CEAS
Council of European Aerospace Societies

BULLETIN AEROSPACE EUROPE

AEROSPACE EUROPE bulletin N° 3-2024 – July - September

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);
- 5 Corporate Members: ESA, EASA, EUROCONTROL, EUROAVIA, von Karman Institute;
- 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.

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- Technical pan-European events dealing with specific disciplines
- The biennial AEROSPACE EUROPE Conference

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

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- European Parliament
- European Commission
- ASD, EDA, OCCAR

HONOURS AND AWARDS:

- Annual CEAS Gold Medal
- Medals in Technical Areas
- Distinguished Service Award
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YOUNG PROFESSIONAL AEROSPACE FORUM

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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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EDITORIAL

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Dear readers,

The illustration of the front page shows the most important event for the European space which took place last week, the successful inaugural flight of Ariane 6 performed from Guiana Space Centre, the Europe's Spaceport, on Tuesday 9 July at 16:00 local time. This was quite an important event because Ariane 6 will guarantee again Europe autonomous access to space, taking over from its predecessor Ariane 5. Modular and versatile, it presents many innovations, in particular its re-ignitable upper stage thanks to which it will be possible to realise multi-payload missions such as the orbiting of satellite constellations or also to execute de-orbiting at the end of mission in order to avoid the spacecraft becomes space debris. Ariane 6 is one of the keys to European sovereignty. So, a new chapter of European space history is beginning, offering fascinating times to the young engineers and technicians of the "Ariane 6 generation."

A brief report on this A6 inaugural flight is presented in the magazine, just after an article dedicated to another extremely important space event, the successful fourth Integrated Flight Test (IFT-4) of the giant mega rocket SpaceX's Starship which took place on last 6 June. The current programme development calls for Starship to land four astronauts - among them one European - on the Moon for the first time in September 2026 on the Artemis III mission.

In addition to space, this issue of the CEAS bulletin also covers the different aerospace related headlines, with in introduction, the long interview with Antonio Blandini, Chair of EREA, conducted at the time of the 30th anniversary of this institution and on the occasion of which the present main aerospace research subjects to which it brings a major contribution were reviewed. I thank you very much Antonio.

Among the different articles presented in the magazine, I wish to mention two important studies recently published by the Air and Space Academy: the Opinion 'Decarbonising Air Transport' and the Dossier 'Progress in Air Transport – New Systemic and Human Competencies'. This Academy is besides preparing a two-day symposium 'Artificial Intelligence – Applications in aeronautics, defence and space' which will be held in Paris on 13-14 November 2024 (see back page).
As regards the Event Calendar, you may observe that the year 2025 begins to be fulfilled, with in the bottom the next CEAS biennial Conference '**AEC2025**' which will be held on 1-4 December in Torino. The next issues of our bulletin will regularly keep you informed about its preparation.

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CEAS PRESIDENT'S MESSAGE

Franco Bernelli Zazzera
CEAS President 2021-2024

As you have surely noticed, this issue of the Bulletin is printed with a slight time delay compared to normal schedule and it is strongly biased toward the space sector. This is clearly due to the interest around the first launch of Ariane 6, that comes just over one year after the last launch of Ariane 5. This has been a long-awaited success and will be a strong asset for Europe, that will regain autonomous access to space. Launch services are key for the development of the services that can be provided from space and are a strategic link, very important in particular in these times in which we have on a global level almost one launch a day, because the satellite market is exploding.
This strategic asset for Europe comes after 117 flights of the Ariane 5, during over 27 years of operations. Despite its first, unsuccessful launch in June 1996, Ariane 5 has been a key vehicle for many years in the commercial space industry, in particular for what concerns geostationary communications satellites. Its notable performance allowed it to successfully launch the James Webb Space Telescope for NASA at the end of 2021.
With Ariane 6, complemented by Vega, Europe is now in the condition to provide a wide range of launch services at competitive costs. The overall European launch capacity remains insufficient with the current market trends, but at least it reassures on the potential autonomy of Europe in this sector. It is significant to note that Ariane 6 foresees around 10 launches a year, while SpaceX has been capable of launching 14 of its Falcon 9 rocket in May 2024 alone.
Ariane 6 is a truly European endeavor, with 13 countries and 600 companies involved at various levels in the production of its components. It is a clear example of collaboration and innovation.
The CEAS community, being also truly European, is inspired by the success of such important projects and is working to keep Europe at the appropriate level of engagement in its field of activity. CEAS is constantly promoting exchange of ideas within the European aerospace community and promoting excellence in research, education, technological advancements and industrial progress. In June CEAS, thanks to its Italian member society AIDAA, has organized jointly with AIAA the Aeroacoustics conference in Rome. It has seen a huge participation and has been the occasion to celebrate the two CEAS Awards. The CEAS Gold Award, awarded annually to a professional that has contributed greatly to the achievements within the aerospace industry, has been assigned to Franco Ongaro, currently Managing Director of the Space Business Unit at Leonardo. The CEAS Distinguished Service Award, given annually to individuals who have demonstrated a great dedication to the aerospace community, has been assigned to Zdobyslaw Goraj, former CEAS President. Both awardees have dedicated their entire professional career to the development of the aerospace sector across Europe and in collaborative form and are excellent examples for the younger generation of professionals.
To stimulate even further the younger generation to excellence in aerospace, CEAS has decided to award prizes to the best student papers presented at every conference organized or co-organized by CEAS. It is a pleasure to say that such a decision has been unanimously approved by the CEAS Board and sees contributions also form other entities sharing the same vision. It has already been implemented in the recent conferences: the Aeroacoustics Conference (shared prize with AIAA), the Forum on Aeroelasticity and Structural Dynamics and the Guidance, Navigation and Control Conference (prize offered by ISAE and ONERA). Later this year, it will include the European Rotorcraft Forum.

To conclude my introductory message, I must inform our readers that CEAS has already fixed the dates of its biennial conference, to be held in Torino (Italy) on December 1-4, 2025. It will be the 10th CEAS conference, marking an important milestone, and it will be combined with the 28th AIDAA Conference and the 10th Aerospace & Defense Meeting. More precise information will obviously follow in the future, and any contribution in ideas and proposals will be welcome. As it is common to say in such cases, "stay tuned".

And now enjoy reading this (as usual) excellent Aerospace Europe Bulletin..

INTERVIEW WITH ANTONIO BLANDINI, CHAIR OF EREA

By Jean-Pierre Sanfourche, Editor in Chief

Antonio BLANDINI
President CIRA –
Italian Aerospace
Research Centre

Prof. Avv. Antonio Blandini is Full Professor of Business Law and of Innovation Law at Naples University "Federico II" and at Luiss University (Rome).
Due to his wide experience both in banking, insurance and financial market laws and regulations and in aerospace management and regulations, Mr. Blandini is a TAIEX expert of the European Commission, and has been appointed as member of relevant bodies in many European and Italian institutions and companies. Among them, he is a current member of the Consultative Working Group for Investment Management Standing Committee in ESMA and former Non-Executive Director of Alenia Aermacchi (Leonardo Group).
In May 2022 he was nominated Chairman of the Board of Directors of CIRA by CNR, the National Research Council. From July 2022 to June 2024, he was Chairman of ESRE, the Association of European Space Research Establishments, and since January 2024 he is Chairman of EREA, the Association of European Research Establishments in Aeronautics.
He is a member of the Board of Directors of AIAD, the Italian Industries Federation for Aerospace, Defence and Security.

This year 2024, EREA will celebrate its 30th anniversary. Could you recall us in a few words the main milestones of its development since its creation in 1994?
Yes, it has been and still is an amazing journey.
It seems long time ago but we are relatively young with respect to aviation history. We are looking at the future with the experience of the past. I'm proud to chair EREA because you can breathe the flavour of Europe just recalling few milestones of its history and looking at pictures as below:

- 1993: Joint Position paper on the Future Role of the Aeronautical Research Establishments in Europe
- October 1994: creation of the Association of European Research Establishments in Aeronautics

- May 1999: Establishment of EREA Association as legal entity according to Dutch law
- 2004: Starting to enlarge EREA membership with VZLU (Czech Republic), till the current configuration (12 Full members + 1 Affiliate member and 2 Strategic Partners)
- 2012: Launch of Future Sky Initiative, a proposal for a European Joint Research Initiative in aviation looking beyond the current framework
- 2013: Issue of the GREEN PAPER on a European Joint Research Initiative for Aviation
- 2018 and 2024: Future Sky reviews for matching new EC targets

When, where and how do you plan to celebrate this 30th anniversary?
Yes, this year, EREA is celebrating 30 years from the signature of the Association and we plan to mark this milestone with some events. A dedicated logo was designed to remind to the aviation community such a great milestone, marking the cooperation at Research Establishments (REs)' level.

Some internal events were conceived, for our researcher's community, to help them prepare excellent EU-proposals, prepare internal EREA cooperation projects and support the increasing of mobility inside EREA REs.
Branded as EREA 30 years and organized by Future Sky, the second edition of the EREA Future Sky event, dedicated to EREA Researchers, was organized in Bucharest

and hosted by INCAS on the 15-16th of May. Main topic was Advanced Air Mobility and the event gathered 18 participants from EREA institutes. Another event dedicated to the young researchers this time, is the special Young Researcher Event in Bristol, that will be hosted by our strategic partner NCC, on the 16th and 17th of October.
In particular another important milestone was reached during this special year, the 50th Board Meeting, celebrated in Rome with a dedicated dinner and a celebration at "Casa Dell' Aviatore", headquarters of the Air Force Officers Club.

For the community there will be 2 special events to be highlighted:
On the 15th of October, the exact date of the signature of the Association, EREA will organize a Fireside dialogue on "The future of aviation Research and Innovation funding in the EU Framework Programme", having high level guests and representatives of all stakeholders in the aviation community in Brussels.
EREA will conclude the year with its traditional Annual Event, to be hosted by BelVue Museum in Brussels on the 16th of December.

Clean Aviation JU has launched its Phase 1 projects and is now entering Phase 2, the Demonstration Phase, with an update of the Strategic Research & Innovation Agenda (SRIA). This phase 2 is being conducted with the objective to reach the goals of ACARE vision for aviation: "Fly the Green Deal". What are the main axes of EREA's support to this important phase?
REs are at the cutting edge of Research, Development and Certification in Europe. Phase 2 will be crucial to verify and validate the technological solutions proposed for implementation coming from Phase 1. After an in-depth exploration and analysis of technological solutions, we will reach TRL 5 through a Ground Test campaign based on the envisaged flight test aircraft. The Wind Tunnel Test Campaign will be oriented to reinforce the final flight tests and guarantee the required safety for flight. Virtual testing will be also a new way to reduce time and cost of the tests. Finally, a major effort by EREA REs' community is devoted to reinforce flight test capabilities support. And on the RTO side, we are looking beyond the current Clean Aviation partnership and have the ambition to contribute to a European Flying Test Bed (EFTB), a similar approach to NASA's X – Vehicles.

The so-called RTD cycle (RTD: Research and Technology Development) bridges the gap from basic research to maturation, validation and operational products. I presume that RTD is not only short- and medium term oriented, but also takes into account the gaps for the long term, isn't it? Which role is EREA going to play in RTD? Is EREA research programme Future Sky being updated in accordance with the new orientation?
Yes, indeed. The Future Sky (FS) programme was designed in 2014 and updated in 2018 and 2024 to provide a vision beyond the current JUs' plans and to prepare the next but one generation of the air transport system. New technologies and solutions are proposed in order to prepare Europe to implement long term objectives and meet ACARE's "Fly the Green Deal" (FtGD) targets. By encouraging collaboration between research establishments, industry and universities, Future Sky promotes technological advances for the benefit of European society and the global aeronautics industry looking beyond the next generation of aircraft. The programme's six thematic areas, updated in 2019 - safety, silent air transport, energy, urban air mobility, aviation security and circular aviation - provide a comprehensive framework for addressing the multifaceted challenges of tomorrow's air transport. And the Future Sky programme is currently being updated with 8 Future Sky themes to address the challenges highlighted in the FtGD vision.

Anyway, it will be fundamental to adopt a synergic approach at European level through all the stakeholders. ACARE and the new FP10 should support an integrated RTDI (Research, Technology, Development and Innovation) plan by guaranteeing a transparent and balanced way of funding all the RTDI cycle, with a dedicated, independent and effective structure, which includes on the one hand a strong relationship with industry, through specific instruments like JUs, but also on the other hand the possibility of developing bottom-up new ideas, at low and intermediate TRLs. It is crucial to find an appropriate system that preserves the independence of the 2 trends (bottom up and top down), ensures balanced funding, and preserves the efficiency and effectiveness of basic and collaborative research (L0-L1 vs L2-L3).

Till recently, EREA was exclusively oriented on civil aviation? Now military aerospace research programmes are to be including within the framework of the European Defence Fund (EDF). How do you see this evolution?
From a community perspective, we welcome this development, in particular the fact of having dedicated spaces for RTDI at EU level; EREA highly stresses the importance of continuing to use existing instruments such as Horizon Europe and the European Defence Fund with appropriate budgets in the next MFF. It should be noted that

fundamental / low TRL research matures independently of the type of application, civil or military. EREA supports the research and development of technologies with potential Dual-Use, considering the implementation of collaborative research projects, bringing together stakeholders from both sectors on selected topics, seeing this as an asset contributing to reinforce a critical mass of Research for new technologies, but also helping to inspire new joint critical initiatives, such as UAS/UAV improvements toward fully safe and autonomous flight.

Upgrading existing facilities is needed to respond to new aviation challenges and new technologies. EREA is the best possible organisation to coordinate the overall action plan, isn't it?

Yes, as owners of existing facilities, it's coming per se that there is a common intent to upgrade or build new facilities in order to respond to new technologies needs and requirements. Indeed, certification is not a matter that you invent in a day and the 30th years of experience of EREA (and an even longer experience of each EREA RE) are fundamental for implementing Best Practices and lesson learned. A close collaboration with EASA since the begin of RTDI cycle is needed indeed to take into account complex safety issues to be proofed and certified for a full safe integration. An MoU with EASA is already in place to implement a synergic approach.

Perhaps some words about EREA implication in SESAR JU research programmes?

ATM and the digitalization of EU Sky is more and more important for a future clean and efficient Single Eu Sky. Airport Capacity and a smart management of air space is mandatory for facing air transport growth and needs. Artificial Intelligence, new integrated navigation technologies, with a triangled control Satellite-On Board-On Ground are key aspects to be studied and developed for a Dynamic management of the traffic. EREA members are fully committed also as SESAR3 members contributing both at basic research through the ER (Exploratory Research) projects and at implementation and deployment level through IR (Industrial Research) and DSD (Digital Sky Demonstration). Finally, EREA REs are strongly working on full Impact assessment model for the aviation cycle and optimized trajectories, being these critical for meeting FtGD targets.

