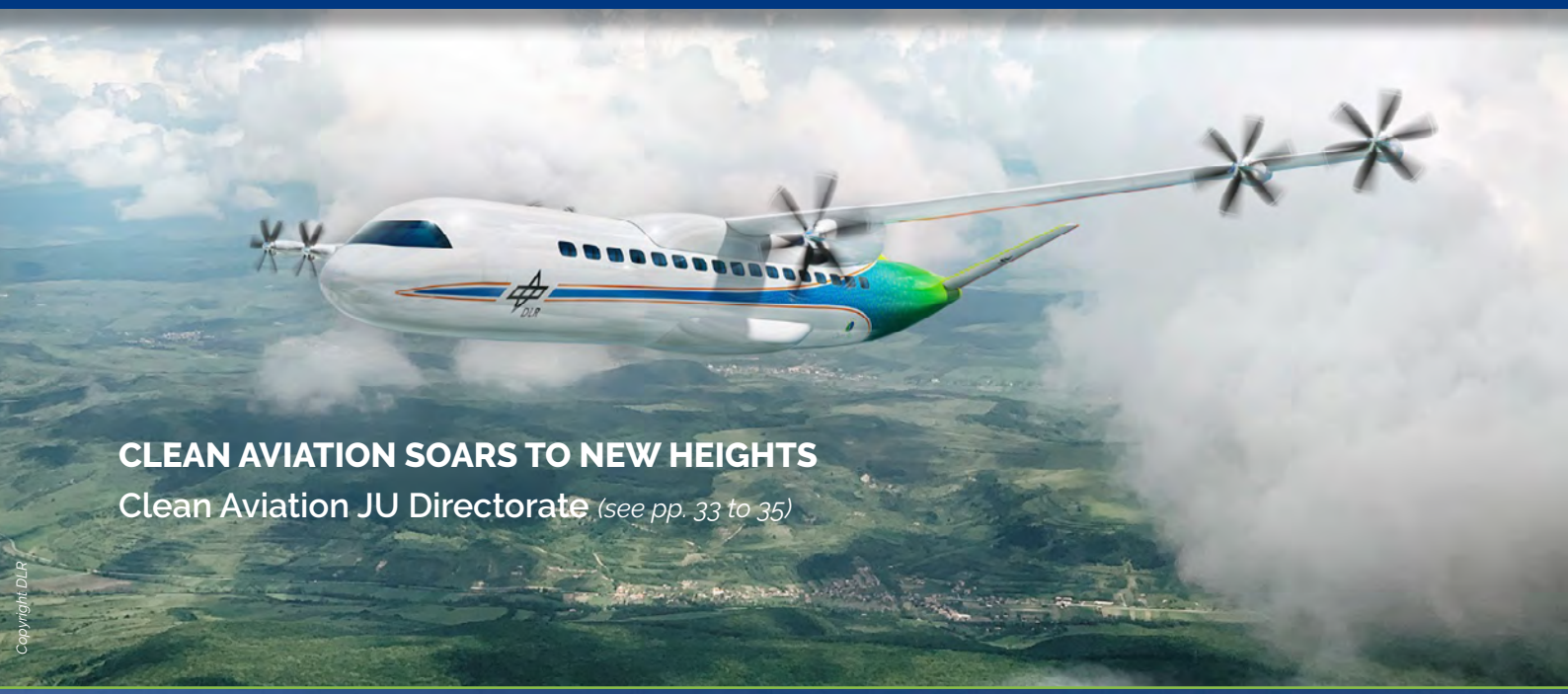
CEAS
Council of European Aerospace Societies

BULLETIN

AEROSPACE EUROPE



CLEAN AVIATION SOARS TO NEW HEIGHTS

Clean Aviation JU Directorate *(see pp. 33 to 35)*

LESSONS LEARNED FROM THE MMF PROGRAMME

OCCAR - NSPA - EDA *(see pp. 36 to 40)*

CEAS

The Council of European Aerospace Societies (CEAS) is an International Non-Profit Organisation, with the aim to develop a framework within which the major European Aerospace Societies can work together.
It was established as a legal entity conferred under Belgium Law on 1st of January 2007. The creation of this Council was the result of a slow evolution of the 'Confederation' of European Aerospace Societies which was born fifteen years earlier, in 1992, with three nations only at that time: France, Germany and the UK.

It currently comprises:

- 11 Full Member Societies: Czech Republic (CzAeS) – France (3AF) – Germany (DGLR) – Italy (AIDAA) – Netherlands (NVvL) – Poland (PSAA) – Romania (AAAR) – Spain (AIAE) – Sweden (FTF) – Switzerland (SVFW) – United Kingdom (RAeS);
- 4 Corporate Members: ESA, EASA, EUROCONTROL and EUROAVIA;
- 8 Societies having signed a Memorandum of Understanding (MoU) with CEAS: AAE (Air and Space Academy), AIAA (American Institute of Aeronautics and Astronautics), CSA (Chinese Society of Astronautics), EASN (European Aeronautics Science Network), EREA (European association of Research Establishments in Aeronautics), ICAS (International Council of Aeronautical Sciences), KSAS (Korean Society for Aeronautical and Space Sciences) and Society of Flight Test Engineers (SFTE-EC).

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

AEROSPACE EUROPE

Since January 2018, the CEAS has closely been associated with six European Aerospace Science and Technology Research Associations: EASN (European Aeronautics Science Network), ECCOMAS (European Community on Computational Methods in Applied Sciences), EUCASS (European Conference for Aeronautics and Space Sciences), EUROMECH (European Mechanics Society), EUROTURBO (European Turbomachinery Society) and ERCOFTAC (European Research Community on Flow Turbulence Air Combustion).
Together those various entities form the platform 'AEROSPACE EUROPE', the aim of which is to coordinate the calendar of the various conferences and workshops as well as to rationalise the information dissemination.
This new concept is the successful conclusion of a work which was conducted under the aegis of the European Commission and under its initiative.

The activities of 'AEROSPACE EUROPE' will not be limited to the partners listed above but are indeed dedicated to the whole European Aerospace Community: industry, institutions and academia.

WHAT DOES CEAS OFFER YOU ?

KNOWLEDGE TRANSFER:
- A structure for Technical Committees

HIGH-LEVEL EUROPEAN CONFERENCES:
- Technical pan-European events dealing with specific disciplines
- The biennial AEROSPACE EUROPE Conference

PUBLICATIONS:
- CEAS Aeronautical Journal
- CEAS Space Journal
- AEROSPACE EUROPE Bulletin

RELATIONSHIPS AT EUROPEAN LEVEL:
- European Parliament
- European Commission
- ASD, EASA, EDA, ESA, EUROCONTROL, OCCAR

HONOURS AND AWARDS:
- Annual CEAS Gold Medal
- Medals in Technical Areas
- Distinguished Service Award

YOUNG PROFESSIONAL AEROSPACE FORUM SPONSORING

AEROSPACE EUROPE Bulletin

AEROSPACE EUROPE Bulletin is a quarterly publication aiming to provide the European aerospace community with high-standard information concerning current activities and preparation for the future.
Elaborated in close cooperation with the European institutions and organisations, it is structured around five headlines: Civil Aviation operations, Aeronautics Technology, Aerospace Defence & Security, Space, Education & Training and Young Professionals. All those topics are dealt with from an overall European perspective.
Readership: decision makers, scientists and engineers of European industry and institutions, education and research actors.

EDITOR: CEAS
Director of the Publication: Franco Bernelli

EDITORIAL COMMITTEE
Editor-in Chief: Jean-Pierre Sanfourche
sanfourche.jean-pierre@orange.fr
Deputy Editor-in-Chief: Pierre Bescond
(CEAS VP Publications and External Relations)
Committee's Members: Georges Bridel (CEAS Trustee), Jean-François Brouckaert (Clean Sky), Cornelia Hillenherms (CEAS trustee), Leonardo Lecce (AIDAA), Uwe Moeller (EREA), Johan Steelant (ESA/ESTEC), Thomas Vermin (EUROAVIA, IT Manager).
Art Direction & Design: Sophie Bougnon
sophie.bougnon1@sfr.fr / www.sbgraphisme.com

THE OFFICERS OF THE BOARD IN 2022:

President: Franco Bernelli
franco.bernelli@polimi.it
Vice-President, Finance:
Cornelia Hillenherms
cornelia.hillenherms@dlr.de
Vice-President, Publications and External Relations: Pierre Bescond
pierre.bescond@laposte.net
Vice-President, Awards and Membership: Anders Blom
anders.blom@innovair.org
Director General: Andrea Alaimo
andrea.alaimo@unikore.it
Financial Manager: Philip Nickenig
philip.nickenig@dglr.de
Secretary: Beata Wierzbinska-Prus
bprus@meil.pw.edu.pl
Chair of the Aeronautics Branch:
Jonathan Cooper
J.E.Cooper@bristol.ac.uk
Chair of the Space Branch:
Britta Schade
Britta.Schade@esa.int

FULL MEMBERS:

■ Czech Republic – CzAeS

Novotneho lavka 200/5
110 00 Prague, Czech Republic
www.csvts.cz
President and CEAS Trustee:
Daniel Hanus,
hanus@csvts.cz
Vice-President and CEAS Trustee:
Jan Rohac, PhD
xrohac@fel.cvut.cz

■ France – 3AF

6,rue Galilée – F-75016 Paris
Tel.: + 33 (0) 1 56 64 12 30 – www.3af.fr
President: Louis Le Portz
louisleportz@orange.fr
Director General: Michel Assouline
secr.exec@3af.fr
Secretary General: Jean-François Coutris - jfcoutris@ccint.fr
CEAS Trustees: Louis Le Portz and Pierre Bescond
Admin. assistant: Caroline Saux
gestionmembres@aaaf.asso.fr

■ Germany – DGLR

Godesberger Allee 70 –
D- 53175 Bonn – Tel.: + 49 228 30 80 50
info@dglr.de – www.dglr.de
President: Roland Gerhards
roland.gerhards@dglr. de
CEAS Trustees: Cornelia Hillenherms and Philip Nickenig
Secretary General: Philip Nickenig
Executive and Team Assistant:
Birgit Neuland - birgit.neuland@dglr.de
Conference Manager: Michael Geimer – michael.geimer@dglr.de

■ Italy – AIDAA

Casella Postale 227 – I-00187 Roma V.R. – Tel / Fax : +39 366 144 21 31
info@aidaa.it – www.aidaa.it
President: Erasmo Carrera
Politecnico di Torino - DIMA
Corso Duca degli Abruzzi 24 - 10129 Torino, Italy – erasmo.carrera@polito.it
Secretary General:
Cesare Cardani info@aidaa.it / cesare.cardani@polimi.it
CEAS Trustees: Sergio De Rosa
sergio.derosa@unina.it and
Carlo Bettanini
carl.bettanini@unipd.it
Secretary: Daniela Vinazza
daniela@aidaa.it

■ Netherlands (The) – NVvL

c/o Netherlands Aerospace Centre
Anthony Fokkerweg 2
NL- 1059 CM Amsterdam
Tel.: + 31 88 511 3055 (secretariat)
nvvl@nlr.nl – www. nvvl.eu
President: Mark van Verooij
mark.van.venrooij@nlr.nl
Secretary General: Dirk Jan Rozema
djrozema@kpnmail.nl
CEAS Trustees: Mark van Venrooij and Fred Abbink - f.j.abbink@planet.nl

■ Poland – PSAA

Nowowiejska 24 – 00-665 Warsaw – Poland – T : +48 22 234 5428
www.psaa.meil.pw.edu.pl
President: Tomasz Goetzendorf-Grabowski: tgrab@meil.pw.edu.pl
Treasurer: Jacek Szumbarski
jasz@meil.pw.edu.pl
Secretary General: Andrzej Zyluk
justyna.staniszewska@itwl.pl
BoD Members: Tomasz Rogalski, Zbigniew Koruba
CEAS Trustees: Tomasz Goetzendorf-Grabowski and Lukasz Kiszkowiak
lukasz.kiszkowiak@wat.edu.pl
Administrative Officer:
Beata Wierzbinska-Prus
bprus@meil.pw.edu.pl

■ Romania – AAAR

220D Iuliu Maniu Ave - 061126 Bucharest 6 – Romania, P.O. 76, P.O.B. 174 – www.aaar.ro
President: Virgil Stanciu
vvirgilstanciu@yahoo.com
Vice-President and CEAS Trustee:
Valentin Silivestru
valentin.silivestru@comoti.ro
CEAS Trustee: Prof. Ion Fuiorea
ifuiorea@yahoo.com

■ Spain – AIAE

COIAE. Francisco Silvela 71, Entreplanta - 28250 Madrid (Spain) – Tel.: + 34 91 745 30 30
info@coiae.es - www.coiae.es
President: Estefanía Matesanz Romero - ematesanz@coiae.es
CEAS Trustees: Arturo de Vicente Hurtado – arturodvh@coiae.es
Estefanía Matesanz Romero
Secretary: info@coiae.es

■ Sweden – FTF

Swedish Society of Aeronautics and Astronautics – c/o SSC, PO Box 4207 - SE-17154 SOLNA
stockholm@ftfsweden.se
President: Roland Karlsson
Häradshammars Prästgård 1
SE-61029 Vikbolandet
T: +46 (0) 705 385 06
rkrolandk@gmail.com
CEAS Trustees: Anders Blom
anders.blom@innovair.org
Petter Krus : Linköping University SE - 58183 Linköping
petter.krus@liu.se
Secretary: Björn Jonsson – Aeronautical Dept Swedish Defence Material Adm.(FMV) – SE-115 88 Stockholm Sweden
bjorn.jonsson@fmv.se

■ Switzerland – SVFW

ETH Zurich – Institute of Fluid Dynamics – Ms Anna Kubik
CH 8092 Zurich – www.svfw.ch
President and CEAS Trustee:Jürg Wildi: juerg.wildi@bluewin.ch
CEAS Trustee: Georges Bridel
c/o ALR, Gotthardstrasse 52,
CH 8002 Zurich
georges.bridel@alr-aerospace.ch
Secretary: Anna Kubik -
akubik@ethz.ch

■ United Kingdom – 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: Howard Nye FRAeS
CEAS Trustees: Emma Bossom MRAeS
emma.bossom@aerosociety.com
Jonathan Cooper CEng FRAeS
J.E.Cooper@bristol.ac.uk
Chief Executive:
David Edwards FRAeS
Head of External Affairs:
Richard Toomer
press@aerosociety.com

CORPORATE MEMBERS:

■ ESA
8-10, rue Mario Nikis - F-75015 Paris
www.esa.int
CEAS Representative:
Britta Schade
Britta.Schade@esa.int

■ EASA
Konrad - Adenauer - Ufer 3
D-50542 Cologne (Germany)
Tel.: +49 (221) 8999 0000
www.easa.europa.eu
CEAS Representative:
Erick Ferrandez
erick.ferrandez@easa.europa.eu

■ EUROCONTROL
Rue de la Fusée 96 - Brussels 1130
CEAS Representative: Marc Bourgois
marc.bourgois@eurocontrol.int

■ EUROAVIA
Kluyverweg 1 - 2629 HS, Delft, NL
www.euroavia.eu
President and CEAS Representative: Victoria Maria Prieto Rueda - victoria.prieto@euroavia.eu
CEAS Representative:
João Bernardo Amaral
joao.amaral@euroavia.eu

SOCIETIES HAVING SIGNED AN 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)
12700 Sunrise Valley Drive
Suite 200, Reston
VA 20191 – 5807 USA
karens@aiaa.org - www.aiaa.org

■ Chinese Society of Astronautics (CSA)
CSA Zhang yao – WANG Yiran,
n° 8, Fucheng Road, Haidian district
P.O. Box 838
100 830 Beijing, China
wangyr@spacechina.com
www.csaspace.org.cn/

■ European Aeronautics Science Network (EASN)
EASN - Rue du Trône 98 –
1050 Brussels,
Belgium – htpps://www.easn.net
Chairman: Andreas Strohmayer
University of Stuttgart

■ Association of European Research Establishments in Aeronautics (EREA)
Chairman: Pawel Stezycki
Lukasiewicz (ILOT)
EREA Secretary: Anne-Laure Delot – ONERA, anne-laure.delot@onera.fr

■ International Council of the Aeronautical Sciences (ICAS)
President: Shinji Suzuki
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)
Room 1001, 635-4
Yeogdam-Dong
135-703 Gangnam
Gu Republic of Korea
ksas@ksass.or.kr
https://www.ksas.or.kr

■ Society of Flight Test Engineers (SFTE-EC)
www.sfte-ec.org/

SIX SOCIETIES IN EUROPEAN AEROSPACE SCIENCE AND TECHNOLOGY RESEARCH CLOSELY LINKED WITH CEAS (ECAERO-2):

■ EASN: European Aeronautics Science Network
Chairman: Andreas Strohmayer (University of Stuttgart)
Strohmayer@ifb.uni-stuttgart.de
Vice Chairman: Konstantinos Kontis – University of Glasgow
Kostas.Kontis@glasgow.ac.uk

■ ECCOMAS: European Community on Computational Methods in Applied Sciences
Campus Nord UPC - Building C3
"Zona Comercial" – Jordi Girona, 1-3
(08034) – Barcelona (Spain)
www.eccomas.org/
eccomas@cimne.upc.edu
President: Ferdinando Auricchio
auricchio@unipv.it

■ ERCOFTAC: European Research Community on Flow Turbulence Air Combustion
https://www.ercoftac.org/
Chairman of Executive Council:
Dominic von Tenzi
admin-cado@ercoftac.org

■ EUCASS: European Conference for Aero-Space Sciences
www.eucass.eu
EUCASS President:
Alain Merlen- Lille University of Science and Technology – alain.merlen@univ-lille.fr

■ EUROMECH: European Mechanics Society
https://euromech.org
President: Marc Geers – m.g.d.geers@tue.nl

■ EUROTURBO: European Turbomachinery Society
https://www.euroturbo.eu
Chairman: Raul Vasquez Diaz
Raul.Vasquez@Rolls-Royce.com

EDITORIAL

Jean-Pierre Sanfourche, editor-in-chief
sanfourche.jean-pierre@orange.fr

ABOUT THE CEAS BULLETIN

During the latest Board of Trustees meeting, the wish was expressed that the CEAS bulletin provides much more of information about the life of our member societies and partners. I start giving effect to this recommendation by publishing articles coming from three member societies – AIDAA, 3AF and SVFW – and one of our partners, the EREA. It is my intention to pursue at the same rhythm in the future.
The CEAS was created with the aim to develop a framework within which its members and partners can work together. So, it is highly desirable to see more papers presenting works conducted in collaboration between different associations, not only in science and technology, but also concerning strategy and public policy matters. May I suggest to the Board of Trustees to set up CEAS Commissions bringing together experts from different countries.

Another big significant improvement would be that all important symposiums conducted by national societies systematically associate other CEAS member societies.
The heading 'Latest issues of the CEAS Journals' managed by Dr.-Ing. Cornelia Hillenherms, DLR, will be actively continued.
As regards strategic topics, the publication of debates between personalities would greatly contribute to increase CEAS influence and reputation. An example: in this issue, is published within the framework of 'Points of View' the Executive Summary of an important work recently performed by a team of high-level experts on the theme: "Human Spaceflight from Guiana Space Centre". Such a question - the necessity for Europe to acquire independent human access to space - should generate animated confrontations of opinions.

CEAS being a knowing association, it is obvious that more and more importance has also to be given to Education and Training. Henceforth it is planned to successively publish an article coming from University (ex. Prof.'s Jonathan Cooper's paper on Bristol University in the previous issue), from industrial partner (ex. Airbus Leadership University in the present issue), and EU-Funded Networks.
If we add to these items the regular chapters Civil Aviation Operations, Aeronautics Technology, Defence and Security and Space, the number of pages of our bulletin will naturally increase a little, but this will remain within acceptable limits.
In his message (see p. 6), President Franco Bernelli evokes the present context of tragic Russia-Ukraine conflict, after what he provides information on the rich activity programme CEAS will be conducting in the coming nine months, so showing the dynamism of our association.

CONTENTS

CEAS PRESIDENT MESSAGE

Franco Bernelli Zazzera
CEAS President 2021-2022

This message can only begin with a note on the situation in Ukraine. The CEAS community expresses solidarity and deepest sympathy to the Ukrainian people. As a Council of technical-scientific association, we work with people and organizations around the world to advance science and promote dialogue. The freedom of science and research is linked to the principles of human rights and international law, and we must stand up for these values. In addition to the political-state institutions, we as a civil society organization are also asked and responsible for maintaining exchange, mutual respect, and the willingness to cooperate in future partnerships for the peaceful progress of mankind. We perceive that many Russian scientists reject the attack to Ukraine and speak out against it. Of course, any cooperation with Russian organizations can no longer take place under these circumstances. For the time being, reflecting the position of its member societies, CEAS suspends membership of all Russian and Belarussian nationals, organisations and institutions and denies access to its events and conferences, which means blocking all papers with any contribution from Russian or Belarussian authors. Also, scientist from a Russian institution will no longer be involved in a review process for the CEAS journals for the time being and no submissions to the journals from Russian or Belarussian institutions will be accepted, for the time being. We sincerely hope that the conflict in Ukraine can be resolved peacefully, and we look forward to resuming Russian involvement in the CEAS activities at a suitable time in the future.

