council for Aviation Research (ACARE), where the updated Strategic Research and Innovation Agenda (SRIA), expected in June, will be disseminated and discussed.
- **"Research Infrastructures in Europe"**, Workshop organized by the European Commission on the current status and future development needs and directions for the European research infrastructure. With the confirmed participation of the Italian Aerospace Research Center, CIRA.
- **"Aircraft Flow Control Technologies"** (AFLoNext). The EC project AFLoNext is a four-year integrated project (level 2) targeting on maturing flow, loads and noise control technologies for transport aircraft. The workshop aims to dissemination of the project results in flow separation control at local areas of the wing to improve the low-speed performance, and in flow control in the cruise regime for stabilizing the shock-boundary layer interaction for buffet control.
- **"Future Education and Training"**, Workshop organised by Euroavia the European Association of Aerospace Students, representing the interests of over 2000 students from 38 universities in 19 European countries.
- **"The 13th European Workshop on Aircraft Design Education EWADE 2017"** will be organised as part of CEAS 2017 as a full day event. The workshop will discuss recent advances in aircraft design (research and teaching) and is organized by Prof. Dr.-Ing. Dieter SCHOLZ, MSME from the Hamburg University of Applied Sciences.

EXHIBITION

- Exhibition space (300 m^2) is available during the Conference for interested participants. Booths can be reserved from the organisers. A minimum of 12 m^2 for a booth applies.
- The exhibition space is located in the Palace of the Parliament building, in the „Unirii" Hall.
- 10 confirmed exhibitors to date:
  - Romanian Research and Development National Institute for Gas Turbines COMOTI, Bucharest, Romania;
  - Magic Engineering, Brasov, Romania;
  - Dassault Systems, Vélizy-Villacoublay, France;
  - National Institute for Aerospace Research „Elie Carafoli", Bucharest, Romania;
  - Aerostar S.A., Bac□u, Romania
  - Industria Aeronautica Romana (IAR), Brasov, Romania
  - Romaero S.A., Bucharest, Romania;
  - INAS S.A., Craiova, Romania
  - The European Aeronautics Science Network - Technology Innovation Services BVBA (EASN), Budingen, Belgium
  - European Space Agency / Romanian Space Agency

PUBLICATION POLICY

- A book of abstracts will be published and provided to the registered participants in both hard copy and in electronic format.
- The accepted peer reviewed papers will be published, following the recommendations of the Scientific Committee of the Conference, in:
  - CEAS Aeronautical and Space Journals (Springer), both indexed in Scopus;
  - INCAS Bulletin (Romania Academy);
  - Or Transportation Research Procedia (Elsevier) as conference proceedings.

KEY DATES

- Review decision and invitation for full paper submission: 30.04.2017
- Early bird registration deadline: 15.07.2017
- Full Paper submission deadline: 01.09.2017
- **Registration closed: 10.09.2017**
- Final conference programme: 15.09.2017
- **Conference sessions: 16 to 20.10.2017**

SOCIAL EVENTS

- **Welcome Cocktail**
- **Conference dinner**
- **Classical music concert**

TECHNICAL VISITS

- 5 technical visits are scheduled for the last conference day (3 in Bucharest, 2 outside), aiming to introduce the participants to the most important research and industrial organisations active in aviation and space in Romania:
- Aerostar Bacau and VinconPanciu wine cellar
- Airbus / IAR Brasov and the Peles Castle
- Magurele, the research and development town
- COMOTI and INCAS Bucharest
- Romaero Bucharest

ORGANISATION

- Executive Board: in charge of all major decisions related to the organisation of the Conference.
- Organisation Committee: in charge of all the aspects related to the organisation of the conference, such as logistics, financial administration and sponsor identification:
  - PoC Dr. Ionut Porumbel, phone: +40.720.090.772, +40.214.340.240, fax: +40.214.340.241
  - Email: ionut.porumbel@comoti.ro,infoceas2017.org
- Scientific Committee and Programme Committee: ensure

the scientific and technical quality of the papers presented at the Conference.

Website

- ceas2017.org
- Weekly website updates

REGISTRATION& FEES

Number of papers2		1	2-3	4-5	> 5
Speaker	Standard	400 €	350 €	300 €	250 €
	Early bird	300 €	250 €	200 €	150 €
	CEAS member	250 €	200 €	150 €	100 €
	AAAR member	200 €	150 €	100 €	50 €
	Graduate student	150 €	100 €	50 €	Free
	Undergraduate student	50 €	Free		
Exhibitor	Standard		1,150 €		
	Early bird		1000 €		
Participant	Standard		100 €		
Additional	Concert		Free		
	Welcome cocktail		Free		
	Conference dinner		75 €		
	Technical visit - ROMAERO		Free		
	Technical visit - Magurele		Free		
	Technical visit - COMOTI and INCAS		Free		
	Airbus / IAR Brasov & Peles Castle		95 €		
	Aerostar Bacau &Vincon Panciu wine cellar		95 €		

PARTNERS

11 confirmed partners to date:

- European Collaborative Dissemination of Aeronautical Research amd Applicatons (E-CAero)
- Romanian Ministry of National Defence
- European Community on Computational Methods in Applied Sciences (ECCOMAS);
- European Research Community on Flow, Turbulence and Combustion (ERCOFTAC);
- “Politehnica” University of Bucharest;
- Aeronautics and Astronautics Association of Romania (AAAR);
- European Turbomachinery Conference (ETC);
- European Mechanics Society (EMS);
- European Association of Aerospace Students (EUROAVIA);
- Romaero S.A., Bucharest
- European Aeronautics Science Network (EASN)

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By Cornelia Hillenherms, Christophe Hermans, Wilhelm Kordulla and Olga Trivailo

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As such the journals disseminate knowledge, promote aerospace research particularly in Europe, e.g. from current EU framework programmes, and foster the transfer of knowledge into practice.

The journals are published regularly with four issues per year. In 2016, authors from 14 / 13 different (also non-European) countries have submitted 117 / 41 manuscripts to the CEAS Aeronautical / Space Journal.

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Volumes[1]	7	8
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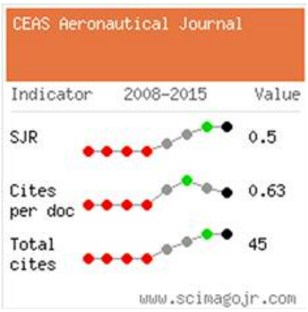
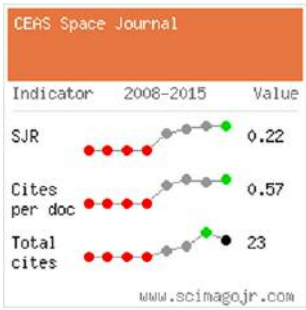
SCImago Journal Rank (SJR)[3]		
Source Normalized Impact per Paper[4]	1,433	1,006
H-Index	6	5
WWW	http://www.springer.com/13272	http://www.springer.com/12567
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DIGITAL CONNECTIVITY & CYBERSECURITY SEMINAR

ROYAL AERONAUTICAL SOCIETY

7 June 2017
No.4 Hamilton Place, London
Conference

SEMINAR SUMMARY

With the ever evolving airborne connectivity technology base and digital aviation journey, the complexity facing operators is increasing. This event will bring together Airlines, Airport Authorities, Air Traffic Control Organisations, GDS and Data Warehousing Companies, IT Solutions Companies, Cybersecurity Firms, Aircraft Design Organisations, Universities, Government Bodies, Civil Aviation Authorities and International Associations to be presented an informative overview of the connectivity technologies today and in the future as well as the cybersecurity regulations, methods and products being explored in order to protect the industry.
As part of the day we will be running a TED style session in which companies can pitch their solutions to digital connectivity and cybersecurity. Please contact conference@aerosociety.com to register your interest.

Why should you attend?
Meet and network with others to explore and understand the implications of evolving cyber threats against the ever connected aviation industry.

Registration

Non-Member	£180 +VAT
RAeS Corporate Partner	£150 +VAT
RAeS Member	£120 +VAT
RAeS Baseline Member	£105 +VAT

Speaker Details
Dr **Kevin Jones**, Head of Product and Cyber Innovation, Airbus Security
Simon Cooper, Partner, Ince & Co
Gillie Belsham, Partner Head of Aviation, Ince & Co

AIDAA CONFERENCE

AIDAA
ASSOCIAZIONE ITALIANA DI AERONAUTICA E ASTRONAUTICA

Associazione Italiana di Aeronautica ed Astronautica
XXIV International Conference
September 18-22 2017 | Palermo – Enna

CALL FOR PAPERS

XXIV International Conference AIDAA 2017 The AIDAA 2017 International Conference (www.AIDAA2017.com) will be held from Monday through Tuesday, September 18-19 at the University of Palermo, and from Wednesday through Friday, September 20-22 at the Kore University of Enna. The Conference will bring together researchers and professionals active in all areas of aerospace sciences and engineering, with the aim of promoting exchange of knowledge and experience and encouraging networking within the community. Contributions in all fields are encouraged including but not limited to Aerodynamics and Fluid dynamics, Propulsion, Materials and Structures, Aerospace Systems, Flight Mechanics and Control, Space Systems and Missions. The AIDAA 2017 technical program will comprise several types of presentations in plenary and parallel sessions, keynote speeches and minisymposia, tutorial sessions, and round tables along with exhibits. Papers are invited in the form of regular manuscripts. Papers must conform to the format and style specified at (http://www.aidaa2017.com/papers-and-symposia/papers.html). Extended abstract and manuscripts should be submitted as PDF document by using the online submission systems (http://www.aidaa2017.com/papers-and-symposia/papers.html. All manuscripts should be written in English. Papers must be characterized by theoretical, numerical and experimental new developments and results in all areas of aerospace science and technology.

Topics to be covered include (but are not limited to):
- Flight Mechanics
- Aircraft Design
- Flight Tests
- Aircraft flight control systems

- Structures and Materials
- Damage and Fracture Mechanics
- Smart Structurs and Materials
- Computational Mechanics
- Fluid dynamics
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- Aircraft Transportation.
- Air Traffic Management
- Aircraft Guidance Navigation and Control
- Aircraft Systems and Equipments
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- Space Exploration and Missions
- Space Engineering and Technology
- Green Aviation
- Noise control
- Aeroelasticity
- Avionics
- Optimization, Control and Identification

SYMPOSIA

Persons willing to organize a mini symposium dedicated to special topics are invited to contact the AIDAA 2017 Organizing Committee at symposia@AIDAA2017.com

IMPORTANT DATES

- **Abstract submission (1 page): April 14, 2017;**
- **Notification of Acceptance: April 30, 2017;**
- **Full Length Paper (8 pages): June 15, 2017.**

REGISTRATION FEES

Early registration deadline (fees must be paid by following the AIDAA registration instructions at www.AIDAA2017.com/registration.html): **May 15, 2017**

Late registration deadline (fees must be paid by following the AIDAA registration instructions at www.AIDAA2017.com/registration.html): **July 31, 2017**

deadline	**Early registration May 15 2017**	**Late registration July 31 2017**
Member fee	€ 500,00	€ 600,00
Non Member fee	€ 550,00	€ 650,00
PhD Student	€ 400,00	€ 500,00
Undergraduate student	€ 100,00*	€ 150,00*

Registration fee includes (no excursion, no dinner)*

- Technical Sessions.
- 20 minutes oral presentation time
- 1 Excursion
- Coffee breaks, Lunch & Conference Dinner.
- Conference accessories & document
- 2 Bus Transfer

CHAIRS

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CONFERENCE VENUE

The AIDAA 2017 International Conference will be held on September 18-19 at the Polytechnic School of the University of Palermo and on September 20-22 at the M.A.R.T.A. Centre – Mediterranean Aeronautics Research & Transportation Academy of the Kore University of Enna.

Contacts and Information: info@aidaa2017.com

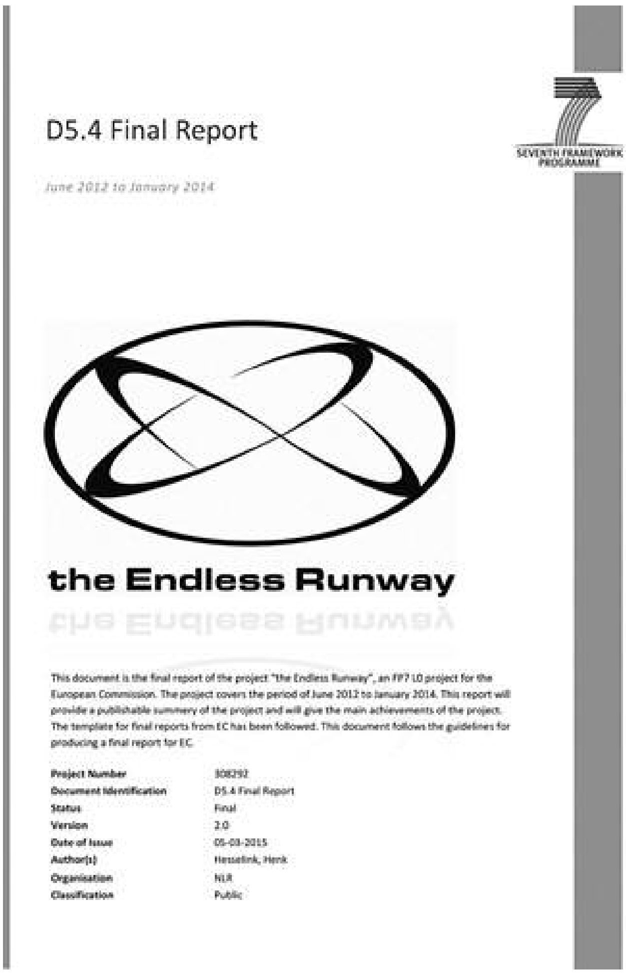
THE ENDLESS RUNWAY PROJECT: WOULD CIRCULAR RUNWAYS DRIVE PILOTS ROUND THE BEND?