The considerable science and technology evolutions need a young generation of talented researchers and engineers. But as I said in my editorial of the CEAS bulletin issue 2-2024, aerospace in Europe has difficulties to recruit high-level talents. I know that it is your intention, in your quality of chair of EREA, to strongly contribute to attract young best talents in aerospace. Could you indicate the main initiatives you envisage to take? Specific conferences and lectures, PEGASUS Association, etc.

As already said, an axe of actions at RE level is to increase the cooperation with Universities and Industries by offering to PhD students support in the form of dedicated programs with experimental work thesis, and ranging from scientific model (Academia) to simulation and test (REs) till technology integration into products (industry).

On the other hand, a strong collaboration with EASN and Pegasus is in place and EREA is always supporting with dedicated Scientific session at EASN Conferences, helping young people to get closer to different disciplines.

Moreover, EREA supports mobility and specific training of young people with dedicated EREA YRE – Young Researcher Events - in order to build a real European Research Area with a multicultural and international workforce Moreover, EREA supports mobility and specific training of young people with dedicated EREA YRE – Young Researcher Events - in order to build a real European Research Area with a multicultural and international workforce. Complementary initiatives are set up at all Research Establishments, starting with school students, with dedicated info-days, courses, summer school classes, or laboratories with scientists, in order to foster passionate and curious minds from the early stage students in schools to promote STEM and in general aerospace careers. Indeed this was also the subject of a successful FP7 EU project – REStARTS.

ANNEXES

A – Antonio Blandini nomination ceremony

As of 1st of January 2024, Prof. Antonio Blandini, President of CIRA, is the new Chairman of EREA. Prof. Blandini will hold this position for the next two years and will be supported by the outgoing EREA Chair, Mr. Pawel Stężycki (President and CEO of ILOT).

B – EREA at a glance

EREA, the association of European Research Establishments in Aeronautics, is a non-profit organisation whose members are Europe's most outstanding research centres in the field of aeronautics and air transport. The objectives of EREA members are: to promote and represent joint interests; to intensify cooperation in the field of civil, military and space-related aeronautics; to improve and intensify the cooperation with third parties in the field of aviation; to facilitate integrated management of joint research activities. EREA is represented in 14 countries as below:

C – An example among the EU-FP collaborative research projects with EREA participation: IMOTHEP

IMOTHEP was an ambitious 4-year technological program (2020-2024) driven by the European aviation research and industry with:

- A holistic approach toward hybrid-electric propulsion (HEP) to reduce commercial aircraft emission,
- An in-depth analysis of power train technologies in close connection with aircraft configurations,
- The ambition to get a clear view of the potential benefits of HEP.

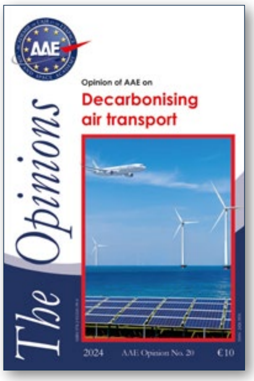
IMOTHEP was carried out by a powerful multidisciplinary consortium, led by ONERA and bringing together EREA partners, academia and industry, with also the participation of Canadian partners.. The project also reached out to the whole European aviation community to finally elaborate the European roadmap toward HEP.

IMOTHEP has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875006 IMOTHEP.

D – CIRA at a glance

CIRA, the Italian Aerospace Research Centre, is an organization mainly of public ownership created in 1984 for the purpose of performing research in the fields of space and aeronautics. The Centre, with headquarters and operational structures in Capua, Campania, was founded by the Italian State with the aim of promoting research and technological development in the fields of space and aeronautics matching that of other European countries, and enabling Italian enterprises to compete at high levels on the international markets. The National Research Council, the Region of Campania, Industries and SMEs of the aerospace sector, who play a part in the company, all ensure that CIRA's goals remain consistent with the strategic national guidelines and the needs of companies, thereby contributing to the economic development of the country. Today, just forty years since it was set up on 9th July 1984, CIRA has the biggest research facilities in the field of aerospace in Italy, with testing facilities that are unique in the world and state-of-the-art laboratories used by industries and bodies in Italy and around the world. The company specialises in the most advanced techniques of aerospace research: from the study of aeronautical craft and spacecraft able to fly autonomously and at very high speeds; to the development of innovative systems that can reduce the environmental impact of aircraft, increase flight safety, and improve the management of air traffic; and to the development of technologies for the space transport systems of tomorrow. CIRA takes part in the main European and International research programmes, collaborates with top Universities and aeronautical and space companies in Italy and other countries, and is also a strong attractor of talent and industrial investments. 370 people currently work for CIRA, mostly in research and in scientific and technological development.

DECARBONISING AIR TRANSPORT



Ten years after its Dossier No. 38 "Flying in 2050", and following the March 2021 conference "Air transport in crisis and the climate challenge: Towards new paradigms", which gave rise to its Opinion No. 13, the Air and Space Academy (AAE) is publishing this Opinion No. 20 "Decarbonising air transport", the fruit of two years' work by its "Energy and Environment" commission (C2E) comprising
more than 60 participants, including 20 from outside AAE, from eight European countries, collectively at the highest scientific and technical level in the fields of climate, energy and aeronautics.

This opinion puts the spotlight on the essential components of the strategy to decarbonise air transport. Why this new publication, when AAE has already expressed its views on the subject several times and the topic is dealt with in a number of publications from a variety of sources? The main reasons are the extremely rapid rate of change of the **general context of decarbonisation in the sector**. The scale of the challenges to be met is increasingly apparent, and raises new questions. These challenges concern three areas:

TECHNOLOGY

Technological innovation will be a key condition for success; firstly, by taking full advantage of what already exists (fleet modernisation) and improving performance (aerodynamics, new configurations, reduced weight, etc.); then by developing the use of very low-emission fuels (SAF, Sustainable Aircraft Fuels), whose production processes are already familiar, but whose synthetic version will require a large quantity of decarbonised electricity, and will be more expensive than kerosene, at least in the initial period. Other types of propulsion are possible (electrification, hybridisation, hydrogen) but for limited aircraft sizes.
Both operational and technical optimisation of air navigation systems could also reduce air transport emissions by up to 5 % in Europe.

Once all these technological solutions have been implemented, any residual emissions will be able to be offset by CO_2 capture and storage (CCS).
In all these areas, a **general acceleration strategy** will need to be put in place: incentives to modernise fleets and use SAF, support for research, investment in SAF production and CCS techniques.

ENERGY

The main new contribution of this opinion is a detailed analysis of energy requirements in terms of SAF, based on new European regulations (ReFuelEU). It is not enough to possess the technological solution, we need to be able to implement it, i.e. to have a sufficient share of decarbonised electricity. We estimate air transport needs to be at least 11% of the total amount required to meet all the needs of the European Union (650 TWh versus 6,000 TWh). As for the investment needed to produce SAF, including electricity production, this is estimated to be at least € 40 billion a year for 25 years.
These figures are very high and demand reflection as to the policy to adopt. We cannot rule out a scenario involving a shortage of decarbonised electricity, which will raise the question of how to allocate this resource to the various sectors of activity. Airlines could be forced to increase their foreign supplies, a development they already seem to be anticipating. The political strategy of decarbonisation could thus become difficult to reconcile with the search for European energy independence.

The public authorities will therefore have to encourage the massive investment needed and/or raise the issue of regulation.
Investors will need **regulatory stability** to give them greater visibility on future markets. Regulations should **take into account the respective technological decarbonisation capacities of the various economic sectors and therefore give priority to air transport.**

SOBRIETY AND REGULATION

Uncertainties surrounding policies call for in-depth reflection on the societal changes affecting air travel in its international context.
The Covid crisis led to a change in attitudes, particularly within companies, with a noticeable drop in business travel. However, tourist travel has resumed its growth, and IATA (International Air Transport Association) is forecasting a record year in 2024. AAE believes that this is not just a cyclical phenomenon, and that air travel professionals must start thinking now about the air travel of tomorrow.
The temptation to impose regulatory constraints on traffic is a very real one. Whatever the arguments, such

a policy applied unilaterally to international air transport would, in our view, have no chance of success, as illustrated in several past examples. Instead, European countries should implement cooperative strategies with third countries and join forces to support policy developments at ICAO (International Civil Aviation Organization) level.
Another idea sometimes advanced is that of artificially increasing costs by applying taxes, and thus exerting a downward pressure on traffic. In addition to its uncertain impact, this type of policy would, in our view, run counter to the policy of European and global liberalisation that has been pursued for over 30 years, which aimed to facilitate access to air transport for the less well-off.

IN CONCLUSION

This opinion raises many political questions, highlighting both the certainties, but also the uncertainties relating to the various possible courses of action. It attempts to provide some points of reference and to open up a debate that can only move forward with in-depth analysis of the different prospective scenarios.
The Air and Space Academy will continue its analyses theme by theme, and is ready to contribute to any wide-ranging reflection. It is also currently publishing an in-depth dossier on the various themes raised here: Dossier

No. 55, entitled
"Decarbonising air transport by 2050:
a question of energy".
Michel WACHENHEIM
President of the Air and Space Academy

SUMMARY AND RECOMMENDATIONS FROM OPINION NO. 20

Air transport has played an important role in improving access and supporting the economic development of many countries and territories. It has driven an incredible surge in relations between the peoples of the world. The combined effect of liberalisation and fuel and cost reductions has opened up access to long-distance travel for a large proportion of the population in developed countries, and this will continue in the rest of the world.
In the coming years, the European air transport sector aspires to be sustainable in the face of the climate challenge, and is aiming for carbon neutrality by 2050.
Decarbonising aviation requires: (a) a sharp reduction in aircraft fuel consumption; (b) the use of alternative fuels to kerosene[3 4]; (c) carbon capture and storage to render emissions from the remaining fossil kerosene "neutral"; (d) sobriety.

a) The acceleration in the replacement of aircraft fleets by recent aircraft (average age 12 years) and the appearance of a new generation of aircraft around 2035 will provide successive gains of 30% and 25% respectively in fuel consumption per passengerkilometre-transported (pkt). Given that medium- and long-haul flights of more than 1,500 km departing from Europe generate over 70% of CO_2 emissions, it is on these flights that action must be taken as a priority.

b) Various SAF variants compatible with current aircraft are in the early stages of industrial production and will enable a safe transition thanks to their drop-in capability.
SAFs from bio-based sources have many advantages, but the quantity available in Europe for aviation will amount to only 20% of requirements5. Consequently, the use of a large quantity of e-fuels is a necessary step, and will call for a great deal of decarbonised electricity.

c) Measurable, certifiable carbon capture and storage operations will generate "negative emissions" that offset the emissions from the remaining use of fossil kerosene on a tonne-for-tonne basis.

d) The notion of sobriety in usage and behaviour will become more accepted, depending on the country, indeed this is already the case for business travel.

Hence the recommendations below:

Recommendation 1: Public authorities should introduce incentives to speed up fleet renewal.

Recommendation 2: Public authorities should give immediate priority to supporting the development of air transport using SAF.

Recommendation 3: The European airline industry and public authorities should encourage massive investment in SAF production, with a stable regulatory strategy and greater visibility as regards future demand.

Recommendation 4: European and national public authorities should arbitrate for access to biomass on the one hand, and to "sustainable" fuel imports on the other, in line with the social and economic value of aviation.

Recommendation 5: Industry and public authorities should accelerate the deployment of CO_2 capture and storage needed to achieve carbon neutrality by 2050.

3. *These alternative fuels are called Sustainable Aviation Fuels (SAF). They are produced either from bio sources (bioSAF), or from CO_2 and hydrogen… and a large amount of electricity (e-SAF/e-fuel).*

4. *For general aviation and short-haul aircraft with less than 100 seats, "all-electric" or "hybrid" or "hydrogen" alternatives seem interesting (see below).*

Recommendation 6: Economic and regulatory measures taken within a national or European framework will only be fully effective if they are accepted and applied by the rest of the world. To this end, they should be negotiated within the framework of existing international agreements (ICAO and bilateral agreements).

Recommendation 7: The European air transport sector should adapt its outlook, embracing a spirit of sobriety and "best use", whilst promoting the irreplaceable nature of travel.

WHAT ARE THE CONDITIONS FOR SUCCESS?

1. Fleet renewal? No major obstacle here: it is known to be in the best interests of the airlines. Any limit will be that of aircraft manufacturers' production rates.

2. Developing new aircraft? Here too, market forces and fuel efficiency gains will be motivating factors for aircraft manufacturers and airlines. Among the various projects, the development of medium- and long-haul liquid hydrogen-powered aircraft raises doubts, as it would have to overcome numerous technical, operational and commercial obstacles, including the setting up of dedicated airport facilities around the world.

3. SAF production? The adoption by the European Union (EU) of the ReFuelEU regulation, requiring greater incorporation of SAF by 2050, removes many uncertainties forninvestors. There are no major technical obstacles, but energy investment outside of aviation needs to move up a gear to avoid a potential shortage of low-carbon energy for society as a whole. This represents a huge industrial and economic challenge. Social obstacles will have to be overcome in order to accelerate the construction of facilities producing decarbonised electricity.

4. Carbon capture and storage? Initiatives are underway for industries where this process is unavoidable, according to the IPCC (Intergovernmental Panel on Climate Change). The aviation sector should play a greater role.

5. Acceptance of a certain sobriety? Aviation bashing is unfair, but open debate is to be welcomed: better, more reasoned uses should gradually be defined by all stakeholders.

A fundamental point: European air transport is not totally in control of its own destiny. It will rely on the supply of a sufficient quantity of decarbonised energy, i.e. a significant proportion of Europe's electricity. Yet the energy transition has barely begun: for EU society as a whole, the investment needed simply to produce enough low-carbon energy would amount to around €6,500 billion, or €250 billion a year until 2050. With 26 years to go, and given the time needed to set up such an industrial complex, this represents an investment programme unrivalled since post-war reconstruction.

Explanation: By 2050, European airports will be required to supply a minimum of 70% SAF, i.e. ~ 28 million tonnes/year (order of magnitude).
This will call for more than 10% of Europe's decarbonised electricity6, i.e. around 650 TWh per year, a quantity equivalent to the total current electricity consumption of countries such as Germany and France.

The amount of decarbonised energy in 2050 is likely to be insufficient to meet the needs of society as a whole7. Hence a reflection that goes far beyond the aviation sector: both national and European "energy transition" plans seem to us to be very optimistic in terms of society's capacity to reduce its energy consumption and to invest. It would be a shame to miss out on such an opportunity to reindustrialise our regions and, in so doing, save €100 billion a year in "sustainable" fuel imports.