After two years of extreme caution in organizing events, due to the Covid pandemic, this year will be heavily occupied by conferences, for the benefit of our technical and scientific community. Events planned on a biennial basis will be supported by events originally scheduled for 2021 and postponed to 2022. CEAS will be involved directly in the 6th CEAS Conference on Guidance, Navigation and Control (EuroGNC), to be held on May 3-5 at the Technische Universität Berlin, in the International Forum on Aeroelasticity and Structural Dynamics (IFASD) to be held on June 13-17, at the University Carlos III Madrid, in the 28th AIAA/CEAS Aeroacoustics Conference to be held on June 14 - 17 in Southampton, in the 48th European Rotorcraft Forum organized on September 6-8 in Winterthur at ZHAW, and in the 2nd International Conference on High-Speed Vehicle Science and Technology" (HiSST) being held in Bruges, on September 12 - 15. CEAS is also happy to promote and support the main events organized in Europe by EUCASS and ICAS, societies having signed a MoU with CEAS. This year should also see the initiation of a joint activity between CEAS and the Korean society KSAS, which substantially benefits both organizations this year and onwards. For 2022, this should take the form of a joint technical session during the KSAS Fall conference.

This year will also bring a consistent enrichment of the CEAS awards. In addition to the CEAS Gold medal, the CEAS distinguished service award and the CEAS technical awards, for the first time CEAS will award the CEAS Journal Paper Award, established to recognise individuals or a team who have demonstrated the successful dissemination of scientific knowledge through publication in one of the CEAS journals. The CEAS Journal Paper Award will be hereafter presented annually.

I would like to conclude this message by thanking the entire CEAS community for their dedication and effort devoted to promoting CEAS and organizing the technical and scientific opportunities, despite the difficult times we are facing. The CEAS Trustees, Officers, Journal and Bulletin editorial boards, are nothing more than the tip of the iceberg, under which there is a vast community that represents the raison d'être of CEAS.

CENTENARY OF THE ITALIAN ASSOCIATION OF AERONAUTICS AND ASTRONAUTICS

By Prof. Mario Marchetti, from University of Rome "La Sapienza"

CASA DELL'AVIATORE, VIALE DELL'UNIVERSITÀ 20, ROME, DECEMBER 7, 2021

On December 7, 2021, we celebrated the centenary of the Italian Association of Aeronautics and Astronautics, the A.I.D.A.A., founded in 1920, at the Casa dell'Aviatore, the Officers' Club of the Italian Air Force. The event had been planned for the previous year but was put off until 2021 because of the Covid 19 pandemic.
Civil and military authorities took part in the celebration: General Chief Inspector of the Air Force Engineers Basilio Di Martino; Engineer Luigi Pasquali, Telespazio C.E.O.; Engineer Luigi Morzillo, President of the Italian Aerospace Research Centre, the C.I.R.A.; Dr Gabriella Arrigo of the Italian Space Agency, the A.S.I.; Prof. Franco Bernelli Zazzera, President of the Council of European Aerospace Societies, the C.E.A.S.; and Dr Pierre Bescond, 3AF- Association Aéronautique et Astronautique de France. Connected on line, Dr Shinji Suzuki, President of the International Council of the Aeronautical Sciences, the I.C.A.S., conveyed his greetings and best wishes.

Authorities

The ceremony began with the Italian National Anthem sung by the soprano Shinobu Nakamura Cardani, accompanied on the piano by Maestro Alessandro Carrera. Prof. Erasmo Carrera, the A.I.D.A.A. President, opened the ceremony by greeting the Authorities and participants and thanking the Air Force for the logistics provided. Although a century has gone by, the aims of the A.I.D.A.A. are still those indicated by the founding members, among them Maurizio Mario Moris and Vito Volterra: "the promotion and encouragement of studies and research on all branches of aeronautics". Today the A.I.D.A.A. is present in both the national and the international scenarios; thanks to its historical prestige grounded above all in the scientific merits of its members, the A.I.D.A.A. has been chosen to host the 2024 international congresses of both the International Council of the Aeronautical Sciences (I.C.A.S.) in Florence and of the International Astronautical Federation in Milan.

After greeting the meeting on behalf of the Air Force

Erasmo Carrera, AIDAA President

Chief of Staff Gen. S.A. Luca Goretti, Gen. Insp. Basilio Di Martino recalled how the A.I.D.A.A. managed to come through a number of highly critical periods in the course of a century, among which two world wars. The constant presence of its members has always furnished the energy and strength to carry forward its activities.

In his speech, Dr. Pasquali from Leonardo, the foremost Italian aerospace industry, recalled how the strategical vision of the company was already directed towards 2030; this will require considerable involvement of many national excellences, especially on the part of the younger generation.

L-R: Mario Marchetti, Erasmo Carrera, Ernesto Vallerani, Amalia Ercoli Finzi

Europe is already in a position to cope with challenges and programmes in a confrontation with other world competitors, as Prof. Bernelli and Dr. Bescond had already pointed out. This development, however, requires greater synergy among the various scientific and cultural organizations within Europe. As Dr. Arrigo and Eng. Morzillo explained, the A.S.I. and the C.I.R.A. are already deeply involved in many international programmes such as

ExoMars, Vega C and Space Rider, which in coming years will bring into yet greater evidence the high level achieved by Italy in the aerospace field.
After the speeches, Prof. Carrera presented the A.I.D.A.A. Centenary Medal to all those present.

L-R: F. Bernelli, E. Carrera, S. Bagassi, P. Bescond

In the second part of the Ceremony, Prof. Marchetti went through A.I.D.A.A.'s one hundred years, taking as his starting point Gaetano Arturo Crocco's words in 1945 at the end of the Second World War: "Like all intellectual Associations, the A.I.D.A.A. has the advantage of a minimum irreplacable vitality, quite independently of its financial status. This vitality is rooted in the mental activity of each of its members; however bleak the post-war period, it will never fail." These simple words contain the fundamental principles of the A.I.D.A.A. and its energy in carrying forward its mission.

Coming from all the Branches throughout Italy: Turin, Milan, Genoa, Padua, Pisa, Bologna, Rome, Naples, Puglia and Palermo-Enna, the members highlighted this "vitality" in a number of anecdotes.

Deep feelings and appreciation were aroused by the speeches of Ernesto Vallerani and Amalia Ercoli Finzi, former Presidents of the Association and examples of dedication and stimulation for the younger generation.
Amalia, the Lady of the Comets, addressed the young, encouraging them to have no fear and to face the projects in which they believe without losing confidence in confronting the inevitable obstacles.

Prof. Leonardo Lecce underlined the importance of the link between the A.I.D.A.A. and the industrial sector, in particular the small and medium industries; he gave the example of Prof. Luigi Pascale who has brought prestige to the country through his academic and industrial activity.
The importance and relevance of the Association's journal, "L'Aerotecnica Missili e Spazio", was illustrated by the Editor and members of the editorial staff: Profs. Aldo Frediani, Sergio De Rosa, Paolo Gasbarri and Vittorio Cipolla. The General Secretary Prof. Cesare Cardani and Ms Daniela Vinazza illustrated the administration on which the solidity of the Association depends to a great extent. Our thanks go to their great professional ability and dedication.

Over the last few years, the contribution of the younger generation has increased remarkably throughout the Branches, as has the participation of women. Nicole Viola, Sara Bagassi, Francesca De Crescenzio, Nunzia Favaloro, Federica Angeletti, Marta Albano, Andrea Delfini, Roberto Pastore and Paolo Marzioli are only some among the many young members to represent the future of the A.I.D.A.A, committed as they are already to the two important events that the A.I.D.A.A. will be organising in 2024: the Congresses of the I.A.F. and of the I.C.A.S.
Lastly, Prof. Marchetti recalled the historical connection between the A.I.D.A.A. and the Italian Air Force, the Corps of Aeronautical Engineers especially, whose Commanders-in-Chief, from Gen. Alessandro Guidoni in 1923 to Gen. Basilio Di Martino today have always taken part in the Association's National Congresses.

At the heart of the A.I.D.A.A. are the Universities with their spirit of never-ending exuberance among our members. Enrico Riparbelli was an Air Force officer and member of the Rome Branch; having worked for a number of years at the D.S.S.E. at Guidonia, he moved to America with several colleagues in 1944. Not only an illustrious scientist, he was also an artist and a poet. The historical event of the Centenary Celebration of the A.I.D.A.A. concluded with the reading of a 1944 poem by Riparbelli, when he was attempting to reconcile his studies and research with the typical office work of a civil servant in the Air Force Ministry.

The celebrations then continued with the Gala Dinner at the Officers' Club of the Air Force Ministry where the music of the Shinobu-Alessandro duo made the evening still more festive and enjoyable.

With a toast that looked forward to the future bicentenary, Prof. Carrera and Prof. Marchetti thanked all those present for taking part in spite of the difficult times

L-R: C. Cardani, E. Carrera, M. Marchetti, G. Sala

caused by the pandemic, and for being present to show their affection and "vitality", as Crocco had said, towards an Association that has brought honour to Italy and will continue to do so until Amalia has discovered all the comets in the Universe!

Two views of the Gala Dinner

PIERRE BESCOND'S CONTRIBUTION TO AIDAA'S CENTENARY

Dec 7th, 2021, Rome

Pierre Bescond,
3AF, in charge of International relations
CEAS, VP for External Relations
& Publications

"Good morning Mister President, good morning everybody, and thank you very much indeed for your invitation to the member societies of CEAS (the Council of European Aerospace Societies), at this prestigious celebration of AIDAA's hundred years of existence. I certainly was happy to accept this invitation on behalf of 3AF, Société Aéronautique et Astronautique de France, and be a witness to the friendly and collaborative framework I was involved in during my space career either through various institutions or more personally.

My first personal encounter with the Italian professional culture was 35 years ago when I joined CNES (The French Space Agency). I was hired initially to be the Technical Director of the Guiana Space Centre in Kourou (CSG) and then I became its Director (1980-1982). The Ariane programme had been proposed by France and accepted by Europe, two thirds of the development budget being covered by France. Thus it was only « human » for the best part of the employees there to speak of Ariane as if it were a French rocket. So we were constantly reminded by the European Space Agency's (ESA) representative in Kourou, an Italian, Gustavo Oelker, that it had to be referred to as a European launcher... And I must say that thanks to Gustavo's remarkable persistence, we managed along the years to discipline our staff to behave as the Ariane's European, rather than French, builders. Surely enough, it was not trivial, it was indeed very important for the image of the programme and of ESA, and we all know how remarkable a European success Ariane became !

The only item I never was able to have Gustavo agree with was limited access for him to some places. As ESA's Rep' he wanted to have unlimited access to all sites at all periods without even asking for permission. That of course could not be allowed: even I, as the Director, would not for instance be tolerated near the launcher or near satellites when they were being filled with dangerous propellants ! But that shows again, however friendly he was, how persistent he could be.
That first and very limited experience of collaboration with an Italian partner at least confirmed the experience I had gained along the 5 years I had spent at the French Embassy in London just before joining CSG, as liaison officer for the Anglo-French aircraft and helicopters collaboration programmes: never underestimate anyone, whomever he is and wherever he comes from.
I had just left French Guiana to take up the position of

Director for Satellite systems operations, in the Toulouse Space Centre (CST), when the fifth launch of Ariane in September 1982 was a failure and the satellites it carried (The Italian Sirio 2 telecommunications satellite and the European MARECS B maritime telecom satellite) were lost, meaning our potential ground stations network support to the initial trajectory of Sirio was of no avail. We had some discussions about the possible use of the Italian San Marco platform for sounding rockets launches but for budgetary reasons the platform was then rather dormant. So I did not really work with Italian colleagues in the four years I spent in Toulouse.

It was then in the United States that I was again faced with very significant expertise from Italy. I had taken up the position of President of Spot Image Corporation in Reston, Virginia, in the vicinity of Washington, DC, in charge of developing this subsidiary of Spot Image and market and sell the SPOT 1 services. With this observation satellite we were the first to dare selling 10m-resolution data commercially and North America was expected to generate 25 to 30 % of the market worldwide. So we developed a full in-house facility to programme the satellite to our users needs and to produce the standard data to be sold. To do that, we had to resort to industrial and service providers of various kinds, especially dealing with computers and software. I was impressed to come across a good number of Italian-connected firms, either subsidiaries of Italian groups, firms created by Italian expatriates, or even high-level Italian managers of big American firms like Arturo Silvestrini. President of Computer Sciences Corporation's System Sciences Division, he developed systems and software for the U.S. space program. CSC was the largest software company in the United States and we could find no better subcontractor for our IT needs. So I dare say it was for me a real eye-opener on the Italian entrepreneurship's capacity to fly so high, especially in the US.

From my years at CNES headquarters as Director of Quality (1990-1993) and later on as Inspector General (1994-1996), very much involved in the quality assurance of all programmes and especially the Ariane launcher, the main thing I remember from our collaboration with the Italian industry is that we did not encounter major quality problems. This of course is a good sign that, contrary to what we experienced in some parts of the launcher, their deliveries were sound. This was pretty significant in the case of the top segment of the Ariane-5 solid propellant boosters, which were the largest solid rocket boosters ever built in Europe : Italy has produced their 23.5 tonnes of propellant in Colleferro ever since.

In-between, as Director of Programmes, I also was a Member of the ESA Council and a Member of the Board of Directors of Arianespace. As such I was part of the tough discussions on the sharing of work between the various countries participating to the programme and I can testify that Italy was one of the toughest (maybe the toughest) partner on "geographical return", an ESA rule by which each participating country is to get national work contracts at a level consistent with its financial participation in the programme. But one of my biggest surprises was to discover on the occasion of a trip with the Arianespace Board to the Baikonur cosmodrome in Kazakhstan, wherefrom Arianespace started to offer Soyuz launches, that Italy had also taken there an interesting entrepreneurial initiative: it had won a contract for the logistic support to the satellite preparation before its installation on top of the Soyuz launcher. And that included building and operating an hotel!

In 1996, I was solicited by WorldSpace, in order to set up and manage a subsidiary in Toulouse, which main duty was to monitor the development of their satellite system awarded to Alcatel Espace. WorldSpace was a newly created private company which embarked upon developing a space and ground network to deliver direct radio programmes via satellites to radio sets, essentially in Africa, the Middle East, and Asia. The headquarters were in Washington, DC. To help in this new venture they had appointed an advisory committee consisting of three space telecommunications top experts. By then I was used to dwelling on Italian expertise and although I was not expecting it in such an environment, I was not surprised when I learnt that along with the French and the Russian experts there came an Italian one, whose name unfortunately I don't remember.

Then, one of the last positions I held before retiring was head of the consultancy group, Satel Conseil, created by the French Agency CNES, together with the Telecom Administration before it became privatized as France Telecom, to help industry promote their telecommunications satellite systems around the world. And I only mention it here to say that this group had created one single affiliate, called ESCO … with our Italian friends. In actual fact at this same time, I had also to work with the Telecom satellite operators, and that included Eutelsat and its CEO Giuliano Berretta, whom I had known for many years as an Arianespace customer. I'm glad to remind here how successfully this bright Italian executive transformed the international consortium Eutelsat into a private firm.

During all these years I also had been very active in space congresses, including of course those of the IAF, the International Astronautical Federation, and its daughter institution, the IAA, the International Academy of Astronautics. No need to say I friendly interacted with many Italian professionals there like Professor Amalia Ercoli-Finzi whom I also worked with when she was a Trustee of CEAS and I became President in 2011 & 2012,

and Professor Ernesto Vallerani who himself had been CEAS President in 1995. It had been the same with Maria Antonietta Perino from Thales Alenia Space, « Woman of Excellence 2010 » dall'AIDDA-FCEM (l'associazione italiana "Femmes Chefs d'Entreprises Mondiales") who was a very strong support to me, being my deputy when I was until recently chairman of the HAC, the Honours and Awards Committee of the IAF. And last but not least, it is good to know that the executive team of the IAF has relied upon a pretty good number of Italian female employees to carry out its very demanding tasks for the congresses organization, one of them, Giulia Maria Berardi having even been promoted Deputy Executive Director.

Having spent most of my carreer in space business, the facts I quoted so far come of course essentially from there. But I also had some experience in aviation. Amongst others, a few years back I had an excellent work relation through a contract with the European Commission, ECAero, with Euroturbo, a not for profit international scientific organization on turbomachinery, and its Italian chairman Professor Francesco Martelli who was one of its founding members. So I dare say again, all this makes me proud and honoured to be part today of this very important AIDAA event.

But actually since my retirement I have remained involved in many professional associations and have been able to take advantage of the international network I developed during my professional life, including as you may guess many Italian friends. So beyond being proud of sharing this day with you all, I also am very happy to meet all the friends who sit in this room. I already mentioned Amalia and Ernesto, but there are many others.
I am very sad we are missing Professor Franco Persiani, who had been one of the two Italian Trustees for AIDAA in the Board of CEAS when I was President. We owe Franco Persiani the wonderful 3rd CEAS conference organization in Venice in Oct 2011 and it was a terrible loss for us when he passed away. He trained a good number of students though, and I was very glad indeed to make the acquaintance of one of them: working with the brilliant young lady Doctor Sara Bagassi around this conference and within CEAS has been a real pleasure. I just learned through a previous presentation that Sara will be the Italian representative on the Board of ICAS, the International Council of the Aeronautical Sciences. Congratulations, you made the right choice.

And last but not least, speaking of CEAS, Italy is currently its backbone since Franco Bernelli has been elected President whereas its Director General is Andrea Alaimo. They are both present today and I wish them every success in their endeavours. Indeed CEAS is in very good hands and I know for sure from what we've already done together so far that interesting breakthroughs will happen during Franco's CEAS presidency.

So thank you Franco, thank you AIDAA and Mr President for having invited me today. Testifying from my small perspective on some of the big things our Italian friends are capable of doing in the aerospace business was a real pleasure. Enjoy this centenary celebration and I wish you a lot of even bigger successes in the upcoming hundred years".

LIST OF COURSES 2022

AIDAA Educational Series & Academy

AIDAA is pleased to announce the **list of courses for 2022** in the framework of the institutionalactivities for members organized by the Educational Series and Academy technical committee.

Courses will be **online on Webex**, and exact dates will be announced for each course via dedicated webpages on www.aidaa.it. **Twenty-three courses** are scheduled to date, but a few more could be added.

Participation fees are indicated below, and registration platforms will be available soon.
At the end of each course, **attendance certificates** will be sent to participants.

For further info:
https://www.aidaa.it/courses/
academy@aidaa.it.

3AF: THE FRENCH AERONAUTICAL AND SPACE LEARNED SOCIETY 2.0

RESOLUTELY TURNED TOWARDS THE FUTURE, OUR ASSOCIATION SUPPORTS THE NECESSARY TRANSFORMATION OF THE AERONAUTICS, SPACE AND DEFENSE SECTORS

By Olivier Martin, 3AF Emeritus member, Ingénieur Général de l'Armement (ret.), and Michel Assouline, General Manager of 3AF, Ingénieur de l'Ecole Centrale de Paris

This text, translated by Jean-Pierre Sanfourche with courtesy of the authors, was published in the French Magazine des Ingénieurs de l'Armement, in October 2021.

Olivier Martin

Michel Assouline

TRANSMIT KNOWLEDGE AND PASSION TO PREPARE THE FUTURE OF OUR SECTORS

In a context where the digital economy and globalization are breaking conventional patterns, accelerating the innovation cycle and regularly changing the situation on the geopolitical chessboard, it has become crucial for the industrial and institutional players in our sectors to have, in their ecosystem, exchange facilitators, actors and promoters of transversal approaches to reflect and prepare their future.

A learned society that has become the French reference in the fields of Aeronautics, Space and Defense, the Association Aéronautique et Astronautique de France – 3AF – has held this role for more than 70 years[1]!

The mission of 3AF is the transmission and production of scientific and technical knowledge and expertise through interdisciplinary, intergenerational, and, of course, international exchanges. It is the link between the academic, industrial and institutional worlds.

3AF regularly cooperates with the Air and Space Academy (AAE) with which it shares the sector of activity (aeronautics and space) and the main objectives, but differs from the latter by welcoming many members, mainly French, from the academic, state and industrial worlds in the aeronautics sector, while the AAE, as an Academy, brings together French and European personalities whom it has itself distinguished and who have accepted to be a member.

With its network composed of more than 1200 members, 60 societies, institutions or schools from the aeronautics and space scientific community, 3AF aims to offer all its members a unique opportunity to connect with both professional engineers and technicians. or researchers from all disciplines of aeronautics and space, civil and military, and from all industrial and academic backgrounds. The DGA, the DGAC and CNES are "ex officio" members of its Board of Directors, elected every three years from among the various "colleges" that make up the members and which constitutes the main steering body of the learned society. By its neutrality, 3AF offers an ideal ground for exchanges and crossing of experiences.

FOUR PILLARS TO FACE THE FUTURE AND STAY IN THE RACE

3AF relies for this on four fundamental "tools", harmonized by a High Scientific Council composed of experts:

1. The Technical Commissions,
2. Colloquia and Conferences,
3. Regional Groups
4. The 3AF letter

• **The Technical Commissions:**

The 18 Technical Commissions of 3AF active in 2021 make up a framework structured in five areas:

1. Products and Systems
2. Disciplines Techniques
3. Space and Environment
4. Intelligence and Strategy
5. Humanities

The Commissions are the heart of the association and the point of meetings and exchanges between its various members. They produce the majority of scientific and technical content, or strategic and economic analyses, added value of 3AF obtained thanks to this transversal approach that characterizes it. Their respective roadmaps are dictated by the expectations and questions of their members.