By Jean-Pierre Sanfourche, Editor-in-Chief
From the article written by Bill Read FRAeS , published in AEROSPACE magazine, 4 April 2017

The quickest way to get from A to B is in a straight line. Or should it be going around in a circle? A consortium of five European research centres led by the Netherlands Aerospace research (NLR has published a report poking in the potential advantages of building an airport with a circular runway. Headed by NLR's senior R&D Manager Henk Hesselink, the Endless Runway project was carried out by NLR, DLR (Germany), ONERA (France), INTA (Spain) and ILOT (Poland). It received funding through the European Commission 7th Framework Programme (FP7).

The idea of the circular runway is not new: a number of concepts were presented and tested since 1919. In 2011 the concept was again highlighted during the 'Fentress Global Challenge: Airport of the Future' in which two students from Stanford's University and Malaysia's University of Science proposed a circular runway concept.

Here below, is an abstract of the Endless Runways Final Report from the Consortium.


D5.4 Final Report

June 2012 to January 2014

SEVENTH FRAMEWORK PROGRAMME

the Endless Runway

This document is the final report of the project "the Endless Runway", an FP7 L0 project for the European Commission. The project covers the period of June 2012 to January 2014. This report will provide a publishable summary of the project and will give the main achievements of the project. The template for final reports from EC has been followed. This document follows the guidelines for producing a final report for EC.

Project Number	308292
Document Identification	D5.4 Final Report
Status	Final
Version	2.0
Date of Issue	05-03-2015
Author(s)	Hesselink, Henk
Organisation	NLR
Classification	Public

Figure 1. The Endless Runways Final Report (NLR)

ENDLESS RUNWAYS: WHAT IS IT, IN SHORT?

Hub and spoke airport

A circular runway would need a minimum diameter of 3.5km with an inner runway radius of 1,500m. It would be connected to the terminal apron via a taxiway system consisting of an outer and an inner taxiway ring. The outer taxiway would operate in the same direction as the runway and would be connected to the runway through high speed exit taxiways where one aircraft can hold if needed. The inner taxiway would operate in the opposite direction to the outer one. Taxiways between the airport's buildings would link the inner circular ring to the inner airfield area. The terminal being closer to the runway, aircraft taxi times could be reduced by between 40% and 95%.

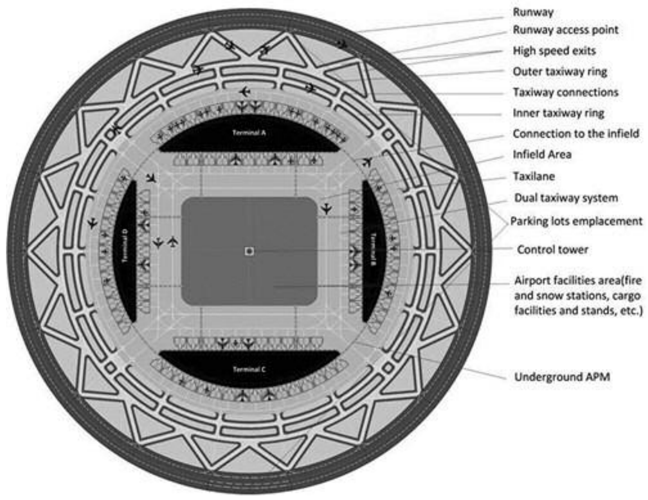


Figure 2. All the airport infrastructure would have to fit within the runway diameter. (NLR)

The terminal buildings would be located in the centre of the circular site around which the aircraft would park. The inclusion of vertical take-offs and landing within the airport could also be envisaged.

Figure 3. Space beneath the banked runway could be used for parking. (NLR)

Landing sideways

Because aircraft will be required to take-off and land in a circle with centrifugal force pulling them sideways, the circular runway would need to be banked in a similar way to curves on a motor racing circuit. Of course changing a runway from a straight level surface to a curved banked formation creates a number of challenges.

Another problem is the issue of clearance between the runway surface and the aircraft engines, wing tips and undercarriage.

Figure 4. Landing a large commercial commercial aircraft on a banked circular runway would require a new set of pilot skills. (NLR)

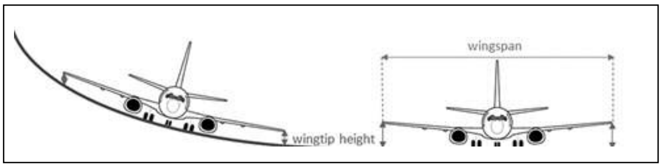


Figure 5. Wingtip and engine nacelle clearance for large commercial jets would be less on a circular runway. (NLR)

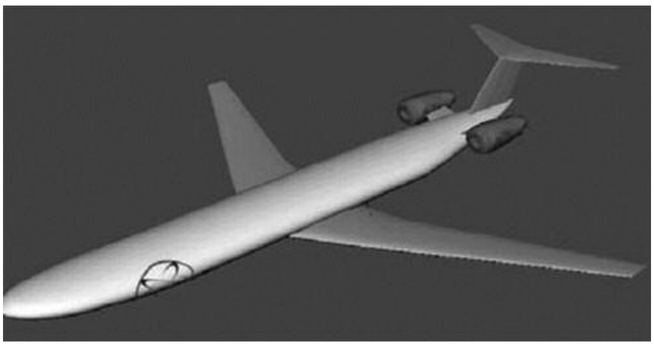


Figure 6. A concept image of the ERAC future aircraft customised for circular runway operation. (NLR)

No longer necessary to change runway approaches depending on which way the wind is blowing

Every time the wind changes, there would be a different point on the endless runway for optimal take-off and landings.

Rethinking ATM

The report proposes an increased use of automatic systems using ILS, MLS or Space-Based Augmentation Systems). Naturally the current ATC operations, procedures and systems would have to be changed.

Figure 7. Traffic could approach and leave an endless runway from any direction. (NLR)

Among circular advantages

Economy of space – Pilots can land in whatever direction is favourable – Aircraft can land and take-off at any point in the circle – Risk of wake turbulence from following the paths of other aircraft avoided - Taxi times reduced.

Among circular disadvantages

The Endless Runway concept creates a number of concerns raised particularly from pilots with regard to safety issues when taking off and landing.

Other concerns include building costs. It is not practical to rebuild an existing airport with a circular runway, so a new one would have to be built from zero.

About the future of the concept

The authors of the report conclude that much work still needs to be done. As a matter of fact, significant challenges will have to be overcome in many areas, including that of safety, which might only be solved through the use of future technologies yet to be developed.

In particular the report estimates that development of the Endless Runway concept could take another 20 years to come to fruition, by which aircraft and ATC systems would be sufficiently matured to enable computers to control the landings to precisely line up with the runway. It also sets the question: how current operations and procedures should be changed and what new developments would be necessary?

So, a long time will be necessary before the Endless Runway concept will come from dream to reality.

ABOUT PROGRESS AND PERSPECTIVES OF SOLAR FUELS

By Jean-Pierre Sanfourche[1], Editor-in-Chief

The SOLAR-JET programme was presented during the Seventh European Aeronautics Days – AERONAUTICS-DAYS2015 – held in London on 20-23 October 2015. Here below is given a short summary highlighting the main components of the concept.

The large volume availability of drop-in capable renewable fuels is of great importance for decarbonising the aviation sector.

Currently, biomass-derived synthetic paraffinic kerosene is the only renewable fuel option for civil aviation. But the use of bio fuels at the scale of global demand necessitates a very large share of the global agriculture land due in particular to the low area-specific yield of bio fuel production. In contrast 'SOLAR FUELS' offer new attractive perspectives, why?

Solar fuels are not based on natural photosynthesis but on high-temperature thermo chemistry, and therefore offer much higher area specific yield and are most efficiently produced in desert regions with high direct normal solar irradiation solar irradiation: DNI, typically higher than 2000 kWh.m^{-2} per year. Thus there is no competition for land with food or feed production. Solar fuels could meet the future fuel demand by using less than 1% of the global arid and semi-arid land.

In reason of the highest interest of this concept, researches have received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 285098 – Project SOLAR-JET.

REDOX CYCLE

The SOLAR-JET (Solar chemical reactor demonstration and Optimisation for Long-term Availability of Renewable JET fuels) approach uses concentrated solar energy to synthesize liquid hydrocarbon fuels from H_2O and CO_2. This reversal of combustion is a two-step cycle which splits H_2O and CO_2. It is accomplished through a high-temperature thermo chemical cycle based on metal oxide reduction-oxidation (Redox) reactions which convert H_2O and CO_2 into synthetic gas ('syngas'), a mixture of H_2 and CO.

SOLAR SYNTHETIC GAS PRODUCTION AND FUEL SYNTHESIS

– Experimental setup at ETH Zurich for synthetic gas gas production

A high-flux solar simulator produces a radiative flux with equivalent properties to that of highly concentrated solar radiation. This simulated sunlight heats a solar thermo chemical reactor up to 1700°C for the reduction step (Figure 1).

– Solar reactor technology

The solar reactor (Figure 2) consists of a cavity-receiver which contains a reticulated porous ceramic (RPC) structure, made from ceria, with dual-scale porosity (small- and large- scale).

– Synthetic gas production

'Syngas' are produced by simultaneous splitting of CO_2 and H_2O. Ceria based solar-thermochemical cycles can

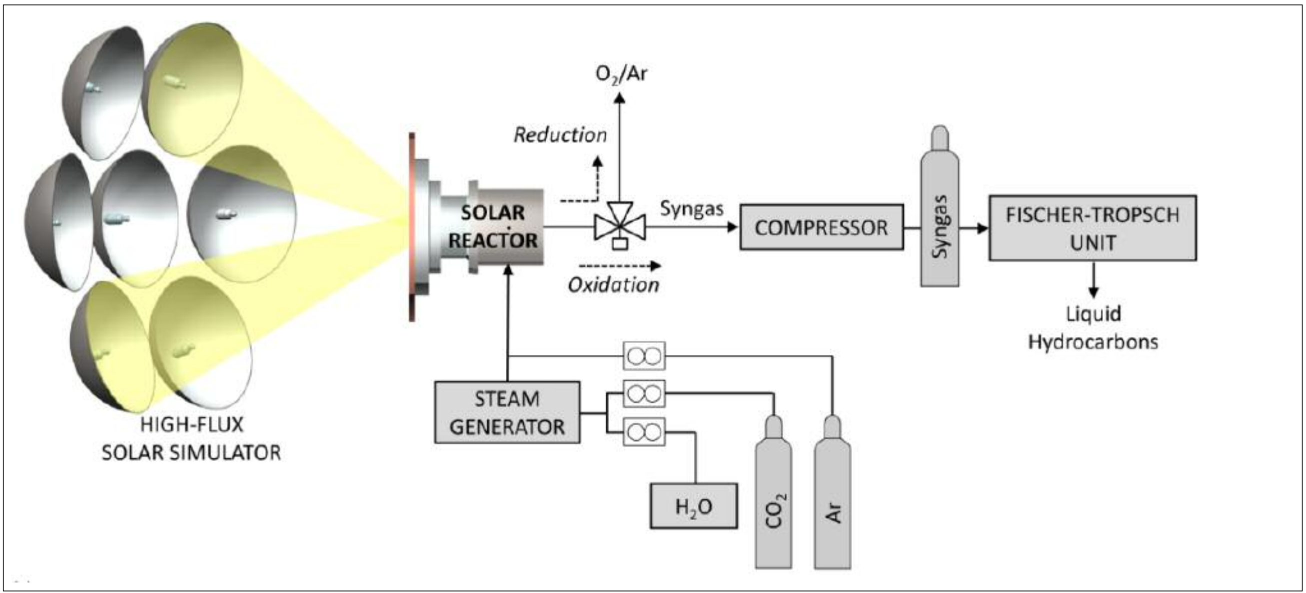


Figure 1: Schematic of the experimental setup, featuring the main system components of the production chain to solar kerosene from H_2O and CO_2 via the ceria-based thermochemical redox cycle.