■

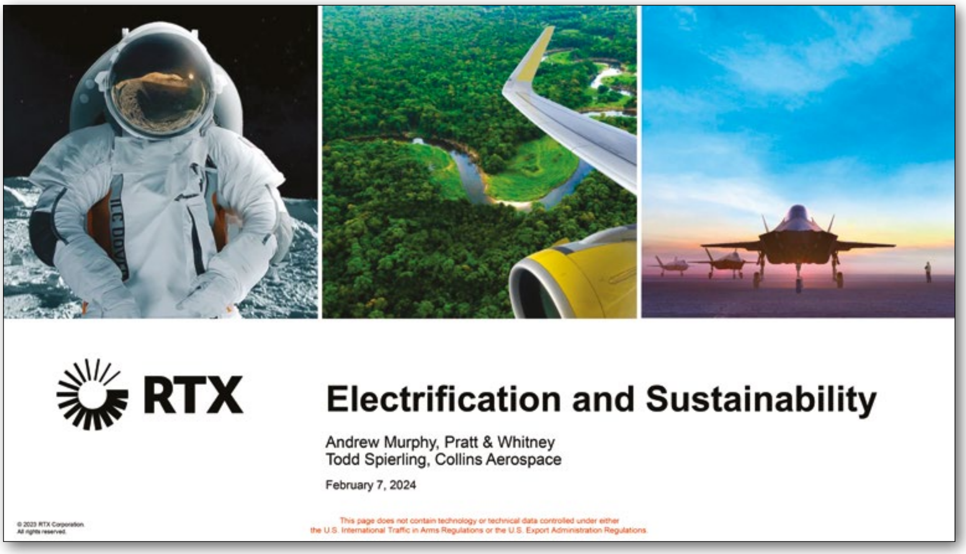
5. *This 20% figure is confirmed by a report by the French Académie des Technologies – June 2023: "La décarbonation du secteur aérien par la production de carburant durable".*

6. *In fact, while road transport saves 50% energy by switching to electric power, synthetic kerosene doubles electrical energy requirements. The availability of sufficient quantities of decarbonised electricity is therefore key.*

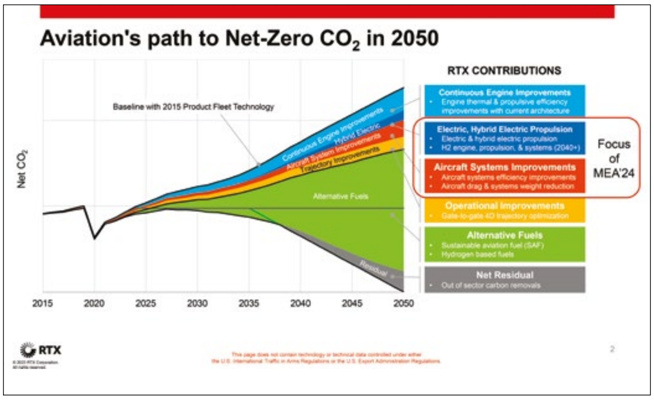
7. *The United States, with its Inflation Reduction Act (IRA), has created a momentum commensurate with the challenge.*

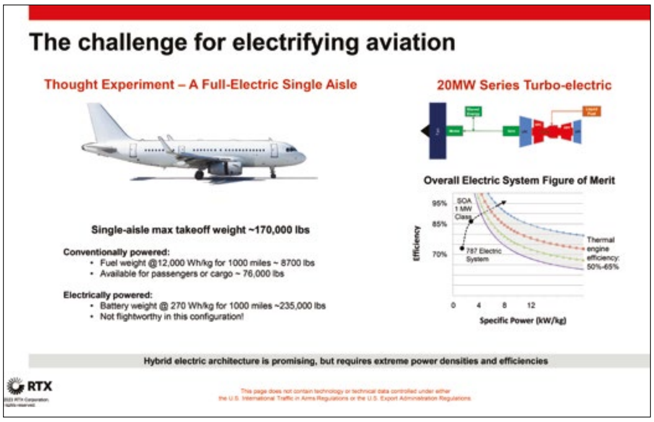
MORE ELECTRICAL AIRCRAFT

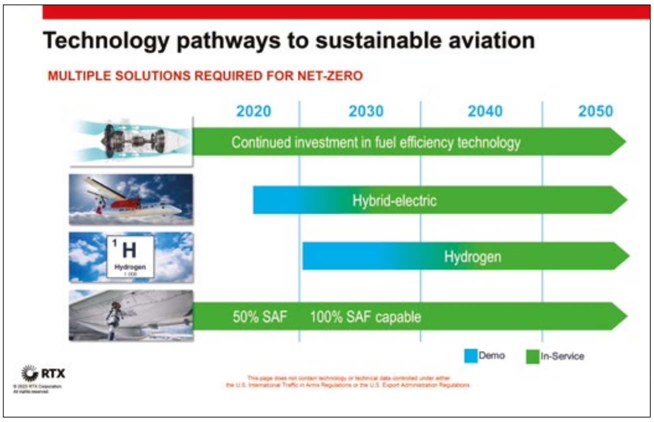
On 7 and 8 February 2024, took place in Toulouse (France) at ISAE-SUPAERO the International Conference MEA 2024 whose objective was to bring support to the transition towards more electrical aircraft. A number of high-level experts had the occasion to present their views on the this subject. Among them, Andrew Murphy from Pratt & Whitney and Todd Spierling.

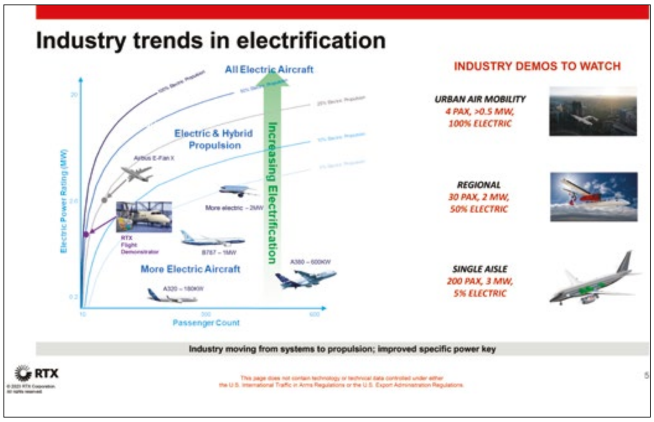


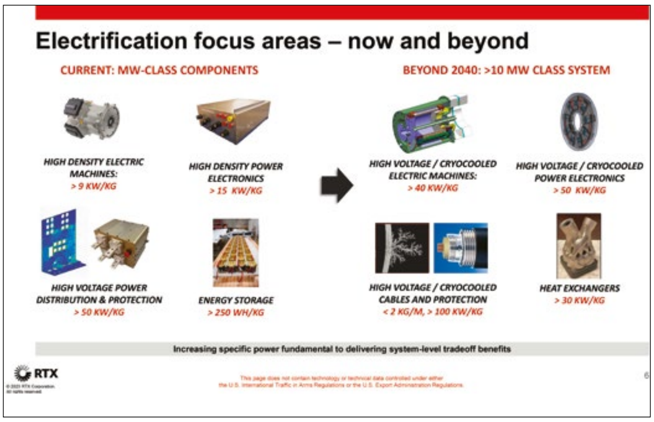
Electrification and sustainability Andrew Murphy – Chief Engineer, Advanced Commercial Engines at Pratt & Whitney Todd Spierling, Principal Technical Fellow – Electrification, Collins Aerospace Wednesday, Feb. 7, 10:00 am, Amphi 1 Around the world, all sectors of industry are strategizing on how to reduce greenhouse gas emissions to mitigate their effects on global warming. The aviation sector in general, and RTX in particular, has committed to achieve net zero by 2050 through a series of measures to reduce CO_2 emissions, including Electric/Hybrid Electric Propulsion and Aircraft Systems Improvements, which are of particular interest at this More Electric Aircraft '24 conference. One of the key approaches that the industry is working on to improve the fuel efficiency of engines and aircraft is electrification, with full electric concepts for small aircraft, and hybrid electric concepts for regional and larger aircraft. The maturation of electric propulsion architectures depends on the development progress of key constituent technologies, including rotating electrical machines, power electronics, energy storage, protection and distribution systems, and synergies with more electric aircrafts, with both near-term targets and longer-term technologies that promise even further impact. This presentation will outline challenges, approaches, technologies, and demonstrator programs being executed across RTX in support of this Electrification initiative. It will highlight component, propulsion system, and aircraft level initiatives that are currently underway in both Europe and North America in support of these sustainability goals.

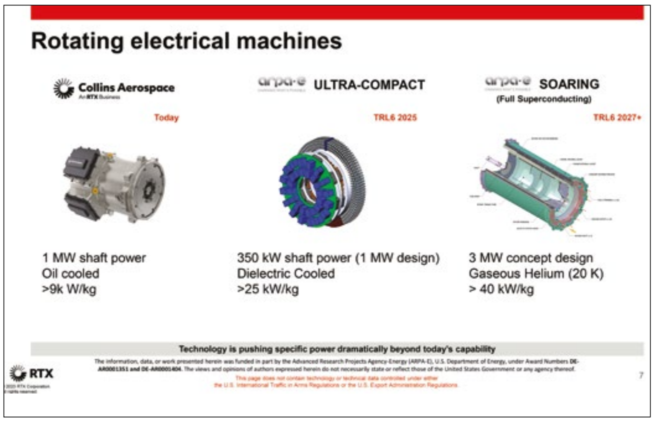


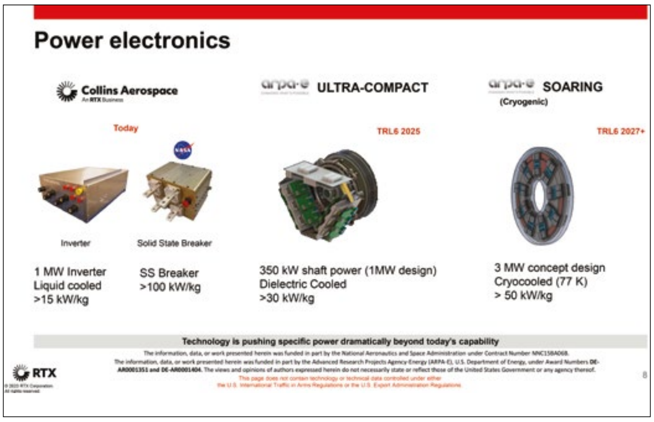


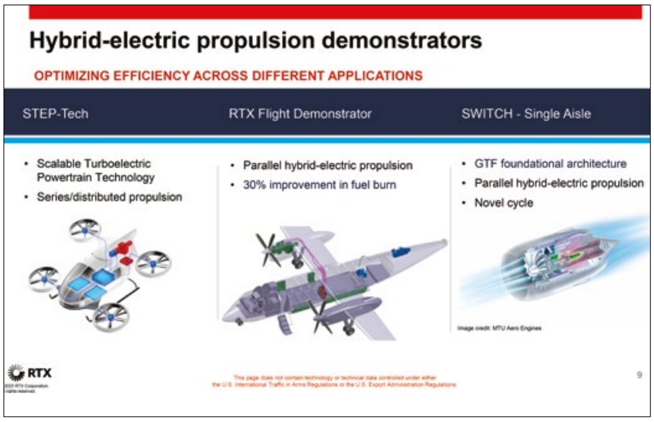

Technology pathways to sustainable aviation
MULTIPLE SOLUTIONS REQUIRED FOR NET-ZERO
2020
2030
2040
2050
Continued investment in fuel efficiency technology
Hybrid-electric
Hydrogen
50% SAF
100% SAF capable
Demo
In-Service
RTX

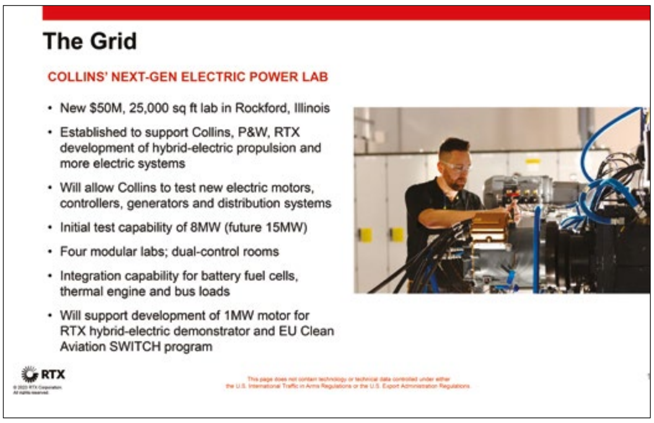

Industry trends in electrification
All Electric Aircraft
Electric & Hybrid Propulsion
Increasing Electrification
More Electric Aircraft
Electric Power Rating (MW)
Passenger Count
INDUSTRY DEMOS TO WATCH
URBAN AIR MOBILITY
4 PAX, >0.5 MW, 100% ELECTRIC
REGIONAL
30 PAX, 2 MW, 50% ELECTRIC
SINGLE AISLE
200 PAX, 3 MW, 5% ELECTRIC
Industry moving from systems to propulsion; improved specific power key
RTX

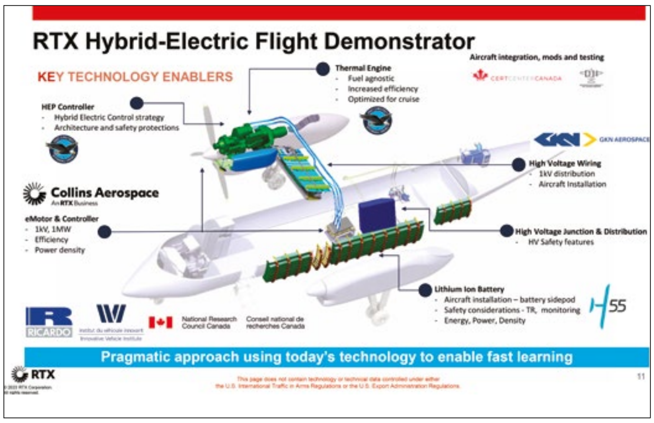

Electrification focus areas – now and beyond
CURRENT: MW-CLASS COMPONENTS
BEYOND 2040: >10 MW CLASS SYSTEM
HIGH DENSITY ELECTRIC MACHINES: > 9 KW/KG
HIGH DENSITY POWER ELECTRONICS > 15 KW/KG
HIGH VOLTAGE / CRYOCOOLED ELECTRIC MACHINES: > 40 KW/KG
HIGH VOLTAGE / CRYOCOOLED POWER ELECTRONICS > 50 KW/KG
HIGH VOLTAGE POWER DISTRIBUTION & PROTECTION > 50 KW/KG
ENERGY STORAGE > 250 WH/KG
HIGH VOLTAGE / CRYOCOOLED CABLES AND PROTECTION < 2 KG/M, > 100 KW/KG
HEAT EXCHANGERS > 30 KW/KG
Increasing specific power fundamental to delivering system-level tradeoff benefits
RTX


Rotating electrical machines
Collins Aerospace
Today
ULTRA-COMPACT
TRL6 2025
SOARING
(Full Superconducting)
TRL6 2027+
1 MW shaft power
Oil cooled
>9k W/kg
350 kW shaft power (1 MW design)
Dielectric Cooled
>25 kW/kg
3 MW concept design
Gaseous Helium (20 K)
> 40 kW/kg
Technology is pushing specific power dramatically beyond today's capability
RTX

