CEAS
Council of European Aerospace Societies

BULLETIN

AEROSPACE EUROPE

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THE AEROSPACE EUROPE CONFERENCE 'AEC2023' HELD IN THE EPFL OF LAUSANNE ON JULY 9-13 WAS A SUCCESSFUL EVENT

IT WAS THE JOINT 10TH EUCASS CONGRESS – 9TH CEAS CONFERENCE

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) – The Netherlands (NVvL) – Poland (PSAA) – Romania (AAAR) – Spain (AIAE) – Sweden (FTF) – Switzerland (SVFW) – United Kingdom (RAeS);
- 4 Corporate Members: ESA, EASA, EUROCONTROL and EUROAVIA;
- 9 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), PEGASUS (Partnership of a European Group of Aeronautics and Space Universities) 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, EDA, 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.

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■ Society of Flight Test Engineers (SFTE-EC)
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EDITORIAL

SOME THOUGHTS ABOUT AEC2023

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If this issue of our AEROSPACE EUROPE bulletin appears with some delay, it is because the biennial CEAS conference was just held last week 9-13 July. In fact this Aerospace Europe Conference was not an only CEAS event but the 'Joint 10th EUCASS- 9th CEAS Conference'. The efficiency of the collaboration between both associations made possible to offer the aerospace community this unified European congress. Taking place in the premises of the prestigious Ecole Polytechnique Fédérale de Lausanne, it was very successful as the following figures show: more than 700 delegates from 34 countries, 40% students, 20 topics leading to about 100 technical sessions and more than 600 presentations.

This joint event organisation is perfectly in line with the ECaero project of the European Commission which was initiated some years ago by Dr.-Ing. Dietrich Knörzer. As a matter of fact the main objectives of ECAERO (European Collaborative dissemination of AERONautical research and applications) are:

- enhance coordination and communication between associations;
- rationalisation of conferences to avoid duplication of events, improve their visibility and increase their audience;
- scientific expertise better aggregated to conferences organised in cooperation between associations;
- provide scientists and technologists with a better harmonised information;
- define a project for common Journal and publishing policy.

So, it is my conviction that this joint CEAS-EUCASS event should be repeated and even extended to other CEAS partners.
Regarding the publishing policy, the Journals already exist - the CEAS Aeronautical Journal and the CEAS Space Journals - they have just to be more and more used by all CEAS aerospace association partners!
Whilst an only short executive summary of AEC2023 is published in the present issue, the next will give an extended report on this event.

As usual, this bulletin covers all regular headlines and I wish here to thank very much Mr Joachim Succker, Director of OCCAR-EA, for having accepted our interview about this very important institution for European Defence. I also express my gratefulness to the different contributors: Nicole Viola and Roberta Fusaro, for supersonic aviation paper, Giuseppe Sarri and Manual Baroni for the description of the European mission to Jupiter'e Icy Moons and Emmanuel Zenou for the recently created European Space University for Earth and Humanity.

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CEAS PRESIDENT'S MESSAGE

Franco Bernelli Zazzera
CEAS President 2021-2023

As this issue of the bulletin is in process of completion, the Aerospace Europe Conference 2023 is ongoing in Lausanne. It is obviously early to draw conclusions, but at a first glance the event looks quite successful. The merger of two major European conferences, organized independently by CEAS and EUCASS, into a single conference has brought to Lausanne over 700 participants, which is more than any previous conference. The next issue of this bulletin will include a detailed report and a deep analysis of the event.

The Aerospace Europe Conference is the best opportunity for CEAS to strengthen its relations with the European aerospace community, and in specific this year the participation of EREA is particularly appreciated. The EREA Chairman, Paweł Stężycki, has provided an interesting presentation on the achievements and the future perspectives of EREA. The event has also been the scenario for the delivery of the 2022 CEAS Awards, celebrated during the Gala Dinner at the Olympic Museum in Lausanne. Our Awardees, Dietrich Knoerzer and Johann-Dietrich Wörner, had the pleasure to receive their recognition in front of a very large audience, a perfect mix of experienced professionals and young students.

For what concerns the life of CEAS, two important news are worth mentioning: the nomination of Mr Łukasz Kiszkowiak as Vice President for External Relations & Publications, and the new membership of the von Karman Institute for Fluid Dynamics as Corporate Member.

Mr Łukasz Kiszkowiak is currently Assistant professor in the Section of Aircraft Design & Maintenance, Institute of Aviation Technology, Faculty of Mechatronics, Armament & Aerospace, Military University of Technology in Warsaw, Poland. He is an expert in the field of numerical aerodynamic analyzes using HPC, experimental tests of aircraft scaled models in wind and water tunnels, numerical analysis of static and dynamic stability of aircraft flight and scaled models flight tests. He has a good international experience, having worked in international context. He is the secretary of the General Aviation Construction and Technology Cluster, which is a link stimulating cooperation between industry, research organizations, national and local government administration, and is an important factor determining the growth of innovativeness of enterprises and regions. He has a publication track of over 50 scientific publications and is reviewer for the most prestigious international aerospace journals. Besides being Trustee of the Council of European Aerospace Societies, he is also member of the International Council of the Aeronautical Sciences Programme Committee, Chairman of Review Panel of the Polish Society of Aeronautics and Astronautics, CapTech Aerial Systems Governmental Expert in European Defense Agency and European Defence Fund Consultative Group Expert. His capacity, motivation and experience will help the development of CEAS.

The membership of the von Karman Institute for Fluid Dynamics is not new since the Institute has already participated in the past to CEAS. This renewed interest is important because it opens CEAS straight to the Belgian community and, even more, to the wider community of the research centers. The dual nature of the Institute, education and research, provides a nice added value to the CEAS community.

With new members, new officers, and a successful conference just closed, CEAS can look at its future with the right thrust and enthusiasm. Now it is time to enjoy the Summer break.

AEC2023 EXECUTIVE SUMMARY

By Franco Bernelli

Opening ceremony

Opening ceremony - L-R: Doyle Knight, Alain Merlen, Franco Bernelli

The Aerospace Europe Conference 2023, joint 10th EUCASS – 9th CEAS conference, just ended. It has been hosted in Lausanne, Switzerland, from 9th to 13th July. The very first impression is that the event has been quite successful and well organized. We like to share immediately some key figures of the event.

- Over 700 participants from 34 countries.
- 40% of participants are students.
- Technical Committee including 130 members.
- 20 conference topics.
- 97 Technical Sessions.
- 14 Plenary Invited Lectures.
- 605 presentations, including 65 posters.

It is also worth mentioning that the conference programme included contributions from EASN and EUROTURBO, thus covering a very wide spectrum of topics. All papers have been clustered into the following groups of subjects:

- Advanced Performance Engineering in Aerospace using integrated Multi-Physics simulation
- Aerodynamics and Flight Physics for Aircraft and Launch Vehicles including Re-Entry bodies
- Aerostats, Airships, balloons, lighter than air
- Climate-Neutral Aviation Fuels and Alternative Propulsion Systems (Session Organized with EASN)
- Flight Dynamics/GNC & Avionics for Aeronautic and Space Applications

Opening ceremony

Opening ceremony

Conference venue

- Advanced Aerospace Designs by Innovative Flow Control Technologies
- Hybrid Electric Propulsion
- Human factors in Aviation and Space
- New systems for future space operations
- PERSEUS - European Space Research Student Project
- Propulsion Physics for Aeronautic and Space Applications
- Turbomachinery for Aeronautical and Space Applications (Session Organized with EUROTURBO)
- Reusable Systems for Space Access and In-Orbit Operations
- Space Exploration - In Situ Resource Utilization
- Structures & Materials for Aeronautic and Space Systems
- Sustainable Aviation: Aircraft Design and Flight Operations
- Sustainable Space: Logistics and Space Debris
- System-Integration on Aircraft and Space Systems
- Testing in Aerospace
- UAVs: Future Applications/Services and Specific Technologies

The gala dinner of the event has provided the scenario to formally deliver the CEAS Gold Award to Johann-Dietrich Wörner and the CEAS Distinguished Service Award to Dietrich Knörzer.

Delivery of CEAS Awards during gala dinner - L-R: Johann-Dietrich Wörner, Franco Bernelli, Dietrich Knörzer, Andrea Alaimo

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.

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– Johan Steelant

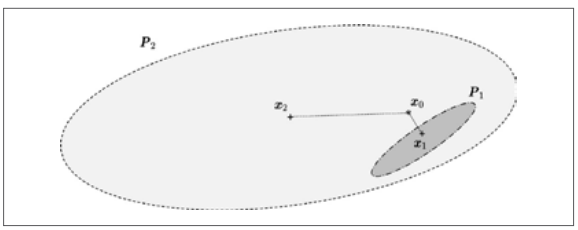
"Cites / Doc (2 years)" counts the number of citations received by documents from a journal and divides them by the total number of documents published in that journal in the past two years – similar to the Impact Factor™.

CEAS SPACE JOURNAL

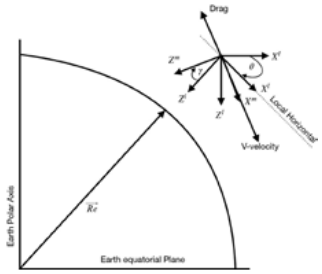
Volume 15, Issue 4, July 2023

Special Issue on "Advanced Manufacturing for Space Applications"

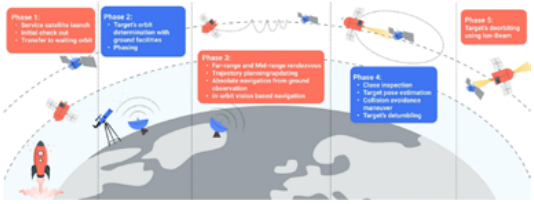
[TRACK-TO-TRACK ASSOCIATION METHODOLOGY FOR OPERATIONAL SURVEILLANCE SCENARIOS WITH RADAR OBSERVATIONS]
A. Pastor, M. Sanjurjo-Rivo & D. Escobar / Published online: 13 July 2022 (Open Access)



[RE-ENTRY PREDICTIONS OF SPACE DEBRIS FOR COLLISION AVOIDANCE WITH AIR TRAFFIC]
F. Bernelli-Zazzera, C. Colombo & Y. Sidhoum / Published online: 28 July 2022 (Open Access)

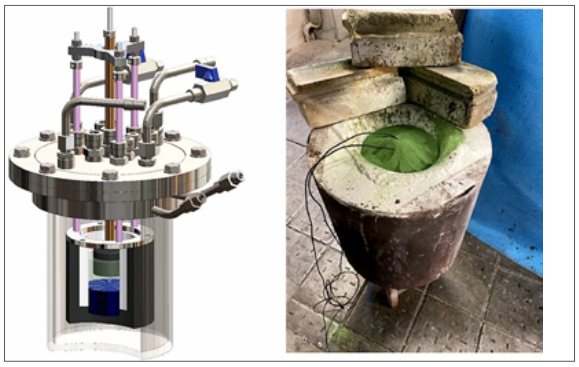


[CONCEPTUAL ANALYSIS FOR A TECHNOLOGY DEMONSTRATION MISSION OF THE ION BEAM SHEPHERDS]
R. Colpari, N. Sajjad, A. Kiran, M. Chakraborty, V. Tripathi, P. Baranwal, B. Janardhana, D. Stepanova & D. Wischert / Published online: 29 July 2022



FROM LUNAR REGOLITH TO OXYGEN AND STRUCTURAL MATERIALS: AN INTEGRATED CONCEPTUAL DESIGN

A. Radl, K. M. Neumann, H. Wotruba, E. Clausen & B. Friedrich / Published online: 30 July 2022 (Open Access)

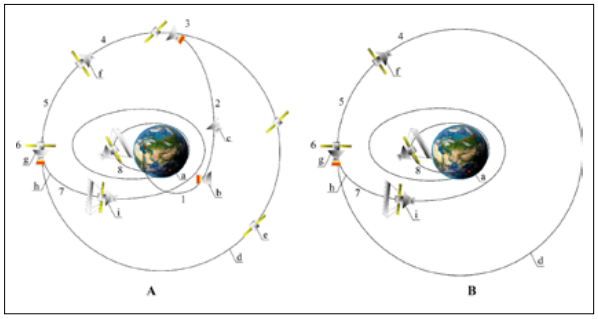


A DESIGN STRATEGY FOR WATER-BASED NOISE SUPPRESSION SYSTEMS IN LIQUID ROCKET ENGINES FIRING TESTS

P. M. Zolla, M. Fiore, P. E. Lapenna, D. Bianchi & F. Nasuti / Published online: 17. August 2022 (Open Access)

COMBINED METHOD FOR SPACECRAFT DEORBITING WITH ANGULAR STABILIZATION OF THE SAIL USING MAGNETORQUERS

A. Alpatov, M. Dron, A. Golubek & E. Lapkhanov / Published online: 25. August 2022

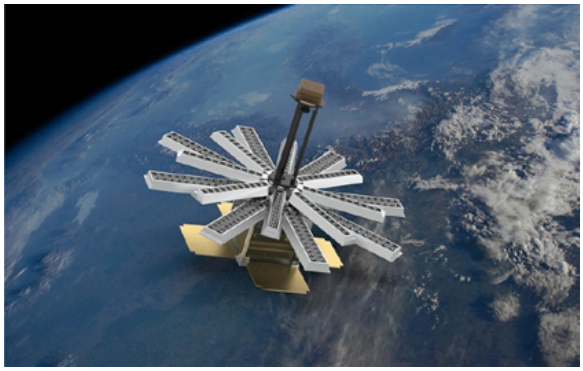


AN INVESTIGATION INTO DIRECTIONAL CHARACTERISTICS OF THE ROCKET PLANE IN A TAILLESS CONFIGURATION

A. Kwiek & M. Figat / Published online: 29 August 2022 (Open Access)

A NOVEL DESIGN OF A DEPLOYABLE CUBESAT FOR MATERIAL EXPOSURE MISSIONS IN LOW EARTH ORBIT

L. Xiao, W. Shi, X. Li, C. Shen, Y. Wang, R. Mu, F. Zhang, H. Zao & K. Wang /Published online: 7 September 2022

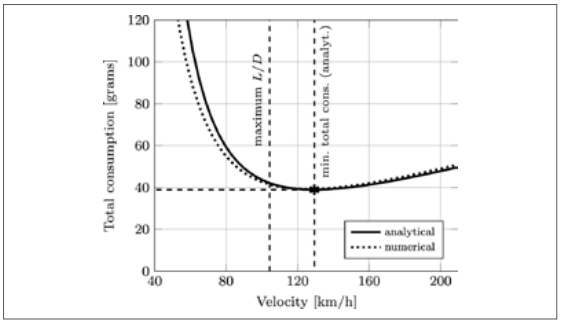


CEAS AERONAUTICAL JOURNAL

Volume 14, Issue 2, March 2023

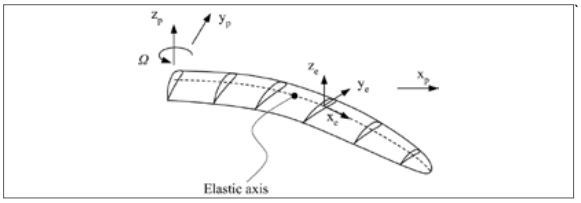
MINIMUM FUEL CONSUMPTION OF FUEL-CELL-POWERED AIRPLANES DRIVEN BY FIXED-PITCH PROPELLERS