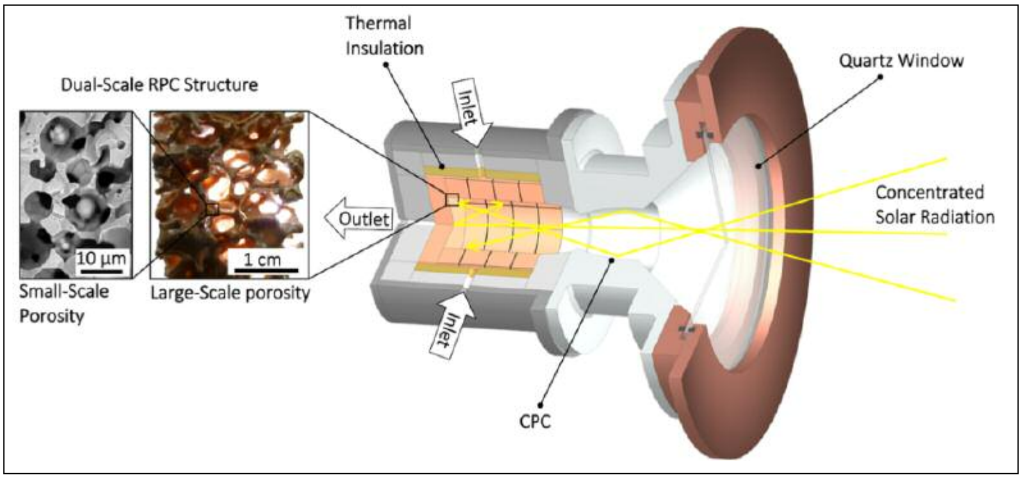


Figure 2: Schematic of the solar reactor configuration. The cavity-receiver contains a reticulated porous ceramic (RPC) structure, made from ceria, with dual-scale porosity in the mm- and µm-scale.

directly produce H_2, pure CO, or syngas at a desired molar ratio. The net product is a high-quality syngas, which is further processed to synthetic paraffinic kerosene via **Fischer-Tropsch** (FT) synthesis.

– **The world's first solar kerosene**

The entire process chain to Fischer-Tropsch derived solar has been successfully demonstrated in a 4-kW scale laboratory environment. The FT reaction was carried out in a fixed-bed micro flow unit. The liquid product and the gaseous product were collected as 'heavy product' and 'light product'. Hydro cracking is the final step that converts Fischer-Tropsch wax (heavy product) into kerosene and other middle distillates like diesel and naphta. To minimise the risk of failure only a small fraction of the product wax was used for hydro cracking. The final liquid product mostly contained kerosene (Figure 3): **the world first 'solar' kerosene was produced, this was the first-ever production of jet-fuel via a thermo chemical H_2O/CO_2 splitting using simulated solar concentration.**

SOLAR-JET has clearly demonstrated the possibility to produce carbon-neutral kerosene from CO_2 captured from air, water, and solar energy first-ever production of jet-fuel via a thermo chemical H_2O/CO_2-splitting cycle using simulated concentrated solar radiation.

Figure 3 : Final Fischer-Tropsch products derived from solar synthetic gas. Left: Heavy product (waxes). middle: condensate from light product stream (H_2O and hydrocarbons). Right: the world's first solar kerosene.

AMONG BENEFITS

- A far-reaching alternative towards the production of carbon-neutral kerosene from CO_2 captured from air, water, and solar energy.
- Demonstration of pioneering processes for risk aversion in high-impact strategic long-term investments for the aviation energy future.
- Demonstration of the key technological components for solar aviation drop'in fuel production that enables the use of existing fuel infrastructure, fuel system, and aircraft engine, while eliminates the logistical requirements of bio fuels, hydrogen, or other alternative fuels.
- The very large production potential of solar fuels could meet the global aviation fuel demand from less than 1% of the global desert area.
- As a socio-economic impact, large-scale production of SOLAR-JET fuel is expected to increase energy supply security and wealth from local fuel production in economically challenged countries with vast areas of arid non-arable land.

CONTINUED RESEARCH IS REQUIRED, AMONG OTHERS:

- To increase the solar-thermochemical energy conversion efficiency with the aim to achieve competitive production costs: optimised solar chemical reactor design for syngas production;
- To validate the thermochemical process in a field environment;
- To scale-up the throughput to leverage the expected socio-economic and environmental benefits.

PARTNERS AND INDUSTRIAL ADVISORS OF SOLAR-JET:

• Core team: Bauhaus Luftfahrt – ETH Zürich – DLR-VU – Shell – ARTICC

• Aviation industry advisors: IATA – Lufthansa – Airbus Group Innovations – MTU Aero Engines

1. Article written by Jean-Pierre Sanfourche from notes taken during the presentation of the subject at the Aerodays2015 and from information available on Internet.

NEW ACTIVE ELECTRONIC SCANNING ANTENNA MULTIFUNCTION RADARS FOR IAMD IN THALES

Luc Dini – Co-chairman 3AF IAMD Conference – IAMD Director for Thales's air operations and weapon systems activities

With contributions from Messrs Remi Mongabure (Director of Multifunction radars bids for Thales's surface radars activities), Ronan Moulinet (Head of radars advanced studies offers for Thales's surface radars activities), and Bart van der Graaf (Operational Business development manager for Thales in the Netherlands).

WHY NEW ACTIVE ANTENNA MULTIFUNCTION RADAR TECHNOLOGIES?

Thales has been involved into air defense for many years and has provided surveillance radars to a lot of navies and land forces. The Ground Master 400 air defence radar (Figure 1a) belongs to the Ground Master family which has been sold to over 100 countries. In parallel, Thales in the Netherlands has manufactured many SMART-L family air surveillance radars (or S1850M) for the European navies on the Horizon frigates (Franco-Italian), T45 (UK), but also German, Danish and Dutch frigates (Figure 2a). Moreover, Thales has also manufactured Multifunction radars and fire control systems for medium range systems equipped with Aster missiles which are adapted to different missions and naval platforms for France, Italy and Great Britain and non-European navies. Thales provides for example ARABEL MFR X band radar, both in land version for French/Italian SAMP/T system (Figure 1b) and in naval version for SAAM system (for Aircraft Carrier PA CDG – Figure 1c – and Sawari 2 frigate), but also S band MFR Herakles (Figure 1d) radar for FREMM frigates.

Because of the evolution of the threat (cruise missiles, ballistic missiles with manoeuver capacity), the air defence and missile defence are moving towards an integrated vision called Integrated Air and Missile Defense where new performances and technologies are needed. This is why Thales developed new Active Antenna digital multifunction radars technologies to extend its radars portfolio to increase performance and early warning/ early detection capabilities, in L (Figure 2), UHF (Figure 3), and S (Figure 4) bands to perform long range detection, tracking and engagement (for some of them) of various threats from air breathing threat to Ballistic missiles.

ABOUT LATEST INNOVATIONS IN THALES

This article depicts the latest innovation for Active Antenna radars in Thales. Thales is also working on a more global approach for new MFR radars integration and networking not only for surveillance but also for fire control systems networking. In this environment, Thales is working with other industries to promote new concepts of fire control architectures to enhance the capacities and resilience of IAMD fire control systems. A study is currently conducted through NIAG (NATO Industry Advisory Group) on Multifunction Sensors Networking into Fire Control Clusters.

Fig. 1a: Ground Master 400

Fig. 1b: ARABEL X band MFR radar in land version (SAMP/T)

Fig. 1c: ARABEL X band MFR radar in sea based version (PA CDG)

Fig. 1d: Herakles MFR radar in S band

Figure 1

Thales has produced many sea based air surveillance SMART-L radars operating in L band for European navies. Since 2012, Thales has developed a new SMART-L with AESA antenna providing longer range for BMD/ IAMD in naval and land based versions. These radars are currently under integration and functional tests and prepared for first integration on Dutch frigates in 2018.

Fig. 2a: SMART-L

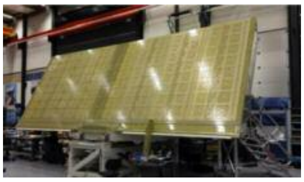


Fig. 2b: SMART-L EWC in integration

Fig. 2c: SMART-L EWC naval version under tests

Fig. 2d: SMART-L EWC land based version under tests

Figure 2: SMART-L familly

GLOSSARY

ABD: Anti Ballistic Defence

ABT: Air Breathing Target

AESA: Active Electronically Scanned Array

BMD: Ballistic Missile Defence

EWC: Early Warning Control

FREMM: Frégate Multi Missions

FTI: Frégate de Taille Intermédiaire

HMI: Human Machine Interface

IAMD: Integrated Air and Missile Defence

MFR: MultiFunction Radar

NIAG: NATO Industry Advisory Group

SAAM: Surface-to-Air Anti-Missile

SAMP/T: Surface-Air moyenne Portée/Terrestre

(French-Italian Surface-to-Air Defence Missile System)

SMART/L: Signaal Multibeam Acquisition Radar for Tracking /L band

TLP: Très Longue Portée

TBM: Tactical Ballistic Missile

TLP Very Long Range Radar (Figure 3a) *is a key element for early warning function in order to compute all types of ballistic threat. This ground-based low frequency sensor is a radar realizing the surveillance and acquisition of the ballistic missile target in its ascending and ballistic phases to produce trajectory parameters. The operation in Low Frequency band brings unsurpassable assets for the long range detection of the high endo and exo atmospheric ballistic missiles. Moreover TLP can provide cueing data to Centimetric band Fire Control Radar by integration in BMD system.*
The Very Long Range Radar is an active phased array technology (AESA) and multifunction radar based on fence surveillance interleaved - as soon as a target is detected – with a tracking mode based on specific tracking beams.
French MoD awarded a risk reduction contract to Thales and ONERA in October 2011 for the development and the experimentation of a radar demonstrator based on the principle of one column of the radar (Figure 3b) *defined in the concept study.*
In addition to column, the demonstrator solution (Figure 3c) *integrates real time software in term of signal processing and data processing. As operational radar, it includes HMI with Aerospace visualization, supervision statement and built in test dispositive.*
The objective of demonstrator is double:
- *Validation of architecture and technology choices;*
- *Evaluation of the detection and accuracy performances in order to anticipate operational performances of the Very Long Range Radar.*

Nowadays integration on site is closed in order to process phase of experimentation.

Fig. 3a: complete version

Fig. 3b: one column reduced scale antenna version

Fig. 3c: fully functional operational one column radar

Figure 3: Very long range alert UHF Radar.

Thales prepares the marketing of new generation radars with AESA technology, with a Fully Digital receive chain (FD-AESA), allowing Element Level Digital Beamforming. The MFR family is therefore a combination of a set of technological breakthroughs including Modular Aesa antenna (see Figure 4a), software radar and fully digital beam. Radar products will be available in naval (Figure 4b) *and ground versions, with fixed or rotating panels. Building on the GS1000/M3R demonstrator launched in 2004 and wide experience with air defense radars of the GM400 class, they combine deep operational experience with the latest technology.*

On the new French Navy FTI (Frégate de Taille Intermédiaire) class, the AESA 4 fixed panel Sea Fire radar (Figure 4c) *in S-band is arriving to take the place which was previously fulfilled by the multi-function radar Herakles. Using the same antenna technology, larger versions to handle BMD missions, and ground versions that can be coupled with the SAMP/T B1NT, are under definition.*

These radars are modular and allow for the covering of all ranges and powered by the dimensioning of the antenna and the adjustment of the number of Transmit/Receive (TR) modules. The functionalities of the range of radars cover both ABT (Air Breathing Target) and TBM (Tactical Ballistic Missiles) defence roles, and manage the effector component by the inclusion of missile link functionality for the ASTER family of missiles. A high level of performance in surveillance and tracking is attained thanks to the large multibeam capability (>50 simultaneous beams!) and to the optimization in real time of these multibeam patterns according to simultaneously performed missions and targets (Figure 4d).

Fig. 4a: Modular AESA antenna: This antenna is modular to integrate from hundreds up to thousands of T/R modules, fitted with GaN high power amplifier, to match all needs up to ATBM.

Fig. 4b: Sea Fire S band radar as integrated on a large Frigate.

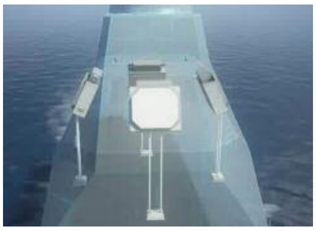


Fig. 4c: 4 fixed panel Sea Fire radar

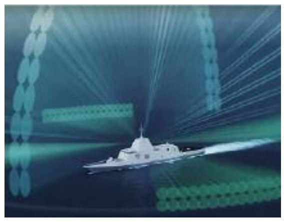


Fig. 4d: Multi-beam management dedicated multibeam patterns optimized for different tasks such as volume search, horizon search and cued target search can be automatically interleaved.