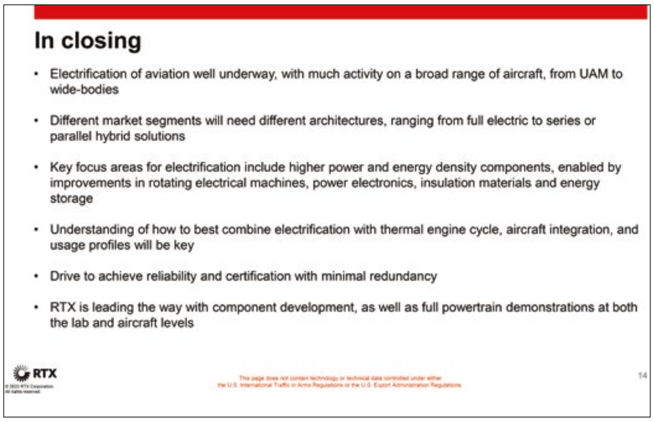

Power electronics
Collins Aerospace
Today
ULTRA-COMPACT
TRL6 2025
SOARING
(Cryogenic)
TRL6 2027+
Inverter
Solid State Breaker
1 MW Inverter
Liquid cooled
>15 kW/kg
SS Breaker
>100 kW/kg
350 kW shaft power (1MW design)
Dielectric Cooled
>30 kW/kg
3 MW concept design
Cryocooled (77 K)
> 50 kW/kg
Technology is pushing specific power dramatically beyond today's capability
RTX

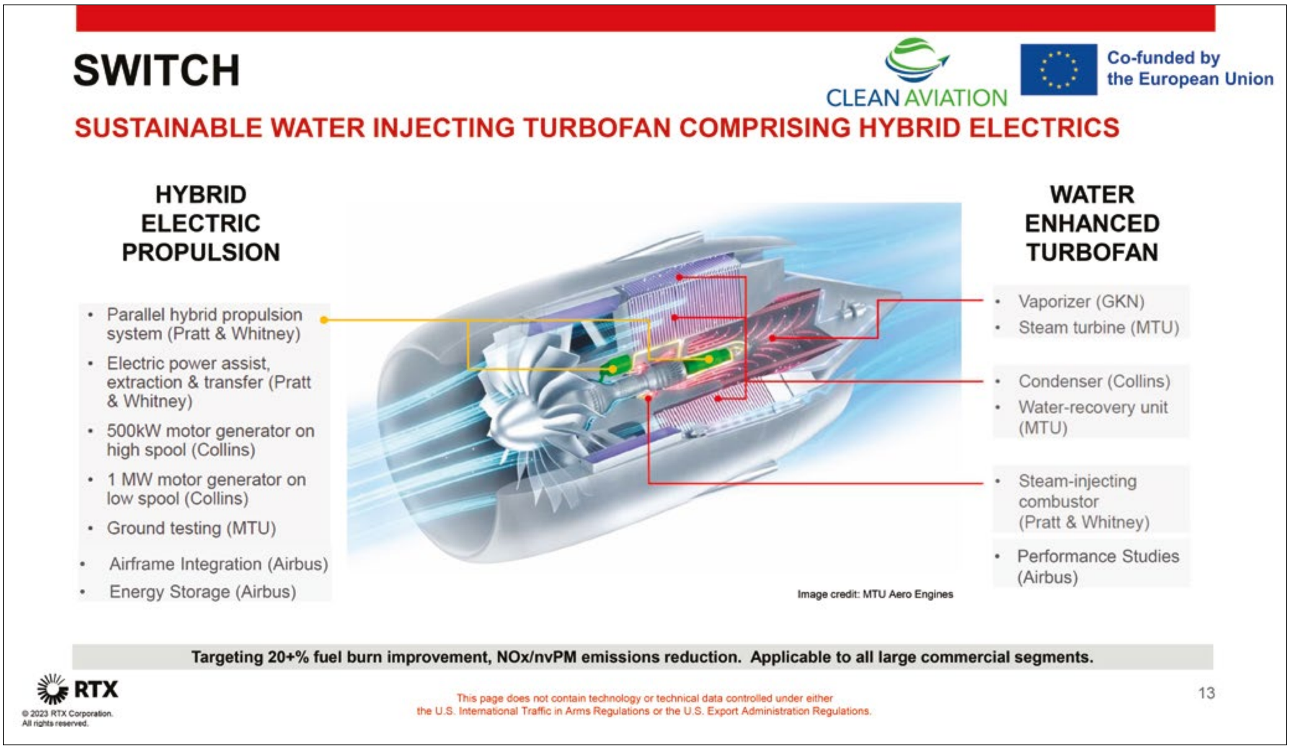

Hybrid-electric propulsion demonstrators
OPTIMIZING EFFICIENCY ACROSS DIFFERENT APPLICATIONS
STEP-Tech
RTX Flight Demonstrator
SWITCH - Single Aisle
Scalable Turboelectric Powertrain Technology
Series/distributed propulsion
Parallel hybrid-electric propulsion
30% improvement in fuel burn
GTF foundational architecture
Parallel hybrid-electric propulsion
Novel cycle
Image credit: MTU Aero Engines
RTX


The Grid
COLLINS' NEXT-GEN ELECTRIC POWER LAB
New $50M, 25,000 sq ft lab in Rockford, Illinois
Established to support Collins, P&W, RTX development of hybrid-electric propulsion and more electric systems
Will allow Collins to test new electric motors, controllers, generators and distribution systems
Initial test capability of 8MW (future 15MW)
Four modular labs; dual-control rooms
Integration capability for battery fuel cells, thermal engine and bus loads
Will support development of 1MW motor for RTX hybrid-electric demonstrator and EU Clean Aviation SWITCH program
RTX


RTX Hybrid-Electric Flight Demonstrator
KEY TECHNOLOGY ENABLERS
Aircraft integration, mods and testing
Thermal Engine
Fuel agnostic
Increased efficiency
Optimized for cruise
HEP Controller
Hybrid Electric Control strategy
Architecture and safety protections
Collins Aerospace
eMotor & Controller
1kV, 1MW
Efficiency
Power density
High Voltage Wiring
1kV distribution
Aircraft Installation
High Voltage Junction & Distribution
HV Safety features
Lithium Ion Battery
Aircraft installation – battery sidepod
Safety considerations - TR, monitoring
Energy, Power, Density
National Research Council Canada
Conseil national de recherches Canada
Pragmatic approach using today's technology to enable fast learning
RTX


Hybrid-electric milestones
2021 Funding from Canada/Quebec
Suppliers' selection
2022 Supplier announcements
Strategic Investments
First Engine Run
2023 1MW motor test
2024 Full power propulsion system test
Aircraft mods
Flight Test
RTX
12


In closing
• Electrification of aviation well underway, with much activity on a broad range of aircraft, from UAM to wide-bodies
• Different market segments will need different architectures, ranging from full electric to series or parallel hybrid solutions
• Key focus areas for electrification include higher power and energy density components, enabled by improvements in rotating electrical machines, power electronics, insulation materials and energy storage
• Understanding of how to best combine electrification with thermal engine cycle, aircraft integration, and usage profiles will be key
• Drive to achieve reliability and certification with minimal redundancy
• RTX is leading the way with component development, as well as full powertrain demonstrations at both the lab and aircraft levels
RTX
14


SWITCH
CLEAN AVIATION
Co-funded by the European Union
SUSTAINABLE WATER INJECTING TURBOFAN COMPRISING HYBRID ELECTRICS
HYBRID ELECTRIC PROPULSION
• Parallel hybrid propulsion system (Pratt & Whitney)
• Electric power assist, extraction & transfer (Pratt & Whitney)
• 500kW motor generator on high spool (Collins)
• 1 MW motor generator on low spool (Collins)
• Ground testing (MTU)
• Airframe Integration (Airbus)
• Energy Storage (Airbus)
WATER ENHANCED TURBOFAN
• Vaporizer (GKN)
• Steam turbine (MTU)
• Condenser (Collins)
• Water-recovery unit (MTU)
• Steam-injecting combustor (Pratt & Whitney)
• Performance Studies (Airbus)
Image credit: MTU Aero Engines
Targeting 20+% fuel burn improvement, NOx/nvPM emissions reduction. Applicable to all large commercial segments.
RTX
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WORLD'S FIRST IN-FLIGHT STUDY OF COMMERCIAL AIRCRAFT USING 100% SUSTAINABLE AVIATION FUEL SHOW SIGNIFICANT NON-CO_2 EMISSION REDUCTION

© Airbus 2021 - photo by S. Ramadier

Berlin, 6 June 2024 - Results from the world's first in-flight study of the impact of using 100% sustainable aviation fuel (SAF) on both engines of a commercial aircraft show a reduction in soot particles and formation of contrail ice crystals compared to using conventional Jet A-1 fuel.

The ECLIF3 study, in which Airbus, Rolls-Royce, the German Aerospace Center (DLR) and SAF producer Neste collaborated, was the first to measure the impact of 100% SAF use to emissions from both engines of an Airbus A350 powered by Rolls-Royce Trent XWB engines and followed by a DLR chase plane.

Compared to a reference Jet A-1 fuel, the number of contrail ice crystals per mass of unblended SAF consumed was reduced by 56%, which could significantly reduce the climate-warming effect of contrails.

Global climate model simulations conducted by DLR were used to estimate the change in the energy balance in Earth's atmosphere - also known as radiative forcing - by contrails. The impact of contrails was estimated to be reduced by at least 26 percent with 100% SAF use compared to contrails resulting from the Jet A-1 reference fuel used in ECLIF3. These results show that using SAF in flight could significantly reduce the climate impact of aviation in the short term by reducing non-CO_2 effects such as contrails, in addition to reducing CO_2 emissions over the lifecycle of SAF.

"The results from the ECLIF3 flight experiments show how the use of 100 percent SAF can help us to significantly reduce the climate-warming effect of contrails, in addition to lowering the carbon footprint of flying – a clear sign of the effectiveness of SAF towards climate-compatible aviation", said Markus Fischer, DLR Divisional Board Member for Aeronautics.

Mark Bentall, head of Research & Technology Programme, Airbus, said : "We already knew that sustainable aviation fuels could reduce the carbon footprint of aviation. Thanks to ECLIF studies, we now know that SAF can also reduce soot emissions and ice particulate formation that we see as contrails. This is a very encouraging result, based on science, which shows just how crucial sustainable aviation fuels are for decarbonising air transport".

"SAF is widely recognized as a crucial solution to mitigating the climate impact of the aviation sector, both in the short term as well as the longer term. The results from the ECLIF3 study confirm a significantly lower climate impact when using 100% SAF due to the lack of aromatics in Neste's SAF used, and provide additional scientific data to support the use of SAF at higher concentrations than currently approved 50%", said Alexander Kueper, Vice President Renewable Aviation Business at Neste.

Alan Newby, Rolls-Royce, Director Research & Technology, said: "Using SAF at high blend ratios will form a key part of aviation's journey to net zero CO_2. Not only did these tests show that our Trent XWB-84 engine can run on 100% SAF, but the results also show how additional value can be unlocked from SAF through reducing non-CO_2 climate effects as well".

The research team has reported its findings in the Copernicus journal Atmospheric Chemistry & Physics (ACP) as part of a peer-reviewed scientific process, and provides the first in-situ evidence of the climate impact mitigation potential of using pure, 100% SAF on a commercial aircraft. The ECLIF3 programme, which also includes researchers from the National Research Council of Canada and the University of Manchester, conducted in-flight emissions tests and associated ground tests in 2021. Click here to read the full report.

SESAR INNOVATION IN THE SPOTLIGHT AT FLY AI FORUM

Advancing Measures to Reduce Aviation Impact on Climate and Enhance Resilience to Climate Change

May. 24, 2024

On 29-30 April, FLY AI partners* organised a two-day conference to explore the latest developments and deployments of artificial intelligence (AI) and machine learning (ML) in aviation. Hosted by FLY AI partner, EUROCONTROL, the conference included updates from the European Commission on AI regulatory matters, the discussion of practical-use cases of AI benefits to aviation, an exhibition of projects and success stories, and an overview of ongoing research and training activities.

Opening a dedicated session on research, **Andreas Boschen, Executive Director of the SESAR JU**, noted the rapid evolution of applications enabled by artificial intelligence and underlined the importance of carefully assessing the opportunities of AI for air traffic management, while addressing trustworthiness, transparency and safety assurance. "*These considerations are driving SESAR research and our collaboration with all European partners. The alignment of research with the EASA AI Roadmap and the AI concept paper are testimony to this*," he said.

Andreas Boschen, Executive Director of the SESAR JU

AI has been the focus of innovation in SESAR over the last decade, which has shown how machine learning applications can help to optimise ATM systems, making them more sustainable, better performing and more resilient.

A good example is the use of machine learning for highly reliable automatic speech recognition in air traffic control, combining language models with airspace and radar data. The concept was initially investigated within the exploratory research projects, MALORCA and HAAWAII, and then went on to be validated, as part of the industrial project (PROSA and PJ10-96), delivering a solution which is now being deployed by several air navigation service providers in Europe. In the context of U-space, AI is a key enabler for safely operating the projected drone traffic in our urban and rural environment. Read the CORDIS Results Pack about AI in ATM.

Research and innovation continues in the SESAR Digital European Sky programme with a portfolio of projects, many of which presented their activities during the main conference and exhibition. Some applications in include airport and tower surveillance (TRUSTY), certification (HUCAN), traffic hotspots (ASTRA, HARMONIC), smart sectorisation (SMARTS), drone operations (AI4HyDrop) digital assistants (JARVIS, DARWIN), dynamic reconfiguration of airport resources (FASTNet), multimodality (MAIA and MULTIMODX), and forecasting (KAIROS), just to name a few. Read about the participating projects

AI is one of the areas being addressed in the update of the European ATM Master Plan, which defines the modernisation of ATM in Europe until 2040. "*We are refining and expanding our vision for a Digital European Sky where automation and artificial intelligence are key levers for the transformation of ATM. Good teamwork and trust between human operators and AI-agents is key within this target vision*," concluded Boschen.

More about AI in SESAR research and innovation

*European Commission, SESAR JU, EASA, EUROCAE, CANSO, ACI Europe, ASD, EDA, IATA, IFATCA, IFATSEA, NATO, and led by EUROCONTROL

SAFELY INTEGRATED REMOTELY PILOTED AIRCRAFT SYSTEMS (RPAS) INTO EUROPEAN AIRSPACE

May. 27, 2024

THE PROJECT OF THE MONTH: IRINA

The IRINA project is working to ensure that unmanned, remotely piloted aircraft systems (RPAS) can safely share the sky with their manned counterparts.