Guilherme N. Barufaldi & Mauricio A. V. Morales / Published: 12 April 2023



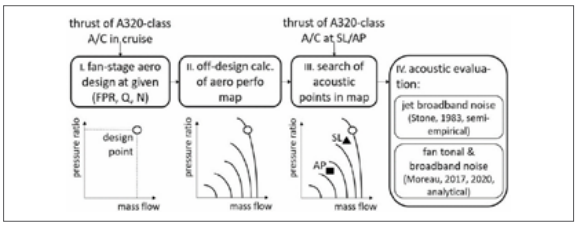
ON THE INFLUENCE OF ELASTICITY ON PROPELLER PERFORMANCE: A PARAMETRIC STUDY

F. Möhren, O. Bergmann, F. Janser & C. Braun / Published: 21 March 2023 (Open Access)



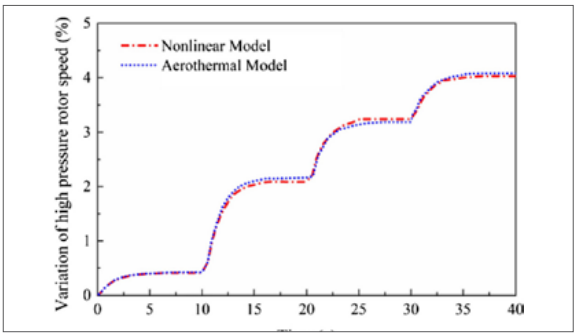
ACOUSTIC PRELIMINARY DESIGN OF A LOW-NOISE FAN STAGE CONSIDERING A VARIABLE-AREA NOZZLE AND VARIABLE-PITCH ROTOR BLADES

A. Moreau, R. Schnell & M. Mennicken / Published: 13 April 2023 (Open Access)



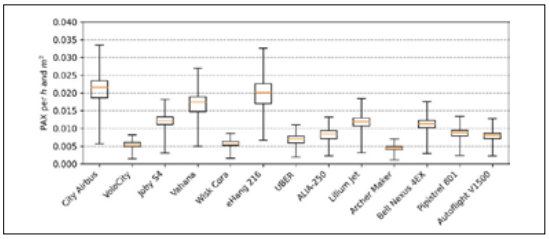
DESIGN OF VARIABLE WEIGHT SDRE CONTROL ALGORITHM FOR CIVIL AEROENGINE TRANSITION STATE

Han Zhenghong, Wang Wei, Liu Shuai & Bai Jie / Published: 12 April 2023



ESTIMATING VERTIPORT PASSENGER THROUGHPUT CAPACITY FOR PROMINENT EVTOL DESIGNS

Lukas Preis/ Published: 06 May 2023 (Open Access)



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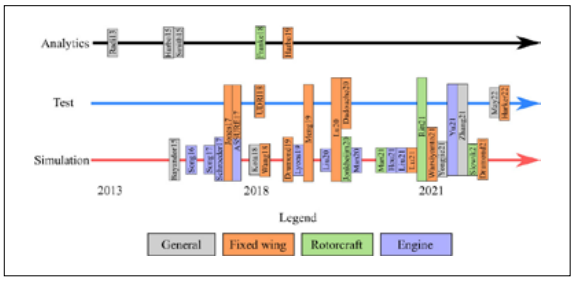

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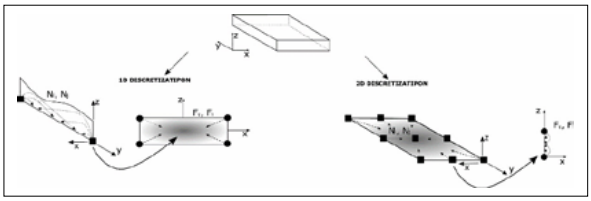
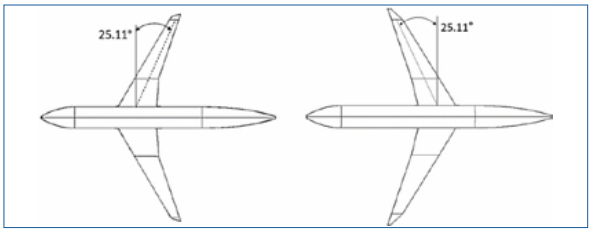
Enrico Zappino, Tommaso Cavallo, Alfonso Pagani & Erasmo Carrera /Published 27 February 2023 (Open Access)



GUST ALLEVIATION BY SPANWISE LOAD CONTROL APPLIED ON A FORWARD AND BACKWARD SWEPT WING

L. Klug, J. Ullah, T. Lutz, T. Streit, R. Heinrich & R. Radespiel /Published: 11 March 2023 (Open Access)



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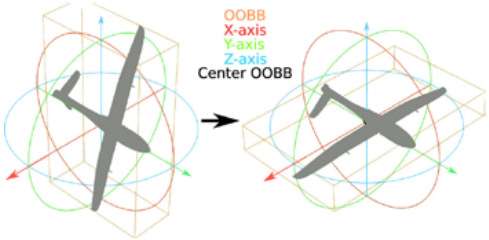
Lina van Brügge, Kaan M. Çetin, Sebastian J. Koeberle, Moritz Thiele, Fabian Sturm & Mirko Hornung / Published: 03 April 2023 (Open Access)



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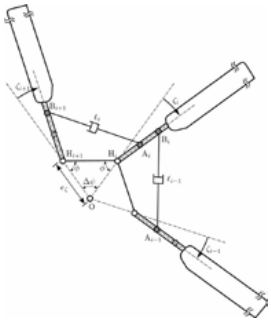
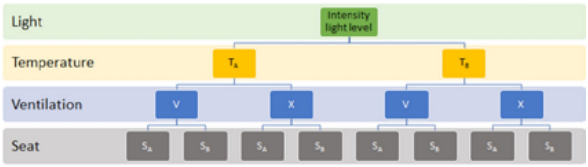


CABIN AIRCRAFT COMFORT EVALUATION OVER HIGH FIDELITY SIMULATED FLIGHT

Antonio Esposito, Calogero Orlando & Andrea Alaimo / Published: 27 January 2023



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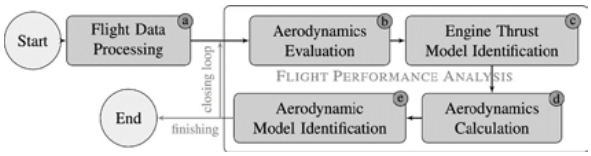
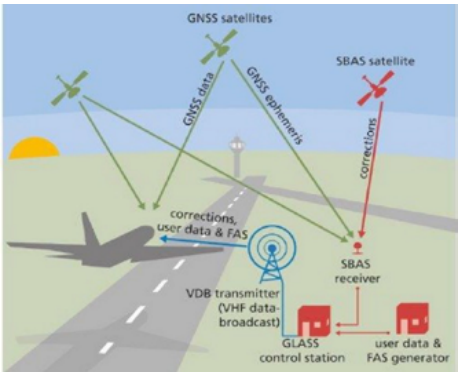
AERODYNAMIC MODEL ADJUSTMENT FOR AN ACCURATE FLIGHT PERFORMANCE REPRESENTATION USING A LARGE OPERATIONAL FLIGHT DATA BASE

Christoph Deiler / Published: 20 April 2023 (Open Access)



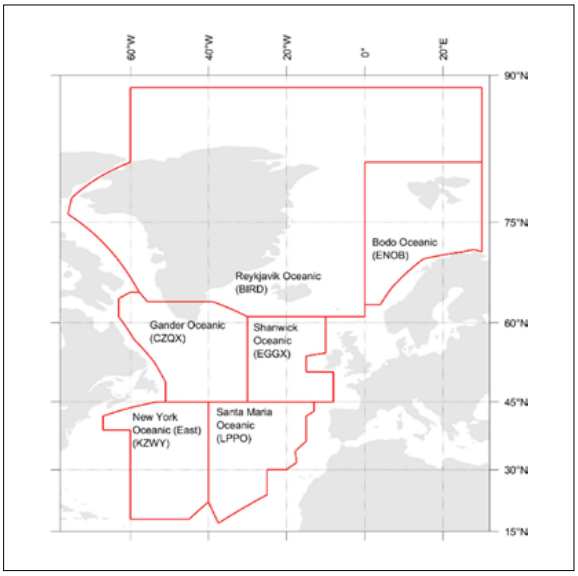
AN OPERATIONAL CONCEPT FLYING GLS APPROACHES USING SATELLITE-BASED AUGMENTATION SYSTEMS

Janes Biernatzki & Thomas Dautermann /Published: 28 January 2023 (Open Access)



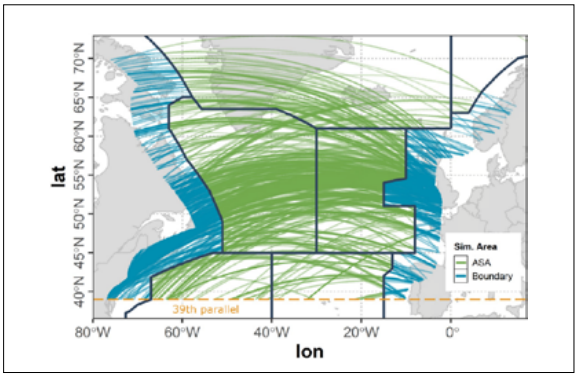
AN AERONAUTICAL DATA COMMUNICATION DEMAND MODEL FOR THE NORTH ATLANTIC OCEANIC AIRSPACE

A. Hillebrecht, T. Marks & V. Gollnick / Published: 25 March 2023 (Open Access)



MODELING AIR-TO-AIR COMMUNICATION NETWORKS IN THE NORTH ATLANTIC REGION

Tobias Marks, Alexander Hillebrecht & Florian Linke / Published: 02 May 2023 (Open Access)



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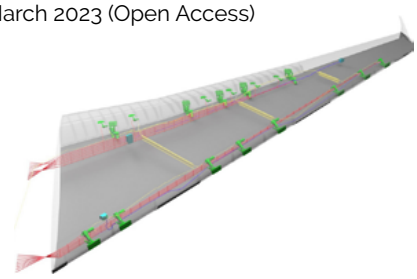
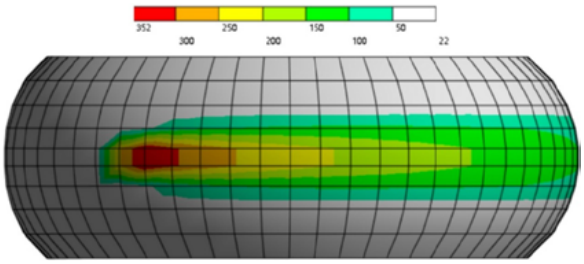
J. Dinkelacker, D. Kaiser, M. Panzeri, P. Parmentier, M. Neumaier, C. Tonhäuser & S. Rudolph / Published: 09 March 2023 (Open Access)



TEMPERATURE ELEVATION OF AIRCRAFT TYRE SURFACE AT TOUCHDOWN WITH PRE-ROTATIONS

Yu Li & Weiji Wang /Published: 21 March 2023 (Open Access)



THE FUTURE OF SUPERSONIC CIVIL AVIATION IN EUROPE IS SUSTAINABLE

By Nicole Viola and Roberta Fusaro, Politecnico di Torino, Mechanical and Aerospace Engineering Department

The aviation industry has transformed dramatically over the past century, forever changing how we live and work by bringing people closer and connecting the world. While travelling thousands of miles in just a few hours is easier than ever before, travelling faster than the speed of sound is also in the air. At the same time, we are now facing a worldwide incentive to reconsider commercial high-speed transport urges Europe to quantitatively assess the potential of civil high-speed aviation with respect to technical, environmental and economic viability in combination with human factors, social acceptance, implementation and operational aspects. Undoubtedly, high-speed commercial flights could be significantly beneficial for long-haul routes to virtually shrink the globe and shorten the time of flight of one order of magnitude for antipodal destinations, thus revolutionizing the present idea of business trips, touristic travels and emergency transports. The satisfaction of this need can however be seriously hampered by the compliance with the environmental sustainability requirements that currently represent the main goal for aviation, unless innovative technological solutions are investigated, developed, and eventually integrated and validated in operative aircraft. The higher is the speed of flight, the higher is the fuel consumption and consequently the chemical emissions, unless breakthrough technologies can intervene to break down this obvious conclusion. The same holds true for noise emissions during landing and take-off (LTO) cycles as well as sonic boom during supersonic mission phases.

In 2021, the European Commission has funded MORE &LESS (https://doi.org/10.3030/101006856) in the framework of Horizon 2020 initiatives, aims at supporting Europe to shape global environmental regulations for future supersonic aviation. This project is only the last of a series of European funded activities after the Concorde retirement in 2003. To contribute maintaining world-class expertise in Europe in the field of supersonic aviation and to advance further the knowledge in the field of hypersonic civil transportation, the European Commission funded several international projects including ATLLAS I/II [1], LAPCAT I/II [2], HIKARI [3], HEXAFLY [4], HEXAFLY Int [5]. and STRATOFLY [6]. The environmental issues have always been tackled in the above mentioned research projects, especially trying to predict the impact of the introduction of highly innovative propulsive technologies. However, it is only in MORE&LESS that a holistic approach is pursued. In fact, aviation is considered as one of the hard-to-abate sectors and to allow for low environmental impact and de-carbonization of air travels by 2050, new solutions need to be designed for the various ranges of flight routes, thus leading to different aircraft configurations, and enabling technologies for short, medium and long-haul range missions.