Figure 4: Future family of SF/GF AESA Multifunction Radars in S band

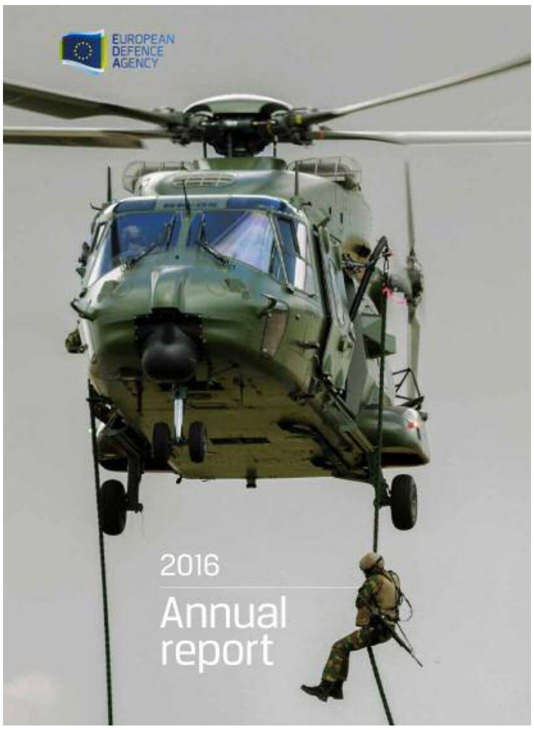
EUROPEAN DEFENCE AGENCY 2016 ANNUAL REPORT

EUROPEAN DEFENCE AGENCY

WELCOME WORD BY JORGE DOMECQ, EDA CHIEF EXECUTIVE

2016 was a seminal moment for European defence and a defining year for the European Defence Agency (EDA). The events that shaped 2016 added a new sense of urgency and determination to see Europe delivering on its potential in defence. The time has gone when Europe's achievements were judged in terms of what it agreed on paper. Henceforth the success or failure of European ambitions in defence will be judged exclusively on the basis of action and implementation. Defence is now, and needs to remain, firmly on the European political agenda.

Three major initiatives contributed to a momentous shift in European defence thinking in 2016. First, Federica Mogherini, the EU's High Representative for Foreign Affairs



and Security Policy, and Head of the EDA, presented the European Union Global Strategy (EUGS) in June, calling for the full use of the "Agency's potential as an essential prerequisite for European security and defence efforts."

This was followed by the Implementation Plan on Security and Defence, which set out a new level of ambition for the EU in defence. Second, the European Commission adopted the European Defence Action Plan, paving the way for a substantive European Defence Fund. Thirdly, the EU-NATO Joint Declaration added new impetus and concrete substance to the EU-NATO strategic partnership. These defining actions of 2016 have opened a window of opportunity for Europe to achieve concrete results starting in 2017.

This means that the critical work on implementation has to begin now. And EDA, whose core tasks are to support capability development through European defence cooperation, increase cooperative efforts in research & technology, and strengthen the industrial and technological base of the European defence sector, will be fundamental.

2016 put the spotlight on the added-value and expertise of the EDA. The four key capability programmes welcomed by the European Council in 2013 have made significant progress over the last 12 months. The contracts for a Definition Study of the European MALE RPAS (Medium Altitude Long Endurance Remotely Piloted Aircraft System) and for Air-to-Air Refuelling (AAR) were both signed in the summer. Cyber security poses ever-changing challenges that require a cross-sectoral approach to developing effective cyber defence capabilities. In 2016, EDA continued to facilitate efforts in education, training and exercise to enhance ambitious about what can be achieved in these programmes in 2017, in terms of increasing the number of Member States involved, addressing the full life cycle of defence capabilities, and developing effective education, training, and exercise initiatives.

This Agency was also a driving force in 2016, breaking new ground in an area that up to a few years ago would have been deemed inconceivable: defence research funded by the EU. The EU's Pilot Project on defence research, which marks the first time that the EU budget is used for defence research, is run and managed by the EDA on behalf of the European Commission. Its implementation is well advanced and the three contracts it foresees were signed in October. As a test bed for the conditions of defence research in an EU framework, it also paves the way for the next milestone on the road towards dedicated EU defence research: the launch of the so-called 'Preparatory Action' on CSDP-related research.

The next twelve months will have a transformational impact on European defence. EDA will be at the heart of it. Each year, this Agency grows its expertise and track record of delivery: 2016 was no different.

A pivotal moment for the EDA, but 2017 will be equally crucial in demonstrating the added-value of EU-funded research in the defence sector.

I believe that 2016 is defined by the fresh momentum behind European defence, but sustaining this momentum requires a strong partnership with industry. Europe's strategic autonomy is dependent on a globally competitive, technologically advanced and innovative industrial base, that supports the development of the military capabilities Europe needs. This year EDA has identified sources of support for the defence industry, launched a process to earmark future activities and concrete initiatives in support of defence-related SMEs, and has started to reorient is engagement with industry to better reflect the evolving defence industrial environment.

The growing interest of the European Commission in defence issues puts a premium on ensuring that the Agency plays its role to the full as the interface between Member States and the Commission. It has already done this successfully, be it in terms of the Pilot Project and the Preparatory Action on defence research, or EU legislation that has implications for defence, such as REACH, related to hazardous chemicals which may have a direct impact on the operational effectiveness of the armed forces aswell as the competiveness of the European defence industry. Equally, the establishment of the EDA Single European Sky (SES) Military Aviation Board, a milestone that will form the basis for EDA's work on relevant military aspects of SES, underscores the pivotal role of this Agency.

EDA is an outward looking agency that puts a premium on enhancing cooperation with other institutions and bodies to consolidate cooperation and optimise our overall impact. Its relationship with NATO, based on substantive dialogue at all levels, is ensuring mutually-reinforcing capability development. The Administrative Arrangements with both OCCAR and European Space Agency (ESA) have greatly improved synergies across programmes this year. In 2016, the EDA signed new agreements with SESAR JU, EUROCONTROL, and the European Union Satellite Centre (SATCEN).

The EDA has now passed the 185 mark in terms of projects facilitated and managed since its inception, representing almost €1 billion in R&T investment by the contributing Member States. In 2017 this Agency will continue to work in support of our Member States and strive to reinforce the European industrial and technological defence base. The launch of the EDA Long Term Review at the end of 2016 aims to set out the long-term objectives, priorities and way of working for this Agency as we move into the future and carry forward the implementation of the EUGS.

2016 has elevated European defence to a new level and set out an ambitious vision for the future. This Agency will work with even greater determination and will deploy its full range of expertise so that successful implementation will be the defining characteristic of the year ahead. I hope that 2017 will witness an even greater evolution in European defence cooperation.

EXOMARS 2020 MISSION

Rafael Bureo Dacal, ESA/ESTEC, Lead Mechanical Engineer, Mechanical Department rafael.bureo.dacal@esa.int

ExoMars is a mission jointly developed by ESA (Directorate of Human and Robotic Exploration) and ROSCOSMOS (the Russian national space Agency).
The Mars 2020 system prime contractor is TAS-I located in Torino, Italy. The Carrier Module responsible industry is OHB located in Bremen, Germany. The Rover responsible industry is Airbus UK located in Steevenage, UK. The Descent Module responsible industry is Lavochkin located in Moscow, Russia. A consortium of around 120 European and Russian industries supports the system level contractors.
A cooperation agreement between ESA and NASA in the US will allow the ExoMars 2020 landing assets to access the US Deep Space Network of Ground Stations, and also to relay science data through the American Mars orbiters as a backup to relaying data through the Trace Gas Orbiter. Reciprocally, American landing assets will be able to use the TGO to relay their data to the Earth.

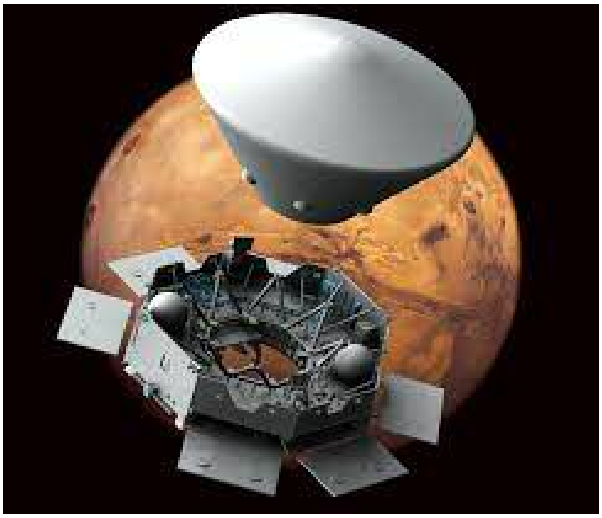


Figure 2 - Carrier Module releasing the Descent Modules which brings the surface Platform and the Rover down to Mars . Credit: OHB

TWO MISSIONS

The ExoMars programme is based on two missions: one consisting of the Trace Gas Orbiter plus an Entry, Descent and landing Demonstrator Module (EDM), known as Schiaparelli, already launched on 14 March 2016, and the other, featuring a Rover and a Russian landing scientific platform, with a launch date on July 2020.

THE AIM

The aim of the ExoMars programme is to demonstrate a number of essential flight and in-situ enabling technologies that are necessary for future exploration missions, such as an international Mars Sample Return mission. These include:

- Entry, Descent and Landing (EDL) of a set of payload instruments on the surface of Mars;

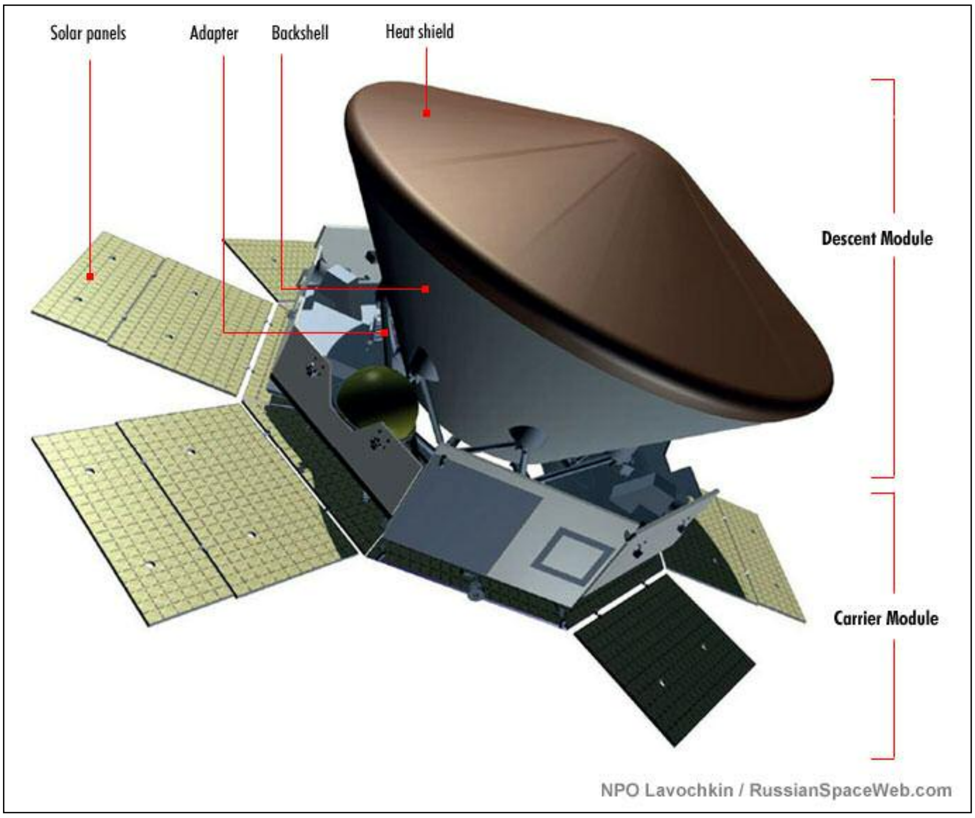


Figure 1 - Carrier and Descent Modules. Credit: NPO LAVOCHKIN

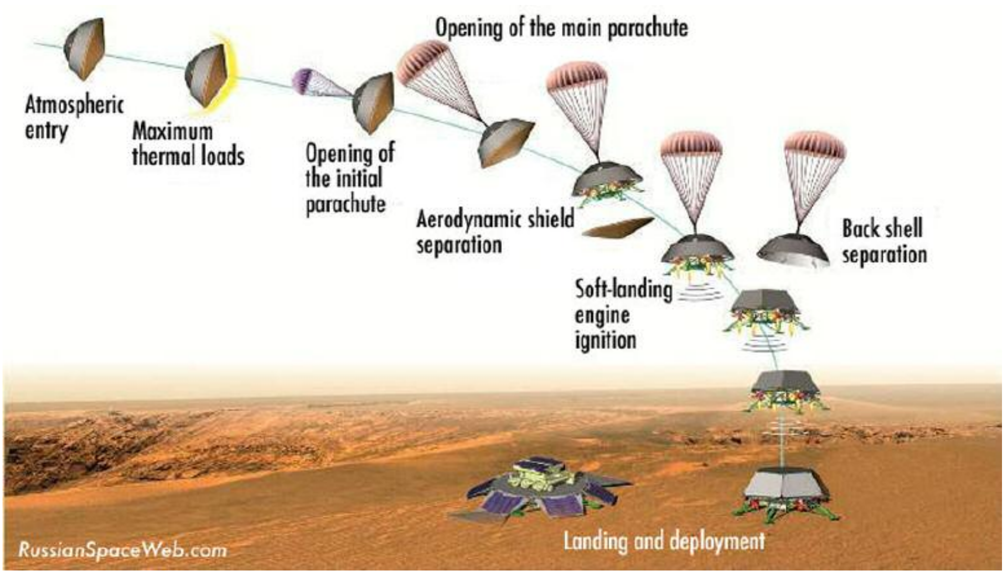


Figure 3 - Entry, Descent and Landing (EDL) profile.