Whether used for inspection, survey, surveillance, or delivery operations, RPAS have the potential to revolutionise society and the economy. But leveraging this potential requires that these aircraft, which are remotely operated by a pilot, be able to fly alongside manned aircraft in all airspace classes.

Unfortunately, this is currently not the case, with RPAS being restricted to segregated airspaces in Instrument Flight Rules classes.

"Managing RPAS traffic is particularly challenging for air traffic controllers as these aircraft fly significantly slower than conventional jet airliners," says Julia Sanchez, UAS ATM & C-UAS Expert at EUROCONTROL. "They also tend to experience latency in communicating with the ground, sometimes even losing the communication link altogether."

Furthermore, the high level of automation and capabilities of RPAS differ significantly from those of today's manned aircraft, creating additional challenges to their safe integration into both controlled and uncontrolled airspace.

Addressing these challenges is the SESAR-funded IRINA project

Coordinated by EUROCONTROL, the project contributes to the relevant standardisation and regulatory bodies. It does this by sharing its findings and developing acceptable means of compliance that meet the regulatory requirements that will allow RPAS to be fully integrated into European airspace.

The project has created an advisory committee that involves the UAS and military RPAS communities (e.g., EDA, NATO), air navigation service providers, air traffic controllers, airspace users, flight crew, industry, European institutions, ICAO, standardisation and regulation bodies, the scientific community, other airspace user associations, and academia.

THE DETECT AND AVOID PIECE OF THE INTEGRATION PUZZLE

Safely integrating unmanned aircraft into European airspace is a complex puzzle. The IRINA project focuses on the Detect and Avoid piece of that puzzle.

The Detect and Avoid (DAA) function is what enables RPAS to avoid collisions, especially when operating in airspace classes where all traffic is not flying under ATC guidance.

While other projects have scratched the DAA surface, IRINA looks to get into the weeds. "We aim to go beyond just showing how RPAS can be integrated, we want to propose the standards, regulations and procedures that will ultimately make such integration happen," explains Sanchez.

For the IRINA project, this means focusing more on the people than the technology. "The technology is there," adds Sanchez. "Our job is to advance this technology and to make sure the people – the air traffic controllers, the remote pilots, the pilots of unmanned aircraft – can all leverage this technology in a way that enables everyone to safely use the same airspace."

FROM CLASS A TO CLASS G AND EVERYTHING IN-BETWEEN

On the one hand, the project will look at integrating RPAS into controlled airspace, specifically, the A to C classes. Leveraging prior work done by the SESAR-funded ERICA project, IRINA researchers look to address such issues as ground safety and communication with air traffic controllers.

The project will also help accommodate RPAS into classes D to G, a category that includes both controlled and uncontrolled airspaces. These classes are particularly challenging as they include a wide range of users, some of which lack any means of communicating with any type of drone.

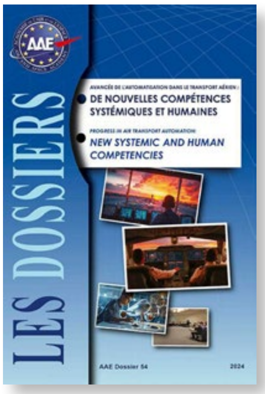
"We're basically starting at a point where there are no rules for integrating RPAS into these airspace classes," concludes Sanchez. "At the end of the day, we want to create recommendations – even conclusions – that clarify how manned and unmanned aircraft can safely fly in the same sky."

A work-in-progress, the IRINA project is currently in the process of launching a set of fast and real-time simulations. Using the data and results derived from these simulations, researchers, together with other relevant stakeholders, will begin developing the solutions that could help clear the way towards a fully integrated European airspace.

More about the project

PROGRESS IN AIR TRANSPORT AUTOMATION

NEW SYSTEMIC AND HUMAN COMPETENCES



THE AIR AND SPACE ACADEMY HAS RECENTLY PUBLISHED AN IMPORTANT DOSSIER ABOUT THE REVOLUTION THE DIGITAL TECHNOLOGY HAS BROUGHT INTO THE AIR TRANSPORT WIT THE INTODUCTION OF AUTOMATIC SYSTEMS. THIS DOCUMENT IS PRESENTED HERE AFTER,

Digital technology has brought about a revolution with the introduction of automatic systems into the various components of air transport. This continuous evolution, facili- tated by ever-increasing computing power, is justified by the need to improve efficiency in this sector, while compensating for human limitations. Flight safety has benefited greatly from this. The various players in the air transport system are concerned to opti- mise this development, essentially by coordinating concomitant advances in the perfor- mance of humans and automated systems. The Air and Space Academy, noting that creeping changes are appearing in the competencies required of the corresponding players and organisations, organised workshops on the subject in 2021 and 2022, bring- ing together the main players in the sector. These workshops were a success for all participants thanks to the breadth of discussions, which revealed differences in approach as well as new needs. AAE published the corresponding reports, but wanted to go further in terms of overall reflections inspired by these developments. Hence the idea for this dossier.

In fact, air transport constitutes a "metasystem" of complex "systems of systems", inte- grating the design, production and equipment operation chains, training paths, regulatory activities and marketing, via organisations and companies that ensure its functioning. The key elements of the system belong either to the world of humans or to the world of machines, and although one has generated the other, these worlds are not reducible to each other, each having its own idiosyncrasies, with its own ethnic groups, cultures and languages, and the same problems of internal and external communications, power and skills. These two worlds meet in two theatres of operations: "on the ground" and "on board", cooperating as best they can to satisfy the primary objectives of air transport, which are safety and profitability.

Situation analysis reveals the major difficulties behind the necessary role of humans in the ongoing Human-Systems dialogue, with the corollary need, given the competencies accorded to systems, to identify those skills required to ensure that humans remain in control of the system, since human control is imposed by the ethical, legal and social aspects governing any activity. In terms of competencies, it should be emphasised that they can be at the level of the individual, of a group of players, or even at the level of the performance of the systems involved. It is felt that the emergence of artificial intelligence (AI) will not fundamentally change this "relational" aspect, which requires critical judgement on the part of humans, at least for the period in question, up to 2050.

For all types of activity in the aeronautical sector, the particular problem is that of iden- tifying, acquiring and maintaining the competencies of the many players in a wide variety of trades and professions. Because of the extent and complexity of this metasystem, governed by a large number of regulations, AAE has chosen to give priority to those professions directly involved in safety, intrinsic to air transport, and in minimising impact on the climate. It is for this reason that we are publishing here our findings in the fields of operations directly linked to flights, with the necessary prerequisites for the design of systems, hardware or software.

The aim of this dossier is to provide some findings based on practical experience. It is aimed at researchers, manufacturers, operators, certifiers and trainers, whatever their size, in the aeronautics sector, as well as other sectors facing similar problems involving a significant level of human involvement with automated systems and the need to ensure a high level of safety.

Michel WACHENHEIM
President of the Air and Space Academy

■

SUMMARY

The human transport aircraft is a very special "machine" because of the conditions in which it is used between the two-dimensional ground and the three-dimensional atmos- phere, and the particularity that it cannot stop operating in flight. As a result, any new product needed must demonstrate the required level of safety before being accepted. Current developments in highly automated systems aimed at further optimising air trans- port operations are making the whole ensemble increasingly complex, so it is up to the professional community to assess and deal with the risks involved. This community, made up of researchers, developers, certifiers and operational staff, remains vigilant and must anticipate problems through an increasingly global approach, because the conse- quences of major errors on safety and the economy would be unacceptable. In this respect, bold innovations have become rarer, with progressive developments being pri- oritised, especially by the main manufacturers, concerned about the continued appeal of their product families. It should be noted, however, that newcomers, especially in the case of smaller products, can take greater risks by differentiating themselves.

Air traffic management and control evolve in parallel with aircraft, but at its own pace. ATC aims to ensure optimised, safe traffic by managing national airspace around the planet. In fact, the airspace managed is highly fragmented due to civil (and underlying military) sovereignties, resulting in a jigsaw puzzle of historically different organisations. The result is a large number of systems largely marked by cultures and nationalities. The sector is slow to evolve and does not follow the same timeframe as that of the aircraft; it must also be able to factor in older aircraft.

The rapid development of automation has been mainly at the level of the aircraft and its systems, with the dual objective of improving air transport safety and performance by reducing the crew's workload. The first to be automated were functions, then increas- ingly complex tasks, and finally we are even envisaging the automatic execution of parts of missions and even whole missions, including the capacity for diversion and dialogue with ATC, which requires autonomous operation of systems. This autonomous operation will be able to make use of AI, which considerably opens up the field of automation development while raising issues of safety and the relationship between humans and systems that are far from being resolved.

The roles belonging to the human operator are affected by those the system can take over, and EASA considers three levels of autonomy for the role of AI-based systems: assistance to the human (the system proposes an action), Human-Systems collabora- tion (one executes, the other monitors) and autonomous system (the human role is reduced to "supervision").

Even without considering this last stage of autonomous system operation, the develop- ment of automation changes the role and tasks assigned to the operator and conse- quently modifies the competencies required. This question, which is the main subject of the dossier, will be dealt with in more detail later in the document for each of the aero- nautical professions considered, but we can identify some general considerations that apply to all of these professions.

The first consequence that comes to mind is that there is less need for human compe- tencies in areas relating to the functions performed by automated systems, provided that the probability of their failure is sufficiently low and therefore that there is no need for the operator to regain control in order to demonstrate that safety objectives have been met. It is important to note that competencies in these areas can also be diminished by auto- mation when they are no longer sufficiently used (e.g. the ability to control trajectory if the majority of flights use autopilot). However, it must be borne in mind that new competencies are required due to the increasing complexity of systems resulting from the sophistication and multiplication of automated functions: a greater and broader level of scientific and technical knowledge is needed for selecting and monitoring automated systems, fault detection and post-fault recovery. In particular, capabilities are needed that can be likened to "knowledge of the system". Conversely, the system has to be designed around the competencies of the humans working on it.

A well-known difficulty facing operators of highly automated systems is the risk of loss of vigilance when the operator's role is simply to monitor the system, leaving them vul- nerable to startle effects when an unlikely, unexpected fault (or event) occurs. This dif- ficulty can be overcome by designing appropriate systems (detection of loss of vigilance, aids for fault detection and analysis).

These examples highlight the need to design the system to optimise the performance of the operator-system pair: this is the role of Human-Systems Integration (HSI), which organises the consideration of human factors throughout the system design and devel- opment cycle.

A final important point is that of relations between the various operators required to cooperate in carrying out air transport missions (pilots, air traffic controllers, airline oper- ational control centres) and the interconnection of the corresponding systems, which are heavily dependent on software. This obviously raises the question of the synchronisation and compatibility of changes to these systems (to be dealt with at engineering stage), and also the need to ensure sufficient knowledge for all operators of each other's work and systems.

Note:. *Because of the specific nature of each of the three areas analysed in Chapters 6 and 7 (pilots, traffic controllers, engineering), the relevant sections were written by a team identified at the top of each section.*

HYDEF

The **HYDEF (HY**personic **DEF**ence) Interceptor Programme was launched in response to the 2021 European Defence Fund (EDF) call on the topic "Endo-atmospheric Interceptor" in the category "Protection against High Velocity Aerial Threats".

HYDEF is closely linked to the PESCO EU programme «Timely Warning and Interception with Space based TheatER surveillance» (TWISTER) and deals with the development of an overall endo atmospheric interceptor concept for air defence.

This programme is funded with a total amount of €110 million, of which €100 million are co-funded by the EU European Defence Fund (EDF) and the other €10 million are funded by the five Participating States: Belgium, Germany, Norway, Poland and Spain.

The main objective of HYDEF Programme is to research and define the concept of one European interceptor that incorporates the latest technologies in propulsion, aerodynamics, advanced guidance, cutting-edge sensors and actuator systems. These technologies will allow the interceptor to achieve maximum manoeuvrability and the capability to neutralize hypersonic threats. The challenge of intercepting manoeuvring ballistic missiles and hypersonic threats will require the study of state-of-the-art technologies and novel functional chains inside the missile, gathered in the objectives of the call.

On 31 October 2023, the contract between OCCAR and SMS (as Programme Coordinator) was signed, becoming the first European programme for defence against hypersonic threats. The HYDEF Consortium consists of 14 companies from seven different European Nations, all of which have a long experience in development and production of high-performance components for air defence applications. The Consortium integrates the following members: SONACA from Belgium; LKE from Czech Republic; Diehl Defence from Germany; NAMMO from Norway; ILOT and ITWL from Poland; SMS, EM&E, GMV, Instalaza, INTA, Navantia and Sener from Spain; and Beyond Gravity from Sweden.

The Programme coordination within the HYDEF Consortium is led by the Spanish company SMS, based in Madrid, Spain, while the Technical Coordination, from the development of the overall system, is the responsibility of the German air defence systems company Diehl Defence, based in Lake Constance.

Over the next three years the HYDEF Consortium will work on the first phase of the programme, the concept study, which main objective is to assess the feasibility. This first phase will be divided into two main activities, leading to MDR (Pre-Feasibility) and PRR (Feasibility or Phase A), plus a parallel activity on the early maturation of critical technologies and designs.

HYDEF Participating States

Co-funded by the European Union

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FRENCH ARMY'S NH90 FOR SPECIAL FORCES HAS STARTED FLIGHT TESTING

May. 24, 2024

Marignane - Airbus Helicopters has launched the flight test campaign for the prototype of the NH90 Standard 2. This standard is one of the latest NH90 configurations and is being developed specifically for the French Army Aviation, to support special forces operations. The French Ministry for Armed Forces has ordered a total of 18 NH90s in the Standard 2 configuration. Flight testing will continue until the end of the year in accordance with the schedule agreed with the French Armament General Directorate (Direction Générale de l'Armement).

The Standard 2 configuration includes the integration of the Safran Euroflir 410 electro-optical system, a new digital map generator, installation for a third crew member and new enlarged rear sliding windows able to accommodate self-protection guns.
The tests will validate the design of the new configuration. The prototype of the NH90 Standard 2 has also been equipped with mechanical and electrical provisions dedicated to the Distributed Aperture System (DAS) and a new generation Helmet Mounted Sight Digital Display (HMSD-DD) in the view of a future integration at a later stage. These systems will improve the special forces capabilities to operate in highly demanding conditions.
These flight tests are part of the programme launched in 2020 by the NATO Helicopter Management Agency (NAHEMA) and NHIndustries (NHI) and its partner companies (Airbus Helicopters, Leonardo and Fokker) for the development and the upgrade of 10 NH90 TTHs in the Standard 2 configuration.

Following the programme launch, in December 2023, NAHEMA on behalf of the French Ministry for Armed Forces, awarded a contract to NHIndustries for the production of eight additional NH90 TTHs in the Standard 2 configuration, thus renewing their confidence in the NH90 programme.