The H2020 MORE&LESS project has been conceived as a natural follow-on of the H2020 STRATOFLY project. Starting from the main achievements its predecessor (Fig. 1), the H2020 MORE&LESS project, aims at establishing and formalizing recommendations on the basis of the outcomes of extensive high-fidelity modelling activities and test campaigns that merge into the multi-disciplinary optimization framework to assess the holistic impact of supersonic aviation onto environment. To seek this goal, MORE&LESS addresses the following objectives:

1) To assess near and far-future supersonic aviation paradigms, considering low and high-supersonic aircraft and missions, looking at a wide set of configurations ranging from Mach 2 to Mach 5;
2) To contribute maintaining citizens and environmental protection at local, regional and global levels, by thoroughly assessing pollutant and greenhouse gas emissions, as well as noise generated by supersonic aviation;
3) To support the definition of regulations and procedures for the future supersonic aviation, by suggesting practical implementation actions based on the results obtained within the project in different disciplines, through high-fidelity simulations validated through test campaigns;
4) To contribute maintaining world-class knowledge and skills in Europe in the field of supersonic aviation, by creating synergies among the most important partners (13 European Universities and Research Centers, 1 UK Company) and key players (2 US Industrial Partners) (Fig. 2 and 3)
5) To foster international cooperation, paving the way towards the definition of global and internationally agreed regulations, by involving partners within a proper advisory board supporting the Project in maintaining a worldwide vision. Indeed, MORE&LESS includes representatives of the Regulatory Community as members of the Expert External Advisory Board (EUROCONTROL, ENAC, EASA and FAA) to provide feedbacks throughout the project and to acknowledge all the technical findings and derived suggestions for the definition of regulations and procedures to be adopted for the future supersonic aviation.

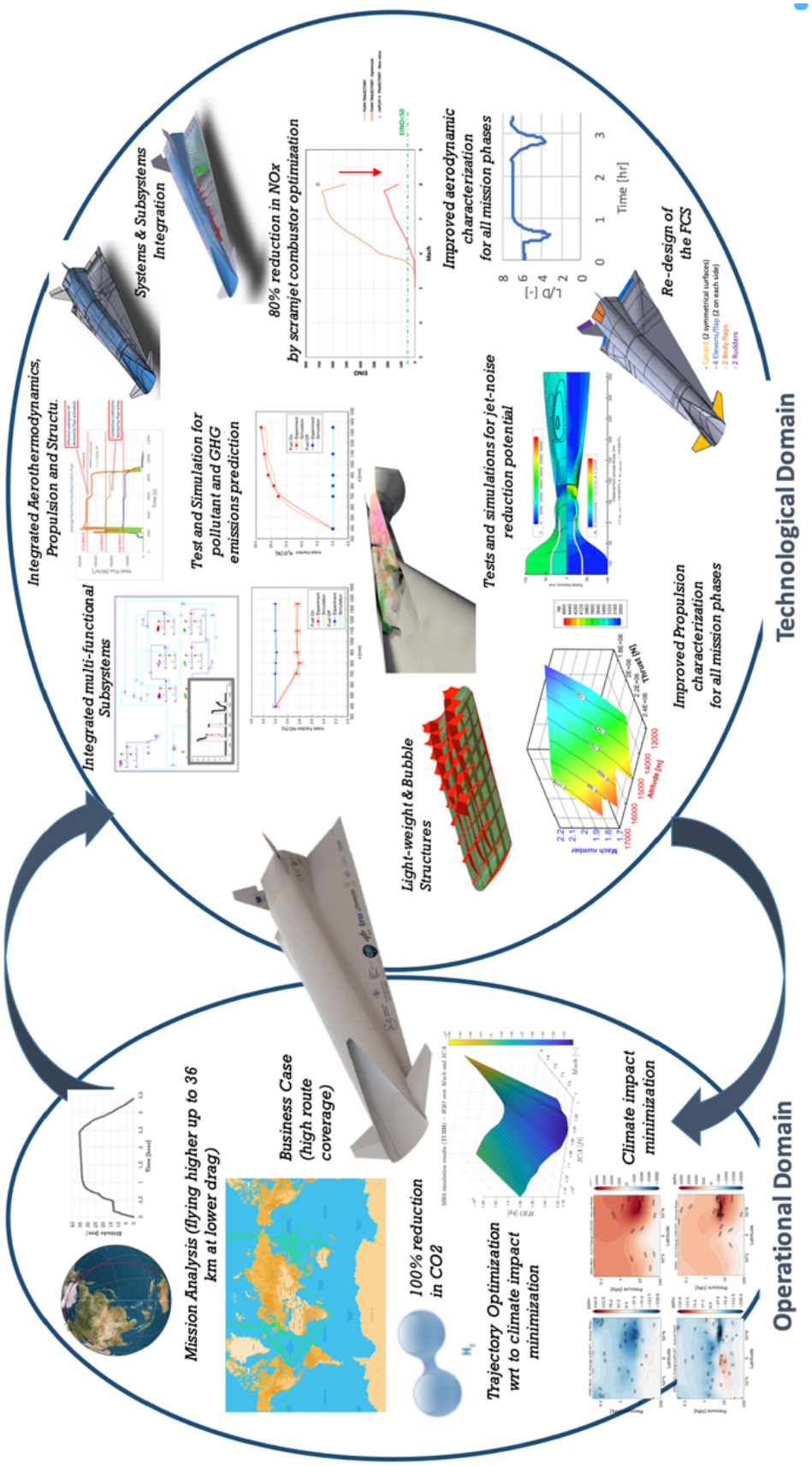


Figure 1 H2020 STRATOFLY main achievements

6) To engage and inspire new generations of students, scientists and engineers through dedicated dissemination actions and initiatives.

Hereafter, the reader can find a brief summary of the main activities currently on-going within the project per each of the most relevant topics.

POLLUTANT AND GREENHOUSE GASES EMISSIONS

On the pollutant emissions side, the main challenge addressed by MORE&LESS is to update the ICAO Annex 16- Environmental Protection, Volume II – Aircraft Engine Emissions [7] to make it applicable to new supersonic aircraft. To meet this goal, MORE&LESS aims at coupling high-fidelity Large-Eddy Simulations together with low-speed and high-speed combustion test campaigns to create validated pollutant emissions models. In addition, according to the latest ICAO standards limiting also CO2 emissions, MORE&LESS aims also at verifying to which extent the Annex 16 - Environmental Protection, Volume II – Aeroplane CO2 Emissions [8] can be applicable for supersonic airplanes. In particular, to allow supersonic transportation contributing to the aviation sector to implement the COP 21 Paris Agreement and in line with the European Strategy for Low-Emission Mobility Communication, and the Accelerating Clean Energy Innovation Communication, MORE&LESS focuses on the exploitation of bio-fuels and liquid hydrogen as propellant for future supersonic aircraft. Furthermore, MORE&LESS perfectly fits with the objectives on the United Nations Sustainable Development Goals (UN-SDGs) 13 – Climate Action and 7-Affordable and Clean Energy. Indeed, MORE&LESS is in line with the UN- SDG 13, especially for the goal "Integrate climate change measures into national policies, strategies and planning".

Thanks to the activities currently on-going in MORE& LESS,

- Europe will further understand the bio-fuel combustion for propulsion of supersonic aviation, including accurate modelling of the combustion, relevant pollutant emissions and eventually their reduction potential. This study also provides a solid understanding of carbon footprint of supersonic aviation using bio-fuels or bio-fuels blends;

- innovative approaches to model advanced propulsion systems and related pollutant emissions will be disclosed and applied to supersonic aviation, with a combination of high and low fidelity methods. Developed methodologies and findings will be highly beneficial for subsonic aviation and might be of interest for other transportation sectors.

- Exhaustive test campaigns encompassing the combustion chamber and the entire engine tests, will constitute an unprecedented dataset on combustion and quantification of pollutant emissions for high-speed propulsion. Consequently, the large set of validated high-fidelity numerical simulations will serve for optimization of such propulsion systems for future supersonic aviation.

NOISE EMISSIONS

Considering the challenge of noise emissions, in ICAO guidelines, and following the outcomes of the HISAC (environmentally-friendly High Speed AirCraft) project, MORE&LESS research and experimental activities aim at verifying the possibility to operate supersonic aircraft that are as quiet as current and future subsonic aircraft during Landing and Take-Off (LTO) operations. The extension of current available regulations (Annex 16) for subsonic aircraft to higher speed regimes ensures proper acceptance levels and guarantees the regulatory process not to be disconnected from public need and political reality. The theoretical and experimental activities in MORE&LESS will allow:

- further understanding the shock-induced contribution and the jet mixing contribution to jet-noise emissions, which is a fundamental aspect to properly predict the noise generated by supersonic aviation;
- developing innovative modelling approaches of jet-noise emissions and relative impact at airport level through a combination of high-fidelity simulation techniques together with wave equations and acoustic analogies including noise sources reconstruction and propagation;
- validating predictive models with innovative jet-noise test campaigns in laboratory environment, replicating LTO operations

SONIC BOOM

In addition to the investigations of noise produced in airport proximities, MORE&LESS aims at providing the scientific community and regulatory entities with accurate high-fidelity models able to predict the variability of sonic boom phenomenon due to meteorology, urban environment and buildings. The results of the theoretical activities are validated with outdoor test campaigns and indoors experiments. The outcomes of these research and experimental activities are planned to be integrated within the holistic multidisciplinary optimization framework and can provide useful suggestions for the introduction of sonic boom annoyance limits in ICAO Annex 16 - Environmental Protection, Volume I.

To achieve this goal, MORE&LESS pursues technological developments and adopts solutions beyond the state-of-the-art in the following areas:

- innovative modelling techniques to capture the variation of sonic boom loudness due to different atmospheric propagation, where the meteorological conditions will be obtained by means of high-fidelity Whether Research and Forecasting (WRF) simulations

with unprecedented meso-scale resolution including micro-scale turbulence, and accounting for varying stability conditions such as found during nocturnal/diurnal cycles in particular;

- sonic boom propagation in urban environments will be tackled with a novel numerical strategy where Whether Research and Forecasting (WRF) meso-scale simulations will be coupled with micro-scale RANS simulations, providing added realism by combining realistic inflow conditions with local surface forcing of the urban boundary layer;
- small-scale sonic boom outdoor test campaigns for a rapid assessment of noise signature of free-flight models representative of newly developed supersonic aircraft;
- indoor test campaigns, with synthetic reproduction of the aircraft sonic-boom signature at small-scale, with the final goal of correlating the annoyance variability in different urban environments, i.e. to propagate the Mach cone over a group of small-scale buildings.

Figure 2 H2020 MORE&LESS Expert External Advisory Board

REFERENCES:

[1] Steelant, Johan. ATLLAS: Aero-thermal loaded material investigations for high-speed vehicles", 15th AIAA International Space Planes and Hypersonic Systems and Technologies Conference. 2008.

[2] Steelant, J., Varvill, R., Defoort, S., Hannemann, K., Marini, M.: Achievements Obtained for Sustained Hypersonic Flight within the LAPCAT-II Project, 20th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, Glasgow, Scotland, AIAA- 2015-3677, 2015.

[3] E. Blanvillain, E. Gallic, "HIKARI: Paving the way towards high speed air transport", 20th AIAA International Space Planes and Hypersonic and Technologies Conference. Glasgow, Scotland, 2015.

[4] J. Steelant et al., "Conceptual Design of the High-Speed Propelled Experimental Flight Test Vehicle HEXAFLY", 20th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, Glasgow, Scotland, 2015.

[5] N. Favaloro et al. "Design analysis of the high-speed experimental flight test vehicle HEXAFLY International", 20th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, Glasgow, Scotland, 2015.

[6] Viola N., Fusaro R., Ferretto D., Gori O., Saracoglu B., Ispir A.C., Schram C., Grewe V., Plezer J.F., Martinez J., Marini M., Cutrone L., Saccone G., Hernandez S., Lammers K., Vincent A., Hauglustaine D., Liebhardt B., Linke F., Bodmer D., Nilsson T., Fureby C., Ibron C H2020 STRATOFLY PROJECT: FROM EUROPE TO AUSTRALIA IN LESS THAN 3 HOURS (2021) 32nd Congress of the International Council of the Aeronautical Sciences, ICAS 2021

[7] Secretariat, I. C. A. O. Annex 16—environmental protection volume II—aircraft engine emissions. ISBN 978-92-9231-123-02008, 2008.

[8] International Civil Aviation Organization. Annex 16-Environmental Protection Volume III-Aeroplane CO_2 Emissions. International Civil Aviation Organization, 2017.

Figure 3: H2020 MORE&LESS Consortium

OFELIA : OPEN FAN FOR ENVIRONMENTAL LOW IMPACT ON AVIATION

SAFRAN TO LEAD OPEN FAN DEMONSTRATION PROGRAMME WITH EUROPEAN PARTNERS UNDER CLEAN AVIATION OFELIA PROJECT

April 27, 2023 – Villaroche (France)
Safran Aircraft Engines is coordinating the Clean Aviation project OFELIA, working with 26 industry European key partners including Airbus, Avio Aero, GKN Aerospace, as well as research lab such ONERA and academics from several countries across Europe. The OFELIA consortium is set to receive 100 M€ in European funding from Clean Aviation JU.

OFELIA's objective is to demonstrate the benefits of an open fan architecture in terms of efficiency to address the need of future Short & Medium Range (SMR) aircraft around 2035, on the path towards industry target to achieve net-zero carbon emissions by 2050.
The Open Fan aims to save 20% consumption and CO_2 emissions compared to today's narrow body engines. Within the framework of OFELIA project, Safran Aircraft Engines and its partners will mature a set of technologies to TRL 5 (TRL: Technology Readiness Level) for low-pressure systems,high-pressure core ans advanced systems including hybridization that will pave the way to ground anf flight test demonstrations on an Airbus A380 powered with an Open Fan by the middle of this decade.

The consortium also targets to ensure the full compatibility of this disruptive architecture with Sustainable Aviation Fuels (SAF) and hydrogen.

The Open Fan architecture is the major innovation of CFM International1 RISE (Revolutionary Innovation for Sustainable Engines) technology development programme with GE Aerospace and stands as a key driver to improve next generation engine's efficiency.

The OFELIA roadmap will encompass more than 20 tests at partners' facilities. Safran Aircraft Engines, Aero Avio and GKN Aerospace will work together to design and manufacture components for the Open Fan engine Demonstrator. In parallel, OFELIA will address specific topics such as whirl flitter, unducted FAN, propeller and vanes , high speed booster, high speed low pressure turbine aerodynamics, high power compact reduction gearbox, light weight engine components, combustor emissions, high pressure compressor aerodynamics, engine hybridization.

In order to be ready for the second phase of Clean Aviation focused on flight tests, Airbus will prepare the preliminary dossier of the Aircraft Flying Test Demonstrator.