(1) 3AF was created on February 7, 1972, by the merger of AFITAE, French Association of Engineers and Technicians of Aeronautics and Space, founded in 1945 and SFA, French Society of Astronautics, founded in 1955.

Three examples of achievements testify to the vitality and variety of contributions of 3AF's Technical Commissions

1. The DGA (French Armament Procurement Agency) and CNES (French Space Agency) have entrusted the **Optronic Technical Commission** of 3AF with the task of establishing an inventory and an Optronic Roadmap to strengthen the French optronics sector, whose industrial component represents more than 150 companies (large groups, mid-caps/SMEs/SMIs) and more than 10,000 jobs. To carry out this work, an Optronic Coordination Platform (PCO) was set up by the 3AF, bringing together all the actors, ranging from integrator prime contractors to component manufacturers. At the end of this study, an executive summary and a detailed report were produced and disseminated by 3AF and specific presentations were organized, particularly in the Region, as part of a third phase of work targeting more particularly the ecosystem of SMEs / SMIs actors in the sector and competitiveness clusters.

2. The Aerodynamics Commission, which meets at least four times a year, deals with all aspects of this discipline: theoretical and experimental aerodynamics, applied, internal and external, for all types of aeronautical applications (transport and combat aircraft, light aircraft and gliders, drones, helicopters, launchers, missiles) and non-aeronautical (automobiles, trains, buildings, energy production). It organizes an annual international conference bringing together specialists in the field and regularly produces publications, such as the annual edition of a special issue of the scientific journal "the International Journal of Engineering System and Simulation" (IJESMS) where the best papers of the conference are published, or the excellent "Experimental Aerodynamics", published in 2020 by Springer.

3. The Strategy and International Affairs Commission regularly produces notes and reports on topical issues at stake and often "on demand". Thus, in response to the request of the OPECST made by Senator G. Longuet, the 3AF has recently set up a working group composed of experts from the learned society and in particular members of the 3AF Strategy and International Affairs Commission to develop a synthesis document entitled: *Innovation as a strategic perspective for the valorization of satellite services.*

■ Colloquia and Conferences

As an extension of the activity of its Technical Commissions, 3AF organizes each year up to 6 conferences of national or international scope, most of them in direct connection and valuing the work of its Technical Commissions. Some examples illustrate both the diversity of themes and the scale of events:

1. Major international conferences that regularly bring together several hundred participants from many countries, thus constituting a unique opportunity to discover innovative solutions and establish particularly rich and productive exchanges between colleagues from different disciplines and different countries. By way of illustration:

- The Space Propulsion International Conference organized every two years with partners such as ESA, CNES and Ariane Group and brought together nearly 700 specialists in space propulsion for transport and spacecraft.
- The Integrated Air and Missile Defence conference, also organized every two years with partners such as MBDA, Thalès and Ariane Group, which had its fourteenth edition last December in Nice, also brings together nearly 200 participants from fifteen different countries.

2. New conferences on emerging themes, the 3AF ensuring to evolve this offer of conferences to better meet the demand of its members. Thus, in November 2021, the Association opened to its audiences the first edition of a conference on the theme of Air-Land Combat. Scheduled to take place in Versailles on 9 and 10 November 2021, this conference aims to explore the evolution of needs and solutions related to air-land combat beyond the programmatic horizon of 2035.

3. Thematic webinars organized by its Regional Groups to strengthen access to these conferences, especially during the COVID crisis. 3AF has proposed according to this format a forum on Economic and Strategic Intelligence as well as its last annual conference on Aerodynamics.

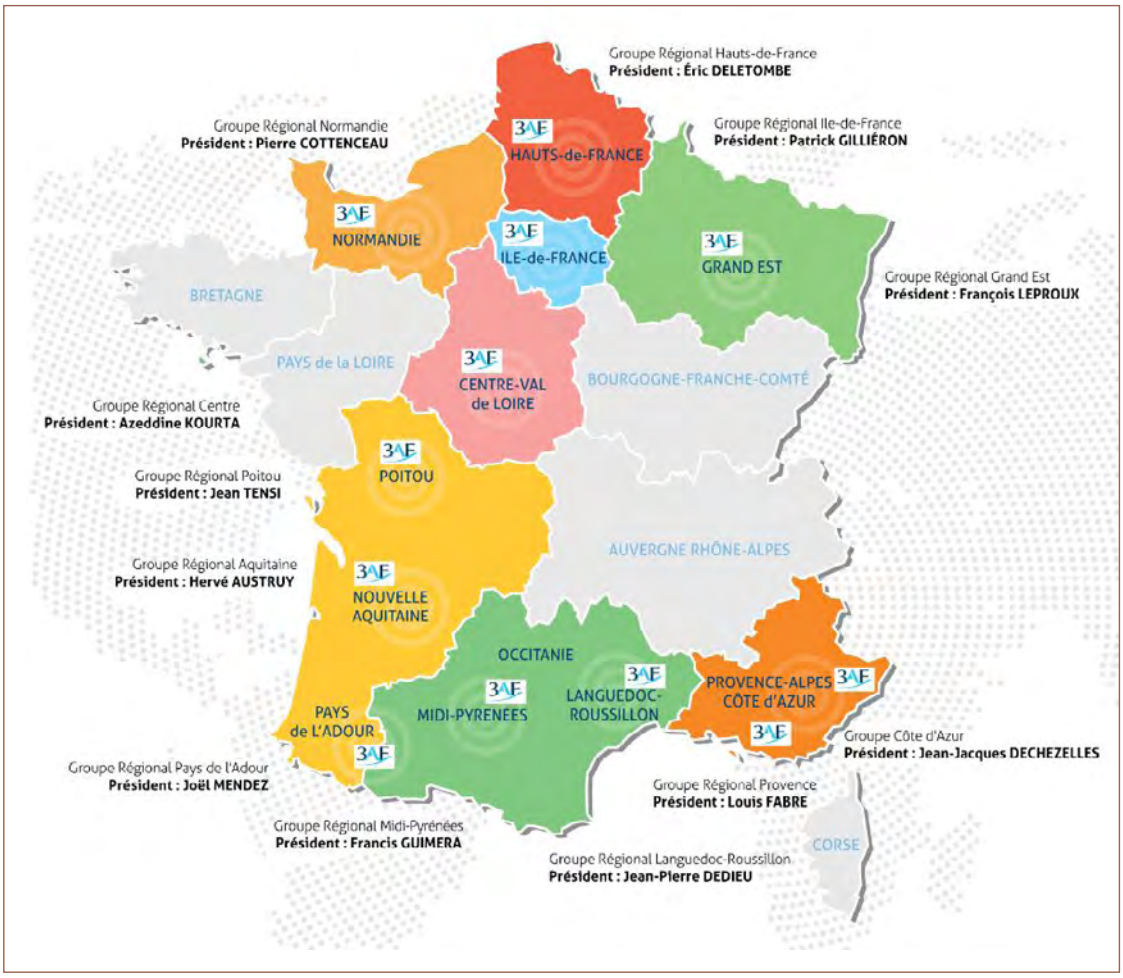
■ Regional Groups

3AF's 12 regional locations relay the national approach as closely as possible to the active as well as the youngest, especially students. They are the main contributor to the influence of our sectors among all audiences.
This organization has a long tradition, which contributes to good relations with local authorities, facilitates local animation through many initiatives, allows provincial members to get to know each other better and finally, relays the ambitions of the association.

MEA 2019 Conference organized by the Nouvelle Aquitaine Regional Group

The many visits or conferences that these groups offer in France are powerful means to spread and contribute to the influence of scientific and technical culture among a wide audience. In addition, some regional groups propose, often in cooperation, symposia that have become references in their field. These include the following blisters set up in cooperation with the SEE (Société de l'Electricité, de l'Electronique et des TIC):

- MEA (More Electric Aircraft) organized alternately between Bordeaux-Aquitaine and Midi-Pyrénées,
- ERTS (Embedded Real Time Software & Systems), and ETTC (European Test & Telemetry Conference) organized in Toulouse by the Midi-Pyrénées Group.



3AF Regional Groups

The 3AF Letter

This is the quarterly 3AF publication, broadly disseminated either in printed version or electronically via the 3AF website. It covers civil aerospace, defence and space domains with science & technology papers, commercial, strategy and public policy papers, as well as air and space history articles.

AN EXTENDED DIALOGUE ACROSS BORDERS

The 3AF association is obviously part of an international cooperation scheme and thus cooperates with its British (RAeS), German (DLR) or American (AIAA) counterparts in common approaches. It takes an active part in the coordination of European learned societies, the 3AF, the RAeS and the DGLR being at the origin of the creation of the CEAS (Council of European Aerospace Societies) – a structure for which 3AF organized in 2020 in Bordeaux the 7th international congress AEC (Aerospace Europe Conference).

3AF is also a member of the IAF (International Astronautical Federation) or the ICAS (International Council of Aeronautical Sciences) Council which 3AF has chaired on several occasions.

PRIORITY TO PASSION, TALENTS AND ACHIEVEMENTS

Last but not least, 3AF highlights women and men who compose it. Highest importance is given to talent and high-level achievements reconnaissance. Every year are attributed:

- Grades: Senior and Emeritus (the equivalent of Members or Fellows in the UK);
- Prizes.
- Palms.

Special Grand Prizes are also regularly conferred to high personalities belonging to different domains. The three latest personalities were Sandra Magnus, Thomas Pesquet and Philippe Petitcolin.

A demonstration that passion which gets together and animates our members is the best possible engine for generating innovation and achieving decisive advances!

'AEC2020': as a full member of CEAS (Council of European Aerospace Societies), 3AF organised and hosted the CEAS biennial International Conference AEROSPACE EUROPE CONFERENCE in February 2020 in Bordeaux. Here above, the 3AF President Louis Le Portz delivering his welcome address.

UPCOMING 3AF EVENTS 2022

Five International Conferences

- **09-13 May:** Estoril (Portugal) – Space Propulsion
- **01-02 June:** Toulouse – ERTS2022 – Embedded Real Time Software Systems
- **08-10 June:** Versailles – OPTRO2022 – Optronics in Defence and Security
- **27 June-01 July** – Lille – EUCASS-3AF ConFERENCE
- **18-20 October** – Toulouse – TSA2022 – Towards Sustainable Aviation Summit

Two 3AF Technical Commissions Colloquiums

- **28-30 March** – Toulouse at ISAE-SUPAERO – Applied Aerodynamics
- **23-24 November** – Paris – IES2022 – Strategic and Economical Intelligence

EUCASS – 3AF INTERNATIONAL CONFERENCE

France and **Belgium** join forces and invite you to Lille (France, #hellolille) from Monday, June 27th to Friday, July 1st, 2022, on the occasion of the **9th European Conference for Aerospace Sciences** organised by **EUCASS**.

This edition has received the support of the **Association Aéronautique et Astronautique de France (3AF)** and will be carried out with the partnership of the clusters **Aér'Hauts-de-France, Normandie Aerospace** and **Skywin** for Belgium.

After the year 2020 for the aeronautical and space sectors, EUCASS-3AF 2022 will be an opportunity for our scientific community to renew direct scientific contacts and present its results and proposals for tomorrow's aeronautics and space in a world forced to change.

This four-day conference will be held in **Lille Grand Palais**, the congress center located in the capital of the Hauts-de-France northern region.

THE SWISS ASSOCIATION FOR AERONAUTICAL SCIENCES

The Swiss Association for Aeronautical Sciences (SVFW) is a meeting place for more than 300 aerospace professionals and promotes aviation and space sciences in Switzerland. The SVFW organises lectures on topics from science, technology, research, development and innovation such as flight science, flight operations, aviation medicine, aviation law, space technologies, aviation related training as well as contributions with historical background. The association is the link to the international aerospace science organisations ICAS (International Council of Aerospace Sciences) and CEAS (Council of European Aerospace Societies). To promote young scientists, the SVFW awards the Jakob Ackeret Prize for outstanding research work.

SVFW, THE TECHNICAL-SCIENTIFIC FLAGSHIP FOR THE SWISS AEROSPACE

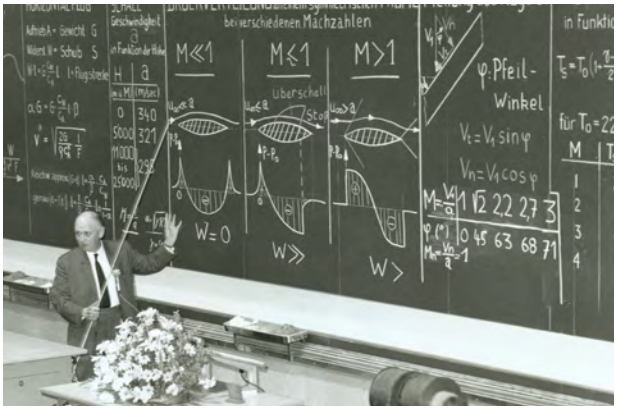
The Swiss Aeronautical Science Association was founded in 1960 on the occasion of the 2nd ICAS congress held in Zurich. The driving forces were ETH professors Jakob Ackeret and Manfred Rauscher, both outstanding personalities in the field of aerodynamics and aircraft structure development. Ackeret, founder of the Institute of Aerodynamics at the ETH, developed important theoretical principles of fluid mechanics, which found broad applications in mechanical engineering and aviation. His most important works include research on supersonic flight and visionary concepts of commercial aircraft and turbine engines. In his habilitation thesis, he proposed the concept of the Mach number. His farewell lecture in 1967 was entitled 'Der Weg zum Überschallverkehrsflugzeug' (The way to the supersonic airliner). Rauscher's research at ETH focused on the subject of new materials, especially glass-fibre composite structures. Exactly 60 years ago, a tailplane of a glider was first built with the new material in his laboratory. This was followed by the development and construction of a fuselage with a T-tail. The work ultimately led to the pioneering Diamant glider from the former Flug- und Fahrzeugwerke Altenrhein, which took the air in 1964.

Research and development in aviation in Switzerland have led to outstanding results to this day, be it in the development and construction of aircraft and helicopters, components and sensors as well as in academic research, here today in particular in the field of autonomous flight controls for small drones. In this context, Switzerland is known as the 'drone valley'.

INTERNATIONAL CONNECTIONS

The reason for founding the SVFW was, as mentioned above, the ICAS congress in 1960. The Swiss representation in ICAS was subsequently taken care of by the SVFW. According to the vision of the founder Theodore von Kárman, ICAS is a global organisation and enables the Swiss members to maintain scientific-technical contacts beyond the national borders and to hold lectures in front of an international audience of experts. ICAS organises the world's largest aerospace congress every two years. The SVFW is represented on the programme committee, whose members meet every two years for a 'mini-congress'. In 2018, the SVFW held this in Winterthur in cooperation with zhaw, the Zurich University of Applied Sciences. The main topics were artificial intelligence and autonomous technologies in aviation. 120 experts from industry, research and governmental organisations explained technical, scientific and regulatory topics that will increasingly shape civil aviation in the future. In particular, the possibilities of artificial intelligence were discussed, be it in the maintenance of aircraft or in flight operations. Here, too, the experts agreed that neither pilots nor engineers will be replaced by robots in the near future. On the contrary, engineering will become more important and it is necessary to further expand and consolidate trust in the technology, according to the experts. Intensive networking developed around the workshop. The presentations are available at https://www.svfw.ch/events/

Since 1999, the SVFW is also a member of the CEAS (Council of European Aerospace Societies), the umbrella organisation of the technical and scientific European



Prof. Jakob Ackeret, co-founder of the SVFW, during his farewell lecture at ETH on the topic of the road to supersonic transport aircraft (Image: ETH Archive)

Swiss aeronautical innovation: In RUAG's wind tunnel, the aerodynamics of new aircraft and aircraft concepts are investigated using the latest measurement methods; the picture shows the Swiss Pilatus PC-24 business jet. (Image: RUAG)

aerospace associations. The SVFW is active together with European societies such as the DGLR (German Aerospace Society), the AAAF (Association Aéronautique et Astronautique de France) and the RAeS (Royal Aeronautical Society). In 2008, the SVFW provided the president of the CEAS. Every two years the CEAS organises a large European congress. The numerous specialist groups regularly hold specialist congresses and seminars where the specialists can discuss the latest findings and future developments 'among themselves'.
The 'CEAS Aeronautical Journal' and the 'CEAS Space Journal' are journals aimed at specialists, while the quarterly bulletin 'Aerospace Europe' provides background information on current aerospace topics and is available free of charge to SVFW members.

JAKOB ACKERET PRIZE

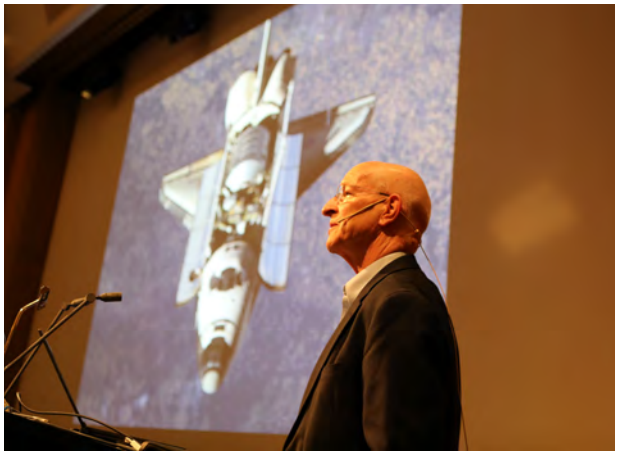
A special concern of the SVFW is the connection to students. There are close contacts with the Academic Aviation Association Zurich, a student organisation. The SVFW periodically awards the Jakob Ackeret Prize for the promotion of young academics in Swiss aviation, thereby honouring outstanding achievements by young students or academic staff who are fascinated by aviation. The award is open to students of the ETHs, universities, colleges and universities of applied sciences as well as to scientific staff in academia and industry who are under 30 years of age. The prize is awarded for outstanding work related to Swiss aviation. This can be student work (semester, bachelor or master theses), dissertations or non-classified research work from academia and industry. The subject areas are broad, and applications can come from aviation technology, operations, organisation and management, logistics or aviation law. In 2019, the prize was awarded twice. One of the prize winners comes from the circle of the Academic Aviation Association Zurich. His topic was mission definition and analysis and the operational potential of a twin-engine hybrid electric commuter aircraft, which he addressed in his master's thesis. The second prize winner researched real-time visualisation technologies for wind tunnel use in his dissertation at ETH Zurich. The topic of the 202/21 price addressed «Safety Critical Optimization of IFR - Low Level Trajectories in Alpine Areas » and is of high importance for the search and rescue helicopter operations. Second and third place winners dealed with upset recovery training for glider pilots and wind tunnel investigations and quantitative flow visualization on an active flow control wing flap configuration.

SVFW EVENTS

The SVFW organises lectures on scientific topics in aerospace such as aeronautics, aviation medicine, aviation law, training and also developments from the past. Visits offer members insights into exciting companies and organisations in Switzerland.

In addition to traditional and historical topics, the lectures and events give wide scope to current trends and developments, with a focus on technology and development. The SVFW offers 6 to 10 lectures, company visits or special events every year.
Since its foundation, the SVFW has held more than 300 lecture events. About two thirds of these have been given by Swiss speakers, and for a good third renowned aerospace experts from abroad have been recruited. The speakers include famous names from the international aerospace scene such as Claudius Dornier, Sergey Sikorsky, Edward Heinemann, Wolfgang Herbst and Joachim Szodruch, as well as Claude Nicollier from Switzerland and many other representatives from science and industry.

The 2020/21 programme conveyed exciting presentations on new and current technologies in the development of combat aircraft. The four companies involved in the evaluation of the Swiss Armed Forces' fighter air-



The Swiss astronaut Claude Nicollier during his 2018 lecture 'Flying the Space Shuttle' in the ETH Zurich Auditorium Maximum

craft have given corresponding presentations. For known reasons, these events had to be switched from physical events to on-line presentations. The 2022 programme will focus on STOL and VTOL topics and include the co-hosting of the 48th European Rotorcraft Forum in September. The lectures will generally take place at the ETH in Zurich and are open to the public. The programme will be published on the website www.svfw.ch as soon as possible.

The lectures of the SVFW are intended on the one hand to sharpen the view into the future of aviation technologies, and on the other hand to make people aware of results and experiences of the past. Science has identified future technologies and, together with industry, has already tested them at a low level of maturity. Keywords are, among others, 'autonomous flying' or 'hybrid-electric flying', also 'CO2-neutral air traffic' and 'environmentally compatible growth'. These are topics in which, in addition to the established aircraft manufacturers, numerous start-ups from the non-aircraft sector are active. Visions of drone applications or individual mobility (urban air vehicles) are attracting the attention of investors such as Google, Amazon or Facebook, who hope to generate new markets and industries. Closing capability gaps between academic success and industrial maturity will be one of the challenges of the future. Aeronautic research and development will experience exciting years, the likes of which we probably only see in aviation every few decades. The SVFW is pleased to be able to act as a knowledge broker and networking partner in this regard.