By the end of the decade, the French Army Aviation will operate 81 NH90 TTHs. The NH90 was first delivered to the French Army in 2011. Sixty-three NH90 TTHs have been delivered so far. It was deployed in operation for the first time in Mali in 2014 and has since reached 50,000 flight hours in total.
The French armed forces' NH90s are supported by NHI under the NH90 Operational Support (NOS) contract common with Germany, a performance based agreement delegating a major part of the nation's logistics and maintenance activity to NHI and enabling the customers to focus on their critical operations.

NHIndustries is the largest rotorcraft joint venture and it is responsible for the design, manufacturing and support of the NH90 helicopter, one of the leaders in the latest generation of military helicopters. The Company takes the best from the European rotorcraft and defence industry, being owned by Airbus Helicopters (62.5%), Leonardo (32%) and GKN Fokker (5.5%). Each company has a long aerospace pedigree and brings the top of its skills and expertise to the end product.

SUCCESS OF ARIANE 6 INAUGURAL PLIGHT

EUROPE'S NEW HEAVY-LIFT ROCKET, ARIANE 6, MADE ITS INAUGURAL FLIGHT FROM EUROPE'S SPACEPORT IN FRENCH GUIANA

AT 16.00 LOCAL TIME ON TUESDAY 9 JULY 2024

© 2024 ESA CNES-ARIANESPACE-ARIANEGROUP-Optique vidéo du CSG - S. Martin , P. Piron

Ariane 6 takes flight © ESA - M. Pédoussaut

The inaugural flight, designated VA262, was a demonstration flight whose aim was to show the capabilities and prowess of Ariane 6 in escaping Earth gravity and operating in space. It had in addition several passengers on board.

THE LIFTOFF WAS PERFECT.

At T+ 1h 06, the first set of satellites onboard Ariane 6 were released from the upper stage and place into an orbit 580 km above Earth.

In addition to the rocket, the liftoff demonstrated the functioning of launch pad and operations on the ground at Europe's spaceport Guiana Space Centre. The new custom-built dedicated launch zone built by France's Space Agency CNES allows for a faster turnover of launches (12 per year instead of 6 per year for Ariane 5).

Commenting the successful first launch of Ariane 6, they declared:

- ESA's Director General Josef Aschbacher: "*A completely new rocket is not launched often, and successi far from guaranteed. I am privileged to have witnessed this historic moment when Europe's new generation of the Ariane family lifted off – successfully – effectively reinstating European access to space.*"

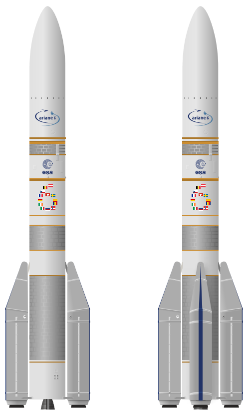
- President-Director General of CNES Philippe Baptiste: "*I would liketo acknowledge the commitment of the employees of CNES, ESA, ArianeGroup, Arianespace and our subcontractors. The last months have been intense, and I would like to thank them all. Europe can be proud of its space programme, Europe can be proud of its knowledge and expertise.*"

- Martin Sion, CEO of ArianeGroup: "*seeing Europe's new launcher lift off into space marks the culmination of an outstanding technical and technological adventure, and the beginning of a long history of Ariane 6 operations.*"

- Stéphane Israël, CEO of Arianespace: "*The new launcher's order book is proof of its capacity to accomplish a wide range of missions into multiple orbits.*"

ARIANE 6 IN SOME FACTS AND FIGURES

Ariane 6 is a modular and multi-mission launcher, able to reach low orbit as well as far away space. It exists in two versions: A62 and A64. The inaugural flight was performed with the A62 version.



Ariane 62 (left) and Ariane 64 (right)

Function	**A62:** Medium-lift launch vehicle
	A64: Heavy-lift launch vehicle
Manufacturer	ArianeGroup
Country of origin	European multi-national[a]
Project cost	€3.6 billion[1]
Cost per launch	**A62:** €70 million (2018 est.)[2]
	A64: €115 million (2018 est.)[2]
Size	
Height	63 m (207 ft)
Diameter	5.4 m (18 ft)
Mass	**A62:** 530,000 kg (1,170,000 [lb])
	A64: 860,000 kg (1,900,000 [lb])
Stages	2
Capacity	
Payload to LEO	
Mass	**A62:** 10,350 kg (22,820 lb)[3]
	A64: 21,650 kg (47,730 lb)[3]
Payload to GTO	
Orbital inclination	6°
Mass	**A62:** 4,500 kg (9,900 lb)[3]
	A64: 11,500 kg (25,400 lb)[3]
Payload to GTO	
Orbital inclination	0°
Mass	**A64:** 5,000 kg (11,000 lb)[3]
Payload to SSO	
Orbital inclination	97.4°
Mass	**A62:** 7,200 kg (15,900 lb)[3]
	A64: 15,500 kg (34,200 lb)[3]
Payload to LTO	
Orbital inclination	97.4°
Mass	**A62:** 3,500 kg (7,700 lb)[3]
	A64: 8,600 kg (19,000 lb)[3]
Associated rockets	
Family	Ariane
Comparable	Falcon 9, Falcon Heavy, H3, Vulcan Centaur
Launch history	
Status	Active
Launch sites	Guiana Space Centre, ELA-4
Total launches	1
Partial failure(s)	1 (VA262)[disputed – discuss]
First flight	9 July 2024[4]
Boosters – P120C	
No. boosters	2 or 4
Diameter	3 m (9.8 ft)
Propellant mass	142,000 kg (313,000 lb)
Maximum thrust	3,500 kN (790,000 lbf) each
Total thrust	**A62:** 7,000 kN (1,600,000 lbf)
	A64: 14,000 kN (3,100,000 lbf)
Burn time	130 seconds
Propellant	HTPB / AP / Al
First stage	
Diameter	5.4 m (18 ft)
Propellant mass	140,000 kg (310,000 lb)
Powered by	1 × Vulcain 2.1
Maximum thrust	1,370 kN (310,000 lb_f)
Burn time	468 seconds
Propellant	LOX / LH2
Second stage	
Diameter	5.4 m (18 ft)
Propellant mass	31,000 kg (68,000 lb)
Powered by	1 × Vinci
Maximum thrust	180 kN (40,000 lb_f)
Burn time	Up to 900 seconds and four burns[5]
Propellant	LOX / LH2

THE THREE PHASES OF THE INAUGURAL FLIGHT

This first flight had three phase each of which demonstrating the various launcher's abilities. (see graphic bottom of page 26) Ariane 6 first flight timeline

- **Phase 1 (steps 1 to 5) - From Earth to space.** This first phase allows the rocket to leave the Earth and enter space by pushing the main stage powered by the Vulcain engine 2.1 together with the strength of the two powerful P120C booster.

Phase 1 included the separation of the main stage from the upper stage, which placed the rocket and its passengers in an elliptical orbit of 300 to 700 km above the Earth.

Ariane 6 from above in the final hours before liftoff © ESA - S. Corvaja

The Vinci engine ran up to about 18 minutes after liftoff, after which Ariane 6 demonstrated that it can reproduce the typical flight profile of the Ariane 5 ECA version.

• **Phase 2 (steps 6 to 9) – Upper stage's Vinci engine re-ignition and satellite deployment**. This second phase was the test of the new 'Breadb 6 capacitance': the re-ignition of the upper stage.

At T+ 56 minutes, the Vinci engine was ignited a second time, which transformed the orbit of Ariane 6 from an elliptical orbit 300/700 km to a circular orbit 580 km from the Earth surface.

The Vinci's re-ignition was followed at T+ 1h 06 by the deployment of the rocket's eight satellites and the activation the five onboard experiments.

First, this was the deployment of the 3 first satellites: OOV-Cube, Curium One and Robusta -3A, and then the activation of two onboard experiments YPSat and Peregrinus.

Moments later, the second group of satellites was deployed - 3Cat-4, ISTSat and GRBBeta – and the last two experiments were activated: SIDLOC and Parisat.

A third separation command then deployed the two last satellites: CURIE and Replicata. Those 8 satellites and 5 experiments had been developed by various space agencies, industrials, research institutes and young professionals.

At this point, Ariane 6 had performed its nominal mission by successfully re-ignited Vinci engine, deploying its eight passenger satellites and activating the five onboard experimens.

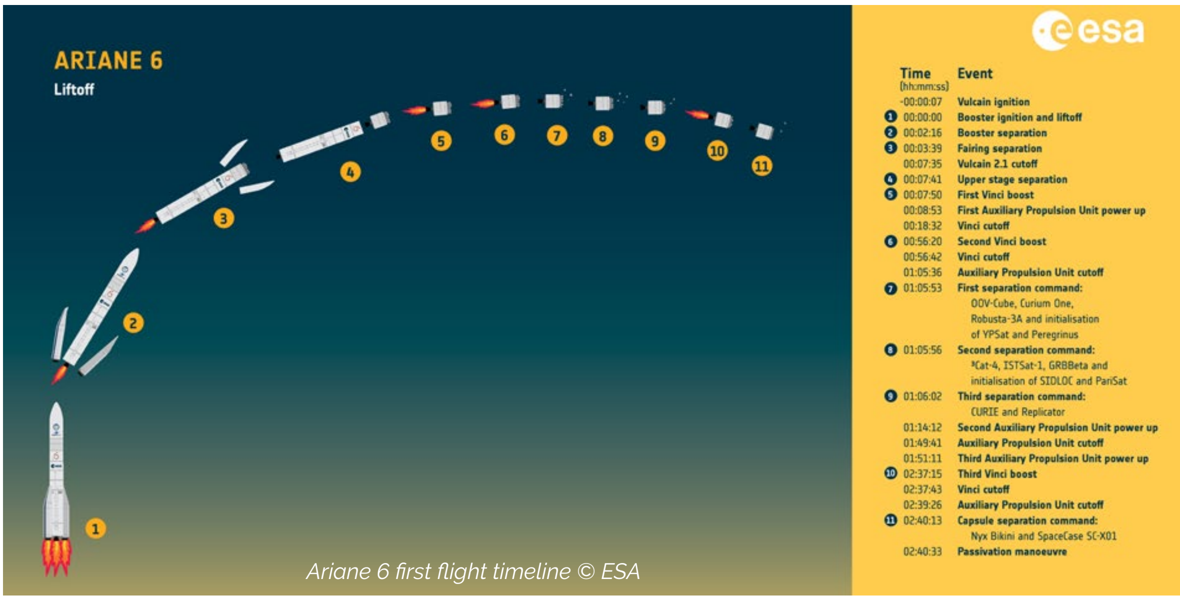
Nota. To re-ignite an engine under microgravity conditions is not an easy because the ergols are freely floating inside the tanks. To do that, an Auxiliary Power Unit (APU) is used. This APU brings its assistance in providing a low but steady thrust so that the fuel contained in the tanks stabilizes and so that the Vinci engine can be activated again.

• **Phase 3 (steps 9 to 12) – Technology demonstrations, de- orbiting and capsule separation.** The objective of Phase 3, from 1h 14 after liftoff, was to push the cryogenic upper stage to its limits.

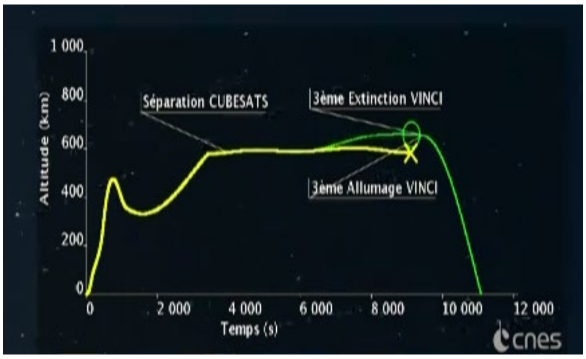
The upper stage had to re-ignite after its longest period of inactivity in space, by microgr aving, and initiate its controlled de-orbit in the Earth's atmosphere above the 'NEMO point' in the South Pacific in order to prevent from becoming additional space debris.

The upper stage was set to release two reentry capsules as it enters Earth's atmosphere.

Moments after Vinci's reignition, the two re-entry capsules



Ariane 6 first flight timeline © ESA



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Moments after Vinci's reignition, the two re-entry capsules onboard had to separate from the upper stage to begin their descent to Earth and prove they can survive a crossing in the burning atmosphere, all three making their safe descent back home, leaving no space debris in orbit.
A last command had to be sent in order to 'passive' (or deactivate) the upper stage before it is consumed in the atmosphere. Why? Delete energy on board in order to avoid possible uncontrolled and uncontrollable explosions during the descent. This series of steps – re-ignite the Vinci engine, reorienting the trajectory with a view to de-orbiting and then descending safely into the atmosphere – is an innovation intended to preserve a sustainable space by preventing the upper stage of Ariane 6 from becoming additional space debris.

The inaugural flight was perfect until the beginning of phase 3, but not until the end of the mission. As a matter of fact, Ariane 6 deviated from its trajectory because the last re-ignition of Vinci did not operate. So, the re-entry into atmosphere of the upper stage together with its two capsules could not be realised.

The desintegration into atmosphere being unavoidable, a last command was sent in order to desactivate. This deactivation has been correctly performed.
So, the Vinci engine has still to demonstrate its capability to restart with the help of its auxiliary power unit APU. This restart capability is quite essential because it allows Ariane 6 to drop off multiple passengers into different orbits on future flights.

NEXT- The next Ariane 6 flight models are already in course of production. The stages of the second Ariane 6 will arrive at CSG in autumn in view of the first commercial flight.

6 JUNE 2024 SpaceX STARSHIP INTEGRATED FLIGHT TEST 4 : A NEW STEP TOWARDS OPERATIONAL STATUS

The SpaceX Starship integrated flight test 4 (IFT-4) took place on 6 June 2024. The main test objectives were: bring Starship's first stage booster 'Super Heavy' (71 m-tall) down for a soft splashdown in the Gulf of Mexico – simulating a landing at a 'virtual tower' - , and achieve a controlled atmospheric re-entry of the 50 m-tall upper stage Starship spacecraft after having survived at least peak heating.
Both of which were accomplished, this was the first integrated test flight where both Super Heavy and Starship spacecraft successfully re-entered and performed a simulated powered vertical landing over the ocean surface.