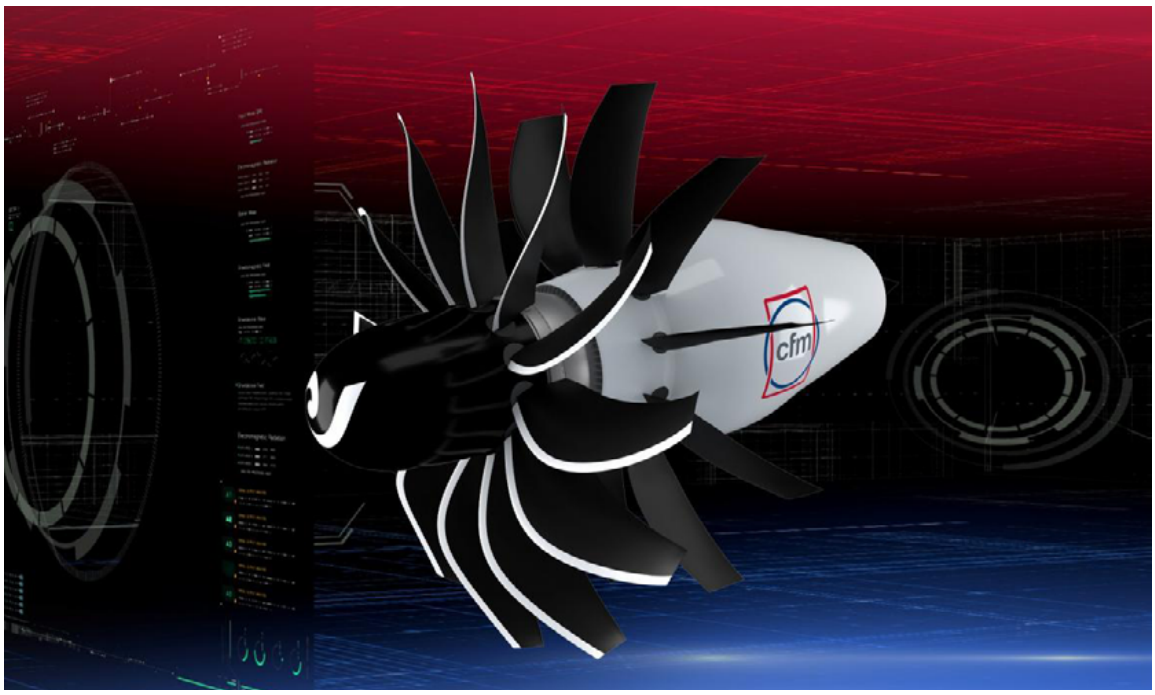


Figure 1 : GE and Safran are evaluating several promising architectures as part of theit technology maturation plan. The most ambitious, the one that will yield the greatest benefit – is open fan architecture. © Safran Group.

Figure 2 : The A380 super jumbo is the flight test demonstrator for the development of advanced propulsion technologies, among which the Open Fan. © Airbus.

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1 CFM International is a 50/50 joint company between General Electric (GE) and Safran Aircraft Engines.

MAKING EUROPE THE MOST ENVIRONMENTALLY-FRIENDLY SKY TO FLY IN THE WORLD

A move to alternative fuel sources in undoubtedly where the aviation industry will be able to make the largest and most-long-lasting inroad into decarbonising its operations, but it is not the only area where energy efficiencies can be made. Research and innovation is showing how emissions savings, albeit smaller, can be made in the shorter term by introducing new technologies and procedures into air traffic management (ATM).

SESAR 3 Joint Undertaking is looking at every phase of the flight and airspace use, and developing technologies to reduce fuel burn and emissions. Much of the focus is greener taxiing of aircraft, fuel and climate-optimised trajectories, and more energy-efficient approaches and landings at airports.

1. Extended arrival management

2. Optimised descent operations

3. Free routing

4. Optimised climb operations

5. Steeper approaches

6. Green taxiing

7. Formation flying/wake energy

8. Advanced use of datalink for enhanced vertical clearances

9. Arrival management/departure management integration

10. Non-CO_2 emisions

To view full screen, click here

SESAR 3 DIGITAL EUROPEAN SKY

EXCERPTS FROM SESAR 3 DIGITAL EUROPEAN SKY BLUEPRINT

https://www.sesarju.eu/sites/default/files/documents/digital_european_sky_blueprint.pdf

What is the digital European sky?

What is the digital European sky?

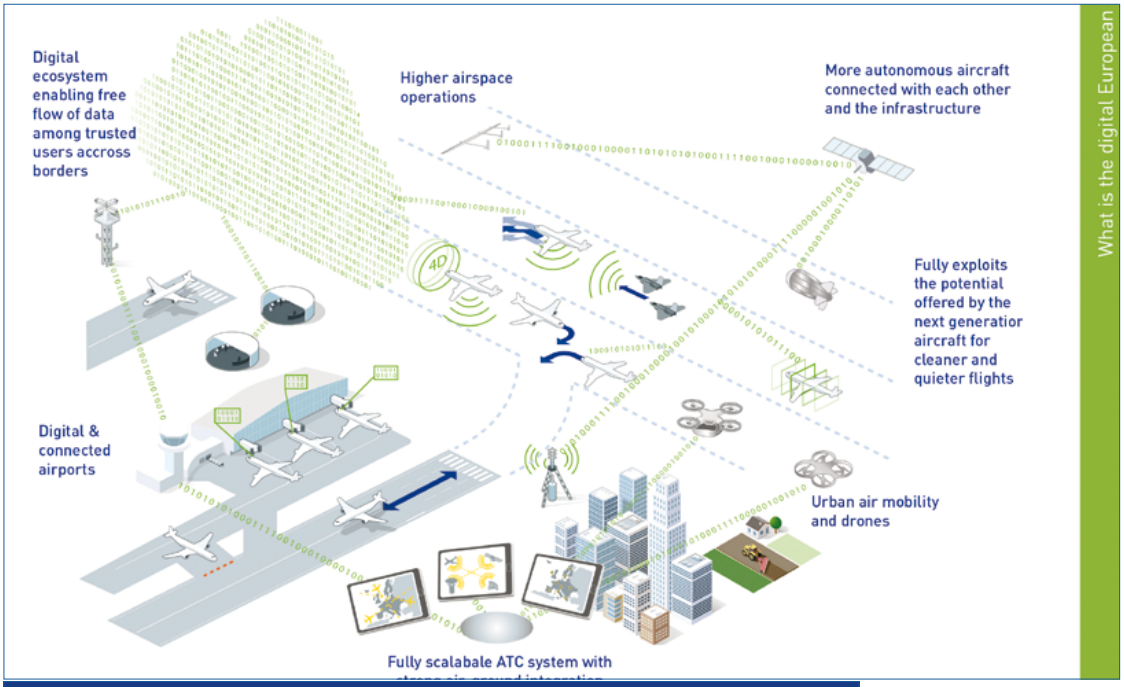
The digital European sky was first proposed by the SESAR Joint Undertaking in 2017 [1], and then further detailed in 2019 in a commonly agreed roadmap by stakeholders from across the aviation community [2]. Further support for the digital European sky was provided by the Wise Person's Group, established by the European Commission to provide recommendations on the future of the Single European Sky [3], and a joint declaration by industry [4].

The digital European sky leverages the latest digital technologies to transform Europe's aviation infrastructure enabling it to handle the future growth and diversity of air traffic safely and efficiently, while minimising environmental impact. This transformation centres on technologies that can increase the levels of automation, cyber-secure data sharing and connectivity in air traffic management (ATM), as well as the virtualisation of its infrastructure and air traffic service provision in all types of airspace, including for very-low and high altitude operations. In doing so, these technologies enable the system to become more modular and agile, while building resilience to disruptions, traffic growth and diversity of air vehicles.

To bring the maximum benefits, the digital transformation will be holistic and passenger-centric, covering air travel door-to-door and involving everyone that plays a role in that experience, from the airports, airlines and air navigation service providers, to the regulatory, standardisation and safety bodies.

(1) Digitalising Europe's aviation infrastructure, October 2017
(2) European ATM Master Plan, 4th edition, December 2019
(3) A report of the Wise Person's Group, established by the European Commission to provide recommendations on the future of the Single European Sky, April 2019
(4) Joint Stakeholder Declaration for a Digital European Sky, September 2019

4



The world of aviation is changing. Aircraft are becoming more autonomous, more connected, more intelligent, and more diverse. Air passengers increasingly expect eco-friendly, smart and personalised mobility options that allow them to travel seamlessly and efficiently. They want quick and reliable data to inform their travel choices, not only on schedules, prices and real-time punctuality, but increasingly also on environmental impacts. To deliver this new era in aviation, leveraging technology is key.

Digital European sky innovation portfolio

To deliver the digital European sky a portfolio of research and innovation activities are required [5], focusing on a number of key areas:

Connected and automated ATM
The future ATM system will deliver hyper connectivity between all stakeholders (vehicle-to-vehicle, vehicle-to-infrastructure) via high bandwidth, low latency fixed and mobile networks. Highly automated systems with numerous actors will interact with each other seamlessly, making the system scalable and even safer than today.

Air-ground integration and autonomy
The progressive move towards autonomous flying enabled by self-piloting technologies requires a closer integration between vehicle and infrastructure capabilities so that the infrastructure can act as a digital twin of the aircraft.

Capacity-on-demand and dynamic airspace
Technology will enable the dynamic reconfiguration and the activation of cross-border capacity-on-demand services to maintain smooth traffic services at busy times.

Virtualisation and cyber-secure data sharing
Service provision will be decoupled from the physical infrastructure, enabling air traffic and data service providers, irrespective of national borders, to plug in their operations where needed in a secure manner.

AI for aviation
Tomorrow's aviation infrastructure will be more data intensive. Thanks to the application of machine learning, deep learning and big data analytics, we will be able to design an ATM system that is smarter and safer by constantly analysing and learning from the ATM environment.

U-space and urban air mobility
A digitally native traffic management system will ensure the safe and secure integration of drones in the airspace especially in urban areas, taking into account new and existing air vehicles and autonomous operations. One of the most challenging use cases from U-space will be to enable urban air mobility, which is expected to advance autonomous technologies in a number of areas.

Civil/military interoperability and coordination
Dual-use technologies such as those for communications, navigation and surveillance, and other solutions that allow real-time exchange trajectory information will improve the predictability of military operations and overall network capacity.

(5) European ATM Master Plan, 4th edition, December 2019

7

Digital European sky innovation portfolio

BRINGING URBAN AIR MOBILITY TO THE FUTURE: EUREKA SET TO PAVE THE WAY FOR VERTIPORTS

On 14th of June 2023, took place at Rome Fiumicino Airport, the kick-off meeting of EUREKA, a European Digital Sky project that aims to make Urban Air Mobility (UAM) a reality by paving the way for safe and efficient integration of 'vertiports' into European airspace.The so-called **vertiports** are **defined areas that support the landing and take-off of eVTOL (electric Vertival Take-Off and Landing) aircraft**.

Comprising a consortium of 35 members led by EUROCONTROL, EUREKA is an essential step forward towards delivering UAM in Europe. By safely integrating vertiport operations into existing airspace, the project will unlock the potential for safe, secure and sustainable UAM transportation systems ans successfully meet tomorrow's urban transportation needs. Planning:

- Vertiport collaborative traffic management, optimising resource utilisation and capacity allocation;
- Vertiport disruption and emergency management;
- Vertiport Network Flow, Capacity & Operational Management, enabling efficient coordination and operations across the vertical airport.

The project will work in close cooperation with EASA and other international and national authorities and organisations, thereby contributing to the consolidation of standardisation and regulatory requirements related to airports and UAM operations.

The outcome of this project will be shared with the wider U-space /UAM community, paying particular attention to other ongoing UAM deployment initiatives on the subject managed by the European Commission, ICAO, EUROCAE and EASA.

This will have particular relevance for the exploitation of EUREKA results. By developing standardisation and regulation recommendations, the project aims to become a reference point for future UAM development and a boost for early UAM deployment.

EUREKA has a total investment of about €23 million, including €6.9 million from SESAR 3 JU and will run until mid-2026.

The EUREKA consortium led by EUROCONTROL comprises several industry leaders in uAM: Abionica, Aeroporti di Roma, Aena, Alliance for New Mobility Europe, ANRA, BlueNest, space Spain, CRIDA, Deep Blue.

INTERVIEW WITH JOACHIM SUCKER, OCCAR-EA DIRECTOR

By Jean-Pierre Sanfourche, Editor in Chief

Joachim Sucker *is the Director of the OCCAR Executive Administration since the 01st of February 2023.*

Previously, he has held various positions as chief of division at the German Ministry of Defence (DE MoD) since 2014. In his last position at the DE MoD, he was responsible for the technical supervision of all armaments projects in the air domain.
Joachim Sucker has extensive experience serving in the German Armed Forces as Technical Officer and Flight Test Engineer and serving at the German Federal Defence Administration and the DE MoD in different functions related to technology.
He started his career in 1979 as a soldier.

Other functions include German OCCAR Board of Supervisors member and Head of German delegation of different boards and committees related to NH90, Eurofighter, Tornado, A400M, MMF and MALE RPAS.
He is married and has two children.

You started your tenure as OCCAR-EA Director on 1st of February 2023, could you tell us in a few words your first appreciations regarding the present status of OCCAR?

- Firstly, let me tell you that I am very honoured to be the Director of an organisation that is so well-fitted for its objective. OCCAR's objective is to manage complex, cooperative defence programmes and that has been done successfully for more than 20 years. It is always a challenge to handle such programmes, but I believe that whichever programme OCCAR has managed, it could not have been managed better by any other organisation.

- OCCAR's successes is largely due to the people who have worked and who are currently working for this versatile organisation. Our aim is always to ensure that we recruit the best people for each job; as a consequence we do not have flagged posts and always apply a competition for the most suitable candidate in our recruitment process. It is a pleasure to work with motivated people and with Nations who believe in our mission and vision.

- Instead of competing internally within the EU, we should focus on competing globally. That requires internal cooperation. It is this message that OCCAR has been trying to convey to all possible stakeholders over the last few years. I will continue to do so.

- In Europe, for a long time we have been inspired by and leaning on the capabilities of our big partner across the ocean. I believe it is now time to change and to begin looking at how inspirational the US approach in the defence arena can be for the European defence industry.
- When I begin to see cooperation between Nations increasing and the European Defence Industry becoming stronger, I will be a very happy man.

The OCCAR only counts today six Member States - Belgium, France, Germany, Italy, Spain, UK –, is it your intention to take measures with a view to increasing this number?