- Surface mobility with a Rover;
- Access to the subsurface to acquire samples; and
- Sample acquisition, preparation, distribution and in-situ analysis.

At the same time a number of important scientific investigations will be carried out, for example:

- Search for signs of past and present life on Mars;
- Investigate how the water and geochemical environment varies; and
- Investigate Martian atmospheric trace gases and their sources.

A EUROPEAN ROVER AND A RUSSIAN SURFACE PLATFORM

The ExoMars 2020 mission will deliver a European rover and a Russian surface platform to the surface of Mars. A Roscosmos provided Proton-M rocket, configured with the Breeze-M upper stage, will be used to launch the mission from the Baikonour cosmodrome. The spacecraft will arrive to Mars after a nine-month journey. The ExoMars rover will travel on the Martian surface to search for signs of life. It will collect samples with a drill and analyze them with a versatile set of payload instruments. ExoMars 2020 will be the first mission to combine the capability to move across the surface and to sound the soil down to 2m depth to study the planet.

During the launch and cruise phase, a carrier module provided by ESA [fig. 1] (and development by OHB) will transport the surface platform and the rover within a single aero shell inside a descent module (DM) provided by Roscosmos (and development by LAVOCHKIN) with some equipment and subsystem contributions by ESA [fig. 2]. The DM will separate from the carrier shortly before reaching the Martian atmosphere. During the descent phase, a heat shield will protect the payload from the severe heat flux. Two parachutes, one supersonic and one subsonic, as well as a breaking engine plus a set of reaction thrusters will reduce the speed, allowing a controlled landing on the surface of Mars [fig.3].

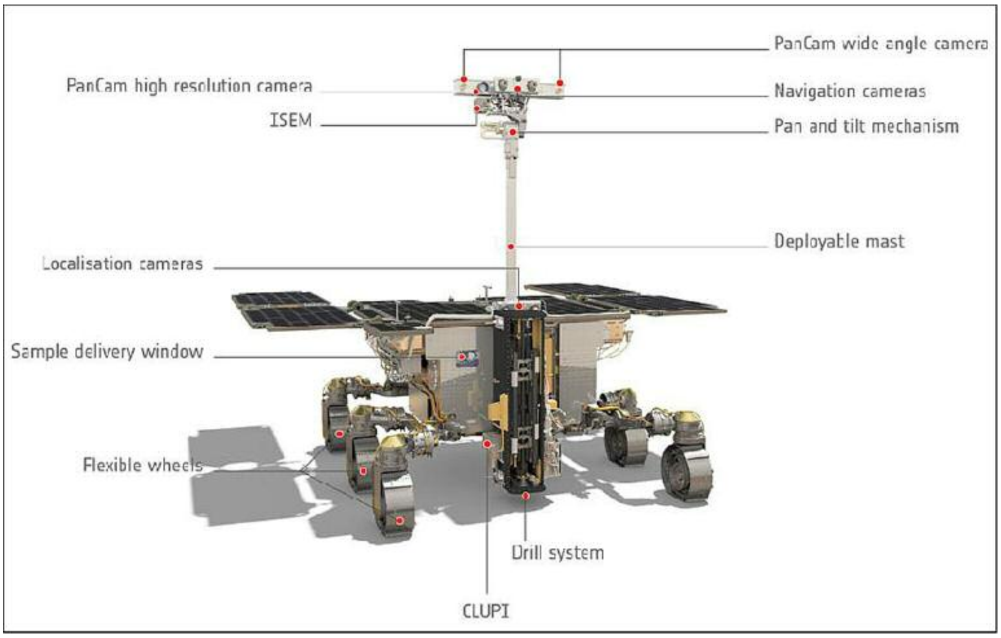


Figure 4 - Artist's impression of the ExoMars Rover. Credit: ESA/ATG Medialab

PanCam - The **Pa**noramic **Ca**mera To perform digital terrain mapping of Mars.	
ISEM - Infrared Spectrometer for ExoMars To assess the mineralogical composition of surface targets. Working with PanCam, ISEM will contribute to the selection of suitable samples for further analysis by the other instruments.	
CLUPI - Close - UP Imager A camera system to acquire high-resolution colour close-up images of rocks, outcrops, drill fines and drill core samples.	
WISDOM - Water Ice and Subsurface Deposit Observation On Mars A ground-penetrating radar to characterise the stratigraphy under the rover. WISDOM will be used with Adron, which can provide information on subsurface water content, to decide where to collect subsurface samples for analysis.	
Adron To search for subsurface water and hydrated minerals. Adron will be used in combination with WISDOM to study the subsurface beneath the rover and to search for suitable areas for drilling and sample collection.	
Ma_MISS - Mars Multispectral Imager for Subsurface Studies Located inside the drill, Ma_MISS will contribute to the study of the Martian mineralogy and rock formation.	
MicrOmega A visible plus infrared imaging spectrometer for mineralogy studies on Martian samples.	
RLS - Raman Spectrometer To establish mineralogical composition and identify organic pigments.	
MOMA – Mars Organic Molecule Analyser MOMA will target biomarkers to answer questions related to the potential origin, evolution and distribution of life on Mars.	

Table 1 Rover Instruments

THE EUROPEAN ROVER

After landing, the rover provided by ESA [fig. 4] (developed by Airbus UK), will egress from the surface platform to start its science mission travelling across the surface of Mars to search for signs of well-preserved organic material, particularly from the early period of the planet. The rover provides key mission capabilities: surface mobility, subsurface drilling and automatic sample collection, processing, and distribution to instruments. It hosts a suite of analytical instruments dedicated to exobiology and geochemistry research [table 1].

The primary objective is to land the rover at a site with high potential for finding well-preserved organic material, particularly from the very early history of the planet.

The rover will establish the physical and chemical properties of Martian samples, mainly from the subsurface. Underground samples are more likely to include biomarkers, since the tenuous Martian atmosphere offers little protection from radiation and photochemistry at the surface.

The rover uses solar panels to generate the required electrical power, and is designed to survive the cold Martian nights with the help of novel batteries and heater units.

The rover drill is designed to extract samples from various depths, down to a maximum of two meters. It includes an infrared spectrometer to characterize the mineralogy in the borehole. Once collected, a sample is delivered to the rover's analytical laboratory, which will perform mineralogical and chemistry determination investigations. Of special interest is the identification of organic substances. The rover is expected to travel several kilometers during its mission.

The ExoMars Trace Gas Orbiter [fig.5] (part of the 2016 ExoMars mission), that is already operational and orbiting Mars will support the communications of the rover and the surface platform. The Rover Operations Control Centre (ROCC) will be located in Turin, Italy. The ROCC will monitor and control the ExoMars rover operations. Commands to the Rover will be transmitted through the Orbiter and the ESA space communications network operated at ESA's European Space Operations Centre (ESOC).

Due to the infrequent communication opportunities, only 1 or 2 short sessions per sol (Martian day), the rover is highly autonomous. Scientists on Earth will designate target destinations on the basis of compressed stereo images acquired by the cameras mounted on the Rover mast. The rover must then calculate navigation solutions and safely travel approximately 100 m per sol. To achieve this, it creates digital maps from navigation stereo cameras and computes a suitable trajectory. Close-up collision avoidance cameras are used to ensure safety.

The locomotion is achieved through six wheels. Each wheel pair is suspended on an independently pivoted bogie (the articulated assembly holding the wheel drives), and each wheel can be independently steered and driven. All wheels can be individually pivoted to adjust the rover height and angle with respect to the local surface, and to create a sort of walking ability, particularly useful in soft, non-cohesive soils like dunes. In addition, inclinometers and gyroscopes are used to enhance the motion control robustness. Finally, Sun sensors are utilized to determine the rover's absolute attitude on the Martian surface and the direction to Earth.

The camera system's images, combined with ground penetrating radar data collected while travelling, will allow

scientists on-ground to define suitable drilling locations.
Data from the novel suite of instruments on-board the ExoMars rover will help scientists to conduct a step-by-step exploration of Mars, beginning at panoramic (meter) scales and progressively converging to smaller (sub-millimeter) studies, concluding with the molecular identification of organic compounds.

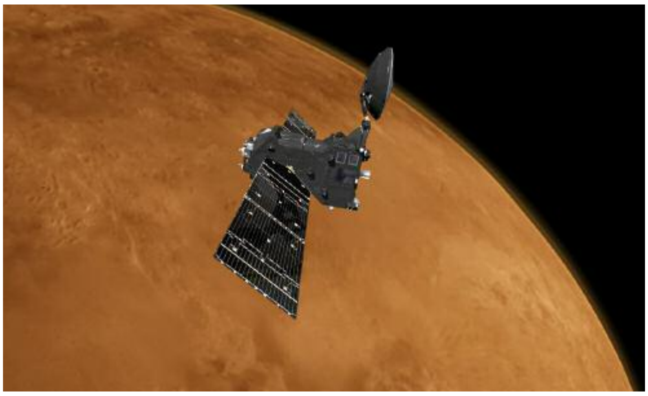


Figure 5 - Trace Gas Orbiter. Credit: ESA

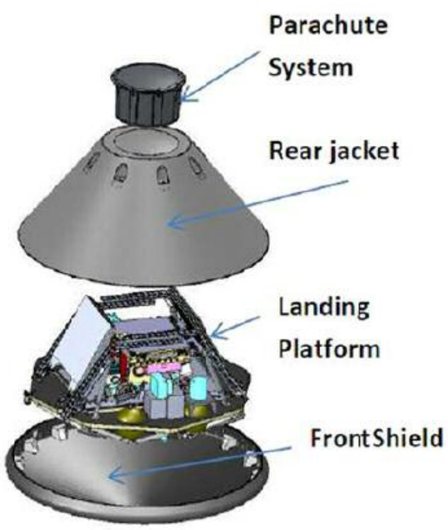


Figure 6 - Descent Module. Credit: Roscosmos/Lavochkin

THE DESCENT MODULE

The Descent Module (DM) [fig. 6], developed by Roscosmos with some developments by ESA like the on-board computer, the parachute system, the radar doppler altimeter and the inertial measurement unit accommodates both the landing platform and the rover. During the launch by the Proton –M, the Breeze upper stage will release the spacecraft composite (carrier plus descent module). The thermal control of the DM will ensure a proper temperature of the rover batteries and of all sensitive instruments during the 9 months of the cruise phase.
The DM is provided with the canister that holds the two parachutes plus the mortars. The ExoMars descent module will enter the Martian atmosphere travelling at approximately 20 000 km/h. The front shield and the rear jacket rear of the DM are covered by a thermal protection system (TPS) that protects the payload during the first deceleration phase of the ballistic entry in the Martian atmosphere to approximately twice the speed of sound. The angle of entry is important – too steep and the DM may overheat and burn up, too shallow and it may skip off the atmosphere, missing the planet altogether. Thereafter, a first supersonic parachute will be deployed. Later, the supersonic parachute will be discarded and a second, much larger parachute will open to bring the vehicle down to subsonic speeds.
After the ejection of the front shield a radar altimeter will measure the distance to the ground and the module's speed over the terrain. The computer will receive this information and combine it with its knowledge of the descent module's attitude and rates to decide how and when to start the controlled landing phase, which uses a brake