ACADEMIC AVIATION ASSOCIATION ZURICH

The SVFW closely cooperates with the Akademische Aviatikverein Zürich (AAZ), which was founded in 2014 by a group of mechanical engineering students interested in aviation. At that point, there was no comparable student association on the Zürich campus that bridged the gap between science and aviation. The fact that the general interest in aeronautics and space travel among students of all disciplines at the universities of Zürich was high, led to a rapid increase in membership, reaching nearly 200 members within the first five years. The AAZ aims to unite students of all disciplines who are interested in aviation in order to promote scientific exchange and experience aviation at first hand. Besides visits to aviation related companies, airshows, and fly-ins, the AAZ also organizes social events, (para-)gliding trial days and many more hands-on events. Regular scientific lectures balance the practical activities and integrate the academic components into the semester program. This broad spectrum of events enables AAZ to establish a direct connection between the lecture hall and the cockpit. The member's backgrounds vary greatly – whilst many are students of various engineering disciplines, physics, geography, medicine, law, business administration and art history are also represented, to name just a few. This diversity and the network of prospective specialists in the Swiss economy distinguish the association as a potential link between university, science, and industry. The expansion and maintenance of this network plays a central role for the young association: In addition to the ETH Students' Association (VSETH), the UZH (VSUZH) and the ZHAW (ALIAS), the Swiss Association for Flight Sciences (SVFW), Swiss aviation journalists (SAJ), HSG Aviation Club and the Center for Aviation Competence (CFAC) are important contributors to the joint exploitation of synergies. In addition, the AAZ cooperates with Skyguide, Horizon Swiss Flight Academy, RUAG and the Swiss aviation magazine "Cockpit" in order to maintain a close relation to the industry.

EREA NEWS
January 2022

EREA Association of European Research Establishments in Aeronautics

THE MESSAGE OF THE NEW PRESIDENT PAWEL STEZYCKI

Dear EREA Friends,

The last two years were difficult and different from what we used to know. Each of us had to face the new reality and reorganise our lives. Yet, we all can look back and say – we did it. I see the year 2022 as the year of hope, that we all are able to do a great job – together. We must look forward with the knowledge that brighter days are ahead of us – although our challenges are great, each of us has the courage and determination to rise up and face them.

As the new EREA Chairman, I wish to express my gratitude for giving me such a privilege, thank you for your trust in me.

I also would like to say thank you to EREA Past Chairman, Michel Peters, whose term of office started together with the COVID crisis, and even though Michel had to face that difficult condition, he brought us through all together. One more time – thank you Michel for your dedication and hard work. I wish us all a very happy and successful Year 2022. I look forward to our joint cooperation.

Sincerely,i

Paweł Stężyck

EREA ANNUAL EVENT

Round table moderated by Pawel Stezycki with Michel Peters, Axel Krein and Richard Frizon, during the EREA Annual Event 2021

The traditional EREA Annual Event was organized this year on December 1st, at the Steigenberger Hotel in Brussels, during which the EREA Board members were delighted to welcome the participants representing the different stakeholders of the European aviation research community.

The EREA Chairman, Michel Peters (President and CEO of NLR), opened the evening by extending a warm welcome to the participants and recalling the two years of his chairmanship of EREA. During this period, EREA has improved its relations with stakeholders, supported and implemented actions related to midand long-term aviation research (including the finalization of the EREA Vision Study and its official handover to stakeholders last June), contributed to the preparation of the aviation partnerships, continued its work in the Future Sky initiative and increased its visibility despite a difficult health context.

EREA was honoured to have the keynote speech of the EREA Annual Event given by Mrs. Rosalinde Van Der Vlies, Director Clean Planet at the European Commission's DG RTD.

The new aviation partnerships were then particularly highlighted in the continuation of the programme with the organization of a Round table on the theme "Can we innovate our way towards climate neutral and sustainable aviation?" organized with Axel Krein (Executive Director of Clean Sky 2 JU), Richard Frizon (interim Executive Director of SESAR 2020 JU) and Michel Peters, in a session moderated by the EREA Vice-Chairman, Pawel Stezycki (CEO of ILOT).

EREA BEST PAPER AWARD 2021

Hand over of the plaque for the EREA Best Paper Award 2021 to ONERA (F. Roudolff on behalf of D. Goutaudier and V. Kehr-Candillea) and 2nd and 3rd place winners during the EREA Annual Event 2021

EREA representatives at the EREA stand at the EASA Rotorcraft Forum, Cologne, 16-18 November 2021

Also during the EREA Annual Event, the top 3 papers participating in the EREA Best Paper Award 2021 were highlighted with brief presentations of their work at the ceremony before the winner was announced. They all received certificates in recognition of their excellent results and the first paper received the EREA Best Paper Award 2021 plaque from the EREA Chairman.

D. Goutaudier and V. Kehr-Candillea (ONERA) were the recipients of the First Prize, for their paper "Long-range impact localization with a frequency domain triangulation technique:

Application to a large aircraft composite panel" written in collaboration with D. Gendre (Airbus) and R. Ohayon (Cnam). The Second place paper was the paper entitled "Integrated Design of a Morphing Winglet for Active Load Control and Alleviation of Turboprop Regional Aircraft" with I. Dimino, G. Andreutti (CIRA), F. Moens (ONERA), F. Fonte (Politecnico di Milano), R. Pecora (University of Naples "Federico II) and A. Concilio (CIRA).

J. Dandois, C. Verbeke and F. Ternoy (ONERA) were the recipients of the Third Prize, for their paper "*Performance Enhancement of a Vertical Tail Model with Sweeping Jets*".

EREA'S PARTICIPATION IN THE EASA ROTORCRAFT FORUM

An important action of EREA was in term of visibility at the end of the year 2021 was its participation in the European conference on rotorcraft in Cologne in November.

On this occasion, EREA (Arnaud Le Pape, ONERA) gave a speech on EREA in keynote.

All EREA members present at this conference had the opportunity to exchange with many participants on the dedicated EREA stand.

Moreover, EREA was strongly involved in the organization of the Rotorthon, for which EREA defined a technical challenge on which students from European universities worked during two months. After evaluation of the results obtained by the student teams in the competition by the members of the Jury, the best student team was awarded.

EREA FACTS AND FIGURES 2020

Key figures full members 2020*

**Based on data of fiscal year 2020 (ILOT: 2019)*

Number of employees in aviation:	**5561**
Total number of employees:	**18179**
Internal aviation research:	**565 M€**
Total internal research:	**2013 M€**
Annual revenue from EU projects:	**95.6 M€**
Number of PhD thesis:	**252**
Number of publications:	**8688**
Publications in refereed journals:	**2260**
Number of new patents:	**400**

OUTLINE OF THE LATEST ISSUES OF THE CEAS SPACE JOURNAL AND THE CEAS AERONAUTICAL JOURNAL

The journals were created under the umbrella of the Council of European Aerospace Societies (CEAS) to provide an appropriate platform for excellent scientific publications submitted by scientists and engineers. The German Aerospace Centre (DLR) and the European Space Agency (ESA) support the Journals, which are published by Springer Nature.

The **CEAS Space Journal** is devoted to excellent new developments and results in all areas of space-related science and technology, including important spin-off capabilities and applications as well as ground-based support systems and manufacturing advancements.
The **CEAS Aeronautical Journal** is devoted to publishing new developments and outstanding results in all areas of aeronautics-related science and technology, including design and manufacturing of aircraft, rotorcraft, and unmanned aerial vehicles.

Both journals play an increasingly important role in representing European knowledge in aerospace research. Nevertheless, the biggest challenge is still to attract an acceptable number of high caliber scientists and engineers to submit articles for publication. Therefore, we invite you and your colleagues to contribute to the development of these journals by publishing your hard-earned results. Papers which are considered suitable will be subjected to a comprehensive blind peer-review process for potential publication in the CEAS Journals.
A list of articles published in the latest issues of both CEAS Journals is attached.

The Managing Editors:
– Andrea Dieball
– Cornelia Hillenherms
– Wilhelm Kordulla
– Stefan Leuko
– Johan Steelant

CEAS SPACE JOURNAL

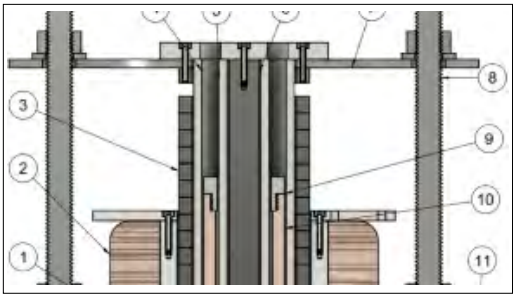
Volume 14, Issue 1, January 2022

THANK YOU TO OUR CEAS SPACE JOURNAL REVIEWERS

S. Leuko / Published online: 05 January 2022 (Open Access)

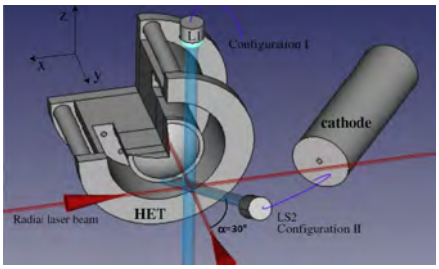
LOW POWER TRUST MEASUREMENTS OF THE WATER ELECTROLYSIS HALL EFFECT THRUSTER

A. Schwertheim & A. Knoll / Published online: 01 March 2022 (Open Access)



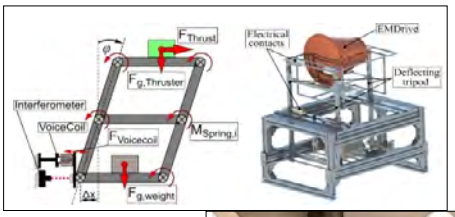
NON-INTRUSIVE TOOLS FOR ELECTRIC PROPULSION DIAGNOSTICS

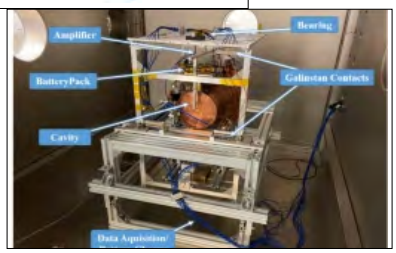
Y. Dancheva, D. Pagano, S. Scaranzin, R. Mercatelli, M. Presi, F. Scortecci & G. Castellini / Published online: 02. April 2021`



HIGH-ACCURACY THRUST MEASUREMENTS OF THE EMDRIVE AND ELIMINATION OF FALSE-POSITIVE EFFECTS

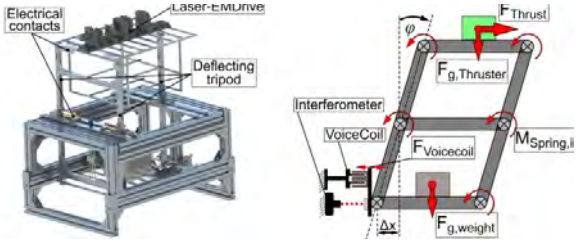
M. Tajmar, O. Neunzig & M. Weikert / Published online: 27 July 2021 (open Access)





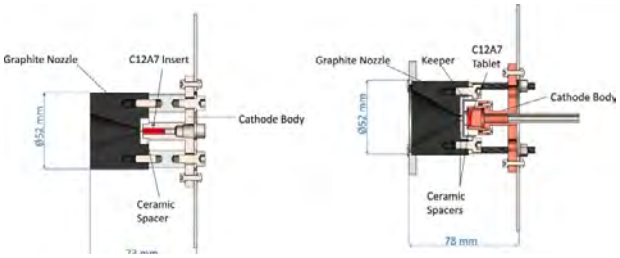
THRUST MEASUREMENTS AND EVALUATION OF ASYMMETRIC INFRARED LASER RESONATORS FOR SPACE PROPULSION

O. Neunzig, M. Weikert & M. Tajmar / Published online: 24. April 2021 (Open Access)



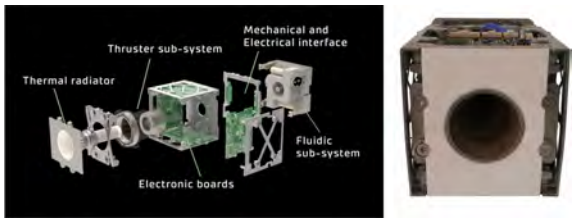
DESIGN OF A HOLLOW CATHODE THRUSTER: CONCEPTS, PARAMETER STUDY AND INITIAL TEST RESULTS

N. Gondol & M. Tajmar / Published online: 26 Mai 2021 (Open Access)



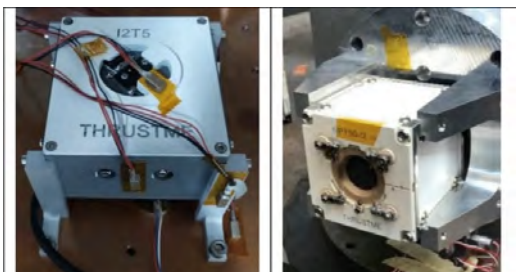
DESIGN AND IN-ORBIT DEMONSTRATION OF REGULUS, AN IODINE ELECTRIC PROPULSION SYSTEM

N. Bellomo, M. Magarotto, M. Manente, F. Trezzolani, R. Mantellato, L. Cappellini, D. Paulon, A. Selmo, D. Scalzi, M. Minute, M. Duzzi, A. Barbato, A. Schiavon, S. Di Fede, N. Souhair, P. De Carlo, F. Barato, F. Milza, E. Toson & D. Pavarin / Published online: 07. June 2021 (Open Access)



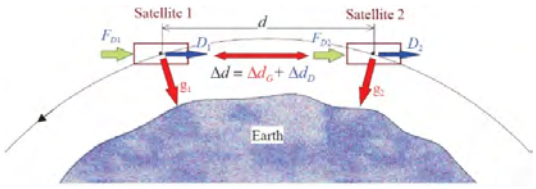
DESIGN AND DEVELOPMENT OF IODINE FLOW CONTROL SYSTEMS FOR MINIATURIZED PROPULSION SYSTEMS

J. Martínez Martínez & D. Rafalskyi / Published online: 01 August 2021



THE NEXT GENERATION GRAVITY MISSION AND THE QUALIFICATION OF THE INDIUM-FED MN-FEEP THRUSTER

L. Massotti, J. Gonzalez del Amo, P. Silvestrin, D. Krejci, A. Reissner & B. Seifert / Published online: 16 September 2021

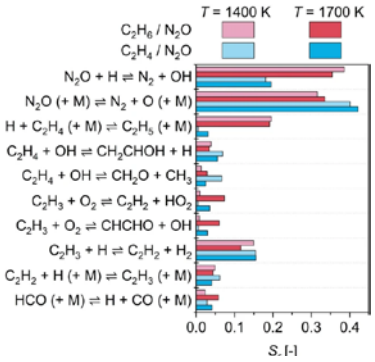


ASYMPTOTIC TRACKING POSITION CONTROL WITH ACTIVE OSCILLATION DAMPING OF A MULTIBODY MARS VEHICLE USING TWO ARTIFICIAL AUGMENTATION APPROACHES

D. Bodmer, M. Krenmayr & F. Holzapfel / Published online: 13. Mai 2021 (Open Access)

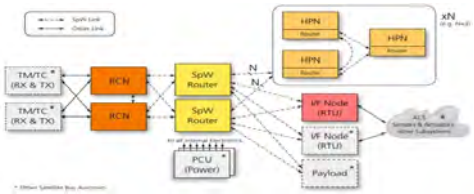
"GREEN PROPELLANTS" AS A HYDRAZINE SUBSTITUTE: EXPERIMENTAL INVESTIGATIONS OF ETHANE/ETHENE-NITROUS OXIDE MIXTURES AND VALIDATION OF DETAILED REACTION MECHANISM

C. Janzer, S. Richter, C. Naumann & T. Methling / Published online: 28 May 2021 (Open Access)



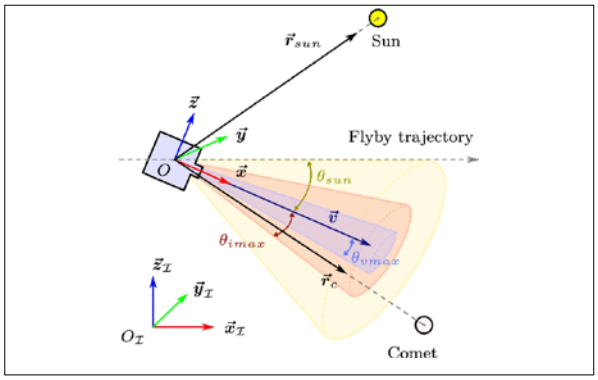
SCOSA SYSTEM SOFTWARE: THE RELIABLE AND SCALABLE MIDDLEWARE FOR A HETEROGENEOUS AND DISTRIBUTED ON-BOARD COMPUTER ARCHITECTURE

A. Lund, Z. A. H. Hammadeh, P. Kenny, V. Vishav, A. Kovalov, H. Watolla, A. Gerndt & D. Lüdtke / Published online: 31 May 2021 (Open Access)



OPTIMAL SCIENCE-TIME REORIENTATION POLICY FOR THE COMET INTERCEPTOR FLYBY VIA SEQUENTIAL CONVEX PROGRAMMING

V. Preda, A. Hyslop & S. Bennani / Published online: 14 June 2021



TWO-LINE-ELEMENT PROPAGATION IMPROVEMENT AND UNCERTAINTY ESTIMATION USING RECURRENT NEURAL NETWORKS

G. Curzi, D. Modenini & P. Tortora / Published online: 15 June 2021

$$t_{ref} = t_i + k\Delta t$$
$$X^{ref} = [a \quad e \quad i \quad \Omega \quad \omega \quad l \quad Lat \quad Lon \quad B^*]$$

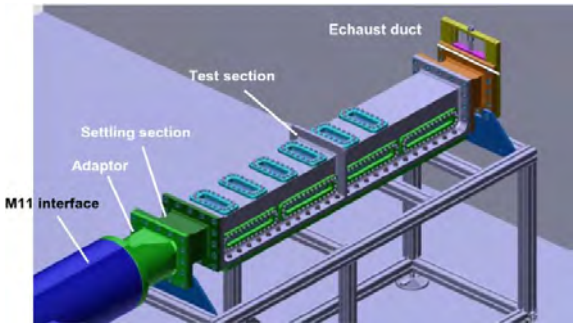
$$dt_k = \begin{cases} 0 & if \ k \neq k_{end} \\ t_k - t_{ref} & if \ k = k_{end} \end{cases}$$

$$t_k = t_i + k\Delta t + dt_k$$
$$X^k = [a' \quad e' \quad i' \quad \Omega' \quad \omega' \quad l' \quad Lat' \quad Lon' \quad B^{*'}]$$
$$dX^k = X_k - X^{ref} = [da \quad de \quad \cdots \quad dLon \quad dB^*]$$

$$x^k(dt_k) = \begin{bmatrix} k\Delta t \\ dt_k \\ dX^k|_N \\ X^k|_N \end{bmatrix}^T = [k\Delta t \quad dt_k \quad da \quad di \quad d\Omega \quad dl \quad Lat \quad Lon]$$

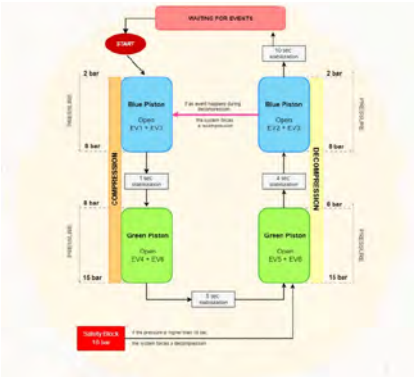
EXPERIMENTAL AND NUMERICAL INVESTIGATION OF ETHANOL FILM COOLING

S. Soller, H. Riedmann, A. Simonini, J.-B. Gouriet, F. Strauss, C. Kirchberger, C. Dinescu, K. Claramunt & J. Steelant / Published online: 14 June 2021



COMMISSIONING OF A BUBBLE CHAMBER FOR SPACE RADIATION DOSIMETRY

M. Felizardo & M. Reis/ Published online: 22 September 2021



CEAS AERONAUTICAL JOURNAL

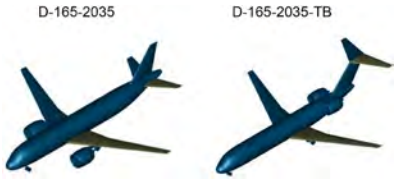
Volume 13, Issue 1, January 2022

THANK YOU TO OUR CEAS AERONAUTICAL JOURNAL REVIEWERS

Published: 31 January 2022 (Open Access)

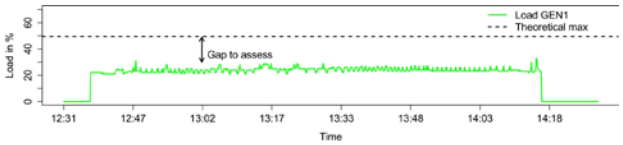
FAN DESIGN ASSESSMENT FOR BLI PROPULSION SYSTEMS

M. Mennicken, D. Schoenweitz, M. Schnoes & R. Schnell / Published: 04 October 2021 (Open Access)



A STATISTICAL APPROACH FOR SIZING AN AIRCRAFT ELECTRICAL GENERATOR USING EXTREME VALUE THEORY

Feriel Boulfani, Xavier Gendre, Anne Ruiz-Gazen & Martina Salvignol / Published: 04 October 2021