- Firstly, allow me to explain something about the governance of OCCAR. As you know, OCCAR was founded by a Convention, which is an international Treaty. The 6 Member States are the ones you stated, but we currently also have 8 Participating States and 2 Observer States.
- This means that our Nations effectively govern OCCAR. Our highest decision making body is our Board of Supervisors which, according to our Convention, is composed of the six Ministers of Defence, who have delegated responsibility to their National Armaments Directors.
- We are continuously integrating more and more programmes. We currently manage 18 programmes, but this will likely increase to 25 in early 2024 and over the forthcoming years. This will also increase the number of Participating States such as Norway or Greece for example.
- These Participating States have the same rights in a programme as Member States. Therefore, within a programme all Nations benefit in the same way from OCCAR's programme management capabilities. The only difference between Member States and Participating States is that Member States define the rules and regulations of OCCAR itself. In this regard, having six Member States makes the organisation lean, flexible and agile. This is a major advantage that OCCAR has.
- In July 2022, the Ministers of our six Member States signed a joint ministerial declaration in which they state that they want OCCAR to play an even more important role and better respond to the changing European security environment, through enhanced armament cooperation at the higher levels of material commonality.
- Our Ministers have encouraged European partners (EU

and associated Nations) to sign framework and security agreements with OCCAR, allowing them to integrate easily into OCCAR programmes. For that reason, I am currently approaching the NADs of those European partners on an individual basis to discuss such agreements.
- For the time being, we do not have an objective to increase the number of Member States. But this does not imply that the door is closed on accepting new ones. Every request will be scrutinised by the Board of Supervisors and decided on a case-by-case basis.

Could we survey the situation of the different aerospace space current programmes?

OCCAR manages a wide variety of aerospace programmes: helicopters, manned and unmanned aircrafts, missiles and into space.

- **The A400M:** The A400M Programme began more than 20 years ago, and is now deeply engaged in its in-service phase: 115 AC were delivered by OCCAR to the Participating States and 4 aircraft delivered to Malaysia. They are being operated extensively, worldwide and in highly demanding operational conditions. The feedback provided by operators is very positive: the versatility of this aircraft; its ability to perform long-range strategic transport as well as tactical missions; to refuel aircraft or helicopters, and to operate in the most severe conditions, are some of the strengths frequently highlighted by the users.

Consequently, the focus of the A400M programme is now shifting to the next stage of such a major military capability: development of new capabilities and enhancement of existing ones, and the placement of In-Service Support contracts. These are the key challenges that OCCAR is addressing together with Industry and Nations:

- Regarding A400M capability enhancements, following in-depth discussions with AMSL, OCCAR and Nations have now established a clear ambition for capabilities that should be available from the end of 2026. The upgrade of communication systems, IFF as well as avionics improvements are part of the roadmap, noting that some national-specific needs are being addressed in parallel,
- Aligned with the extensive use of the aircraft, both aircraft and engine support contracts have become more ambitious. The engine support contract, also known as FESC, is expected to be placed in the coming weeks, and the aircraft support contract is planned towards the very end of this year.

OCCAR-EA is here to continue supporting A400M Nations in the long run, and to constantly enhance A400M weapon system performance for the benefit of the Nations' air forces.

- **The Next Generation of Surface-to-Air Principal Anti-Missile System (PAMMS), in particular the CAMM-ER (Common Anti-Air Modular Missile – External Range) –** CAMM-ER is an active Surface-to-Air missile equipped with a Soft Vertical Launch (SVL) with a turnover system. The benefits include an increased range, and the ammunition is effective against air targets.
- For the Italian Army, Grifo will provide a Short Range Air Defence (SHORAD) system, for the Italian Air Force, MAADS (Medium Advanced Air Defence System) will provide a SHORAD system.
- The OCCAR CAMM-ER project covers the production of CAMM-ER equipped Ground Based Air Defence Systems Grifo, for the Italian Army, and MAADS for the Italian Air Force.

A 400M © Jozef Vanden Broeck

- The two CAMM-ER based systems are currently in an advanced stage of development, including the missile.

- The CAMM-ER production contract was signed on 28 November 2022 and it is managed by OCCAR-EA through a dedicated CAMM-ER Section forming a part of the FSAF-PAAMS Programme Division based at our site in Rome.

- **MALE-RPAS** – The MALE RPAS programme contract started officially on 01 March 2022 and since then a number of significant events have been achieved. The programme is moving forward at a very fast pace and the next big milestone will be the Preliminary Design Review scheduled at the end of the year. The programme is a clear example of a successful European cooperation at both the political and industrial levels. As a matter of fact, the MALE RPAS was one of the two OCCAR programmes awarded with EDIDP funds in 2021 and it is now in the process for possible additional EDF funding for the year 2024. The MALE RPAS will provide to its Participating States for the first time, full sovereignty on a capability of this type.

- **MAST-F** ***(Missile Air-Sol Tactique-Futur)*** – The MAST-F programme is developing the new generation Akeron LP air-to-ground missile for the Tiger helicopter and for the MALE RPAS UAV. It will address the challenges of future warfare, offering a high-precision striking capability with an increased range.

- **MUSIS** ***(Multi Space-based Imaging System)*** **CIL** (***Common Interoperability Layer)*** – MUSIS (MUltinational Space-based Imaging System)- CIL (Common Interoperability Layer) is a multi-mission system that will allow full interoperability between the French Composante Spatiale Optique (CSO) with the Italian Cosmo Sky-Med Second Generation (CSG) space-based systems. Its main objective is to improve international cooperation between intelligence communities and Industries.

After having successfully closed the Critical Design Review, the newly developed system is now in its full test phase. Functional End-to-End test (E2E) activities are ongoing to allow the transition to the operational phase of the Programme.
It is an example of close cooperation between two Nations as there will be one system belonging to and being used by both Nations at the same time (Italy and France).

- **Tiger** – The Tiger helicopters of the three Participating States are currently in service. OCCAR manages the In-Service Support activities covering 51 helicopters for Germany, 68 for France and 18 for Spain, with a specific focus on the support to Nations to achieve the highest operational readiness possible. The two main focuses are on the one hand to tailor the ISS contractual scheme to the Participating States' need, and on the other hand, minimising the impact of a number of important obsolescence cases. In particular, OCCAR enhanced obsolescence management in the frame of the Global Support Contract by implementing a proactive approach, aiming at identifying potential obsolescence at an earlier stage. In parallel, OCCAR is continuously working to maintain the effectiveness of the Tiger helicopter fleets by updating Tiger configuration and, upon Participating States' request, upgrading capabilities. It will allow Nations to take benefit for the decades to come of this combat proven and versatile Helicopter.

MALE RPAS © AIRBUS

Co-funded by the European Union

What is the position of OCCAR regarding the Tempest programme of UK and the Next Generation Weapon System (NGWS)/ FCAS (Future Combat Air System) programme of France/ Germany/Spain? More globally about the future European Collaborative Air Power?

- OCCAR manages programmes on behalf and for the benefit of Nations, dedicated to their satisfaction. The Nations set the objectives and the scope of programmes integrated into OCCAR. So, I respect the sovereignty of Nations to set up future armament programmes and to decide on the level of cooperation. As OCCAR-EA Director, I cannot comment on politically inspired issues. However, I can give you my view on cooperation as a whole from a European perspective.

- In general, we should work on a reduction of the high number of different weapon systems in Europe. So, following sound capability planning and harmonisation of requirements, Nations need to reduce market fragmentation and duplication of efforts. That is the only way to improve standardisation and interoperability, which are both heavily needed on every battlefield. OCCAR has always preached doing more for less, but currently what is being done is wasting money. In other words, we need to get our act together and reduce the number of major weapon systems.

Are working relations of OCCAR with EC, EDA and NSPA close enough?

- Most important to me is that other international organisations such as EDA, NSPA or the European Commission do not consider us and each other as adversaries, but as complementing partners.

- In an ideal world, EDA together with Nations should develop and harmonise requirements. In the early stages of the preparation of such requirements, OCCAR should become involved in order to be ready as early as possible to harmonise the definition, development and production phases of a programme. Further down the line, NSPA can take the lead in the In-Service Support phase and potentially take ownership of the assets. Such cooperation has proven its worth in the MMF Programme, which provides Air-to-Air refuelling, strategic air transport and in the future aeromedical evacuation capabilities based on the Airbus A330 MRTT. Moreover, if a number of such programmes can be co-funded by the European Union through the European Defence Fund, we have created the ideal cooperative world in the European defence arena.

- Although the relationships are good, there is always room for improvement.

- Currently, with EDA, NSPA and the Commission we have legal and security frameworks in place that allow us to closely cooperate.
- With EDA and NSPA, we have proven that such close cooperation works. Let me reiterate the example of MMF. EDA identified together with Nations a gap in the Air-to-Air refuelling capability. It was decided to acquire such capability in a cooperative way, whereby NATO would own the aircraft through NSPA and the procurement would be undertaken by OCCAR. This cooperation, although not easy from the start, proved its value and led to a programme that was managed in such a way that the capability was delivered on time, within budget and which is fulfilling requirements.

- It would be a pity to lose that experience. We should not reinvent the wheel, but should use the lessons learnt from that experience to improve the cooperative management of future complex programmes. Hence, we continually promote to Nations to consider similar cooperation for big programmes to come, such as the major battle tank, new helicopters, the medium sized transport aircraft or the sixth generation fighter.

- With the Commission, over recent years, we have been gradually building up our relationship. Trust is key in any relationship and that is what we are working towards.

- We have successfully passed a pillar assessment that allows us to manage a number of EDIDP projects. Hence, our ESSOR and MALE RPAS programmes are co-funded by the EU under EDIDP. Similarly in 2022, we again passed a complementary pillar assessment that allows us to manage EDF projects. Two new projects are currently being integrated, namely EU-HYDEF (a hypersonic defence interceptor system) and EPC (the European Patrol Corvette). Other EDF projects may be integrated in the future.

- What we are trying to achieve is the optimum solution for Nations. The Commission's objective with EDF is to make the European defence industry cooperate. OCCAR's core business is delivery of capabilities to Nations through cooperation. There is a subtle difference in both objectives, which we need to reconcile. To do so, we need to trust each other and that is exactly what we are trying to achieve, not only with the Commission but with all possible partners and stakeholders.

In conclusion, may I ask you what your immediate priorities are?

- I believe in structured approaches. One can apply a Plan-Do-Check-Act cycle in a number of things, including leading an organisation such as OCCAR.

- Therefore, in the first months in my tenure as OCCAR-EA Director, I observed and learnt. OCCAR is a well-es-

tablished and experienced organisation for managing cooperative armaments programmes. We are known for smart processes and short decision making paths. I like to describe it as a start-up approach within the Defence Environment in Europe and further afield. So far, we have been very successful. During the last decade, the number of OCCAR programmes has massively increased, we have exceeded the 100bn Euro limit of overall operational budget for our programmes, and the number of OCCAR staff members has increased as a consequence. Facing a prospective growing market of cooperative armament programmes, our challenge is to save our start-up approach whilst becoming bigger. We continuously adapt our processes and organisation to the state-of-the-art standards. And this means constantly reinventing OCCAR.

- This is leading to a plan that will allow the organisation to improve on what I believe is currently not a fully ideal situation. That plan will then be executed, evaluated and updated as needed.

- Instead of talking about immediate, intermediate or long term priorities, I would like to highlight a number of specific areas of interest.

- As I stated earlier, OCCAR's core business is to deliver capabilities. Hence, we need to make sure that the requirements of our Customers (Nations and international organisations) are satisfied within our High Level Objectives of Cost, Time and Performance. This implies that our contractual relationship with Industry needs to be at top-level to ensure Industry can and will deliver.

- I have also highlighted a few times that cooperation in the European defence arena, to date, could be enhanced. However, I will continue to spread the message that OCCAR can be a problem-solver for Nations and also international organisations in the setup and management of cooperative programmes.

- Finally, through regular meetings with partner international organisations at executive and working level, I want to make sure that our relationship intensifies, that trust grows and that cooperation becomes more solid. I would like to thank our Member States and the Participating States for their trust in OCCAR and their strong support.

Stand OCCAR at Le Bourget June 2023 © OCCAR

OCCAR buildings in Bonn Bad Godesberg, Germany © OCCAR

JUICE: EUROPE's MISSION TO JUPITER's ICY MOONS

By Giuseppe Sarri, Juice Project Manager giuseppe.sarri@esa.int , and Manuela Baroni, Juice AIT and Launcher Interface Manager manuela.baroni@esa.int

JUICE, The JUpiter ICy moons Explorer, is the first European mission to study Jupiter and its Icy Moons. This impressive spacecraft, in April 2023 embarked on an eight-year journey to Jupiter, to follow with by a four-year mission in the Jovian system, studying Jupiter, Europa, Callisto and especially Ganymede.

WHY ARE WE GOING TO JUPITER?

JUICE is the first large mission in the European Space Agency's Cosmic Vision 2015–2025 program. It has two ambitious goals: a) understanding how does the solar system work, and b) exploring habitable worlds. To achieve this, JUICE carries the most powerful instrument suite to date for the exploration of the Jovian system, comprising of 10 key instruments.

JUICE will explore the Jovian system as a miniature solar system and as a model for gas giants. The mission will study the Jovian atmosphere, to understand what makes the climate at Jupiter so different, so exotic and extreme, compared to our own.

It will study the Jovian magnetosphere, to know the particles and fields radiation environment to understand the conditions that may make Jupiter's moons habitable.

JUICE will also explore the Jovian satellites and ring systems, to monitor the volcanic activity of Io and gather important information on the formation and evolution of the Jovian system *(See figure 1)*.

GANYMEDE AND THE SEARCH FOR LIFE

JUICE will also study the conditions that may have led to the emergence of habitable environments among the Jovian icy satellites (habitable environments are defined as planetary bodies that could support, or might have had supported, organic life). For this it will focus on the three Icy Galilean moons Ganymede, Europa, and Callisto. The reason for this choice is that they are believed to be harbouring vast internal oceans: each of the icy moons is believed to contain more water than all the oceans on Earth, and identifying liquid water is crucial in the search for habitable worlds beyond Earth and in the search for life as we know it.

JUICE will especially focus on Ganymede's possible habitat, Europa's recently active tectonic zones and Callisto as a remnant of the early Jovian system. The primary target of the mission is Ganymede, the largest moon in our solar system. With its 100 km thick saltwater ocean (10 times deeper than Earth's ocean) buried under a 150 km shell of mostly ice, Ganymede provides a natural laboratory to understand the potential habitability of icy and water worlds.

Last but not least, Ganymede is the only moon known to have its own magnetic field (in general having a magnetic field is a rare feature in our solar system - Earth and Mercury are the only other bodies with a magnetic field in our solar system). Ganymede's unique magnetic and plasma interactions with the surrounding Jovian environment are interesting because they may have a role in protecting the moon from radiation, and they can also explain processes at work in extrasolar systems and astrophysical objects.