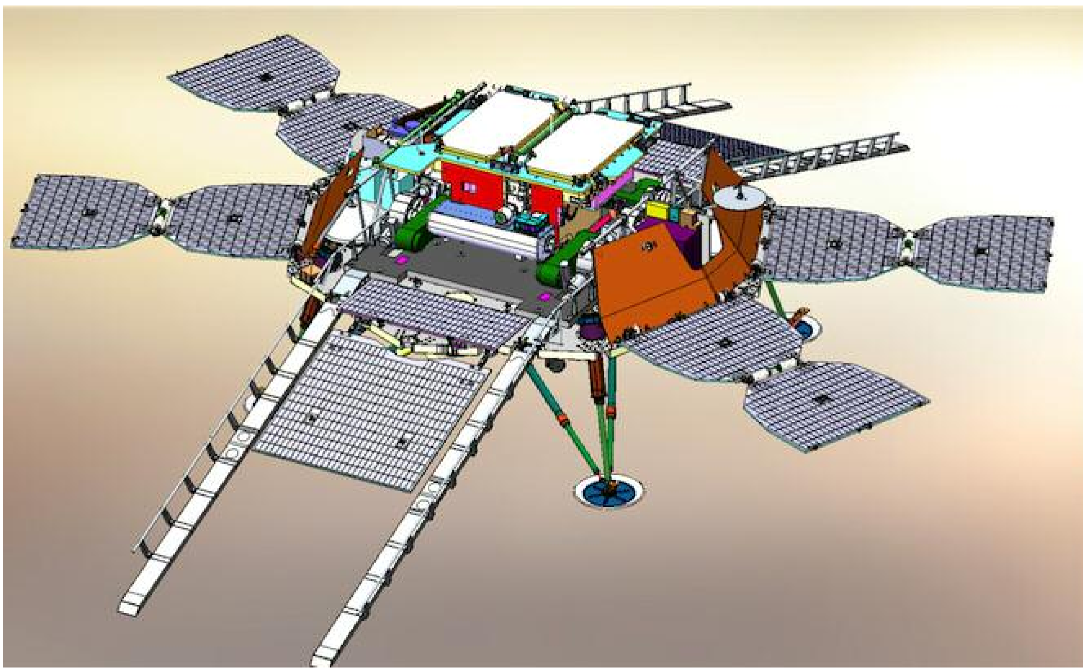


Figure 7 - Sketch of the ExoMars 2018 surface platform. Credit: Roscosmos/Lavochkin/IKI

EXOMARS 2020 SURFACE SCIENCE PLATFORM: INSTRUMENTS	
Instrument	**Description**
LaRa	Lander radio-science experiment
HABIT	Habitability, brine irradiation and temperature package
METEO M	Meteorological package
METEO-P, METEO-H (part of the METEO instrument)	Pressure and humidity sensors
RDM (part of the METEO package)	Radiation and dust sensors
AMR (part of the METEO instrument)	Anisotropic magneto-resistance sensor to measure magnetic fields
MAIGRET	Magnetometer
WAM	Wave analyser module
(part of the MAIGRET instrument)	
TSPP	Set of cameras to characterise the landing site environment
BIP	Instrument interface and memory unit
FAST	IR Fourier spectrometer to study the atmosphere
ADRON-EM	Active neutron spectrometer and dosimeter (can work in tandem with the rover neutron detector)
M-DLS	Multi-channel Diode-Laser Spectrometer for atmospheric investigations
PAT-M	Radio thermometer for soil temperatures (down to 1-m depth)
Dust Suite	Dust particle size, impact, and atmospheric charging instrument suite
SEM	Seismometer
MGAP	Gas chromatography-mass spectrometry for atmospheric analysis

Table 2 Surface Platform Instruments

engine and 4 main thrusters. The rear jacket and the parachute are discarded and the legs of the landing platform will be deployed and used for the final touchdown.
Uncertainties about the state of the Martian atmosphere mean that a landing site cannot be targeted with absolute precision. The best that can be done is to make a probabilistic prediction for the likely landing location. This analysis results in a possible area having the shape of an ellipse. For ExoMars 2020 the landing ellipse is 120 km by 19 km. The mission needs enough atmosphere to effectively slow down its descent, hence the landing site must be in a low-lying area of the planet. It must not contain features that could endanger the landing, such as many craters, steep slopes, and large rocks or steep sand dunes. Two ancient sites on Mars that hosted an abundance of water in the planet's early history have been recommended as the final candidates for the landing site of the 2020 ExoMars rover and surface science platform: Oxia Planum and Mawrth Vallis. Around a year before launch, the final decision will be taken on which site will become the ExoMars 2020 landing target.

THE SURFACE PLATFORM

The surface platform [fig.7], which is the responsibility of Roscosmos and the Space Research Institute of Russian Academy of Sciences (IKI), will remain stationary and will investigate the surface environment at the landing site. The main science priorities for the surface platform are context imaging of the landing site, long-term climate monitoring, and atmospheric investigations. The set of sensors and instruments on the surface platform will operate during its nominal mission lifetime of one Earth year.

Sensors and instruments on the surface platform will also be used to study the subsurface water distribution at the landing site, to investigate the exchange of volatiles between the atmosphere and the surface, to monitor the radiation environment, and to carry out geophysical investigations of the planet's internal structure.

Two European-led instruments will be mounted on the surface platform; the Lander Radioscience experiment (LaRa) and the Habitability, Brine Irradiation and Temperature package (HABIT). LaRa will reveal details of the internal structure of Mars, and will make precise measurements of the rotation and orientation of the planet. HABIT will investigate the amount of water vapor in the atmosphere and the UV radiation environment.

THE ESA ADVANCED MANUFACTURING CROSS-CUTTING INITIATIVE: AN OPPORTUNITY TO RAISE EUROPEAN TECHNOLOGY COMPETITIVENESS

Tommaso Ghidini, Head of ESA's Materials and Process section

Introduction

Europe has been the cradle of the Industrial Revolution and is hosting a manufacturing infrastructure, which builds its strength on a solid engineering tradition, a prestigious Research and Development (R&D) and academic network and a responsive industry (fast adapting to technological developments). In 2012, the manufacturing industry in the EU was worth € 7 Trillion in turnover, employed 30 Million citizens directly, providing twice as much job indirectly, the vast majority in small or medium enterprises (SMEs). It has generated around €2 Trillion of value-added. It accounts for 80% of private R&D expenditure and Europe is a world leader in several manufacturing sectors with a 37% global market share. However, the role of the manufacturing industry has declined in the recent years with 3.8 million jobs lost in Europe since the beginning of the crisis, creating high government's concern. In some cases, entire industrial sectors have been exported overseas.

On the other hand, revolutionary materials and manufacturing processes are readily available in the current European industrial landscape and ESA's Advanced Manufacturing Cross-Cutting Initiative has the main objective to map them and spin them in the space business. This will create new industrial possibilities, in terms of design freedom, streamlined and optimised production lead-times and reduced costs, along with enhanced performances of the final product. The opportunity is there to change the way space industry works while also regaining lost manufacturing capabilities. This shall continue to remain a priority, opening to digitalisation. Advances in manufacturing will likely become increasingly networked and manufacturing is expected to advance to new frontiers, resulting in a more and more automated and data-intensive manufacturing sector that will replace traditional production. An advanced workforce will be needed to develop and maintain these innovations, revitalizing and consolidating the European leadership in advanced manufacturing for space applications, with a great return of investment in many non-space large industrial sectors.

Advanced Manufacturing for Space Applications

The materials and processes used for space hardware manufacturing are confronted with very peculiar challenges and limitations: the omnipresent need on low mass shall be achieved while also guaranteeing very high performances and reliability of the end product (with no repair/maintenance option). Often small and complex geometry operating on highly demanding mission environments (high radiation doses, extremely low/extremely high temperatures, etc.) are necessary. The rather small production series / small procurement volumes typical of the space sector, reduce significantly the influence on the materials/processes supply chain with respect to other industrial sectors, therefore limiting the availability of tailored alloys (challenging materials procurement) and associated manufacturing processes (manufacturability limits the design). This already challenging supply chain is further impacted by the REACH/RoHs regulations, which are even decreasing the availability of suitable and sustainable technologies. Recently larger production volumes required for satellites constellations (particularly in the Navigation, Earth Observation and Telecomunication markets) as well as launchers manufacturing have also opened the challenge of the long-term storage for many of the recurring systems and sub-systems, often produced years before their launch. Long-term storage may induce significant decrease on materials and structures performances, without being

Figure 1 – Herschel Space Telescope primary mirror integrated (left) and the constituent SiC petals, the larger ever build with the selected manufacturing process. © Astrium/Boostec

Figure 2 – Left, Evolving designs: using topology optimisation software combined with 3D printing, manufactured items can be radically different from conventional designs, often widely organic in appearance and moving towards the "bionic" design. Right, AM for planetary colonisation as demonstrated on a recent ESA study, where a 1.5 tonnes lunar regolith moon base segment has been successfully additive manufactured (artist impression). © ESA/Foster Partners

detectable with conventional inspection methods. Furthermore, the requalification of a new manufacturing entity entails major non-recurrent costs and, consequently, established players with heritage manufacturing concepts dominate the supply chain.

On the other hand, some of the major advancements in space technology and exploration have been made possible by many specific breakthroughs in materials and manufacturing processes, enabling the development of highly sophisticated spacecraft systems, launchers and components. A bright example is the ESA giant infrared telescope used on the Herschel Mission. The 3.5 m-diameter primary mirror of the Herschel telescope, Figure 1, is the largest astronomical telescope ever launched and is giving astronomers their best view yet of the Universe at far-infrared and sub millimetre wavelengths. The Silicon Carbide (SiC) used for the mirror manufacturing is an ideal material for large mirrors as it combines high stiffness, low coefficient of thermal expansion, high thermal conductivity and low density. However, its development to space standards required more than one decade and needed the conquering of a succession of extremely challenging and sophisticated processes. Mastering each of these advanced manufacturing processes brought a unique competitive advantage to Europe and enabled the development of other space missions such as GAIA. This space technology was transferred to other industrial fields, ensuring a long-term availability for space and non-space applications: in particular, the European Space Observatory was considering the use of the same materials/manufacturing processes (and same company) for the realisation of the 39 m wide space telescope supporting the set of world's most advanced ground-based astronomical telescopes.

Disruptive Technologies

Many further advanced manufacturing processes are currently available in Europe and shall be matured within the scope of the present ESA's initiative to a space qualification level.

Often described as the 'third industrial revolution' and compared to the Internet with respect to its disruptive impact on our day-to-day life, **Additive Manufacturing (AM)** has experienced an impressive worldwide Compound Annual Growth Rate (CAGR) for 2011-2013 of 32.3 %, and the market is supposed to quadruple to € 6.8 billion over the next ten years. In particular for space hardware manufacturing, AM enables design for performances as opposed to design for manufacturing. It opens the design to completely new and optimised shapes as well as functional structures, Figure 2 (left). Mass saving by more than 50 % is often obtained, and up to 95% has been possible for selected parts. The number of interfaces and associated controls has been reduced, lead-time has been shortened by months, number of manufacturing steps in a process chain has been dramatically decreased. AM includes a large family of processes and technologies and can be applied to a wide range of materials going from metals, polymers and ceramics but also food, living cells and organs. Applications are ranging from structures, to propulsion and thermal, as well as RF and microwave components. Moreover, AM is a key enabling technology also for on planet manufacturing (Moon/Mars) using the in-situ resources (Moon regolith and Mars soil) and the sun energy to build Moon/Mars bases, Figure 2 (right), or for cannibalising and recycling polymers and metals from the no longer needed landing modules into shapes and tools useful for the current mission phase. AM machines for polymers are currently present on the ISS and a metallic one will soon join, in order to enable in-orbit manufacturing and replace failed parts or tools without launching them.

Out of Autoclave Processing (OAP) is an emerging manufacturing methodology of composite materials, both thermosets and thermoplastics. The central feature of OAP is the use of low cost equipment for curing composite materials, Figure 3. This processing method overcomes a number of limitations imposed by the use of the traditional high-cost autoclave systems. OAP allows for large component size manufacturing while improving the overall process time, it massively lowers the overall cost of manufacturing using only a fraction of the energy required by traditional autoclave curing processes (hence constituting a green alternative). From the perspective of space industry OAP opens a possibility to manufacture large structures in a single manufacturing step. Ideal applications could be the manufactu-


Figure 3 – Ariane 6 fairing will be manufactured using Out-of-Autoclave (OAP) processes for costs and performances optimisation. One of the OAP manufacturing step is visible on the right picture (Courtesy of RUAG).

ring of launchers fairings or large, lightweight fuel tanks, which, in turn, will allow for design-for-demise approach towards space debris mitigation. Importantly, thanks to eliminating the need for the use of capital-intensive autoclaves, the OAP could open the aerospace composite business to small companies and start-ups.

Advanced Joining: Satellite propellant tanks are currently built from titanium alloys, mainly due to their high specific strength and good corrosion resistance. They are usually manufactured using expensive forging or forming processes with subsequent machining. The components are then welded using fusion based welding techniques (like electron beam (EB) or tungsten inert gas (TIG) welding), that cause loss of strength mainly due to the recrystallization of the material. Making propellant tanks using these processes involves a typical lead times of up to six months. **Friction Stir Welding (FSW)** is considered to be the most significant development in metal joining in decades. FSW guarantees the high quality and eco-friendly joining of materials that have been traditionally troublesome and even impossible to weld in conventional manners. ESA, together with TWI and ADS, has succeeded in applying a casting technique to manufacture tank end domes and the cylindrical sections using titanium alloy Ti-6Al-4V, that were then welded together using Friction Stir Welding (FSW). This is considered to be the first Titanium tank manufactured using FSW. The fabrication of propellant tank components using the casting technique, has offered typically five times lower costs and two third reduction in lead-time when compared to forging and forming process while FSW has led to the manufacturing of a complete defect free tank, Figure 4, with mechanical performances close to the ones of the parent (un-welded) material.