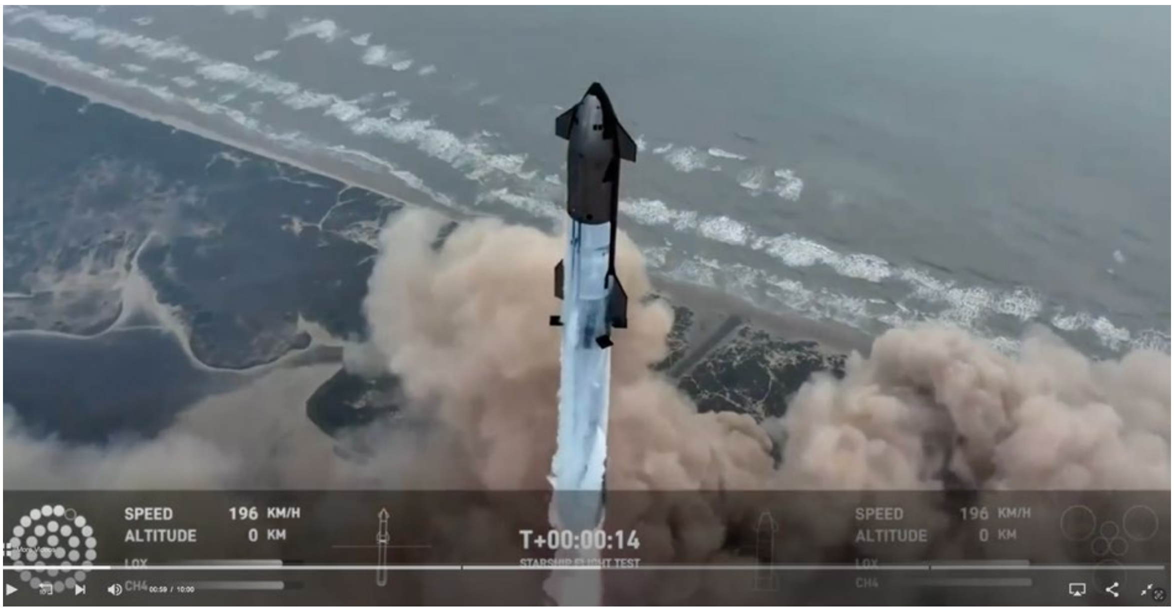
AMONG SUCCESSIVE BASIC MILESTONES

- **- 00:00:03 > 33** Raptor engines ignited with 1 shutting down

- **00:02:46 >** Moment of peak mechanical stress on the rocket
- **00:02:57 >** Starship ship engine ignition and **stage separation** (hot staging)

- **00:02:57 >** Booster boostback burn startup
- **00:03:47 >** Booster boostback burn shutdown
- **00:04:12 >** Hot-stage jettison
- **00:07:04 >** Booster is transonic
- **00:07:09 >** Booster landing burn start-up – 12 of 13 engines ignited

- **00:00:00 > Liftoff**



SpaceX's Starship Flight 4 launches Starship from Starbase at Boca Chica Beach, Texas, on June 6, 2024 at 12:50:00 UTC

- **00:07:23 >** booster landing burn shutdown and **splashdown in the Gulf of Mexico**

- **00:08:37 >** Starship ship engine cut-off (SECO)
- **00:44:54 > Starshipship entry** – Vehicle damaged on re-entry
- **01:03:17 >** Starship ship is transonic
- **01:03:38 >** Starship ship is subsonic
- **01:05:36 >** Starship ship landing flip
- **01:05:39 >** Starship ship landing burn
- **01:05:56 > Starshipship spacecraft splashdown in the Indian Ocean**

REGULAR SUCCESSIVE IMPROVEMENTS SINCE IFT-1

- **IFT-1 – 20 April 2023** – Starship's two stages failed to separate on its debut flight and the mission ended just 4 minutes after liftoff. That liftoff blasted a crater beneath Starbase's orbital launch mount.

- **IFT-2 - 18 November 2023** – Flight 2 achieved stage separation but still ended early. Both Starship and Super-Heavy had been reduced to swirling bits in the earth atmosphere by 8 minutes after launch. This time the launch mount perfectly resisted thanks to the water-spewing metal plate which had been installed as heat-wicking reinforcement.

- **IFT-3 - 14 March 2024** – Starship made a big leap, as matter of fact stage separation occurred on time and Super-Heavy made it to within 500 m of the Gulf of Mexico's wavetops before breaking apart. Starship meanwhile, achieved orbital velocity and flew for about 50 minutes, finally succumbing to intense frictional heating as it re-entered in atmosphere after an uncontrolled roll due to loss of its reaction controlled system.

- **IFT-4 - 6 June 2024** – Since Flight 3, SpaceX has made several software and hardware upgrades. Flight 4 saw yet more improvement, as the Super-Heavy made it safely down to the water while the Ship appeared to maintain roll control during flight. Flight's duration: 1 hour 5 minutes 48 seconds. During launch, the Super-Heavy booster appeared to fire 32 of its 33 Raptor engines during lift-off, with one engine clearly out in video and telemetry. The 32 engines powered the full duration of Starship initial ascent, a minor decrease nevertheless from all 33 firing in IFT-3. Hot staging separation went smoothly, as Starship jettisoned the booster and the hot stag structure without incident. When the Super-heavy fired its 13 engines landing burn, only 12 engines fired, but the booster performed its flip manoeuvre and still appeared to make its loft landing splashdown. Many of the heat shield's ceramic panels flew off during re-entry, and one flap was damaged considerably, holding on by a hair. Even still, the spacecraft held steady through the peak heating and maximum pressure phase of re-entry. Ship ignited all 3 of its centre Raptor engines, performing the first manoeuvre and landing burn, splashing down as planned in the Indian Ocean. So in total Flight 4 completed the expected mission profile.

- **Next -** SpaceX aims to launch 6 test flights in 2024, so will work out to 4 more liftoffs before the end of this year. IFT-5 will fly rather soon, for which SpaceX engineers are expected to further tests of the heat shield technology and may even attempt to catch the Super-Heavy Booster with the Mechazilla 'Chopstick' arms back on the launch pad.

• The current programme development calls for Starship to land NASA astronauts on the Moon for the first time in September 2026, on the Artemis 3 mission. Starship will need to ace many more test flights before it is ready for that landmark mission.

> **SpaceX applies the Silicon Valley 'Test and Learn Strategy' for development approach, an approach of progress through repeat failure 'Rapid approach and error development'.**
> *"We develop, we fly, we break things and go back and fly again", Elon Musk says.*

STARSHIP IFT-4					
Names	Integrated Flight Test-4	**Mission type**	Flight test	**Operator**	SpaceX
Mission duration	1 hour, 6 minutes, 10 seconds				
Spacecraft Properties					
Spacecraft	Starship Ship 29	**Spacecraft type**	SpaceX Starship	**Manufacturer**	SpaceX
Start of Mission					
Launch date	June 6, 2024, 12:50:00 UTC	**Rocket**	SpaceX Super Heavy Booster 11		
launch site	Starbase				
End of Mission					
End of Mission	Landing date 6 June 2024 / Booster 12:57:30 UTC / Spacecraft 13:55:57 UTC				
Orbital Parameters					
Regime	Suborbital	**Apoapsis altitude**	213 km	**Inclination**	26,8°

EASA ACADEMY ARTIFICIAL INTELLIGENCE FOR AVIATION APPLICATIONS

This FREE course is intended for aviation professionals of all levels who would like to get a basic understanding of AI while exploring its application to aviation.

RAVEN

WHAT THE COURSE IS ABOUT

Artificial Intelligence (AI) is the ability of machines or computer systems to perform tasks which would normally require human intelligence. Such tasks may include visual perception, speech recognition, and content generation, amongst others. AI effectively tries to mimic the thinking process, and the problem-solving and decision-making capabilities of the human brain.

AI is becoming ubiquitous and is finding its way in many industries, including aviation. This highlights the need for aviation professionals to have a baseline understanding of AI and its impact on aviation. This course seeks to address this need by providing aviation professionals of all backgrounds with a basic, yet broad, understanding of AI and its application to aviation.

The course begins with a brief look at the history of AI and a description of key AI capabilities and applications. It then describes different ML techniques and algorithms; presents real-world applications of AI in the aviation industry; and discusses various aspects of trustworthy AI and their implications for the aviation sector.

TARGET AUDIENCE

Students, entry-level, mid- to senior level aviation professionals

LEARNING EXPERIENCE

5 hours (may vary from on student to another), linear format.

LEARNING OUTCOMES

Knowledge

By the end of the course, the student will be able to:

- Highlight key milestones in the history of AI
- Describe key capabilities of AI
- Explain basic AI concepts and techniques
- Discuss how AI is being applied to aviation
- Explain the challenges associated with AI in the context of aviation
- Discuss the pillars of trustworthy and ethical AI

Skills

By the end of the course, the student will be able to:

- Analyze the strengths and weaknesses of an AI system
- Identify new applications of AI in aviation
- Detect new trends in AI

Competence

- Analytical thinking
- Problem-solving
- Data-based decision making

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This article explains the origin of SMS and the current requirements originating from EASA Part 145 regulation for SMS implementation.
August 17, 2023

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April 20, 2023

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

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

The **CEAS Space Journal** is devoted to excellent new developments and results in all areas of space-related science and technology, including important spin-off capabilities and applications as well as ground-based support systems and manufacturing advancements.
The **CEAS Aeronautical Journal** is devoted to publishing new developments and outstanding results in all areas of aeronautics-related science and technology, including design and manufacturing of aircraft, rotorcraft, and unmanned aerial vehicles.
Both journals play an increasingly important role in representing European knowledge in aerospace research. Nevertheless, the biggest challenge is still to attract an acceptable number of high caliber scientists and engineers to submit articles for publication. Therefore, we invite you and your colleagues to contribute to the development of these journals by publishing your hard-earned results. Papers which are considered suitable will be subjected to a comprehensive blind peer-review process for potential publication in the CEAS Journals.
A list of articles published in the latest issues of both CEAS Journals is attached.

The Managing Editors:
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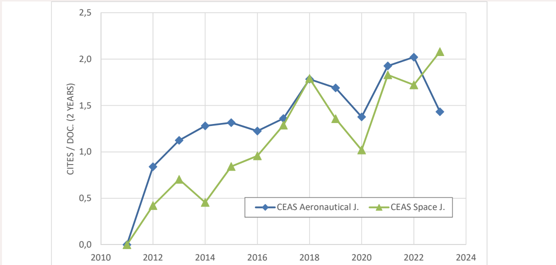


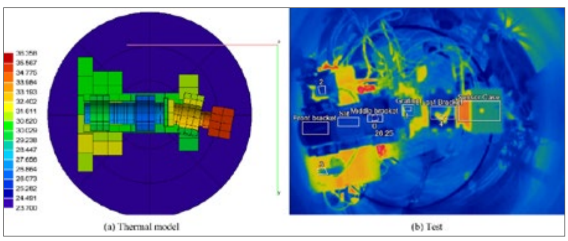
"Cites / Doc (2 years)" counts the number of citations received by documents from a journal and divides them by the total number of documents published in that journal in the past two years – similar to the Impact Factor™.

CEAS SPACE JOURNAL

Volume 16, Issue 4, July 2024

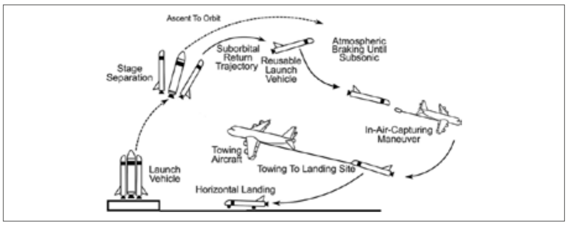
EXPERIMENTAL SET-UP OF A THERMAL VACUUM CHAMBER FOR THERMAL MODEL IN-HOUSE CORRELATION AND CHARACTERIZATION OF THE HYPSO HYPERSPECTRAL IMAGER

Fermin Navarro-Medina, Adriënne Esmeralda Oudijk, Marie Bøe Henriksen, Amund Gjersvik, Fredrik Sommerfelt Grønvold & Tor Arne Johansen / Published online: 20 June 2023 (Open Access)



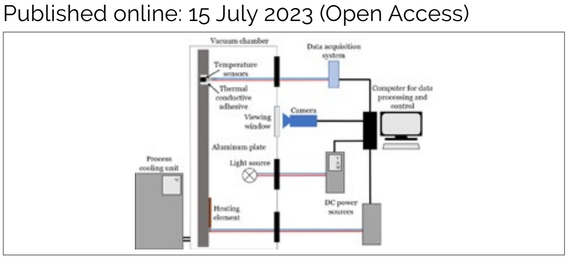
DEVELOPING AN INNOVATIVE AND HIGH-PERFORMANCE METHOD FOR RECOVERING REUSABLE LAUNCHER STAGES: THE IN-AIR CAPTURING METHOD

S. Stappert, S. Singh, A. Funke & M. Sippel / Published online: 13 July 2023 (Open Access)



EXPERIMENTAL DEMONSTRATION OF A METHOD TO ACTIVELY STABILIZE SATELLITE STRUCTURES AGAINST RANDOM PERTURBATIONS OF THERMAL BOUNDARY CONDITIONS USING A CLOSED-LOOP FILTER AND CONTROLLER APPROACH

F. Möller, T. Essig, S. Holzhauer & R. Förstner / Published online: 15 July 2023 (Open Access)



KINEMATIC TESTS ON A DOCKING MECHANISM FOR MICROSATELLITES

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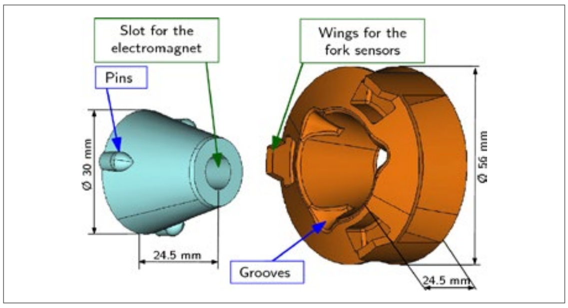

MODELING OF STRATOSPHERIC BALLOONS AND ROBUST LINE-OF-SIGHT POINTING CONTROL

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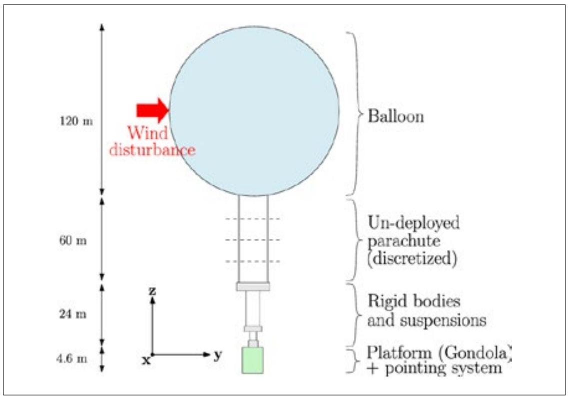

PRECISION LANDING COMPARISON BETWEEN SMARTPHONE VIDEO GUIDANCE SENSOR AND IRLOCK BY HARDWARE-IN-THE-LOOP EMULATION

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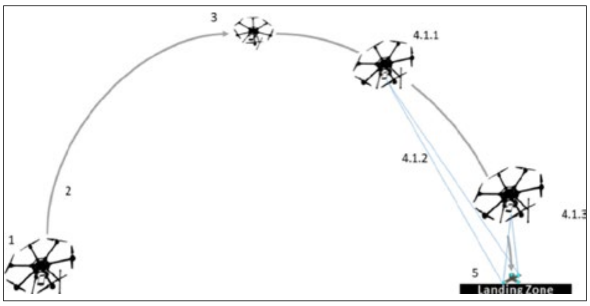