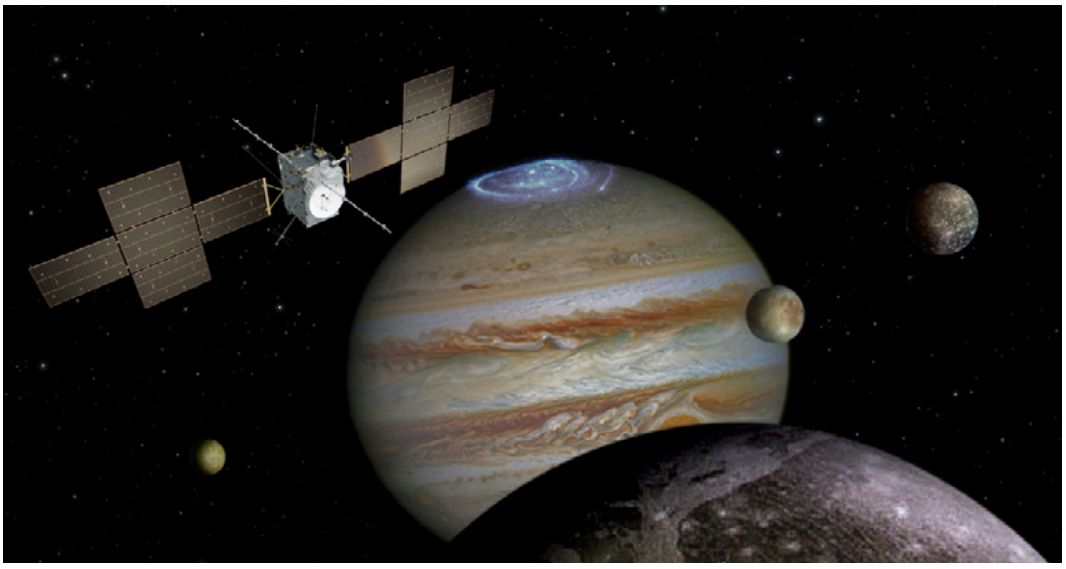


Figure 1: JUICE at Jupiter (ESA)

It is important to point out that JUICE itself will not look for direct signs of life. It will however focus on characterising the conditions that may have led to the emergence of habitable environments among the Jovian icy satellites.

THE JUICE PAYLOAD

To study the science goals described in the previous section, JUICE carries the most powerful instrument suite ever flown to Jupiter. The instruments can be subdivided in three main categories: remote sensing, geophysics and in situ particles and fields. Each category will study different aspects of Jupiter and Jupiter's moons. Among the others, the payload is equipped to study the geology, cloud morphology and atmospheric chemistry of the icy moons, their topography and gravity fields, and their magnetic fields and plasma environments.
Finally, JUICE also carries a radiation monitor, which will provide information on electron, proton and heavy ion, en-route to Jupiter and in the Jovian system. These measurements will allow to know better the radiation environment in the solar system and at Jupiter.

A LARGE SPACECRAFT

JUICE, built by the Prime Contractor Airbus Defence and Space France, is the largest spacecraft that ESA has ever sent into the outer solar system. This is because going to Jupiter requires a very large amount of propellant: as JUICE is very heavy, the launcher cannot give it all the energy required to reach Jupiter and to reach its final destination around Ganymede. This means that JUICE must provide the remaining energy with its own engine. For this it carries nearly 3.7 tons of propellant. This requires larger than usual tanks, which are situated in the central cylinder of the spacecraft, and dictates the height of JUICE: nearly 4.5 meters high from nozzle to the tip of the spacecraft.

The other key feature of JUICE is its solar panels: as Jupiter is more than 5 times further away from the sun than the Earth, light intensity is only 1/25th of the intensity on Earth, or just a bit less than 4% of the sunlight reaching Earth (noon on Jupiter would feel like a dim sunset on Earth). This means that to provide JUICE with the power it requires, we need 85 m2 of solar arrays, which results in a nearly 30 m wide spacecraft when the wings are fully deployed *(See figure 2)*.

Despite the very large solar panels, JUICE will generate relatively little power once it reaches Jupiter, which makes it a very efficient machine: to operate all its subsystems and instruments JUICE will have batteries with a capacity of 6 kWh and the solar array will generate 800 W at end of life: less than what an average microwave oven requires.

JUICE also has a very large high gain antenna (2.5 m in diameter), required to download science data. The additional benefit of this large antenna dish is that it will be used as a sunshield when the spacecraft passes Venus on its 8-year tour of the solar system.

Other striking features are a 16 m long RIME dipole antenna, which will emit a 9MHz signal to sound the subsurface of the icy moons to detect liquid water. Finally, it has a very long boom (10.6 m). This boom carries very sensitive experiments that need to be kept far from JUICE to avoid being disturbed by the electronics on the spacecraft.

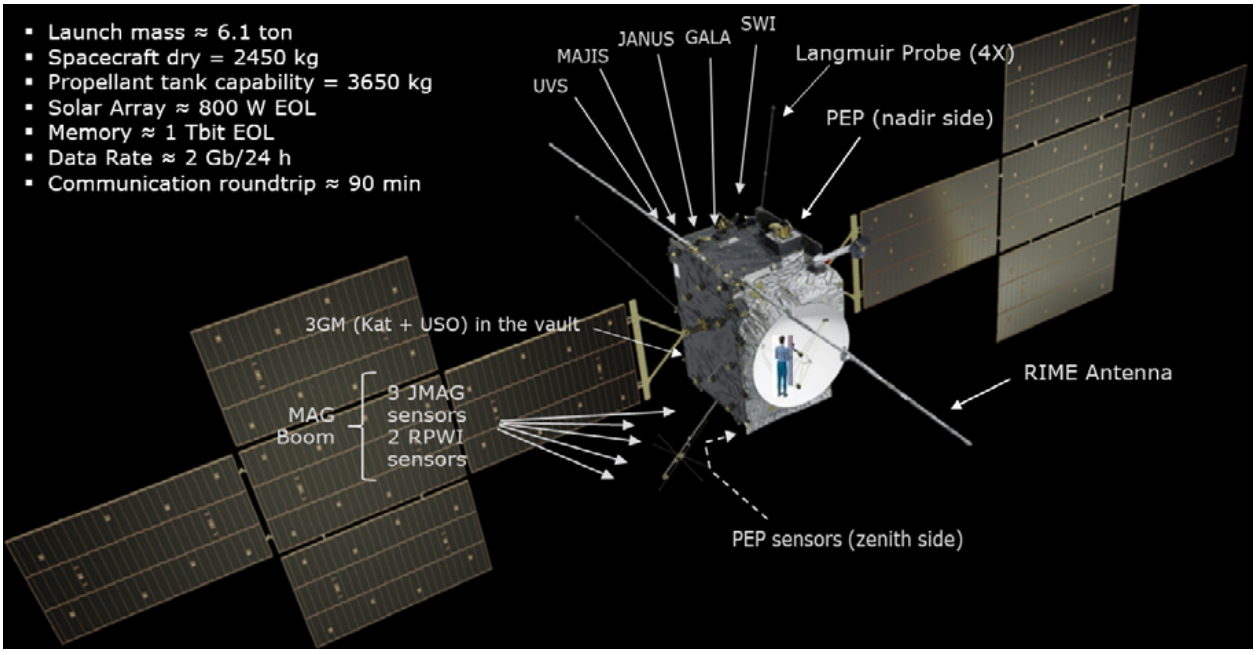


Figure 2: Key features of JUICE (ESA)

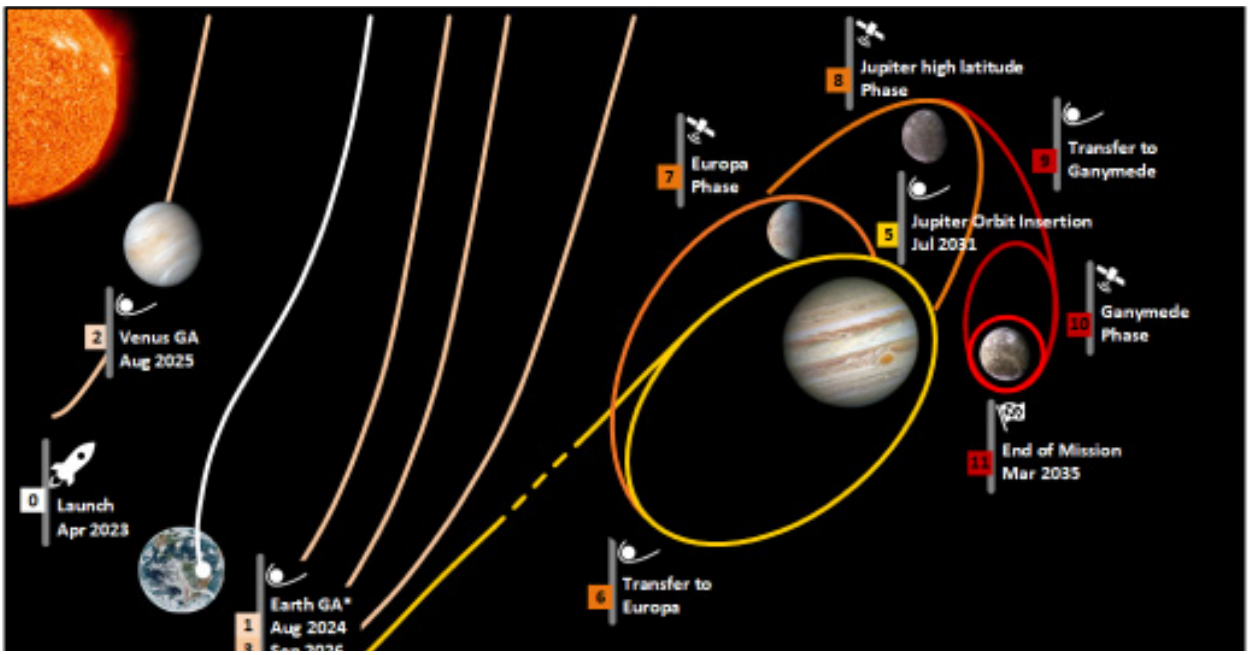


Figure 3: the journey of JUICE (ESA/ADS)

A LONG VOYAGE

JUICE was launched on the 14th of April 2023 from the European Spaceport in French Guiana by an Ariane 5 launcher. It will take more than eight years to reach Jupiter. This long journey is required because of the high launch mass of the spacecraft (> 6 tons). The most powerful version of the Ariane 5, the ECA, is unable to provide a direct injection to Jupiter; therefore, it will use a sequence of gravity assist manoeuvres, where the planet's gravity pulls on the spacecraft and changes its orbit. This can speed up or slow down the spacecraft – depending on whether it passes behind or in front of the planet.
JUICE requires gravity assists of our Moon and Earth, Venus, Earth and again Earth to gain sufficient energy to reach Jupiter *(see Figure 3*).

The first gravity assist, in August 2024, will be a special one, as it will be the first time a combined gravity assist (GA) of both the Moon and Earth will be performed. This to maximise the energy gain required to ultimately reach Jupiter. This will be followed by a GA at Venus in August 2025, one more GA at Earth in September 2026, and one last Earth GA in January 2029, which will provide the final push to Jupiter, where JUICE will arrive in July of 2031.

A large Jupiter Orbit Insertion manoeuvre will slow down the spacecraft to the point of being captured by Jupiter's very strong gravitational field, after which the spacecraft will perform its scientific mission. Focussing on Europa, the polar regions of Jupiter and finally Ganymede. For all these manoeuvres, the mission control team in ESA's control centre in Darmstadt (ESOC) will make maximum use of gravity assist manoeuvres of the Galilean moons: a record total of 35 GA of Europa, Ganymede and Callisto.

The complex sequence of instrument operation will be coordinated from ESA's ESAC science operation centre near Madrid, where the needs of the instruments will be tuned to the capabilities of the spacecraft.
Once the propellant required to maintain the orbit around Ganymede is depleted, the orbit will slowly decay and ultimately the mission will end with an impact on the surface of this icy moon, after spending at least four years in the Jovian system.

JUICE'S UNIQUE OPPORTUNITIES AND CHALLENGES

JUICE faces several unique challenges due to the harsh environment is going to visit. Such challenges have required extensive design efforts from all parties involved and several years of dedicated work.

LOW SOLAR INTENSITY**:** A first difficulty to overcome is the low solar intensity, which required especially developed solar cells that can perform at low intensity and low temperatures. Despite these custom cells, the two cross-shaped panels have a huge surface still: 85 m2, to provide sufficient power for the mission.

EXTREME RADIATION: Jupiter's radiation is also a great challenge. Jupiter's magnetic field is 14 times higher than Earth, and combined with the particles emitted by Io, generates an extremely harmful radiation field, producing the radiation equivalent of 100 million x-rays. This required a combination of radiation hardened components as well as two large lead-lined vaults to protect the electronics and limiting the end-of-life exposure of the devices to less than 50 krad (for reference, whole body doses of more than 1 krad are almost invariably fatal). Without

these vaults, the units would be exposed to doses of well above 2 Mrad. Needless to say, Jupiter is not a pleasant environment for humans.

VERY HIGH AND VERY LOW TEMPERATURES: JUICE is not only requiring to survive the very low temperatures of the Jovian system, but also the very high temperature of Venus when it flies by during the gravity assist manoeuvre. For this, a thermal design was developed capable of withstanding both environments. The very large High Gain Antenna (HGA) is also used as a thermal shield at Venus: by painting it white, the 2.5 m disc will absorb most of the flux from the Sun, protecting the rest of the spacecraft by casting a shadow over it. Only the areas that will be exposed to the sun are covered in the silver Multi-Layer Insulation (MLI), consisting of several layers of insulating materials (StaMet coated black Kapton) that can withstand both the highest temperatures of the mission (> 250 °C) and the very low temperatures (-230 °C). The rest of the spacecraft is covered in black Kapton MLI, ideal for cold environments.

NO REAL TIME COMMUNICATION: the long distance from Earth and the impossibility of real time communication presented another struggle. The distance between Jupiter and Earth varies between 4 and 6.5 Astronomical Units. This means that Jupiter can be nearly one billion km distant from Earth, the signal turnaround time can be more than 90 minutes, thus making real time communications impossible. As a result, JUICE has a high level of autonomy on board, including navigation cameras, which allow the spacecraft a certain independence from mission control during critical manoeuvres.

JUICE IS THE FIRST OF THE ESA COSMIC VISION LARGE MISSIONS.

More than 2000 people from countries all over Europe, but also the United States, Israel and Japan have worked together for over a decade to build this impressive spacecraft, with the most powerful instrument suite yet, capable of overcoming the extremely challenging environment of the Jovian system. The mission not only will advance our knowledge about our solar system's largest planet and its fascinating icy moons, but also pushed the boundaries of Europe's technical capabilities and advances further. Because of this mission we have now new understanding of radiation resistant materials, more efficient solar cells for extreme environments, a further understanding of spacecraft autonomy and the development of highly efficient subsystems. All these technological advances will be part of humanity, contributing to the next step in space and on Earth.