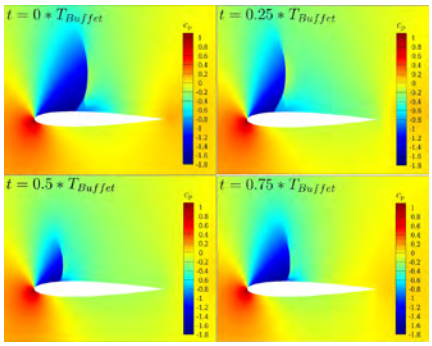


APPLYING EIGENSTRUCTURE ASSIGNMENT TO INNER-LOOP FLIGHT CONTROL LAWS FOR A MULTI-BODY AIRCRAFT

Alexander Köthe & Robert Luckner / Published: 21 December 2021 (Open Access)

AIRFOIL BUFFET AERODYNAMICS AT PLUNGE AND PITCH EXCITATION BASED ON LONG SHORT-TERM MEMORY NEURAL NETWORK PREDICTION

R. Zahn & C. Breitsamter / Published: 18 October 2021 (Open Access)

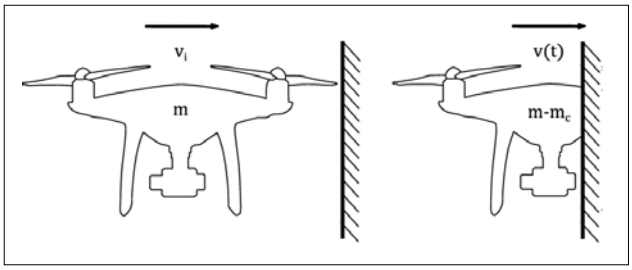


PARAMETRIC WHIRL FLUTTER STUDY USING DIFFERENT MODELLING APPROACHES

Christopher Koch / Published: 06 October 2021 (Open Access)

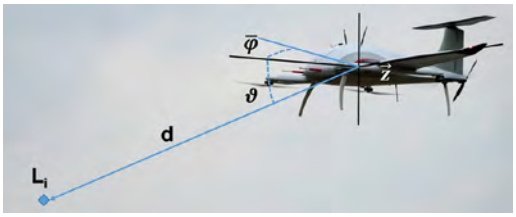
AN ANALYTICAL MODEL TO DETERMINE THE IMPACT FORCE OF DRONE STRIKES

Florian Franke, Michael Schwab, Uli Burger & Christian Hühne / Published: 27 October 2021 (Open Access)



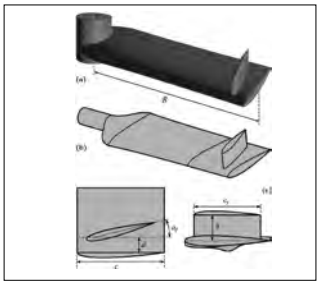
SEMI-EMPIRIC NOISE MODELING OF A CARGO EVTOL UAV BY MEANS OF SYSTEM IDENTIFICATION FROM FLIGHT NOISE MEASUREMENT DATA

Michael Schmähl, Christian Rieger, Sebastian Speck & Mirko Hornung / Published: 02 December 2021 (Open Access)



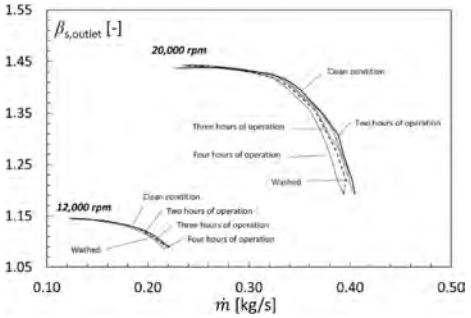
EXPERIMENTAL INVESTIGATION OF A ROTOR BLADE TIP VORTEX PAIR

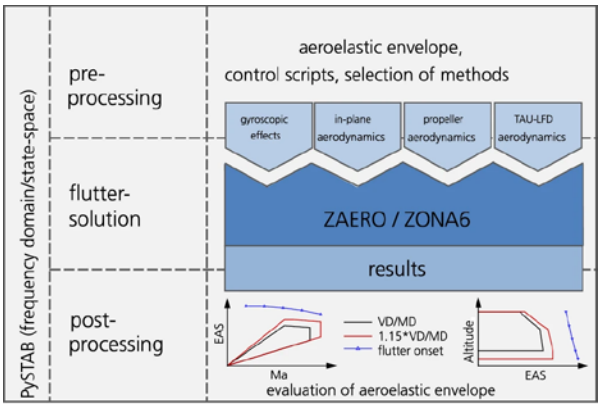
Dominic Schröder, Jorge Aguilar-Cabello, Thomas Leweke, Ralf Hörnschemeyer & Eike Stumpf / Published: 20 October 2021 (Open Access)



PERFORMANCE LOSSES AND WASHING RECOVERY OF A HELICOPTER ENGINE COMPRESSOR OPERATING IN GROUND-IDLE CONDITIONS

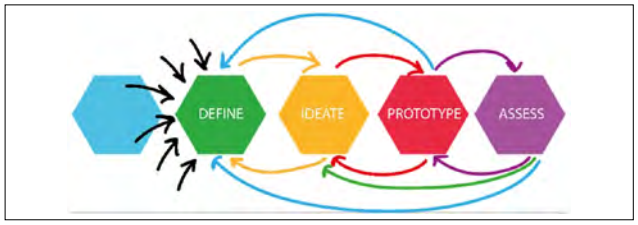
Nicola Casari, Michele Pinelli, Alessio Suman & Alessandro Vulpio / Published: 06 December 2021





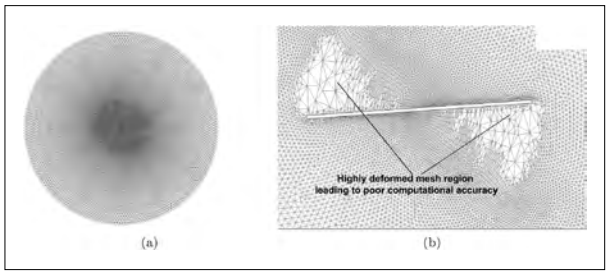
APPLICATION OF VR TECHNOLOGY IN THE AIRCRAFT CABIN DESIGN PROCESS

Ivana Moerland-Masic, Fabian Reimer, Thomas M. Bock, Frank Meller & Björn Nagel / Published: 23 November 2021



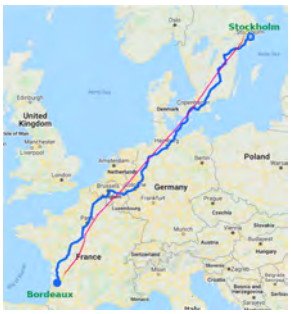
EFFECT OF FLAPPING FREQUENCY, REYNOLDS NUMBER AND ANGLE OF ATTACK ON THE AERODYNAMIC FORCE COEFFICIENTS OF A TRANSLATING WING

Sai Sandeep Dammati, Srikanth Goli, Sai Subhankar Varanasi, P. Srinag & Arnab Roy / Published: 04 October 2021



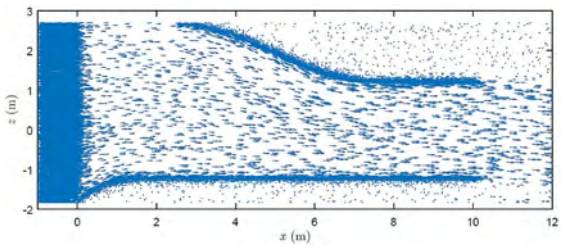
CASE STUDY ON THE ENVIRONMENTAL IMPACT AND EFFICIENCY OF TRAVEL

Evelyn Otero & Ulf Ringertz/ Published: 22 September 2021 (Open Access)



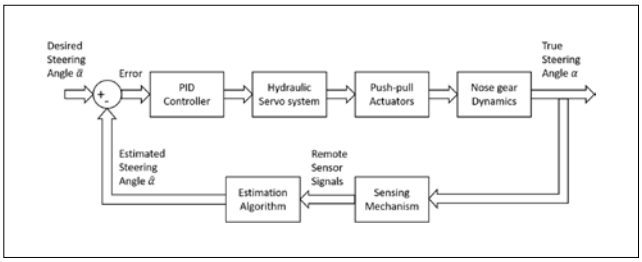
KINETIC AND THERMAL SIMULATION OF WATER DROPLETS IN ICING WIND TUNNELS

A. Fallast, A. R. Rapf, A. Tramposch & W. Hassler / Published: 13 November 2021 (Open Access)



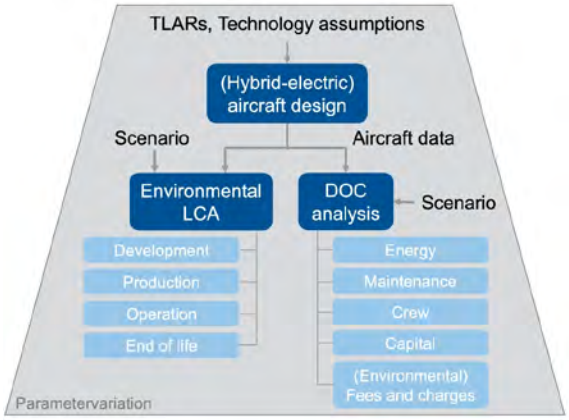
VIRTUAL SENSING OF WHEEL DIRECTION FROM REDUNDANT SENSORS IN AIRCRAFT GROUND-STEERING SYSTEMS

Mattia Dal Borgo, Stephen J. Elliott, Maryam Ghandchi Tehrani & Ian M. Stothers/ Published: 01 November 2021



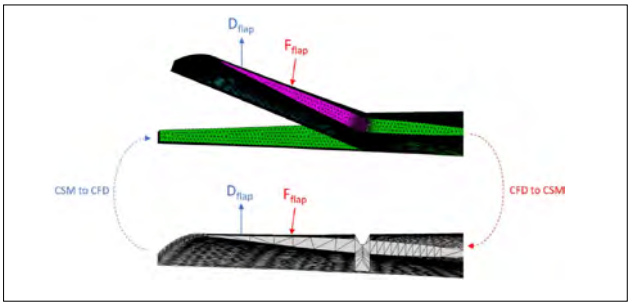
ENVIRONMENTAL LIFE CYCLE ASSESSMENT AND OPERATING COST ANALYSIS OF A CONCEPTUAL BATTERY HYBRID-ELECTRIC TRANSPORT AIRCRAFT

Anna Elena Scholz, Dimitar Trifonov & Mirko Hornung/ Published: 3 November 2021 (Open Access)



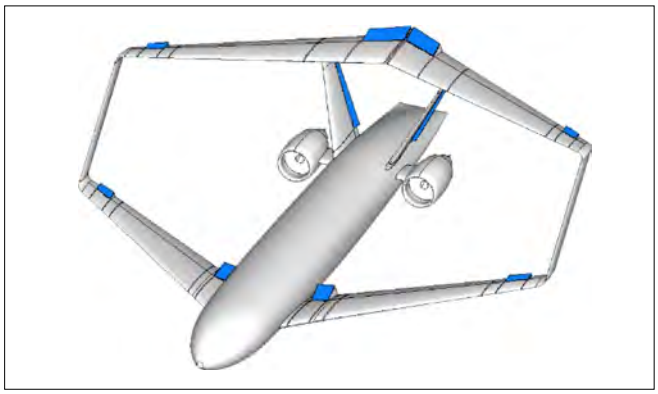
AEROELASTIC SIMULATIONS OF A DELTA WING WITH A CHIMERA APPROACH FOR DEFLECTED CONTROL SURFACES

Christopher Reinbold, Kaare Sørensen & Christian Breitsamter / Published: 12 November 2021 (Open Access)



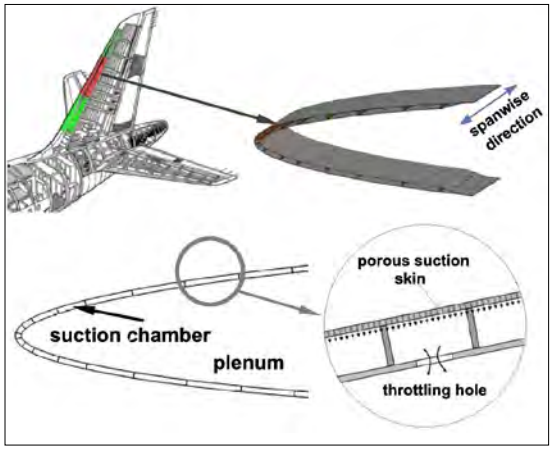
A TRIM PROBLEM FORMULATION FOR MAXIMUM CONTROL AUTHORITY USING THE ATTAINABLE MOMENT SET GEOMETRY

Carmine Varriale & Mark Voskuijl / Published: 26 November 2021 (Open Access)



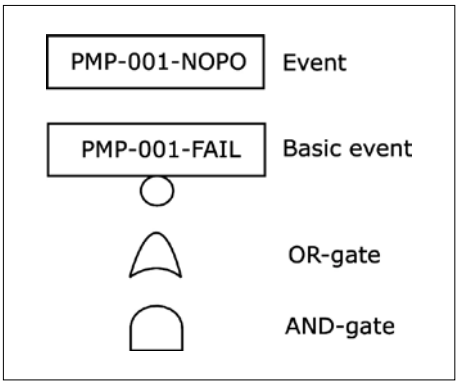
EXPERIMENTAL INVESTIGATION OF HYBRID LAMINAR FLOW CONTROL BY A MODULAR FLAT PLATE MODEL IN THE DNW-NWB

Heinrich Lüdeke & Christian Breitenstein / Published: 04 December 2021 (Open Access)



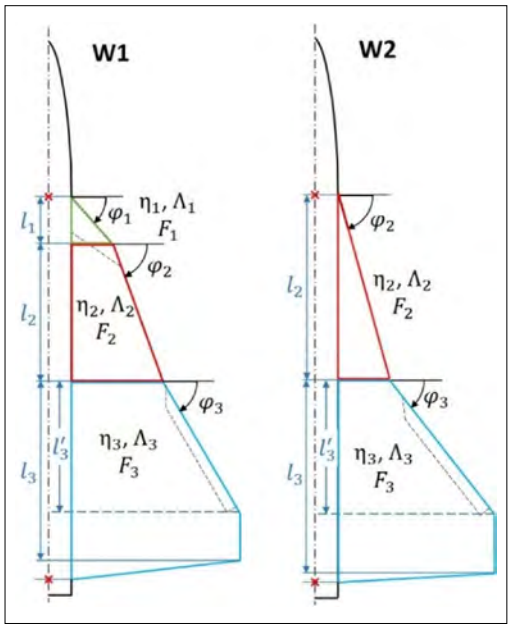
MODEL-BASED SAFETY ASSESSMENT FOR CONCEPTUAL AIRCRAFT SYSTEMS DESIGN

Simon Gradel, Benedikt Aigner & Eike Stumpf / Published: 23 November 2021 (Open Access)



NUMERICAL INVESTIGATIONS OF VORTEX FORMATION ON A GENERIC MULTIPLE-SWEPT-WING CONFIGURATION

D. Sedlacek, S. Biechele & C. Breitsamter / Published: 08 December 2021 (Open Access)



HUMAN SPACEFLIGHT FROM GUIANA SPACE CENTRE

By Jean-Pierre Sanfourche and Christophe Bonnal

INTRODUCTION

The use of space has considerably evolved over the last ten years leading to easier and cheaper access to space, satellite servicing, in-orbit manufacturing, human spaceflights to ever increasing number of orbital stations, and then the missions to the Moon. In this context it appears fundamental for Europe to acquire the independent human access to space.
This subject was deeply studied by an informal dedicated Working Group set up in 2020 at the initiative of CNES (French Space Agency) Launcher Directorate. This group was composed of experts in the domain[1], with a strong background and appropriate past experience coming from Agencies (ESA Space Transportation Systems Directorate, ESA Human & Robotic Exploration Directorate, CNES Launcher Directorate and CNES Guiana Space Centre), Industrials (ArianeGroup and Ariane Defence and Space), ESA former astronaut and former CNES Director of Prospective. It worked during one year on every aspect of a European Human spaceflight system aimed at being launched from Guiana Space Centre. The objective was to elaborate some credible action programmes and to identify the necessary consolidation tasks to be performed to fully demonstrate feasibility.
The results of the works accomplished by the Working Group were presented at the **Global Space Exploration Conference GLEX-2021** which was held in St Petersburg, Russian Federation, 14-18 June 2021, and then published in Acta Astronautica Vol. 188 (Nov. 2021)- GLEX-2021 – 6.1.1 in a paper entitled: **"Human spaceflight from Guiana Space Center".**

GLEX-2021 – 6.1.1

Human spaceflight from Guiana Space Center

Ch. Bonnal[1*] – J-M. Bahu[1] – Ph. Berthe[2] – J. Bertrand[1] – Ch. Bonhomme[1] – M. Caporicci[2]
J-F. Clervoy[3] – N. Costedoat[4] – E. Coletti[5] – G. Collange[5] – G. Debas[5] – R. Delage[6] – J. Droz[5]
E. Louaas[1] – P. Marx[7] – B. Muller[6] – S. Perezzan[1] – I. Quinquis[5] – S. Sandrone[8]
D. Schmitt[2] – V. Taponier[1]

[1] CNES Launcher Directorate, Paris, France – [2] ESA Human & Robotic Exploration Directorate, ESTEC, Noordwijk, Netherlands – [3] Astronaut Novespace, Paris, France – [4]CNES Guiana Space Center, Kourou, France
[5]ArianeGroup, Les Mureaux, France – [6]Airbus Defence & Space, Toulouse, France – [7]Alcadia, Paris, France – [8] Airbus DS

* Corresponding Author

An Executive Summary of this document, co-written by Jean-Pierre Sanfourche and Christophe Bonnal, is presented here after.

LOW EARTH ORBITS (LEO): A FUTURE HUB FOR SPACE OPERATIONS

LEO is becoming a hub for space operations *(Figure 1)* and its applications are numerous: servicing in orbit, orbital assembly, refuelling, inspections, orbital transfer to higher orbits for space solar stations, nuclear waste disposal. New actors are coming in addition to the traditional ones with the intention to occupy space for exploitation, research, security (civil and military). Besides the announced end of the ISS operation opens the road to several other multi-use orbital stations.
This concept of LEO hub raises the question of its accessibility from ground, to and from, both for cargo and human missions.
Europe should have autonomous inhabited access to the LEO hub, which means that it must acquire autonomous spaceflight capacity otherwise there is a real risk that it will be marginalized and no longer considered a major partner of the space adventure in the 21th century.
Presently the European astronauts benefit from a guaranteed access to space thanks to international agreements but this could evolve in the future with the emergence of private flights such as SpaceX Crew Dragon.
LEO and Moon access is a prerequisite for a worthy contribution from Europe. Access to the LEO hub, both for cargo and inhabited missions, appears the minimal step to continue playing a first-rank role at international level.

THE STRONG EUROPEAN EXPERIENCE IN SPACEFLIGHT

Vehicles - A high number of studies were performed in the past: the Hermes space plane which was abandoned in 1993, the **X38-CRV** (Crew Return Vehicle in the frame of ISS) which was stopped unilaterally by US in 2002,

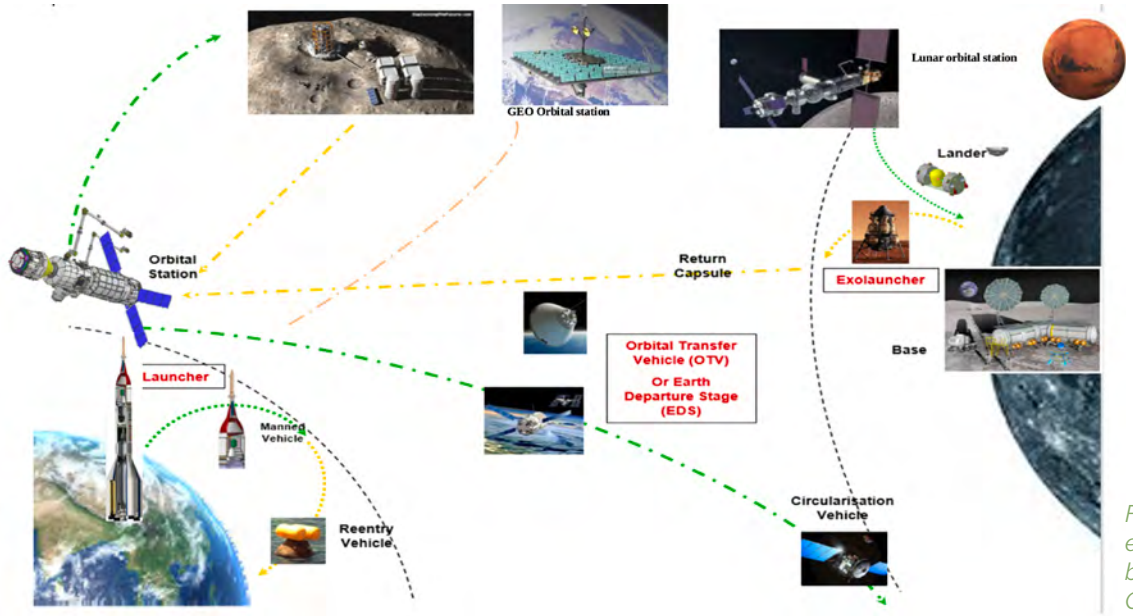


Fig. 1 - Earth orbital environment structured by hubs – Credit CNES.

the **ARD** (Atmospheric Re-entry Demonstrator) which successfully flew in 1998, as well as a number of other in-depth studies among which the **CTV** (Crew Transfer Vehicle) and **ARV** (Advanced Reusable Vehicle).