Manufacturing of thermoplastic composites (offering higher toughness over traditional thermoset and the possibility of being re-shaped even after the primary process), also possible in conjunction with OAP, results in components that can be formed and joined using novel techniques. The use of thermoplastic materials enables the use of welding for plastic/metal and plastic/plastic joining, allowing the automation of assembly, eliminating the use of adhesives and mechanical fasteners, and simplifying the overall manufacturing methodology. From the perspective of space applications, the clear advantage of these techniques is the weight reduction. Examples of welding techniques that can be employed for joining dissimilar materials are ultrasonic welding, friction spot joining, and laser welding, Figure 4. Carbon-fibre reinforced thermoplastics can be induction heated without any additional material since the carbon fibres are electrically conductive. Eddy currents are genera-

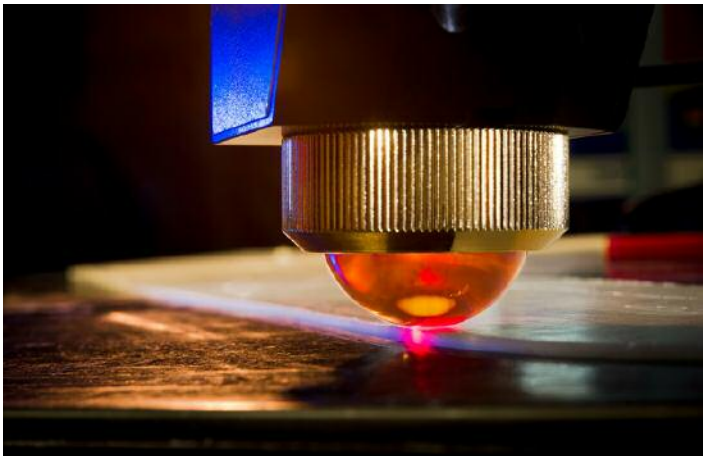



Figure 4 – Left, The prototype propellant tank manufactured using stationary shoulder FSW of two hemispherical domes with a cylindrical section. Two girth welds are quite visible. Right: Laser welding of thermoplastic material (Courtesy of TWI)).

ted in the carbon fibre itself, heating the laminate from within to weld both parts together. Fokker has licensed this "Induct" technology to manufacture vertical tail rudder and horizontal tail control surfaces for the Gulfstream G650 business jet, which has entered service in 2014. The use of thermoplastic welding techniques for composites allowed achieving more than 20% weight reduction over aluminium in the manufacturing of the A380 wing leading edge.

Concluding Remarks

Recent advancement in the manufacturing technologies offer a unique opportunity to reshape the supply chain of the European space sector. The new technologies allow creating new and highly competitive products as well as optimising the existing processes. The scope of the ESA Advanced Manufacturing Cross Cutting Initiative is to identify innovative manufacturing processes in the European industrial landscape, introduce them as integral part of the development process for future designs and to consequently allow faster and more cost efficient entry to the market with globally competitive space products, and large repercussions in many non-space industrial sectors.

■

COPERNICUS: SENTINEL-2B WAS LAUNCHED ON 7 MARCH 2017

The Sentinels are a fleet of satellites designed to deliver the wealth of data and imagery that are central to the European Commission's Copernicus programme.
Sentinel-2 carries an innovative wide-swath (290 km) high resolution multispectral imager with 13 spectral bands (from visible to the short-wave Infrared) for new perspectives of our land and vegetation.

- **Sentinel-2A has been in orbit since 23 June 2015. Launcher: Vega – Location: Kourou, Guiana Space Centre.**
- **Sentinel-2B was launched on 7 March 2017 at 01:49 GMT. Launcher: Vega – Location: Kourou, Guiana Space Centre.**

Launch mass = 1140 kg.
Orbit: Sun-synchronous, 786 km altitude.
Period = 100 minutes (14.3 orbits per day).
Nominal life duration = 7 years, with extension possible until on-board consumables are exhausted (each carries 123 kg of fuel including that necessary for end-of-life de-orbiting), to a maximum of 12 years.
Frequent revisit times allow provide unprecedented views of Earth: global Earth's land surface every 5 days once Sentinel-2A and Sentinel-2B are both are in orbit.

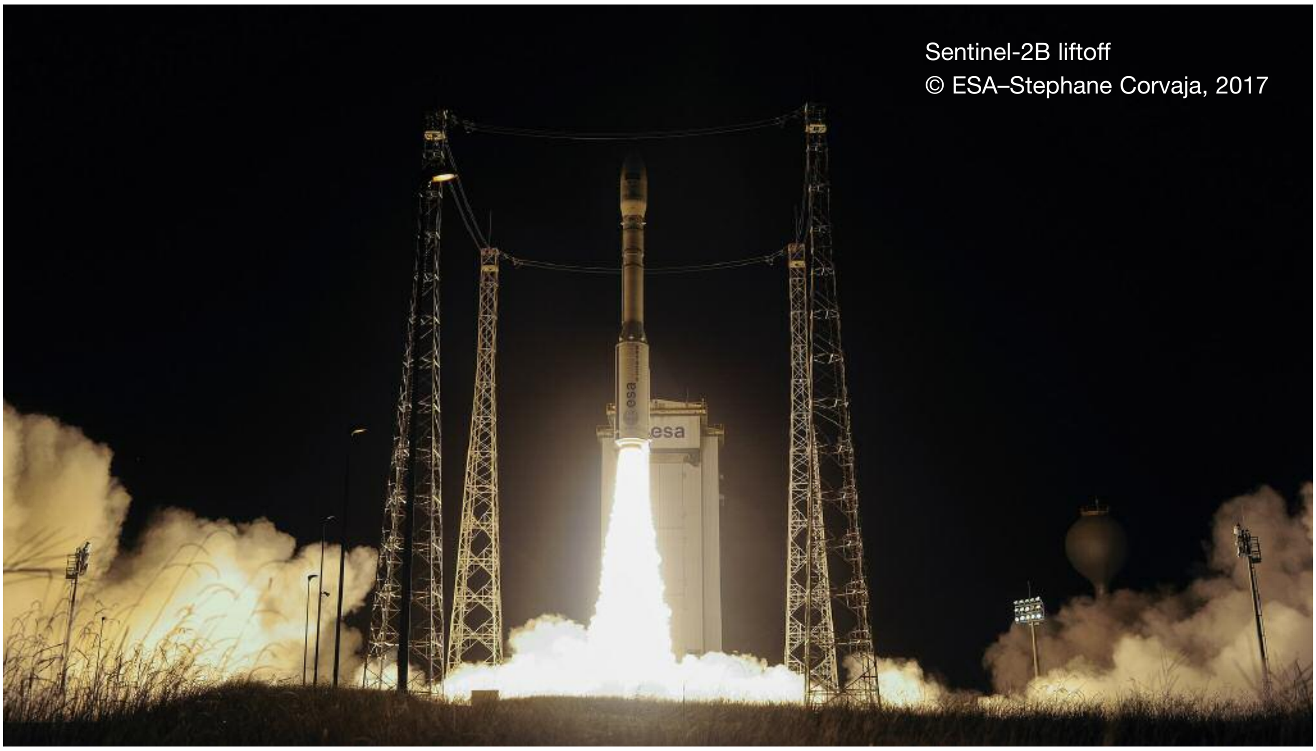
SENTINEL-2 SPACE SEGMENT

Sentinel-2 space segment is a constellation of 2 identical satellites in the same orbit, 180° apart for optimal coverage and data delivery. Together they cover all earth's land surfaces, land islands, inland and coastal waters every 5 days at the equator.

Platform and payload

Sentinel-2 is a 3-axis stabilized Earth pointing spacecraft.

- Mass and power: 1140 kg at launch – 1700 W.
- Propulsion: hydrazine propulsion system.
- 3-axis stabilized based on multi-head star tracker and fiber optic gyro.
- Radiofrequency communication: X-Band payload data



Sentinel-2B liftoff
© ESA–Stephane Corvaja, 2017

Figure 2 – Sentinel-2. 04/03/2015 9:53 am
© ESA/ATG medialab
Sentinel-2 carries an innovative high-resolution multispectral imager with 13 spectral bands for a new perspective of our land and vegetation. The combination of high resolution, novel spectral capabilities, a swath width of 290 km and frequent revisit times will provide unprecedented views of Earth for Europe's Copernicus programme.

downlink at 560 Mbytes/s + S-Band Telecommand-Telemetry & Control data link.

- On-board data coverage: 2.4 TBytes
- Laser communication terminal link

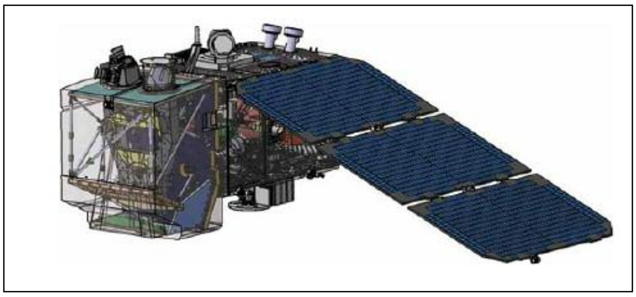


Figure 3 – sentinel 2 Radiometric calibration of the MSI instrument is achieved via a diffuser fitted on the inside face of the combined Calibration and Shutter Mechanism (CSM)

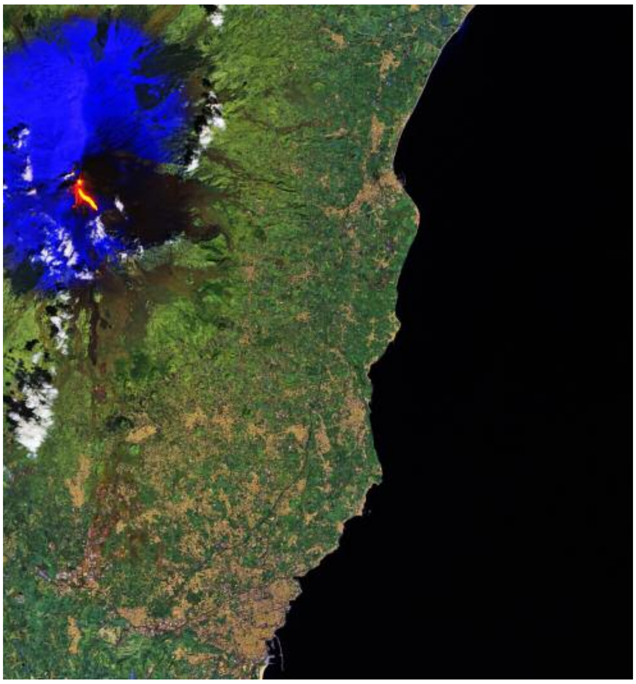


Figure 4 – Etna erupts - 16/03/2017 4:54 pm
© contains modified Copernicus Sentinel data (2017), processed by ESA
This image of the lava flowing from Mount Etna in Sicily, Italy, was captured today at 10:45 GMT (11:45 CET) by the Copernicus Sentinel-2A satellite.
Mount Etna is the largest active volcano in Europe and has one of the world's longest records for continuous eruption. Today, however, there was a sudden explosion resulting in several people being injured.
The red hot lava flowing from Mount Etna can be seen clearly in the image from Sentinel-2A. The surrounding snow has been processed in blue to distinguish from the clouds.Launched in June 2015, Sentinel-2A carries an innovative wide swath high-resolution multispectral imager with 13 spectral bands to monitor changes in land cover and vegetation. The mission is designed as a constellation of two satellites and its identical twin, Sentinel-2B, was launched just a few days ago, on 7 March.

Multispectral Imager (MSI) gives high-resolution optical imagery.
The MSI payloads acquire, store and they download up to 1.6 Terabytes (1.6 X 1012) of data per orbit. Data are transmitted to the Sentinel Ground Station and via high-data rate laser links to a geostationary telecom satellite, Alphasat, and via the ERDS (European Data Relay Satellite system), as well as using an X-band radio data downlink.

Satellite (Astrium GmbH, Germany)
MSI provides images being used to detect crop type and to determine leaf area index, leaf chlorophyll content and leaf water content to monitor plant growth and health. These images are very important for effective yield prediction and applications related to Earth vegetation, to map changes in land cover, to monitor the world's forests, to provide information on pollution on lakes and coastal waters as well as to provide images of floods, volcanic eruptions and landslides, thus contributing to disaster mapping and helping humanitarian relief efforts.