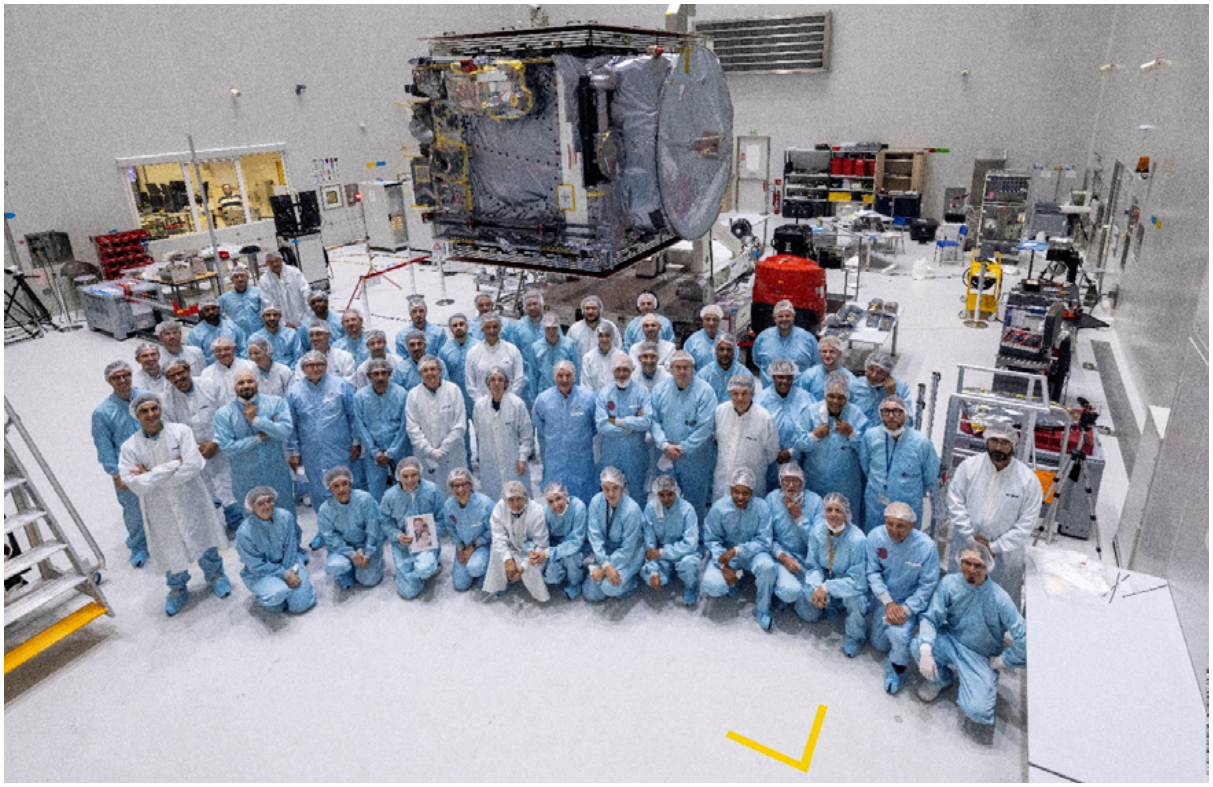


Figure 4: The team working on the final tweaks at the European Spaceport in French Guiana, before launch of JUICE (CNES/Arianespace/ADS/ESA)

SpaceX STARSHIP : FIRST ORBITAL SPACEFLIGHT

On 20 April 2023 at 13:33 UTC, from Boca China, Texas, the Starship rocket was launched on its first orbital test flight.

The rocket lifted off at 13:33 UTC.

SpaceX Starship sits atop its Super heavy booster prior to the launcher's first test flight. © SpaceX

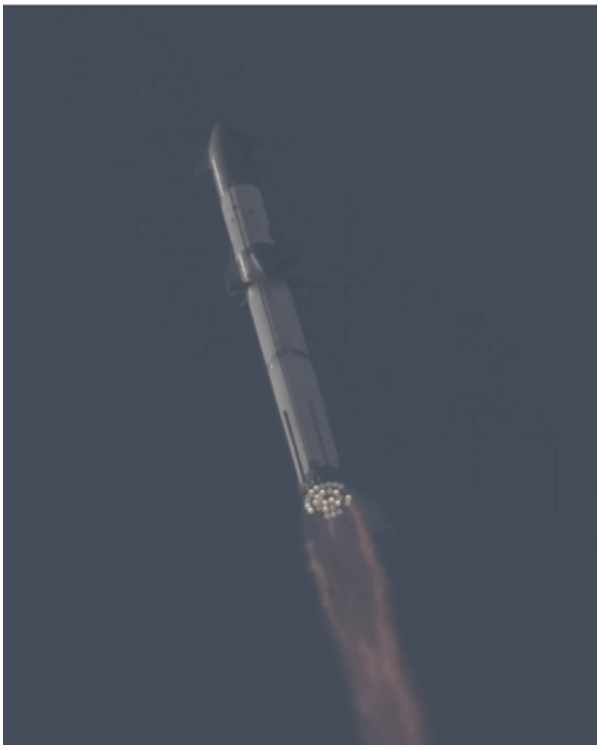
20 April 2023 at 13:33 UTC, Starship lifts off on its first orbital flight test. © SpaceX

Cick here for more informations

It was the first orbital attempt with both Super Heavy booster and Starship upper stage integrated.

It was planned for the spacecraft to complete nearly one orbit around the Earth before re-entering the atmosphere, performing a controlled landing and splashing down in the Pacific Ocean near Hawai. The super Heavy booster was to have performed a similar landing in the Gulf of Mexico, about 30 km off the Texas coast approximately 8 minutes after liftoff.

Booster lifted off having 3 engines out, with at least more shutdowns during the flight. The vehicle passed Mach 1 and enterer supersonic flight, but due to a lack of thrust or thrust vector control, no attempt was made at stage separation. After reaching an altitude of just 24 miles (... km), the entire vehicle began tumbling, falling after 6 miles (... km) before its self-destruct system, so-called ATPS (autonomous flight termination system) was activated but did not destroy the vehicle which was finally destroyed by aerodynamic forces and loss of tank pressure. It exploded 40 s later, so nearly 4 minutes into the flight. Liftoff resulted in extensive damage to the launch pad and its surrounding infrastructure and so, debris spread into Boca China State Park.



The Starship/Super Heavy vehicle climbs through the sky over South Texas during its first test flight. © SpaceX

After the test, FAA grounded the launch programme pending results of a standard "mishap investigation" overseen by NASA and performed by SpaceX. FAA stated that a return to flight would depend on the NASA's determination that future launches would not affect public safety.

Had the launch gone as planned, the booster would have performed a controlled touchdown in the Gulf of Mexico and Starship would have entered a trans-atmospheric Earth orbit before re-entering and performing a hard impact in the Pacific Ocean.

MAJOR UPGRADES BEING IMPLEMENTED FOR PREPARING THE SECOND ORBITAL TEST FLIGHT

Many changes to the Super Heavy rocket and the booster's Texas launch pad are being implemented in view of the second attempt to reach orbit, among which:

• The stage separation is modified.

The reusable Super heavy first stage is equipped with 33 methane –powered Raptor engines while the Starship 2nd stage features 6. The original design called for the Super Heavy engines to shut down after boosting the Starship out of the lower atmosphere. The Starship would separate and ignite its own engines to continue on to orbit. During maiden flight, a number of engines shut down or never started and the Starship never separated from Super Heavy first stage.

For its 2nd test flight, the stage separation is modified: the Starship engines will begin firing before all of the Super Heavy engines have shut down ("hot staging" technique).

• Shielding will be added to the top of Super Heavy stage.

• An extension to booster will be added that is almost all vents essentially.

• Changes to the Raptor's hot gas manifold that directs super-heated methane-rich gas towards the combustion chamber.

• Re-design of the manifold itself (higher torque settings).

• Reinforcement of the launch pad. SpaceX is in the process of adding about 1,000 m3 of steel-reinforced high – strength concrete and a steel sandwich on the top of that.

SpaceX Starship main characteristics

Starship is a super heavy-lift space vehicle under development by SpaceX. At 120 metres in height and with a liftoff mass of 5,000 metric tons, Starship is the largest and most powerful rocket ever flown, surpassing the thrust of NASA's Space Launch System and Saturn V, as well as the Soviet N1, which had previously held the record.

The space vehicle consists of the first-stage Super Heavy booster and the second-stage spacecraft also named Starship. Both stages are powered by Raptor rocket engines, which burn liquid oxygen and liquid methane propellants in a full-flow staged combustion power cycle. Both are designed to be fully reusable, performing controlled landings on the arms of the launch tower used to lift the vehicles and reflown within hours. Starship is designed to have a payload capacity of 150 tonnes to low Earth orbit in a fully reusable configuration and 250 t when expended. Starship vehicles in low Earth orbit are planned to be refilled with propellant launched in tanker Starships to enable transit to higher energy destinations such as geosynchronous orbit, the Moon, and Mars.

Plans for a heavy-lift vehicle at SpaceX date to 2005, with the earliest concept resembling the modern vehicle announced in 2016. SpaceX's Starship development follows an iterative and incremental approach involving frequent, and often destructive, test flights of prototype vehicles.

SpaceX intends Starship to become its primary space vehicle, superseding the Falcon 9 and Falcon Heavy launch vehicles as well as the Dragon 2 spacecraft currently used as part of NASA's commercial crew program to the International Space Station. Starship is often coupled with the company's Mars ambitions. Planned Starship flights include the development of SpaceX's Starlink internet constellation, crewed flights under the Polaris and dearMoon programs, and two crewed lunar landings with a modified Starship spacecraft under the Artemis programme.

STARSHIP FACTS & FIGURES

Function	sub-orbital spaceflightorbital spaceflightinterplanetary spaceflight
Manufacturer	SpaceX

SIZE

Height	120 m
Diameter	9 m
Mass	5,000 t

Capacity

Payload to low Earth orbit

Mass	150 t
Volume	1,000 m^3
Status	In development.

First stage – Super Heavy

Height	69 m
Diameter	9 m
Empty mass	200 t
Gross mass	3,600
Propellant mass	3,400 t
Powered by	Raptor engine (33)
Maximum thrust	74,500,000 N 7,590 Tf
Propellant	liquid oxygen liquid methane

Second stage – Starship

Height	50 m
Diameter	9 m
Empty mass	100 t
Gross mass	1,300 t
Propellant mass	1,200 t
Powered by	Raptor engine (3) Raptor Vacuum (3)
Maximum thrust	14,700,000 N
Propellant	liquid oxygen liquid methane

20 april 2023, Starship first test orbital Spaceflight. Control Room, Bocca Chica - Texas. On the right Elon Musk.
© Space X

Syhthesis written by J.-P.S. from SpaceX information

UNIVERSEH: PROPELLING EUROPE TO NEW HEIGHTS IN COMPREHENSIVE SPACE EDUCATION AND RESEARCH

Since its launch in 2020, UNIVERSEH, the European Space University for Earth and Humanity, has shaped the future of Space Education & Research in Europe. As the first phase draws to a close and the project has just been reviewed, we look back at UNIVERSEH's remarkable journey and explore the exciting possibilities that lie ahead.

CONTEXT AND BACKGROUND OF EUROPEAN UNIVERSITIES

Europe's higher education landscape in Europe has undergone a profound transformation since French President Emmanuel Macron's influential speeches at the Sorbonne and the Gothenburg Summit in 2017. This pivotal moment has led to ambitious plans for Universities in Europe across the continent under the umbrella of the 'European Universities Initiative' through an Erasmus+ financial scheme. This initiative has reshaped the traditional framework of higher education institutions' collaboration and paved the way for innovative, groundbreaking, endeavours such as **UNIVERSEH**.

"European Universities" are defined by the European Commission as "transnational alliances of higher education institutions developing long-term institutional and strategic cooperation, based on shared values and principles and aiming to achieve sustainable cooperation". These alliances are led by a coordinating institution and are organised on the basis of activities shared between the member institutions of the alliance.

Erasmus+ "European Universities" have four main objectives:

- The implementation of a long-term joint education and research strategy.
- The creation of an inter-university campuses enabling the mobility of at least 50% of students.
- The support for an interdisciplinary approach to societal challenges.
- The development of best practice models to enhance the attractiveness and competitiveness of European higher education.

There are currently 50 "European Universities" including the 2023 results. Each project has its own model, based on a strategy developed by the member institutions. While some adopt a disciplinary approach (e.g., engineering), others have a geographical bias (e.g., rural, or mountainous areas) and still others are based on a sectoral approach such as health, the seas or... the universe.

Within this framework, a European university focusing on the space sector was created in 2020 by the alliance of five historic universities across Europe:

- Université de Toulouse (formerly Université Fédérale de Toulouse Midi-Pyrénées), France, including ISAE-SUPAERO, Université Paul Sabatier, Université Jean Jaurès, TBS Education and Toulouse-INP.
- University of Luxembourg.
- Luleå Tekniska Universitet, Sweden.
- Akademia Górniczo-Hutnicza, Poland.
- Heinrich-Heine-University, Dusseldorf, Germany.

UNIVERSEH, the European Space University for Earth and Humanity was born.

UNIVERSEH aims to be the only European University in a changing Space sector, offering an innovative, cross-science, multilingual, multicultural, inclusive, research-based, and sustainable learning environment with excellence and passion.

A fast-changing space sector

The space sector has undergone a revolution in recent years with rapid advancements in technology, growing interest from the public and private sectors, the emergence of New Space (with the arrival of new private players), the occurrence of new countries developing an ambitious space policy, and the growing recognition of the immense potential it represents for scientific discovery, exploration, and societal benefits.

It is also a highly international sector, with numerous global programmes and cooperative ventures. Europe must find its place in an extremely dynamic environment for its sovereignty and own socio-economic interests.

It is therefore crucial for higher education to evolve and adapt to the needs of the sector.

Within UNIVERSEH, the space sector has been divided into 4 segments:

- "Space for Earth and Mankind", or usually called the "downstream segment", to address issues such as climate change, the use of Copernicus data.
- "Access to Space", or usually called the "upstream segment", considering the current difficulties of access to space in Europe.
- "Space settlement and resources", including topics such as telemedicine, long-term human containment and isolation, *in situ* resource utilisation, robotics, AI and autonomy, manufacturing, etc..
- "Space exploration and deep space".

The 'European University' scheme is an ambitious project that must fulfil the missions of a university (education, research, entrepreneurship, and innovation) and embody European values (developing European citizenship, strengthening inclusion and diversity, developing sustainable approaches, etc.).