Launchers - Among performed studies: the possible use of **Ariane 5 ME** to launch Orion and a as a potential back-up for LEO missions and more recently, the possible launch of the Dream Chaser on **Ariane 6**.

Inhabitable modules, such as Columbus, which represent, more than 50% of the ISS pressurized volume, **Axiom, Lunar Gateway** ... all come from Thales Alenia Space in Torino, Italy.

Hot thermal protections - The hot thermal protections come from ArianeGroup in Bordeaux, France, and have been demonstrated in flight during the re-entry of the Intermediate eXperimental Vehicle (**IXV**) successfully flown in 2015.

Orbital autonomy and Rendezvous - These two capabilities have been demonstrated five times with the **ATV** (Automated Transfer Vehicle) developed by Airbus DS and it is important to note that during the fifth flight ATV has been the first automated vehicle to perform an autonomous docking with the ISS.

Key elements such as the Support Module, derived from ATV, or Service Module, derived from the European Service Module **(ESM)** developed by Airbus DS, fully demonstrated and available, are being evolved for the **CLTV** (Cis-Lunar transfer Vehicle) definitions. They will be fundamental for the capsule system development.

LAS - The solid propulsion necessary for the **LAS** (Launch Abort system) is very well under control in Europe.

LEO HUB TECHNICAL TRADE-OFFS

Many solutions have been analysed.

At system level, the working group traded the architecture, with solutions based on capsules, such as ARD, CTV, ARV – lifting body as X38, IXV, Space Rider, Dream Chaser – or winged body as VIRO, Hermes. An important element is the selection of the recovery strategy and various systems were traded.

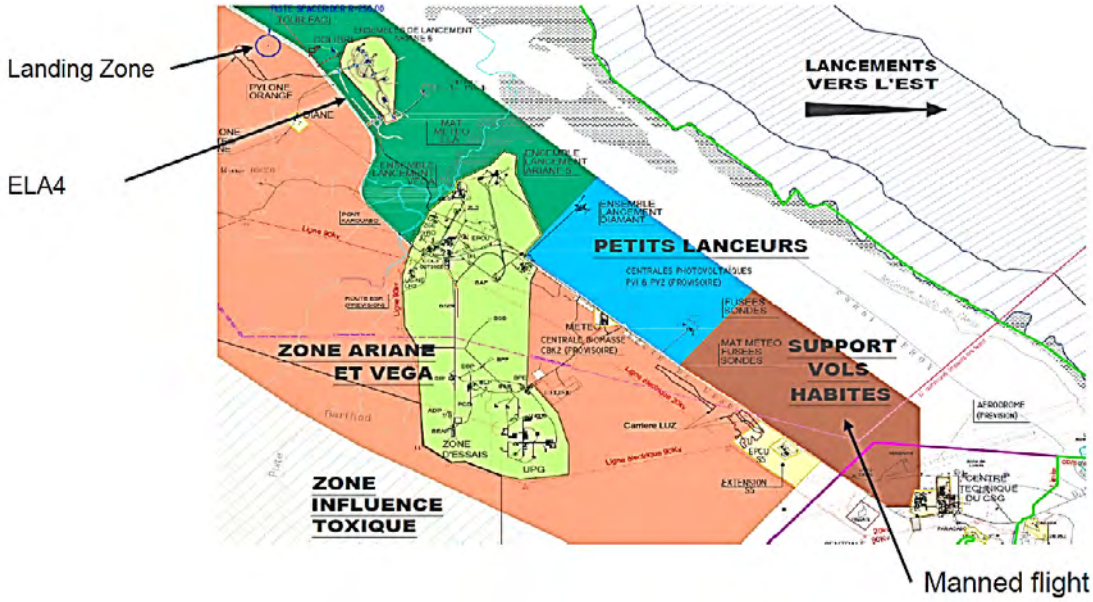


Fig. 2 - General view of CSG installations – Credit CNES

Fig. 3 – Partial retraction of the mobile gantry – Credit CNES

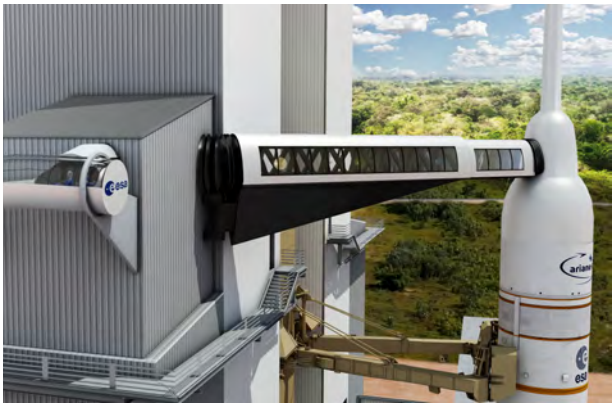


Fig. 4 – Access gateway for astronauts – Credit CNES

At subsystem level and equipment level the key functions were analysed.

Pre-selected solution

A technical choice based on a capsule system, simple and robust, was chosen as the reference for further studies. The system would consist in a recoverable capsule, and a Service & Propulsion Module. There would be two versions of the same size vehicle: a cargo version and an inhabited vehicle.

Launch system

The selected reference launcher is Ariane 6 in its A64 version with 4 solid boosters ESR (Equipped Solid Rocket).

The reliability of the human version will be gained through the large number of cumulated flights in automatic version. Then the safety of astronauts will be addressed via the dimensioning of the LAS, in the same manner as for Falcon 9.

Preliminary trajectories

The preliminary trajectories simulated by ArianeGroup show no unfeasibility issues and the on the opposite, they appear comfortable, as very similar to the ones flown for the ATV on Ariane 5.

GROUND ASPECTS

The general principle is to make maximum use of CSG installations, benefiting in particular from the buildings which were developed for the ATV *(Figure 2)*.

The capsule and Service Module are prepared and integrated in the EPCU S5 (*Ensemble de Preparation Charges Utiles*). The capsule assembly is then transported at the foot of Ariane 6 on the Launch Zone ZL4. The implementation of the Launch Abort System is done at the latest time for safety reasons.

Fig. 5 – Ready for launch – Credit CNES

The launch final chronology begins with the partial retraction of the gantry allowing the start of the Ariane 6 propellants fillings in a non-confined environment *(Figure 3)*.

The access gateway is then installed between the mobile gantry and the capsule. Both stages of the launcher are filled. The astronauts can then arrive on ELA4 and enter the capsule using the access gateway *(Figure 4)*.

After all persons have been evacuated, the synchronized sequence can take place until launcher take-off *(Figure 5)*.

AN AMBITIOUS PROJECT THAT COULD BE PRESENTED AT THE NEXT ESA COUNCIL MEETING AT MINISTERIAL LEVEL

Such development would clarify the question of independence for Europe with a programme being, for once, not just part of a vast domain for which it has not all the keys. This would be a first step towards European autonomous exploration, as a fundamental contribution to cooperative actions with partners at worldwide level. Besides it is obvious that such development would give a strong sign of optimism for the future and would be a great motivation for young generation, excellent for increasing STEM at all levels, and so giving an exciting objective for the next generations of students.

Naturally this initiative, coming in addition to the current commitments, would require a high political commitment leading to additional funding. But it is a matter of independency of Europe within the current no concession multi polar world.

Really it is the right time for Europe to give a new strong impulse to its strategic ambition, including both autonomy and sovereignty. Europe must be a part of a "global horizon" which will drive industries, service companies an SMEs in a general framework of international cooperation.

4DSKYWAYS – CONVINCING STAKEHOLDERS TO INVEST IN TRAJECTORY MANAGEMENT

24 February 2022

TALKS WITH PETER ALTY, EUROCONTROL, PROJECT LEAD FOR THE SESAR 4DSKYWAYS INDUSTRIAL RESERACH PROJECT

Peter Alty, EUROCONTROL

What is meant by trajectory based operations? How does that differ to how aircraft fly today?

From my project manager's perspective, I've learned that trajectory based operations (TBO) is about sharing a common plan for a flight's trajectory; matching that trajectory to the performance needs of the circumstances; and delivering the trajectory via an ATC clearance. How does that differ from today's situation? For me, it's about levelling-up the differences between the advanced capabilities of the airspace user in both flight operations and in the cockpit, with those available at air navigation service providers (ANSPs) and the Network Manager on the ground.

So what is the scope of the 4DSkyways project?

4DSkyways focusses on the flight execution part of the trajectory. The part corresponding to the FF-ICE[1] Release 2 work at ICAO. Once the flight is in execution, the trajectory may need to change – for example - due to weather hazards, crossing traffic, and procedures at the destination airport. And it's these flight execution challenges which are the main focus of the project. Ultimately, air traffic management aims to optimise the performance of the network, whist minimising any deviations from the airspace users' requested trajectories.

4DSkways is SESAR industrial research project. We aim to deliver validated solutions that are operationally acceptable with proven benefits. To this end, the project comprises 22 main partners and 9 linked third parties – a collaborative partnership between industry, ANSPs and EUROCONTROL– performing 21 validation exercises across Europe in 2022.

What solutions are in the pipeline?

The project comprises two main solutions, namely:

- PJ18-W2-53: aims to improve ground trajectory prediction and separation management and monitoring tools using aircraft trajectory data (ADS-C and Mode-S), precise meteo and machine learning;
- PJ18-W2-56: uses complex CPDLC[2] clearances sent in advance of horizontal, vertical and longitudinal trajectory changes to improve synchronisation of airborne and ground trajectory.

In addition, we have a couple of smaller solutions: PJ18-W2-57 studying automation aspects, and PJ18-W2-88 addressing a trajectory prediction common service. We are also working on a trajectory management document that describes the big integrated picture for trajectory management.

What benefits can these solutions provide? What about costs?

In terms of benefits, 4DSkyways aims to deliver validated solutions that can increase capacity, reduce workload,

[1] Flight and flow information for a collaborative environment
[2] Controller pilot datalink communications

improve cost efficiency, and reduce the environmental impact. Airspace users need to be reassured that their investments in aircraft equipment – combined with ground investments – can enable trajectory management solutions for a sustainable aviation growth. Likewise, ASNPs need to be convinced that it is worthwhile to invest in ground systems. With this in mind, a cost benefit analysis is being performed for both Solution 53 and 56.

How can we find out more about the results of the project?

Tangible results from our validation work will be available in the fourth quarter of 2022 and the 1st quarter of 2023.

We plan to organise webinars to share our results, possibly in coordination with some related SESAR projects. In the meantime, we are publishing regular updates on our @4DSkyways LinkedIn site! Stay tuned!

This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 872320

MORE ABOUT THE PROJECT

SESAR INNOVATION PIPELINE 2021

DESCRIPTION

The SESAR research and innovation programme is designed as an innovation pipeline, made up of exploratory research, industrial research and validation and very large-scale demonstrations/demonstrators, where ideas are transformed into tangible solutions.

The SESAR research and innovation programme is designed as an innovation pipeline, made up of exploratory research, industrial research and validation and very large-scale demonstrations/demonstrators, where ideas are transformed into tangible solutions.

The research takes place across 70 projects and in over 50 test beds all around Europe (simulation platforms, on-board commercial flights, dedicated airport testbeds and air traffic control centres), which validate concepts and candidate solutions. The testing is not limited to a specific location, but can be used to test multiple environments irrespective of the location where the physical validation is held.

In 2021, the JU were successful in advancing new technologies and procedures through the SESAR innovation pipeline, in accordance with the timeline set by the European ATM Master Plan – Europe's roadmap for the digital transformation of ATM. This brochure provides highlights of progress made over the course of 2021.

DOWNLOAD PDF SESAR INNOVATION PIPELINE 2021

CLEAN AVIATION SOARS TO NEW HEIGHTS

The European Partnership for Clean Aviation has taken off!

Copyright DLR

Axel Krein

TALKS WITH AXEL KREIN, EXECUTIVE DIRECTOR OF CLEAN AVIATION JOINT UNDERTAKING

What is the European Partnership for Clean Aviation?
With the support of the European Union and in line with the European Green Deal's objectives, the new Clean Aviation Joint Undertaking will pave the way towards climate-neutral aviation in Europe by 2050.
Building on the foundations already laid by the Clean Sky Joint Undertaking, Clean Aviation will develop groundbreaking, innovative technologies before 2030 in order to produce a new breed of aircraft, ready to enter the global fleet by 2035.

How does the partnership work?
As one of ten new European partnerships between the European Union and industry, these public-private partnerships will speed up the transition towards a green, climate neutral and digital Europe, and make European industry more resilient and competitive.
Under Horizon Europe, nearly €10 billion in funding will be provided by the European Commission, a sum which will be matched by at least the equivalent amount of investment by participating partners.

Is it possible to reduce emissions from aviation, and make planes greener?
Aviation has an impressive track record in terms of efficiency and is now 80% more fuel efficient than when mass travel first began in 1970.

Nevertheless, in pre-pandemic times, emissions from aviation continued to grow in absolute numbers, because, even though aircraft became more energy efficient year on year, the sheer number of aircraft in our skies increased by 4.5% each year. So although the aircraft in our skies are much cleaner than ever before, the aviation sector as a whole is still emitting unsustainable amounts of pollutants.
Aviation's share of manmade CO_2 emissions – while still modest – has risen to ~2.5% globally from around 2.0% in the early nineties. If no countermeasures are undertaken, this share will increase in the coming decades.
Overall, aviation emissions account for 3.8% of total CO_2 emissions in Europe, however, taking non-CO_2 effects – such as NOx – into account, aviation's impact on global warming effects in Europe is considerably higher.

How will Clean Aviation reduce aviation's environmental impact?
Clean Aviation aims to curb those effects and emissions with the development and demonstration of technologies for a totally new generation of aircraft. We are focusing on three main areas – three main thrusts, if you will. These three main thrusts will form the pillars of the new Partnership: hybrid electric and full electric concepts, ultra-efficient aircraft architectures, and disruptive technologies to enable hydrogen-powered aircraft.

Hybrid-electric and full electric concepts will become very important for regional connections up to 1000km. Air vehicles operating in this range (including regional aircraft with a capacity of up to 100 seats) will be the first to benefit from an air transport system that will adopt hybrid-electric propulsion technologies and associated complementary solutions for reducing the environmental footprint of aviation.
Hydrogen in particular will be a game-changer for aviation, but effective hydrogen deployment will require several new technologies and innovations to adapt to the specific needs of this energy carrier. For example, hydrogen requires more than three times the tank volume of kerosene, and liquid hydrogen must also be stored at temperatures of -253C.
The three thrusts will culminate in a new breed of regional, short haul and short/medium haul airliners which we anticipate being ready for commercial launch by 2030, followed by entry into service by 2035.

Why short-haul flights? Why not larger passenger aircraft?
This is a strategic decision, taken to maximise the impact of the work performed by Clean Aviation and Clean Sky.

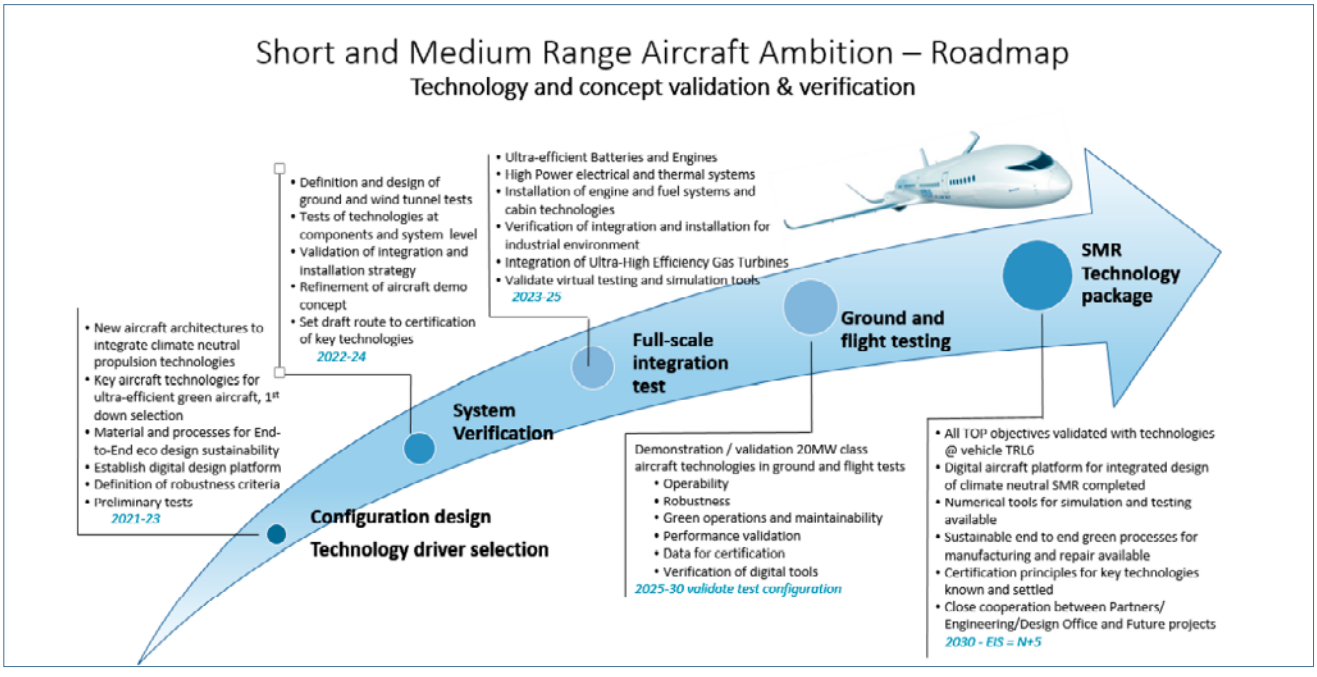
Approximately 2/3 of emissions are produced on city-pairs and routes below 4000 km in length, and 1/3 on flights of less than 1500 km alone. For this reason, the sustainable technologies developed within the new Clean Aviation partnership will target this highly relevant market sector and radically reduce emissions overall.

Today, regional aircraft-operated routes and connections account for over 12% of world available seat kilometres. Regional aircraft currently serve roughly 38% of world city pairs and perform about 40% of the total departures and around 36% of total hours flown. In terms of regional connectivity, 36% of existing airports are relying exclusively on regional turboprop-operated services. We believe that regional aircraft can be the launch pad for new low or zero-emission technologies and bring enhanced networks, while drastically reducing environmental and climate impact with an efficiency increase of up to 50%.

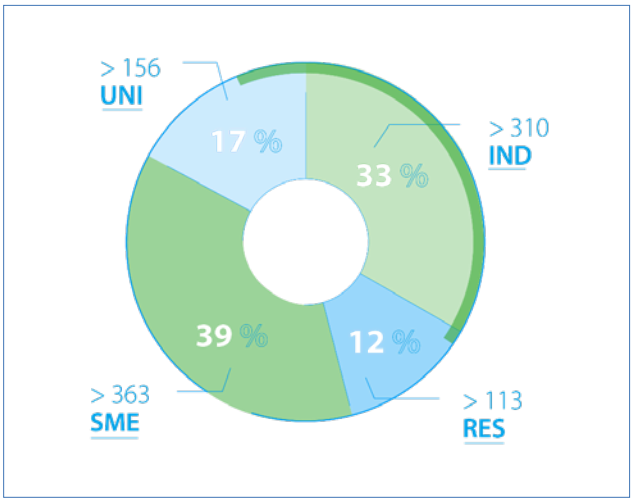
Short/medium-range air transport is another area of focus for Clean Aviation. A 'clean sheet' aircraft design in the short/medium range segment can not only make a hugely positive contribution to reducing aviation's climate impact, but these segments are also where the biggest opportunity lies. The roadmap aims to improve the energy efficiency of a new generation of short/medium-range aircraft by 30%.

How soon will we see these aircraft?
The new aircraft developed as a result of Clean Aviation and Clean Sky are likely to constitute 75% of the world's commercial airline fleet by 2050 and thus will have a major positive effect on aviation emissions and climate impact. In order to get to that figure by 2050, clean aircraft need to be entering the commercial fleet by no later than 2035.
We have no time to waste – rapid, revolutionary innovation is needed immediately if we are to reach that goal. Bold investment is needed to steer aviation firmly on a course towards climate neutrality by 2050.
Fortunately, we are not starting from scratch, thanks to the innovative technologies already developed as part of the Clean Sky and Clean Sky 2 programmes.

What has been achieved under the Clean Sky and Clean Sky 2 programmes?
Clean Sky is ongoing until 2024, and we are now entering the final delivery phase of this programme. This is possibly the most exciting stage in Clean Sky's lifeline,



as it is now that we can see the fruits of seven years of commitment from engineers and scientists throughout Europe. During the next two years, Clean Sky will deliver more than 100 demonstrators and more than 1000 technologies overall.
To discover our demonstrators and innovative technologies, we highly recommend you visit our online stand, where you can get a taste of the work that Clean Sky is doing to foster sustainable aviation. You can also read about our results – for example, the UltraFan project which targets fuel-efficient and more environmentally-friendly engine performance and achieves this by incorporating a raft of technologies and innovative materials; and the Multi-Functional Fuselage Demonstrator which is a unique 8-metre-long fuselage barrel that serves as a platform for examining the full potential of thermoplastic composites and to thereby help future European airliner production to become faster, greener, and more competitive.