THE FLIGHT CONTROL TEAM

Both space craft are operated by a dedicated Flight Control Team from ESA/ESOC (European Space Operations Control Centre), Darmstadt, Germany. This team comprises six engineers who work under Spacecraft operations manager Franco Marchese.

MISSION OPERATIONS OVERVIEW

The Ground Segment is split into 2 halves:

- Flight Operations Segment (FOS) for flight control;
- Payload Data Ground Segment (PDGS) for downloading, processing and distributing the MSI images.

Three phases will succeed: (i) the LEOP (Launch Early Orbit Phase); (ii) the Commission Phase, until Full Operations Capacity (FOC) is reached; (iii) Routine Operations : orbit

Figure 5 – Kiruna station - 09/10/2006 5:16 pm
© ESA-S.Corvaja
The Kiruna S- and X-band station supports ESA's Earth observation missions. The station is located at Salmijärvi, 38 km east of Kiruna, in northern Sweden. The station is equipped for tracking, telemetry and command operations as well as for reception, recording, processing and dissemination of data.

maintenance – mission planning, including systematic image acquisitions and downlinks – downlink of data via ERDS performance monitoring.

OPERATIONS GROUND SEGMENT AND MISSION CONTROL SYSTEM

Kiruna Station

The prime ground station for Sentinel-2 mission control is the 15-meter diameter tracking data at Kiruna (Sweden). Kiruna is part of ESA's tracking station – Estrack – a worldwide network linking satellites in orbit and ESA's operations centre ESOC. Kiruna is used for S-Band uplink (telecommands) and downlink (receiving on-board status information – telemetry – at ESOC).

By J.-P. S. – From information provided by www.esa.int

INTERNATIONAL CONFERENCE "THE CLIMATE NEEDS SPACE" – TOULOUSE (FRANCE) 10-11 OCTOBER 2017

INTERVIEW WITH MARC PIRCHER

by Jean-pierre Sanfourche, editor-in-chief of the CEAS Quarterly Bulletin

Marc Pircher
Graduatef from Stanford University and SUPAERO. Former Head of CNES Toulouse Centre in charge of deployment of all the French space technical roadmaps and orbital prrojects. Member of the French Académie des Technologies. Corresponding Member of the Air and Space Academy

On 10 and 11 October, will take place in Toulouse (France), at Météo-France International Conference Centre an international conference organised by the Air and Space Academy, dedicated to the subject: Climate Needs Space. Considering the importance of this event, the CEAS Management Board has estimated that some months in advance, an interview with yourself, in your quality of Chairman of the Programme Committee, would be quite opportune.

Jean-Pierre Sanfourche: The AAE (Académie de l'Air et de l'Espace – Air and Space Academy) has taken the initiative to hold an International Conference on the theme: "The Climate needs Space". Could you tell us briefly the main objectives of these two-day working session, and the worldwide audience you are expecting?

Marc Pircher –This international conference is mainly European with an interdisciplinary audience.
The main objectives are to put together scientists, technicians, industrials, space agencies, decision makers, and academicians together to exchange on climate change: what is needed?, what is feasible from space and when? At the end the AAE has the ambition to express recommendations.
The scientists will explain in one session their main challenges to represent current observed impacts in climate changes and to be able to reliably forecast future changes. Another session will focus on the requirements of space-based systems for the measurement of key atmospheric variables and the Instrumentalists will expose what is mature and the future trends in the technology for space measurements.

JPS: Following on from the COP 21 climate conference in Paris, December 2015, the heads of the world's agencies came together on 3 April 2016 in New Delhi at 10th edition of the Asia-Pacific Remote Sensing Symposium (APRS) at the end of it they approved the principles of a joint declaration. What is this declaration calling for, regarding the vital role of space vehicles in studying and preserving Earth's climate?

MP –The main objective of this kind of declarations: one (Mexico and New Delhi) before COP21 in Paris, and one after, is to put high priority in space agencies funding for climate oriented programmes.

JPS: On 7- 18 November 2016, took place in Marrakech the COP 22. Did new recommendations and demands concerning the use of space means emerge from it?
MP – Cop22 was in continuity with COP21 and the fact that Space data are essential is now well admitted. For example the French Minister Ségolene Royal presented 'Microcarb' a satellite for CO_2 measurement.

JPS: Scientists have determined approximately 50 parameters which intervene in climate change and which can be detected and measured by space means only: would it be possible to enumerate them, at least the most significant ones concerning the atmosphere on the one hand, and the oceans on the other hand (the types of major data required and their physical characteristics)?
MP – Yes it's exactly the purpose of the two first sessions of the conference.

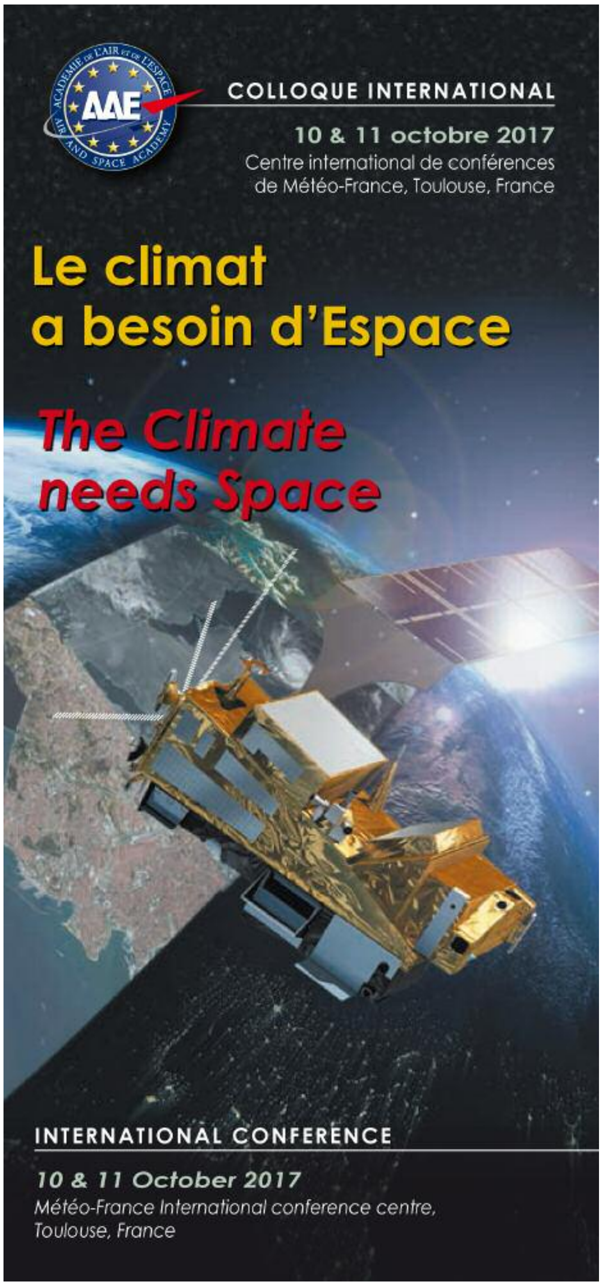
JPS: Many Space Earth Observation and Meteorological Organisations all over the world are working on Climate Change: I assume that only a part of them will be represented in Toulouse: what are they?
MP – We expect all European public and private organisations and NASA representatives.

JPS: The near-real time coordination of the data exploitations between the different nations and agencies involved is a paramount problem: is it foreseen to discuss this matter in Toulouse?
MP – Climate is not a real time phenomenon, the need of near real time data is for the monitoring of anthropogenic emission and the way we could measure it from Space will be discuss in the conference.

JPS: In addition to satellites, other vehicles are being extremely useful, balloons, aircraft: will they be evoked during the conference?
MP – No we will concentrate on Space Systems.

JPS: In terms of high technologies, what are the major advances in preparation at short-term time horizon regarding the scientific instruments and data transmission means you foresee to deal with?
MP – It will be the purpose of session 3 for active and passive instruments.

JPS: What are the step forwards which can be expected from the numerical revolution?
MP – The use of "big data" is present in all the road maps for space data applications, the climate is one of them due to the tremendous number of data needed.



AMONG UPCOMING AEROSPACE EVENTS

22-24 May • **EBAA** – EBACE 2017 – Geneva (Switzerland) – Palexpo – www.ebace.aero/2017

29-31 May • **AESS/IEEE** – 24^{th} Saint Petersburg International Conference on Integrated Navigation Systems – Saint Petersburg – Concern Central SRIE – www.elektropribor.spb.ru

29-31 May • **ERCOFTAC** – DLES 11 Direct and Large Eddy Simulation – Pisa (Italy) – www.ercoftac.org/events

29 May-02 June • **ESA** – 10^{th} International Conference on Guidance, navigation and Control – Salzburg (Austria) – Crowne Plaza Salzburg - www.esaconferencebureau.com/list-of-events

05-10 June • **AIAA** – AIAA AVIATION 2017 Forum - Aviation and Aeronautics Forum and Exposition – Denver, CO (USA) – Sheraton Denver Downtown Hotel – www.aiaa-aviation.org/

05-10 June • **AIAA/CEAS** – 23^{rd} AIAA/CEAS Aeroacoustics Conference – Denver, CO (USA) – Sheraton Denver Downtown Hotel – www.aiaa.org/aeroacoustics/

06-07 June • **FSF/EUROCONTROL** – 5^{th} Annual Safety Forum – Brussels (Belgium) – EUROCONTROL/HQ https://flightsafety.org/event/2017

07 June • **RAeS** – Seminar "Digital Connectivity and Cybersecurity" - London (UK) - RAeS/HQ - www.aerosociety.com/events

12-14 June • **ACI** – ACI – Europe 27^{th} General Assembly Congress and Exhibition – Paris (France) – Salle Wagram www.aci-europe-events.com

13-14 June • **RAeS** – Benchmarking for Improving Flight Simulation – London (UK) – RAeS/HQ www.aerosociety.com/events

13-15 June • **3AF/SEE** – ETTC'17 – Toulouse (France) – Centre de Congrès Pierre Baudis. https://www.see.asso.fr/

19-25 June • **ISAE/GIFAS** – IPAS 2017 International Paris Air Show – Le Bourget Airport – www.siae.fr

AMONG UPCOMING AEROSPACE EVENTS

25-28 June • **EUROMECH** – Euromech Turbulence Conference (ETC) 2017 – Porto (Portugal) – University – Faculty of engineering – www.euromech.org

27-29 June • **3AF** – IAMD 12 – 12th International Conference 3AF Integrated Air and Missile Defence – Stockholm (Sweden) – http://3af-integratedairmissiledefence.com

03-06 July • **EUCASS** – EUCASS2017 – 7th European Conference for Aeronautics and Space Sciences – Milan (Italy) – Politecnico di Milano – www.eucass.eu

10-12 July • **AIAA** – AIAA Propulsion and Energy 2017 forum – Atlanta, GA (USA) – Hyatt Regency www.aiaa-propulsionenergy.org

12-14 September • **AIAA** – AIAA SPACE 2017 Forum – Orlando, FL (USA) – Hyatt Regency – www.aiaa-space.org

12-15 September • **ERF** – ERF2017 – 43rd ERF – Milan (Italy) – Politecnico di Milano – Campus Bovisa https://www.erf2017.org

13-16 September • **CEAS** – 21st Workshop of the Aeroacoustics Specialists Committee of the Council of European Aerospace Societies – Dublin (Ireland) – Trinity College, University Dublin– www.aiaa.org/events - https://www.aiaa.org/CEAS-ASC-Workshop2017/

18-22 September • **COSPAR** – 3rd Symposium COSPAR – Small Satellites Space Research – Jeju Island (South Korea) ICC Jeju – https://cosparhq.cnes.fr

18-22 September • **AIDAA** – XXIV International Conference AIDAA – Palermo, University of Palermo on 18-19 and Enna, Kore University on 20-22. Italy. www.aidaa2017.com

25-29 September • **IAF** – 68th International Astronautical Congress – Adelaide (Australia) – Adelaide Convention Centre www.aiaa-space.org

03-05 October • **Aviation Week** – MRO Europe 2017 – London (UK) – Excel London www.mroeurope.aviationweek.com/

10-11 October • **AAE** – International Conference “The Climate Needs Space” – Toulouse (France) – Congress Centre Météo – France – www.academie-air-espace.com/espaceclimat

16-20 October • **CEAS** – Aerospace Europe 2017 Conference – 6th CEAS Air & Space Conference – Bucharest (Romania) Parliament of Romania – www.ceas2017.org

25-29 October • **ESA** – 6th international Colloquium on Scientific and Fundamental Aspects of GNSS/Galileo – Valencia (Spain) – TU Valencia – http://esaconferencebureau/list-of-events

13-15 November • **IAA** – 1st International Academy of Astronautics (IAA) Conference on Space Situational Awareness – Orlando, FL (USA) – www.icssa2017.com