The world of higher education is also changing very rapidly. Students no longer have the same expectations of a course at their university as they did twenty years ago. They want more variety in teaching methods, more autonomy and flexibility, and more interaction with the teacher, using active methods. We need to reconsider our learning objectives and outcomes in terms of teaching methods, without eliminating the longstanding methods, but enriching them with new ones.

Students are future professionals, in large industry or in an SME. They will need more and more soft skills, besides hard skills. For example, they need to be able to work in a multicultural environment, possibly asynchronously: teams are increasingly spread across different countries, different companies, different cultures and different organisations.
One crucial point is to design new multidisciplinary and interdisciplinary modules and programmes of interest to the space sector, using new pedagogical approaches. One of them is the 'ADN' for Aerospace Digital Nugget. ADNs are short digital interactive pedagogical contents created by professors and industry expert for both students and professionals. By fostering an open and collaborative environment, ADN facilitates the development of a vibrant community focused on knowledge sharing, innovation, and cooperation in the dynamic space sector.

Professionals will also be a relevant target group for universities. They change jobs more often, and therefore have lifelong learning needs, as well as having a family life: we must therefore also be able to adapt to teaching and transmitting skills in very different contexts.

THE EIGHT PILLARS OF UNIVERSEH 2.0

The UNIVERSEH project started in 2020 and the project has just been been renewed for four years. Eight pillars consolidate the foundations of the project, with two partners joining the alliance: the Université de Namur (Belgium), and the Università degli di Roma Tor Vergata (Italy).

Higher education for all. UNIVERSEH will consider students and professionals, together called "learners", as the beneficiaries of its new project: new interdisciplinary courses and programmes, new professional programmes, whatever the status, origin, and situation of the learner. All academic disciplines will be considered, as UNIVERSEH aims to break down academic barriers and develop multidisciplinary approaches: science and engineering, medicine and health, humanities, art and cultural studies, humanities, and social sciences, economics, and management, etc.

Space and Societies. The space sector is not just for scientists and engineers and must be open to the world and society. The contributions of the space sector benefit everyone, well beyond its own borders, and issues related to space and space exploration must be approached from a variety of angles; as political science, law, psychology, sociology, arts and culture, philosophy, economics, etc.

Space and Economy. The space sector needs human capital with a particular entrepreneurial attitude that correctly mixes intellectual property and open innovation, finance and value creation, and public procurement because it is a unique and exclusive labour market. To prepare European minds for the demands of the space industry, UNIVERSEH 2.0 aims to weave these issues together. To help our learners progress in the acquisition of knowledge, skills, attitudes and experience, in-depth and frequent exchanges with economic players will be stepped up.

Space and Life. Life beyond Earth in a hostile environment must be approached from different angles such as adaptation to life, health and maintaining performance in extreme environments. It will also examine the concept of agriculture and ecology in the context of the circular economy (life support), exobiology, space colonisation and habitat, as well as all the technologies and related subjects for optimised management of resources such as energy and the meaning of life. These themes are essential to enable a sustainable life option for our spaceship Earth, promoting science and technology but

also inspiring us to preserve our planet sustainably and human health for the future. Looking at these extreme challenges from different angles, combining science, technology, and medicine will certainly help at a time when climate is underway, to address similar challenges on Earth.

Space for all. Diversity is at the heart of our project: diversity of country, culture, gender, and social background, but also diversity of discipline, skills, and know-how. The space must be inclusive and diverse to mimic human nature and all its components. The aim of UNIVERSEH 2.0 is to serve society as a whole, i.e., to ensure that knowledge is accessible to as many people as possible, to provide an inclusive and diverse learning environment, and to ensure equality for all those interested or involved in space.

Space Crew. UNIVERSEH 2.0 supports a paradigm that engages the community of students, staff, and stakeholders of this unique and thematic European university. The space sector requires collaboration and coordination across all dimensions, underpinned by the cultural awareness that is essential to maintaining a coherent approach to its work. This is the long-term sustainability approach of UNIVERSEH, enabling proactive management of relationships in a human, legal and regulatory environment. The members of UNIVERSEH 2.0 are therefore committed to developing strong space crews.

Space and Sustainability. There is no doubt that the increase in space activity is creating environmental problems on Earth and in space: atmospheric pollution from the manufacture of space systems and launchers, combustion during launches, but also space debris and the resulting risk of collision, as well as the extremely limited resources available for space missions. All these factors pose considerable challenges in terms of sustainability.

UNIVERSEH as One Entity. The governance of UNIVERSEH 2.0 will support the development of projects in a sustainable and efficient manner. Therefore, the governance structure put in place during the first phase will be fully maintained and improved. The existence of a single legal entity with all the characteristics of governance could strengthen the presence of UNIVERSEH 2.0 in society. In addition, significant funding from private entities such as foundations and companies will also be facilitated, supporting the long-term financial viability of the Alliance. The aim is to go beyond a 'classical European project.

JOIN UNIVERSEH!

UNIVERSEH's ambition is to be very open to society, in close contact with its stakeholders. One of the main challenges is to work concretely with all stakeholders, for example to better design courses and programmes, to offer professionals lifelong learning, to prepare future professionals with solid skills but also with soft skills, etc. UNIVERSEH is supported by a wide range of stakeholders: ESA and national agencies, industry, SMEs, associations, local, national, and European political bodies, research organisations, and many more.

A number of working groups have been, or soon will be, set up to interact concretely with stakeholders: an observatory of qualifications and skills for the future. An initial study was carried out in 2022, highlighting the needs, particularly of industry, for future graduate profiles, lifelong education, human sciences in UNIVERSEH, student activities, equity, inclusion and diversity, awareness-raising activities, research with society, and innovative teaching models.

The purpose is to develop an organisation that is of interest to everyone: academics are advised by professionals, but professionals can also participate in the university's practical activities and or strategic orientations, propose hackathons, work more closely with students.

CONCLUSION

UNIVERSEH stands as a beacon of innovation and collaboration in Space and New Space within its own knowledge square, which will propel Europe to new frontiers in space education, research, innovation, and outreach towards the society. The remarkable journey of this European Space University for Earth and Humanity reminds us of the vast possibilities open to us in our quest to understand the cosmos and improve life on our planet.

To keep abreast of the ground-breaking research, cutting-edge initiatives, and transformative discoveries taking place at UNIVERSEH, we invite you to follow their progress and get involved in their mission. By staying connected, you will witness first-hand a new era in space exploration and contribute to the advancement of knowledge and the betterment of humanity.

Authors

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This article is based on the conclusions of a collaborative workshop among the 7 partners to prepare the application to the European Commission for the renewal of the UNIVERSEH project.

2023 AMONG UPCOMING AEROSPACE EVENTS

JULY

19-21 July – ECCOMAS – **AeroBest 2023 – Thematic Conference on Multidisciplinary Design Optimization of Aerospace Systems** – Lisbon (Portugal) – https://www.eccomas.org/

26-28 July – SARES – **ISSA'2023** – International Symposium on Sustainable Aviation – Taiwan – Tainan City – National Cheng Kung University – HYBRID Mode – https://2023.issasci.org

AUGUST

13-17 August – AAS/AIAA – **2023 AAS/AIAA Astrodynamics Specialist Conference** –Big Sky, MT (USA) – https://space-flight.org

24-26 August – SARES – **ISATECH'23** –International Symposium on Aircraft Technology, MRO and Operations – Hanoi (Vietnam) – HYBRID Mode – https://2023.isatech.org/-symposium.isatech@gmail.com

28-31 August – ICAO – **Air Navigation World 2023 – Shaping the skies of tomorrow –** Addressing key issues and technologies in Air Navigation and Safety – Montréal (Canada) – ICAO/HQ – https://www.icao.int/Meetings/

SEPTEMBER

04-06 September – EUROMECH – **ETC18 2023 – 18th European Turbulence Conference** – Valencia (Italy) – https://www.euromech.org/ www.etc18.webs.es

04-06 September – EUROMECH – **Conference Data Driven Fluid Mechanics** – Italy – 629.euromech.org – https://euromech.org/

04-06 September – ERCOFTAC – **XXVI FMC – Fluid Mechanics Conference –** Warsaw (Poland) – Warsaw University of Technology – https://www.ercoftac.org/events/

04-07 September – AIDAA – **AIDAA XXVII International Congress** – Padova (Italy) – University of Padova – https://www.aidaa.it/aidaa2023/

05-07 September – EUROCONTROL – **Altimetry System Error Workshop** – Brussels (Belgium) – EUROCONTROL/HQ – https://www.eurocontrlint/event/

05-07 September – DGLR/CEAS – **ERF2023 – 49th European Rotorcraft Forum** – Bückeburg (Germany – Lower Saxory) – https://erf2023.dglr.de - https://ceas.org/european_rotorcraft_forum

05-08 September – EASN – **13th International Conference on Innovation and Space for opening New Horizons** – Salermo (Italy) – https://easnconference.eu

06-08 September – ERCOFTAC – **ETMM14 – Symposium on Engineering, Turbulence, Modelling and Measurements** – Barcelona (Spain) - https://www.ercoftac.org/events/

12-14 September – ESA – **6th ESA Cubesat Industry Days** – Leiden (NL) – Stadsgehoorzaal – https://www.event-sair.com/

12-14 September – RAeS – **RAeS – FDM2023** – Fracture, Damage and Structural Monitoring – To promote further international co-operation among scientists and engineers from different disciplinesinvolved in FDM – London (UK) – Imperial College London – South Kensington Campus - http://fdm.engineeringconference.net.new/

12-15 September – EUROMECH – **Conference Finite Fracture Mechanics** – Lyon (France) – 635.euromech.org – https://euromech.org/

14-16 September – ESA – **41st Antenna Workshop** – Noordwijk (NL) – ESA/ESTEC – https://atpi.eventair.com/

19-21 September – ESA – **6th Quantum Technology Conference** - Matera (Italy) – https://www.eventsair.com/

19-21 September – DGLR – **General Aerospace Congress – DLRK 2023 - Luft und Raumfahrtkongress 2023** – Stuttgart (Germany) – https://dlrk2023.dglr.de – contact: dlrk@dglr.de

20-22 September – RAeS – **President's Conference 2023 – Future of Flight Summit** – London (UK) – RAeS/HQ – www.aerosociety.com/events

21-22 September – ESA – **1st EO Commercialisation Days** – Paris (France) – https://www.eventsair.com/

22-24 September – DGLR – **German Aerospace Congress** – https://dlrk2023.dglr.de

25-28 September – ESA – **41st Antenna Workshop –** Noordwijk (NL) – ESA/ESTEC – https://www.eventsair.com/

AMONG UPCOMING AEROSPACE EVENTS

OCTOBER

02-06 October – IAF – **74th International Astronautical Congress** – Global challenges and Opportunities – Give Space a Chance - Baku (Azerbaijan) www.iac2023.org

02-06 October – ESA – **ESPC 2023 – European Space Power Conference - 13th Edition** – Elche (Spain) (NL) – https://atpi.eventair.com/

02-06 October – ESA – **EDHPC 2023 – European Data Handling & Data Processing Conference** – Juan-les-Pins (France) – https://atpi.eventair.com/

03-04 October – RAeS – **8th Aircraft Structural Design Conference** – London (UK) – RAeS/HQ – https://www.aerosociety.com/events

10-12 October – ICAO/EASA – **Forum on Regional Safety Oversight Organizations (RSOOs) 2nd Edition** – Nairobi (Kenya) – https://www.icao.int/Meetings/

11-13 October – WEC - **WEC 2023 – 7th World Engineers Convention** - Prague (Czech Republic) – https://www.wec2023.com

17-19 October – MRO Europe Aviation Week – **MRO Europe Conference** - RAI Amsterdam (NL) – https://mroeurope.aviationweek.com/en/home/html

17-22 October – SEOUL – Seoul ADEX 2023 – **Seoul International Aerospace & Defense Exhibition 2023** - Seoul (South Korea) – Seoul Airport – Seongnam Air Base – www.seouladex.com/intro/intro.php

18-20 October – ESA – ASTRA2023 - **17th Symposium on Advanced Space Technologies in Robotic and Automation** – Leiden (NL) – Scheltema – https://www.event-sair.com/

20 October – EUROCONTROL – **Safety of Vertical Navigation of Final Approach Workshop** – Brussels (Belgium) – EUROCONTROL/HQ – https://www.eurocontrol.int/event/

23-25 October – AIAA – **2023 ASCEND – Accelerating Space Commerce Exploration and New Discoveries** – Las Vegas, Nevada (USA) – Las Vegas and ONLINE – https://aiaa.org/events

23-26 October – ASCEND/AIAA – **ASCEND Conference** – Las Vegas, NV (USA) – www.aiaa.org/events

23-27 October – ESA – **ISSO – International School on Space Optics** – Noordwijk (NL) – ESA/ESTEC – https://atpi.eventair.com/

23-27 October – ICAO – **ICAO Air Navigation Procedures for Today** – Singapore (Singapore) – https://www.icao.int/Meetings/

23-27 October – ICAO – **ICAO Security Week 2023 – AVSEC & CYBERSEC –** Will cover all aspects of aviation security including aviation cybersecurity – Montréal (Canada) – ICAO/HQ – https://www.icao.int/Meetings/

NOVEMBER

06-08 November – FSF – **International Air Safety Summit – 76th Edition** – Paris (France) – Paris Mariott CDG Airport Hotel – https://flightsafety.org/event/

06-09 November–ESA/JRC/SatCen–**BigDatafromSpace 2023** – Vienna (Austria) – https://www.eventsair.com/

06-10 November – ESA – **Innovations Technologies for Space Optics – Workshop –** Noordwijk (NL) – ESA/ESTEC – https://www.eventsair.com/

12-16 November – UAE– **Dubai Airshow 2023 – The Center of Aerospace Strategy and Inspiration** – Dubai (UAE) – Dubai World Central Al Maktoum Jebel Ali – https://www.dubaiairshow.aero

14-15 November – 3AF – **CAT 2035 – Combat Aéroterrestre 2035 - 2nd Edition** – Versailles (France) – https://www.3af-cat2035.com

16-18 November – The Scientist – **GSEAMAE 2023 – 3rd Global Summit and Exposition on Aerospace and Mechanical Engineering** – Rome (Italy) – https://www.thescientist.com/2023/aerospace-mechanical-engineering - contact: gseame2023@thescientist.com

27-30 November – SESARJU – **13th SESAR Innovation Days – Inspiring long-term research in the field of ATM.** Sevillia (Spain) – University of Sevilla – https://www.sesarju.eu/events

27 November**-01** December – ESA/GEWEX/CNES – **HYDROSPACE2023 – 5th Space for Hydrology Workshop** - (GEWEX Global Energy and Water Exchanges) – Lisbon (Portugal) – https://www.eventsair.com/

29 November – EREA – **EREA Annual Event –** Brussels (Belgium) – https://erea.org/event/