Who's involved in Clean Sky and Clean Aviation?
The Clean Sky Joint Undertaking nurtured a high-performing innovation eco-system of more than 940 entities in 30 countries with more than 5000 scientists and engineers participating in our programme.
Clean Aviation will follow this best-practice model – we aim to include expertise from all across Europe in order to maximise our success.

Our collaborative approach does not only apply to participants. It is vital to connect with national and regional authorities which are also working on sustainable aviation initiatives in order to develop complementary technology roadmaps within an integrated Innovation Architecture.

What does the future look like for aviation?
The benefits of aviation are manifold: increased employment opportunities, connecting businesses, enabling us to visit relatives on the other side of the globe, or to travel and expand our horizons. In 2019, 4.5 billion people were passengers on the world's airlines, and nearly 88 million jobs existed thanks to aviation.
Looking to the future, we must retain the many socio-economic benefits that the aviation sector brings, whilst removing its unsustainable impact on the environment.
Our ultimate vision – a world where everyone can fly without worrying about their carbon footprint.

Engage with Clean Aviation: registration is now open for the Clean Aviation Forum on 22-23 March, which will be held online and in person in Brussels. Learn more and register here.
Clean Aviation's first Call for Proposals will open soon ! Stay updated on our website.

Copyright Onera

LESSONS LEARNED OF THE MMF PROGRAMME

A reference for future cooperative Defence acquisition initiatives

By Joachim Weidmann, OCCAR-EA, MMF Programme Manager and Coordinator, Angel Saiz-Padilla, NSPA, MMF Principal Coordinator Officer and Dion Polman, EDA, Project Officer Aviation

Joachim Weidmann

Angel Saiz-Padilla

Dion Polman

European Nations face nowadays an uncertain and unpredictable strategic situation. New scenarios require new capabilities in growing numbers, whilst the cost of individual weapons systems is increasing exponentially, stretching to the maximum the funds allocated for defence investments.
The multinational organisations devoted to European Defence and Security reacted in support of their Member States launching concepts and initiatives such as "Pooling & Sharing" within the European Union (EU) in 2010, or "Smart Defence" solutions of NATO in 2011 with the intent to optimise the available resources.

At the same time new efforts have focused on the identification of the most critical capability shortfalls and on new and creative ways to procure them. Following operations in Libya, Afghanistan or Syria, and after extensive analyses by the European Defence Agency (EDA), NATO, at the 2012 Summit, welcomed that the EDA was taking the lead of an initiative to address the shortfall in Air-to-Air Refuelling (AAR) capacity in Europe.

This later crystallised in a specific Letter of Intent (LoI) signed by ten European Nations, which became the genesis of today's Multinational MRTT Fleet (MMF). In December 2013, the European Council identified once again in its conclusions the AAR capacity, together with strategic transport, as one of the critical shortcomings in military capabilities in the EU countries. These conclusions endorsed the same capability gaps identified in 2012 by the EDA and NATO.

The MMF represents the best example of a successful answer to those urgent calls to join efforts addressed to cover military capability gaps. This multinational fleet arrangement is a cost-effective and flexible solution that mitigates the European shortage in AAR and strategic transport capabilities.

The project demonstrates that a deep cooperation between NATO and the European Union can deliver critical capabilities, on time, on budget and exceeding customer expectations. This was possible thanks to the excellent cooperation between NATO Support and Procurement Agency (NSPA), EDA and the Organisation for Joint Armament Cooperation (OCCAR) since the very beginning of the project.

MMF A330 MRTT Air to Air refuelling two Eurofighter – © MMU

Since the EDA started the initiative, the project has grown into a mature programme managed by the NSPA, on behalf of the nations, and supported by the OCCAR on the acquisition phase and the first two years of Initial In-Service-Support.
Being now close to the delivery of the seventh MMF aircraft, it is of special interest to analyse the main success factors of the MMF Programme that may have applicability in future similar initiatives, some of them today following feasibility studies or in early conceptual phase. During different sessions, the EDA, OCCAR and NSPA were able to identify a number of these success factors, both in the tactical and strategic level for future applicability.

New MMF A330 MRTT Air ti Air refuelling F 35 – © Norwegian Air Force

MMF aircraft on the fround. © MMU

FIND A LEAD NATION AND DARE TO LAUNCH THE PROGRAMME

The Netherlands decided to step forward in 2016 and assumed the role of lead Nation of the Strategic MRTT Initiative. With Luxembourg, both Nations combined their requirements for AAR and Strategic Transport in a Pooling & Sharing initiative to jointly procure a fleet of MRTT aircraft. The Netherlands identified the political appetite and decided to move forward and launch the MMF initiative, despite all the uncertainties linked with the management of a new cooperative multi-agency Programme. The challenges were many but they were progressively managed over the following two years.

After starting small in 2016, Germany and Norway joined in 2017, followed by Belgium in 2018 and the Czech Republic in 2019. The six European Allies signed the Memorandum of Understanding (MRTT-C MoU) and became members of the MMF Support Partnership with equal membership rights, regardless of their level of participation and funding contribution. The MMF Nations will share the use of a fleet of Airbus A330 MRTTs, as well as their sustainment and operation. The MMF comprises nine aircraft with scheduled deliveries between 2020 and 2024, although the fleet is expected to grow in the coming years both in member Nations and in number of aircraft.

Probably the first and most important lesson learned from the early stages is to acknowledge the fact that a multinational pooling and sharing initiative comes full of uncertainties that cannot be identified and planned to the detail from the very beginning.
Difficulties will progressively arise as the programme develops, more Nations might join or more agencies might be involved; all the challenges must be tackled as they appear. Despite all those concerns, it is necessary to **dare to launch the Programme**, with a clear vision of the desired outcome and a committed group of Stakeholders to make it a success. In too many occasions, very interesting initiatives do not move beyond the conceptual phase for lack of commitment, difficult negotiations or the logical doubts of the early stages.

In this complex scenario, a second lesson learned of MMF is that a **strong lead Nation is essential to the success of a multinational cooperative Programme**. The Netherlands have played a crucial role as the driving force for the MMF Programme. As lead Nation, they provided key personnel to steer several working groups, chaired the Programme management bodies (Steering Group and Support Partnership Committee) and the MMF Executive Board, provided essential Host Nation Support and play the role of Registering Nation to the MMF. They were also instrumental to the growth of the Programme, negotiating the MoU conditions for new partners in close cooperation with EDA.

One of the creative solutions that made the MMF a success is linked to a **fair and transparent cost share arrangement embedded in the MoU**, making this another important lesson learned.

The MRTT-C MoU establishes a clear and equitable funding agreement by calculating the financial contribution per Nation based on an annual Flight Hour (FH) factor that defines the National participation in the Programme. This enables Nations with a limited need of FH to join MMF and still getting assured access to an entire fleet of aircraft that otherwise they might not be able to afford. Also bigger Nations benefit of economies of scale of this multinational cost share arrangement, beyond the obvious operational benefit of owning a larger fleet than they could otherwise afford. This provides an incredible surge capability to cover urgent AAR and strategic transport needs.

Another lesson learned linked with the framework of the MMF initiative is that **the legal construct of the MRTT-C MoU allows for broader participation across institutional limits**. The MRTT-C MoU is open to any interested party; it is not limited to NATO or EU Member States and thus purely multi-National. Also the governance through a Multinational Executive Board and that the fleet is manned by a multinational unit highlights the purely multinational character of the MMF Programme.

A330 MRTT for MMF - Technical Information

MAXIMUM PAYLOAD	45 000 kg
TOTAL FUEL CAPACITY	111 000 kg
MAXIMUM CRUISE SPEED	0.82 Mach
RANGE WITH MAXIMUM PAYLOAD	7000 km
FERRY RANGE	14 800 km
OVERALL LENGTH	58.80 m
OVERALL HEIGHT	17.38 m
WING SPAN	60.30 m
CREW	3 (2 pilots + 1 Air-to-Air Refueling operator)
MAXIMUM NUMBER OF PASSENGERS	267

MMFA330 MRTT Fact Sheet – © OCCAR-EA

The A330 MRTT can perform military air transport, air-to-air refueling and MEDEVAC (Medical Evacuation) roles, including combination of those roles in one mission.
The aircraft for the MMF is equipped with two under-wring hose & drogue refuellig pods and a refueling boom.

ESTABLISH AN EFFECTIVE MULTI-AGENCY COOPERATION

The next few lessons learned emanate from the unique management structure of the MMF Programme, which involves three international organisations: The European Defence Agency (EDA), the NATO Support and Procurement Agency (NSPA) and the Organisation for Joint Armament Co-operation, (OCCAR as per its name in French).

The embryo of the initiative flourished in the framework of EDA, as a result of its mission to support the development of military capabilities and cooperation among its Member States. **The use of EDA was instrumental to trigger political involvement, ensuring high level top down support** from the very beginning. The shortfall in AAR was addressed first and foremost by EDA at the ministerial level in 2014, through a Joint Declaration and the Letter of Intent on a European Strategic MRTT initiative. The political acknowledgement of the shortfall was crucial for the successful launching of the MMF project. As the project developed under the umbrella of EDA project team AAR, it ensured immediate awareness amongst the 27 EDA Nations. The continuous support from EDA to interested Member States to harmonise the operational requirements and agree on the baseline financial (including cost sharing) and legal conditions, has resulted in the accession of several additional partners to the MMF MoU. MMF Nations entrusted NSPA with the responsibility of the ownership, together with its future operation and in-service support. **NATO ownership of the MMF aircraft** (through NSPA) leads to a greater delegation from Nations to the agencies (NSPA and OCCAR), preventing diverging national agendas or micromanagement, common in other cooperative Programmes.

Mainly due to the tight timeline imposed to launch the MMF initiative, NSPA delegated in OCCAR the responsibility for managing (on behalf of NSPA) the complex contract processes associated with the acquisition of the fleet, its acceptance and the initial logistic support. The close relationship between both organizations is governed through a specific Cooperation Agreement for the MMF Programme. This arrangement allows to **use OCCAR and NSPA within their strengths:** OCCAR for its specific skills in managing complex cooperative acquisition contracts, where NSPA used its own experience in managing in-service fleet support. In this way, the strengths and wide expertise of both agencies are combined in the same initiative, maximizing synergies and allowing for a mutually learning experience.

However, this innovative multi-agency management arrangement required for some adaptation on both sides. OCCAR and NSPA established the Cooperation Agreement under time pressure and succeeded only partially to provide a clear and detailed description of roles and responsibilities, leaving ground to interpretation in certain areas. The ambiguities created some duplicities and mutual interferences that led to unnecessary tensions. These circumstances triggered the need for further planning and a revision of the management structure that was recently finalised. A key lesson identified here was that **multi-agency cooperation requires upfront clear and detailed description of roles and responsibilities, including duration of the joint venture**. It is imperative to the success of a Programme with more than one agency involved, that these rules are clear from the beginning of the cooperation and fine-tuned over the first few months of operations.

An adverse consequence of cooperative acquisition through the specialised agencies such as OCCAR or NSPA is that Nations with limited experience in multi-national cooperative programmes might perceive the agencies' procedures intricate and inflexible. One of the early challenges that The Netherlands and Luxemburg had to face was precisely the fact that **procedures for non-NATO/non-OCCAR interested Nations should have been clear upfront**. More clarity would have saved cost and time.

Interconnected with the above, another aspect to consider in future initiatives is the fact that **Programme management structures should be clear, unique and established at the beginning of the partnership**. When OCCAR and NSPA included MMF in their portfolios, both agencies tried to apply their standing structures and processes over those of the other organization, not recognizing MMF's distinctness and the need for flexibility to ensure fruitful cooperation. One consequence of this misinterpretation was for a time the lack of unity of command and duplication of effort. As an example, OCCAR established very soon a full Programme Division in Bonn (Germany) lead by an A-5, later followed by a System Manager at NSPA (also A-5) in Capellen (Luxembourg) and a reinforced management team there. The management structure was finally rationalized in 2018 by establishing a virtual System Management Office (SMO), tying all elements needed for the success of the Programme under the single direction of the NSPA System Manager. The SMO solution worked, in large part due to the people involved in the MMF Programme, all committed and true believers in the success of the MMF.

In retrospect, it would have been more effective if both agencies had clearly **identified a lead Agency, created one Programme office, appointed one Programme Manager, and created a single Integrated Programme Team** from the beginning, even using personnel from both organizations if necessary. When it comes to locate the management teams, proximity to the prime industry partner (OEM) during production phase, and to the Main Operating Base of the Fleet during in-service phase provides improved efficiency.

CHOOSE THE RIGHT SYSTEM AND INDUSTRY PARTNER

The platform selected to satisfy the AAR and strategic airlift capability was the Airbus Defence & Space (Airbus DS) A330-200 MRTT aircraft, an Off-The-Shelf solution with a mature design, already in service for several users around the globe, what limited the design and development efforts. Final assembly of the A330-200 basic airliner platform is performed in the factory of Airbus in Toulouse. The civil aircraft then converts into an MRTT in the Airbus DS' factory in Getafe, Madrid. This military conversion adds the ability to perform AAR, strategic transport of personnel and cargo, as well as medical evacuation (MEDEVAC) operations and limited VIP transport. All roles can be performed simultaneously if necessary.

The first lesson learned linked with the weapons system itself is the clear benefit of **using a single lead industry (prime), what allows for effective Programme management**. For the MMF Programme, Airbus DS acts as industrial prime, taking responsibility for the production and a large majority entry into service of the aircraft. This way most risks and responsibilities are assumed by a single

MMF Aircraft landing in Eindhoven. © AIRBUS

organization, making for a simpler supervision from the SMO. Exceptions are the DIRCM system, the MEDEVAC equipment and some of the military components (radios, crypto etc.) that are provided by the MMF Nations (through NSPA) to Airbus DS as GFX.

Another distinct aspect of the MMF initiative is that **no industrial compensation (*just return*) was expected by the MMF Nations**. This might seem an unprecedented example of generosity but it is a mandatory characteristic of any Programme managed by OCCAR. Most large cooperative acquisition contracts embrace the opposite direction, later proving to be the source of big inefficiencies, complex (unnatural) industrial consortia that increase the final unit price and promote the dilution of responsibilities. MMF lacks these negative effects or else are handled by the prime, compelled to aim for the most efficient and lean production chain.

Another lesson learned linked with the system itself is the commonality in configuration throughout the entire fleet. **The MMF requirements were harmonized upfront,** during the initiation of the project, EDA facilitating the harmonization of the operational requirements of the interested partner Nations. This allowed for a smooth take-over by NSPA and OCCAR to further develop the Programme and engage with Industry with stable contractual requirements.

One of the strong principles of the MMF proved to be that any Nation joining the Programme has to accept the single configuration, based on the harmonized requirements. In the rare cases that changes to the configuration were deemed appropriate, they were accepted for the whole fleet (examples are the DIRCM and MEDEVAC improved configurations). This takes a disciplined support partnership but **sticking to one single configuration enables the Programme to be on time, within budget and within scope.**

The last highlight linked with the system and the industrial partner, is that the **inclusion of the Initial In-Service Support (I-ISS) in the acquisition contract assures smooth entry into service**. On behalf of NSPA, OCCAR manages not only the acquisition of the fleet, but also the ISS set up and the first two years of initial in-service support, all to be provided by a single contractor, Airbus DS. This allows for a sole interface from the customer towards industry, combined with an individual contactor taking the burden of delivering the aircraft as well as ensuring a smooth and easy entry into service. Subsequently, NSPA enjoys more time to refine the know-how about the weapons system and to contract for the best follow-on ISS solution.

DO NOT REINVENT THE WHEEL

The current restrictive economic conditions will most likely remain in the near future, causing pressure on the Defence budgets allocated to procure new equipment. Allied Nations will surely be compelled to look for alternative options and smart acquisition solutions such as MMF, to provide for the military capabilities required today.

For most Nations, the modern critical and complex, but expensive weapons systems cannot be developed and procured nationally in the right numbers; they will slowly become unaffordable unless the acquisition strategy evolves from individually procured material to cooperative or joint procurement solutions, sharing acquisition or sustainment costs. The cooperative approach will most likely become the norm in the immediate future, rather than the exception. There is no better way for most European and Allied nations to satisfy operational needs applying best value for money practices.

The success of the MMF initiative is a unique example of effective procurement of military capabilities through a multinational cooperation, in a *pooling* & *sharing* arrangement. Conscious of the uniqueness of the MMF, all the MMF Stakeholders jointly developed this article to present the reasons behind the success of the initiative; a cooperative Programme that will surely be a reference for future initiatives.

Industrial partners, Nations and Agencies are now encouraged to **not reinvent the wheel** and make the most out of the lessons learned by MMF, when shaping the new multinational, cooperative, multi-agency, pooling & sharing initiatives that will surely be the preferred approach in the coming years.

GLOSSARY:

AAR: Air-to-Air Refuelling
DIRCM: Directed Infra Red Counter-Measure
EDA: European Defence Agency
EU: European Union
FH: Flight Hours
I-ISS: Initial-In Service Support
LoI: Letter of Intent
MEDEVAC: MEDical EVACuation
MMF: Multinational MRTT Fleet
MRTT: Multirole Tanker Transport Aircraft
MoU: Memorandum of Understanding
NATO: North Atlantic Treaty Organisation
NSPA: NATO Support and Procurement Agency
OCCAR: Organisation Conjointe de Coopération en matière d'ARmement
OEM: Original Equipment Manufacturer
SMO: System Management Office

ESA DECISIONS FROM THE 2022 SPACE SUMMIT

EUROPEAN LEADERS CONFIRMED THEIR AMBITIOUS PLANS TO WORK CLOSELY TOGETHER TO ACCELERATE EUROPE AS A WORLD LEADER IN SPACE DURING A SERIES OF HIGH-LEVEL MEETINGS HELD IN TOULOUSE, FRANCE.

16 February 2022

Under the plans, ESA, the EU and their member States are uniting to ensure that Europe fully realises the enormous untapped potential for space to tackle the urgent and unprecedented societal, economic and security challenges it faces.

The French Presidency of the European Space Agency and the European Union chaired the meetings, reflecting the close and growing cooperation between the EU and ESA.
European leaders reaffirmed their strong political support for the three "accelerators" identified by ESA to address challenges – from the climate change induced crisis and their consequences to threats to crucial European infrastructure in space and on Earth.

"Space for a green future" aims to use data derived from Earth observation satellites to help Europe act to mitigate climate change and to support reaching a carbon-neutral economy by mid-century. "Rapid and resilient crisis response" seeks to better use space data, cognitive cloud computing and intelligent interconnectivity in space to support those in charge to provide the vital responses to crisis on Earth. Thirdly the "protection of space assets" will contribute to prevent damage to the European space infrastructure and avoid disruption to its economically vital infrastructures such as power supplies and communications links due to space weather conditions.

The three ESA accelerators fully complement the EU Secure Connectivity initiative and the EU proposal on Space Traffic Management.
Individual ESA member and associated States will be invited to champion one or more of the three accelerators or elements within them.

Government ministers in charge of space activities also mandated the ESA Director General, Josef Aschbacher, to initiate a discussion on a human exploration "inspirator", which is an essential sovereign capability among all the major space powers except Europe. A high-level advisory group will be established; it will report progress to the next ESA Council of Ministers held in November 2022 ahead of a space summit held in 2023.

Josef Aschbacher said: "I am very happy to accept President Macron's proposal to establish a high-level advisory group on 'human space exploration for Europe'. This decision will shape what Europe will look like in the decade to come. We have to involve experts from all walks of life and mainly from non-space, for example historians, economists, geo-political experts, explorers on Earth, and philosophers to fully grasp all its implications and help us take the right decision."

Ministers also expressed their support to increase Europe's ambition in space science through a proposed "inspirator" of a sample-return mission to search for extra-terrestrial life on one of the icy moons orbiting Jupiter or Saturn.
Ministers acknowledged the coherence and the links among the three accelerators and two inspirators. They endorsed seed funding of these at the next ESA Council of Ministers, while encouraging ESA to identify other major sources of funding.
Finally, they approved the principle of holding another space summit in 2023, to be attended by heads of governments of the 30 countries that are members of the EU, ESA or both.

Josef Aschbacher said: "Europe faces urgent and unprecedented societal, economic and security challenges – from climate change causing floods and fires to cyberattacks on our vital infrastructure. Working closely with the EU and private companies, ESA will ensure that Europe fully realises the potential for space to contribute to tackling these challenges. At the same time, Europe must seize the opportunity to join the leading spacefaring nations through developing a sovereign capability for human exploration and bring Europe's space ambitions to the next level."

More information

ESA Vision
https://vision.esa.int/

European Astronauts' Manifesto
https://esamultimedia.esa.int/docs/corporate/ASE_Manifesto.pdf

ESA STATEMENT REGARDING COOPERATION WITH RUSSIA FOLLOWING A MEETING WITH MEMBER STATES ON 28 FEBRUARY 2022

28 February 2022

We deplore the human casualties and tragic consequences of the war in Ukraine. We are giving absolute priority to taking proper decisions, not only for the sake of our workforce involved in the programmes, but in full respect of our European values, which have always fundamentally shaped our approach to international cooperation.

ESA is an intergovernmental organisation governed by its 22 Member States and we have built up a strong network of international cooperation over the past decades, which serves the European and global space community through its very successful programmes.
We are fully implementing sanctions imposed on Russia by our Member States. We are assessing the consequences on each of our ongoing programmes conducted in cooperation with the Russian state space agency Roscosmos and align our decisions to the decisions of our Member States in close coordination with industrial and international partners (in particular with NASA on the International Space Station).

Regarding the Soyuz launch campaign from Europe's Spaceport in Kourou, we take note of the Roscosmos decision to withdraw its workforce from Kourou. We will consequently assess for each European institutional payload under our responsibility the appropriate launch service based notably on launch systems currently in operation and the upcoming Vega-C and Ariane 6 launchers.
Regarding the ExoMars programme continuation, the sanctions and the wider context make a launch in 2022 very unlikely. ESA's Director General will analyse all the options and prepare a formal decision on the way forward by ESA Member States.
ESA continues to monitor the situation in close contact with its Members States.

Further information
More information about ESA: www.esa.int

Contact
If you have further questions, please contact media@esa.int.

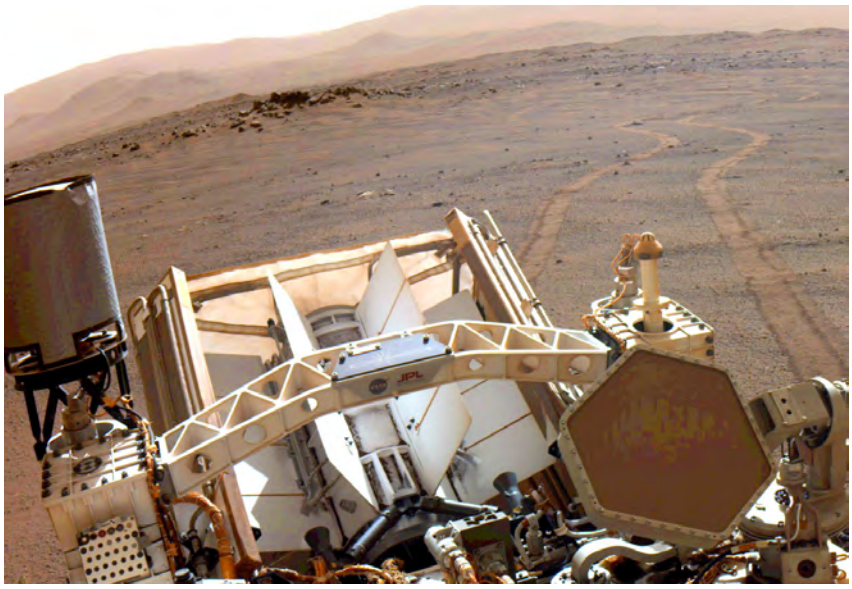
TO KNOW EVERYTHING ABOUT THE JWST STATUS

> CLICK TO THE PICTURE TO SEE THE WEBSITE

THE LATEST FROM MARS 2020 MISSION

■ NASA'S PERSEVERANCE CELEBRATES FIRST YEAR ON MARS BY LEARNING TO RUN

18 February 2022



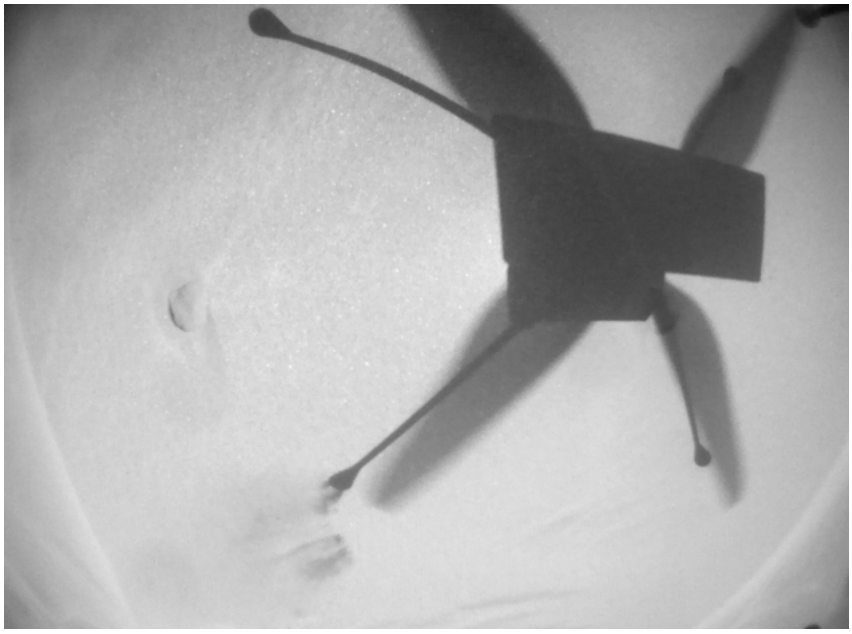
For more about Perseverance:
mars.nasa.gov/mars2020/
and
nasa.gov/perseverance

> CLICK TO THE PICTURE TO SEE THE WEBSITE

Figure A shows a cropped version of the same image

■ MARS 2020 MISSION – INGENUITY HELICOPTER STATUS

23 February 2022



For more about Perseverance:
https://mars.nasa.gov/technology/helicopter/status/366/dusty-flight-19-completed-and-looking-ahead-to-flight-20/

NASA's Ingenuity Mars Helicopter acquired this image using its navigation camera. This camera is mounted in the helicopter's fuselage and pointed directly downward to track the ground during flight. This image was acquired on Feb. 8, 2022 (Sol 345 of the Perseverance rover mission) at the local mean solar time of 12:03:14. This was the date of Ingenuity's 19th flight.
Image Credit: NASA/JPL-Caltech

ABOUT ARTEMIS 1 MISSION

Artemis I is the uncrewed test flight for NASA's Artemis programme. It will be the first flight of the SLS (Space Launch system) super heavy-lift NASA launch vehicle, as well as the first flight of Orion MPCV (Multi-Purpose Crew Vehicle).
As of February 2022, Artemis I is expected to be launched not earlier than May 2022.

NASA's Space Launch System (SLS) rocket and Orion spacecraft, standing atop the mobile launcher, are photographed at Launch Pad 39B at the agency's Kennedy Space Center in Florida on March 18, 2022.

The Artemis I stack was carried from the Vehicle Assembly Building to the pad – a 4.2-mile journeythat took nearly 11 hours to complete – by the agency's crawler-transporter 2 for a wet dress rehearsal ahead of the uncrewed launch. Artemis I will test SLS and Orion as an integrated system prior to crewed flights to the Moon. Through Artemis, NASA will land the first woman and the first person of color on the lunar surface, paving the way for a long-term lunar presence and serving as a steppingstone on the way to Mars.

ARTEMIS 1

Names	Artemis I Exploration Mission-1 (EM-1)
Mission type	Uncrewed Lunar orbital test flight
Operator	NASA
Website	www.nasa.gov/artemis-1
Mission duration	26-42 days (planned)

Spacecraft properties

Spacecraft	Orion CM-002
Spacecraft type	Orion MPCV
Manufacturer	Boeing Lockheed Martin Airbus Defence and Space
Power	watts

Start of mission

Launch date	May 2022 UTC (planned)
Rocket	Space Launch System, Block 1
Launch site	Kennedy Space Center, LC-39B
Contractor	NASA

End of mission

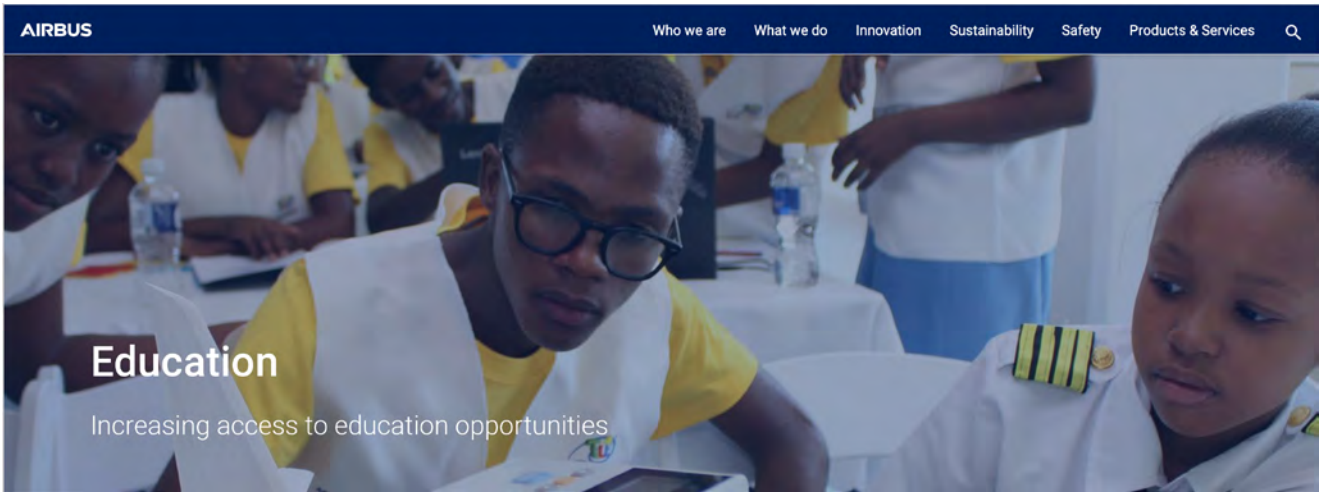
Landing site	Pacific Ocean

Orbital parameters

Reference system	Selenocentric
Period	6 days

Moon orbiter

AIRBUS GROUP: AN EXAMPLE OF AEROSPACE EDUCATION AND TRAINING COMMITTED COMPANY



Education is one of the most powerful drivers of progress. At Airbus, we believe everyone is entitled to quality education, including our employees and young people worldwide. We partner with universities, schools and NGOs to increase access to education and to support programmes that inspire passion for aerospace.

AIRBUS LEADERSHIP UNIVERSITY: OUR GLOBAL EDUCATION NETWORK

The Airbus Leadership University is a global education network that provides technical and soft skills development to our employees. Its mission is to develop our people's leadership skills by:

- Promoting experiential development
- Connecting them to other Airbus leaders, entrepreneurs and start-ups, and other external leaders to encourage collaboration and open innovation
- Providing access to a broad portfolio of development programmes, including courses, blended learning solutions, conferences, learning expeditions and more

The University's flagship campus is located in Toulouse, France. An additional six campuses are located close to Airbus sites around the world. And thanks to a portfolio of thousands of online programmes, the University's reach extends to approximately 30,000 employees each year, across all functions and levels.

LEADERSHIP UNIVERSITY

Unique in its mission and international set-up, the Leadership University provides tailored development solutions for all employees as Airbus firmly believes that everyone is a leader!

The Airbus Leadership University was launched in 2015. Employees from all levels have access to a broad portfolio of development programmes, courses, blended learning solutions, conferences, learning expeditions, events, team workshops, coaching, to enhance their leadership and team development skills. The University promotes experiential development and goes beyond traditional ways of learning.

The Leadership University brings leaders together – connecting them with other Airbus leaders, communities and ecosystems as well as with external leaders. Entrepreneurs and start-ups are involved in the development of leaders, inspiring and encouraging transversal collaboration and open innovation while partnerships with other companies and universities enable our leaders to stay connected with latest business practices and industry trends.

In addition to its flagship campus in Toulouse, the Leadership University consists of a global hub system with campuses located close to Airbus sites around the world - providing employees with the same development opportunities everywhere. Employees also have the possibility to access online content on its virtual campus. Airbus Leadership University was recognized at the 2017

U-Spring 'Printemps des Universités d'Entreprise' (annual meeting of the HR community and corporate universities in France) for its outstanding initiatives and the quality of its projects and practices in two of the ten categories taking home a gold trophy in the Best Pedagogical Innovation category and a silver trophy in the Best Digital Integration category.

INNOVATION ECOSYSTEM

Leveraging collective intelligence to deliver results
Innovation happens when great ideas, people and challenges intersect. At Airbus, we make these intersections happen by partnering with an innovation ecosystem – from inside Airbus to the outside world – to translate innovative ideas into aerospace breakthroughs more quickly than ever before. The way we work with our partners is open and agile.

STUDENTS

Internship / Placement
The internship or placement program is designed to provide our students the opportunity to consolidate their theoretical foundation through practical experience.

A major component of this experience is the formation of a professional attitude. The students are expected to develop their personality and capacity to adapt and handle, challenging situations in the real business world.

To qualify, you must be enrolled in a university and be looking for a placement that will last between three months and one year.

2022 AMONG UPCOMING AEROSPACE EVENTS

APRIL

13-15 April – ESA-ESTEC – **8th European Space Cryogenics Workshop** – Innovation and Challenges - Noordwijk (NL) – ESTEC – https://atpi.eventsair.com/

20-21 April – SESAR – **ECHO – European Concept of Higher Airspace Operations** – Workshop – Brussels (Belgium) – EUROCONTROL/HQ – https://www.sesarju.eu/events

27-30 April – AERO Friedrichshafen – **The leading show for General Aviation –** Friedrichshafen (Germany) – Messe Friedrichshafen Exhibition Centre – https://www.aero-expo.com

MAY

03-05 May – CEAS/DGLR – **CEAS EuroGNC 2022**– Biannual conference for community researchers and practitioners in te field of aerospace GNC – Berlin (Germany) – TU Berlin – https://eurognc2022.dglr.de – Contact: michel.geimar@dglr.de

08-13 May – ESA-ESTEC – **SOIDT2022 – Space Optics Instruments design & Technology** – IPoltu Quatu (Italy) – https://atpi.eventsair.com/

09-13 May – 3AF/ESA – **SP2022 - Space Propulsion International Conference** – Estoril (Portugal) – https://www.3af.fr-spacepropulsion.com

10-12 May – ESA-ESTEC – **ARSI-KEO – Advanced Remote-Sensing Instruments - Instruments & subsystems + 5th Ka-band EO radar missions (KEO)** – ESTEC (NL) – www.arsi-keo.com

11-12 May – FSF – **BASS2022** – Business Aviation Safety Summit 2022 – Savannah, GA (USA) – Convention Center – https://flightsafety.org/event/

15-20 May – ESA/CNES/ONERA – **ISMSE15 – 15th international Symposium on Materials in the Space Environment** – Leiden (NL) – Naturalis Biodiversity Centre – https://atpi.eventsair.com/ismse15/

16-18 May – AirEXPO Shanghai China – **Shanghai International Aerospace Technology and Equipment Exhibition** – Shanghai (China) – Shanghai New International Expo Center – https://www.tradefairdates.com

16-20 May – ESA-ESTEC – **4S Symposium 2022 – Small Satellites Systems and Services –** Vilamoura (Portugal) – https://atpi.eventsair.com/

23-25 May – ESA-ESTEC – **ESA Workshop on Aerospace EMC** – FULL ONLINE EVENT – https://atpi.eventsair.com/emc-2022/

23-25 May – NBAA/EBAA – **EBACE 2022 – 2022 European Business Aviation Convention & Exhibition** – Geneva (Switzerland) – Geneva's Palexpo – Geneva International Airport – https://ebace.aero/2022/about

JUNE

30 May - **01** June – ISUDEF – I**SUDEF'22 – International Symposium Unmanned Systems and the DEFence industry** – Madrid (Spain) – Fully online/Hybrid – https://2022.isudef.org.registration

01-02 June – 3AF – **ERTS2022 – Embedded Real time Software Systems** – Toulouse (France) – https://www.3af.fr/agenda/erts-2022-2141

02-03 June – SAE International – **AEROCON2022 – Organised by SAEINDIA - Autonomous Airborne Systems – Trends, Challenges and Opportunities** - Bangalore (India) – https://saeindia.org/aerocon2022/ - https://www.sae.org/

05-09 June – ECCOMAS – **ECCOMAS Congress 2022 – 8th European Congress on Computational Methods in Applied Sciences and Engineering** – Oslo (Norway) – https://www.eccomas.org/

08-10 June – ASC/READ/EWADE – **ASC&READ& EWADE2022** – Warsaw (Poland) – Wrasaw University – https://www.ewade-aircraftdesign.org

08-10 June – 3AF – **OPTRO2022** – Optronics in Defence and Security – Versailles (France) – https://www.3af-optro.com

13-17 June – IFASD2022 – **Aeroelasticity and Structural Dynamics – International Forum** – Madrid (Spain) – University Carlos III – https://eventos.uc3m.es/

14-16 June – FAA/EASA – **2022 FAA-EASA International Aviation Safety Conference – Washington D.C. (USA)** – https://www.easa.europa.eu/ - monoka.nielsen@aia.aerospace.org

14-17 June – AIAA/CEAS – **28th AIAA CEAS Aeroacoustics Conference** – Southampton (UK) – Venue TBC – https://www.aerosociety.com/events-calendar/

19-23 June – ESA-ESTEC – **FAR2022 – 2nd International Conference on Flight Vehicles, Aerothermodynamics and Re-Entry Missions** – Heilbronn (Germany) – https://atpi.eventsair.com/far2022

21-23 June – CANSO/ATCA – **World ATM Congress** – Madrid (Spain) – IFEMA – Feria de Madrid – https://www.worldatmcongress.org/contact-un

21-24 June – AIAA – **ICNPAA2022 –** Mathematical Problems in Engineering Aerospace and Sciences – Prague (Czech Republic) – www.icnpaa.com/index-php/icnpaa/ICNPAA2020

21-27 June – AIAA – **AIAA Aviation Forum –** AIAA Aviation and Aeronautics Forum and Exposition – Chicago, IL (USA) – Hilton Chicago – https://www.aiaa.org/aviation/

22-25 June – BLDI – **ILA BERLIN 2022 – International Air Show – Motto: INNOVATION AND LEADERSHIP IN AEROSPACE –** Berlin (Germany) – Berlin ExpoCenter Airport – New HYBRID CONCEPT at BER Airport with focus on Innovation, Technology and Sustainability – https://www.ila-berlin.de/en

23-25 June – ESA-ESTEC – **2022 ESA Workshop on Aerospace EMC –** Postdam (Germany) – https://atpi.eventsair.com/emc-2022/

24-26 June – ICCIA – **ICCIA2022 –** 7th International Conference on Computational Intelligence and Applications – Nanjing (China) – Nanjing Tech University – www.iccia.org contact: iccia@zhconf.ac.cn

JULY

27 June – **01** July – AIAA – **AIAA Aviation Forum and Aeronautics Forum and Exposition** – Chicago, IL (USA) – Hilton Chicago – Event in presence and Online – https://www.aiaa.org/aviation

27 June – **01** July – EUCASS/3AF – **EUCASS Conference –** Lille (France) – Grand Palais Bold Halle – https://www.eucass.eu

16-24 July – COSPAR – **COSPAR2022 - 44th Assembly of the Committee on Space Research (COSPAR) and Associate Events –** ATHENS (Greece) – Megaron International Conference Centre – MAICC – https://www.cospar-athens2022.org/

18-22 July – FIA2022 – **Farnborough International Air Show –** Farnborough (UK) – https://www.farnboroughairshow.com/fia2022/

AUGUST

03-05 August – **ISSA'22 – International Symposium on Sustainable Aviation** – Melbourne (Australia) – https://2022.issasci.org – ahercan@eskisehir.edu.tr

SEPTEMBER

04-09 September – ICAS/FTF/Innovair – **ICAS2022 – 33rd Congress of ICAS (International Council of the Aeronautical Sciences** – Hosted by FTF and Innovair – Stockholm (Sweden) – www.icas2022.com – www.ftfsweden.se – www.innovair.org

05-09 September – ERF/CEAS – **ERF2022 – 48th ERF – Winterthur (Switzerland)** – Zurich University of Applied Sciences ZHAW – www.erf2022.ch – https://rotorcraft-forum.eu/

12-15 September – CEAS/ESA – **HiSST2022 – 2nd international Conference on High-Speed Vehicle Science and Technology** – Bruges (Belgium) – Oud Sint-Jan – https://ceas.org/2nd-international-conference-on-high-speed-vehicle-science-and-technology/

13-16 September – EUROMECH – **EFMC14 – 14th European Fluid Mechanics Conference** – Athens (Greece) – University Patras – www.efmc.14 - https://euromech.org

18-22 September – IAF – **Hosted by CNES – IAC 2022 – 73rd International Astronautical Congress** – Space for @ ll – Special attention will be paid to students and young people – Paris (France) – Paris Convention Centre – https://iac2022.org

OCTOBER

03-07 October – ESA-ESTEC – **ICSO2022 – International Conference on Space Optics** – Dubrovnik (Croatia) – https://atpi.eventsair.com/icso2022/

18-21 October – EASN – **12th EASN International Conference - Innovation in Aviation and Space for Opening New horizons** – Plenary Talks – Thematic Sessions – Technical Workshops – Barcelona (Spain) – Universitat Politecnica de Catalunya – https://easnconference.eu

24-26 October – ASCEND/AIAA – **Las Vegas, NV (USA)** – Li & Online – 2022 Ascend will feature visionary speakers inspiring sessions, and a community spirit that welcomes everyone who loves space. https://www.aiaa.org/

NOVEMBER

02-05 November – Indoaerospace – **Indo Aerospace Expo and Forum** – Jakarta (Indonesia) – Jakarta International Expo Kemayoran – http://indoaerospace.com

23-24 November – 3AF – **IES2022 – Strategic and Economical Conference** – Paris (France) – https://www.3af.fr/agenda

DECEMBER

08-10 December – Aerospace 2022 – **International Conference and Exposition on Aerospace and Aeronautical Engineering** – Madrid (Spain) – https://www.pages-conferences.com/2022