ADVANCED TEST ENVIRONMENT FOR AUTOMATED ATTITUDE CONTROL TESTING OF FULLY INTEGRATED CUBESATS ON SYSTEM LEVEL

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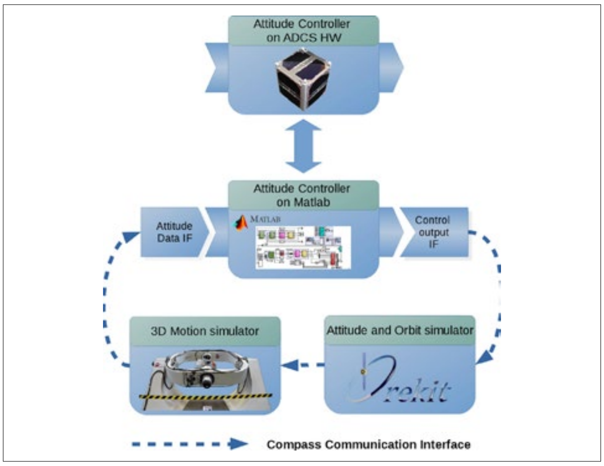
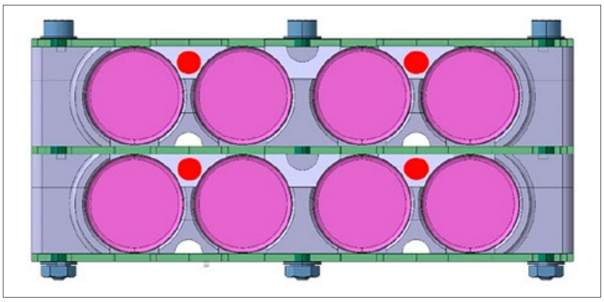


ANALYSIS OF THE THERMAL DESIGN OF A COTS-BASED MODULAR BATTERY SYSTEM FOR SATELLITES BY THERMAL VACUUM TESTING

Marius Eilenberger, Hariharan Gunasekar, Daniel Gomez Toro & Cornelie Bänsch/Published online: 11 October 2023 (Open Access)



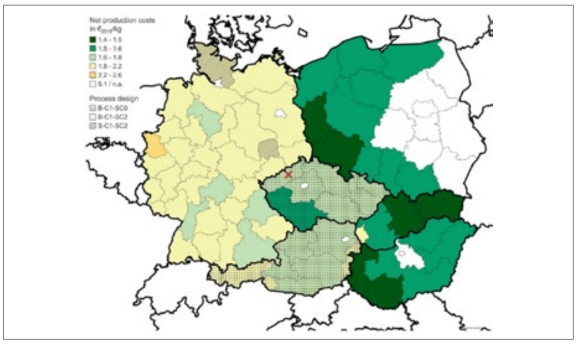
CEAS AERONAUTICAL JOURNAL

Volume 15, Issue 2,

January 2024

[TECHNICAL, ECONOMIC AND ECOLOGICAL ASSESSMENT OF EUROPEAN SUSTAINABLE AVIATION FUELS (SAF) PRODUCTION]

R.-U. Dietrich, S. Adelung, F. Habermeyer, S. Maier, P. Philippi, M. Raab & J. Weyand / Published: 02 March 2024 (Open Access)



[A METHOD FOR AN EFFICIENCY AND WEIGHT-OPTIMISED PRELIMINARY DESIGN OF A HYDROGEN-POWERED FUEL CELL-BASED HYBRID-ELECTRIC PROPULSION SYSTEM FOR AVIATION PURPOSES]

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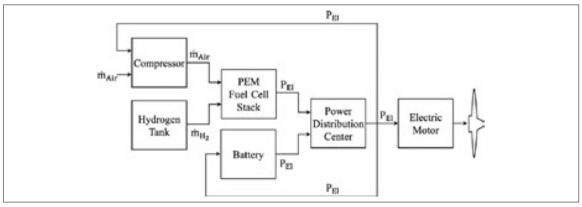

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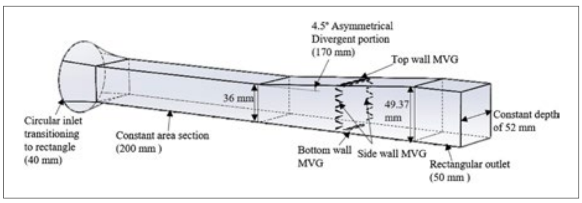

[EXPERIMENTAL INVESTIGATION ON A LIGHT–WEIGHT, EFFICIENT, COUNTER-ROTATING FAN WITH AND WITHOUT BOUNDARY LAYER INGESTION]

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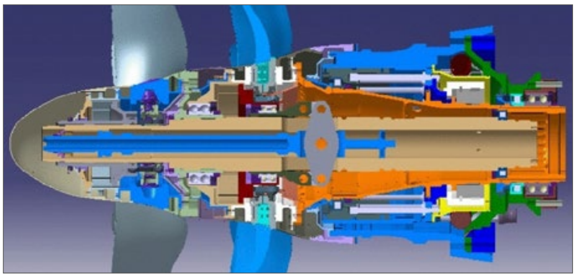

[THE ENGINE MISSION SIMULATION SYSTEM: COUPLED SIMULATION OF AIRCRAFT AND ENGINE IN THE MISSION]

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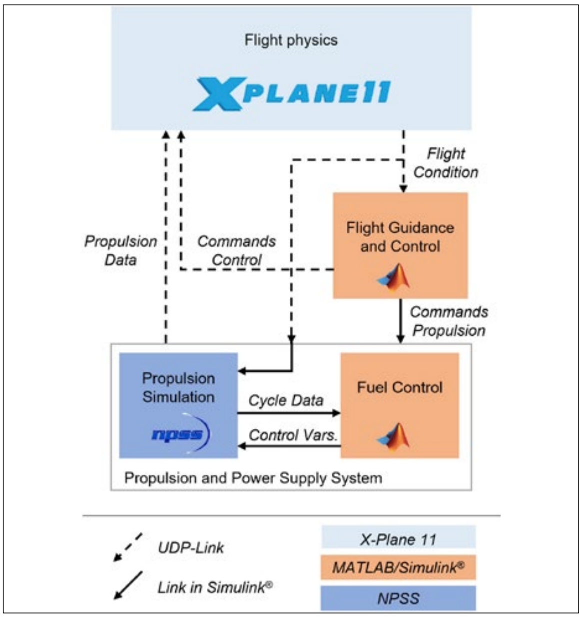

[COMBINING SHAPE-ADAPTIVE BLADES AND ACTIVE FLOW CONTROL IN A MULTI-STAGE AXIAL COMPRESSOR: A NUMERICAL STUDY]

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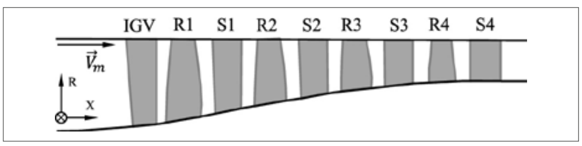

AERODYNAMIC INTERACTIONS BETWEEN DISTRIBUTED PROPELLERS AND THE WING OF AN ELECTRIC COMMUTER AIRCRAFT AT CRUISE CONDITIONS

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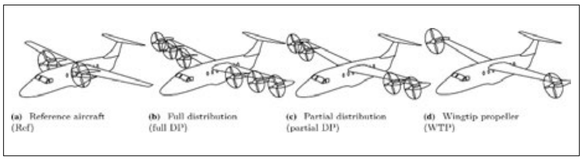

FREE FALL DRAG ESTIMATION OF SMALL-SCALE MULTIROTOR UNMANNED AIRCRAFT SYSTEMS USING COMPUTATIONAL FLUID DYNAMICS AND WIND TUNNEL EXPERIMENTS

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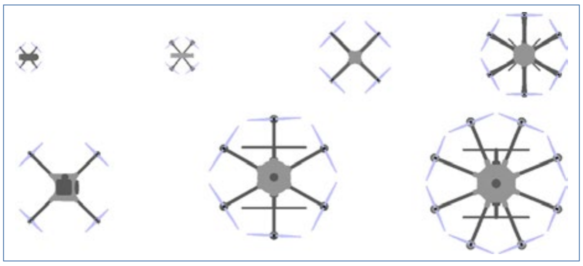

AERODYNAMIC MODELING OF A DELTA-WING UAV FOR MODEL-BASED NAVIGATION

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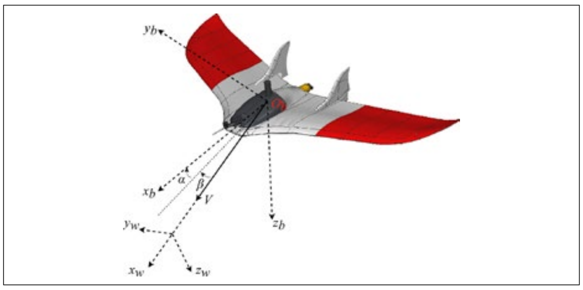

BIO-INSPIRED ALTITUDE CHANGING EXTENSION TO THE 3DVFH* LOCAL OBSTACLE AVOIDANCE ALGORITHM

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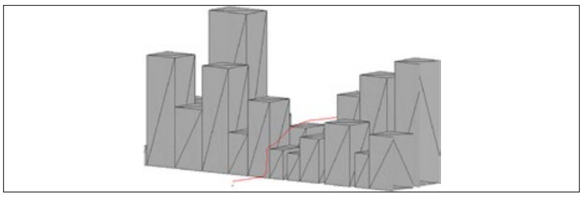

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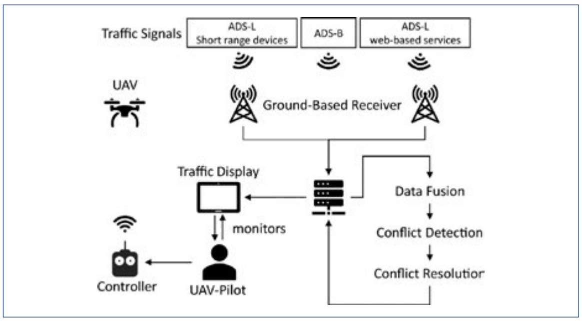


CONCEPTUAL DESIGN OF A PILOT ASSISTANCE SYSTEM FOR CUSTOMISED NOISE ABATEMENT DEPARTURE PROCEDURES

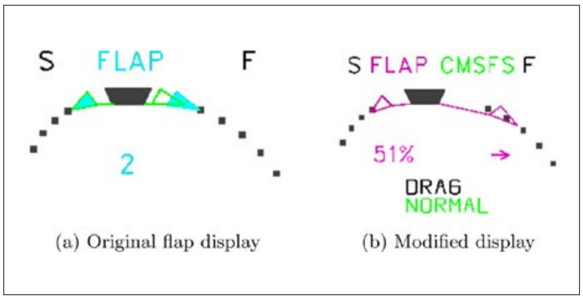
Joscha Kurz & Jason Blinstrub / Published: 18 November 2023 (Open Access)

DLR **LNAS Departure**

Procedure	Acceleration (AGL)		Thrust Reduction (AGL)		ΔNoise		ΔFuel		ΔTime	
NADP-2/2 ▽	1500	ft	-	ft						
NADP-2/3	**800**	**ft**	**800**	**ft**	**-6.1**	**%**	**+3.7**	**kg**	**+0.3**	**min**
NADP-2/1	800	ft	-	ft	-5.8	%	-0.2	kg	+0.2	min
NADP-2/3	1000	ft	1000	ft	-5.3	%	+6.5	kg	+0.3	min
NADP-2/1	1000	ft	-	ft	-4.9	%	+2.5	kg	+0.2	min
NADP-2/3	1200	ft	1200	ft	-4.8	%	+9.3	kg	+0.3	min
NADP-2/2	800	ft	-	ft	-4.6	%	-8.8	kg	-0.1	min
NADP-2/3	1400	ft	1400	ft	-4.0	%	+12.2	kg	+0.3	min
NADP-1	2400	ft	1200	ft	-3.8	%	+39.9	kg	+0.6	min
NADP-1	2600	ft	1000	ft	-3.8	%	+48.7	kg	+0.7	min
NADP-1	2600	ft	1200	ft	-3.8	%	+46.2	kg	+0.7	min

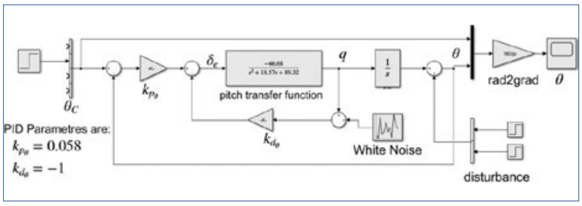
EVALUATION OF AN AUTOMATIC CONTINUOUS HIGH-LIFT SYSTEM IN A FLIGHT SIMULATOR STUDY WITH AIRLINE PILOTS

Pia Eichhorn & Flávio Silvestre / Published: 08 December 2023 (Open Access)



[UAV LONGITUDINAL AUTOPILOT DESIGN USING SLC AND TECS CONTROLLERS]

Nourddine Ghelem, Djamel Boudana & Ouahid Bouchhida / Published: 08 February 2024



EXPLORATION OF OPTIMAL CONTROL BASED SURROGATE MODELING AS A BASIS FOR FUEL EFFICIENT 4D AIRCRAFT ROUTING ON GRAPHS

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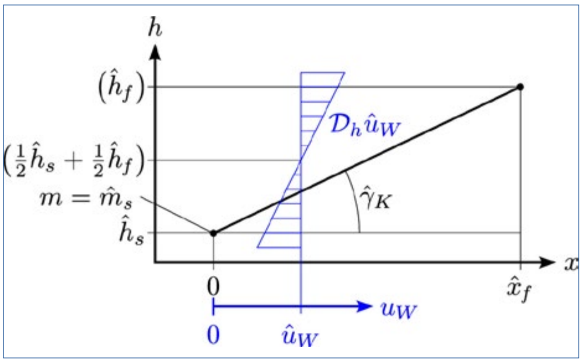

HELICOPTER SHORT-TERM COLLISION AVOIDANCE WITH SAMPLING-BASED MODEL PREDICTIVE CONTROL

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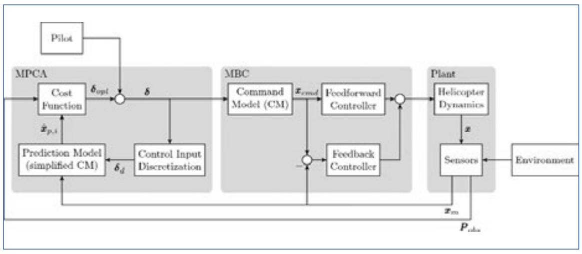

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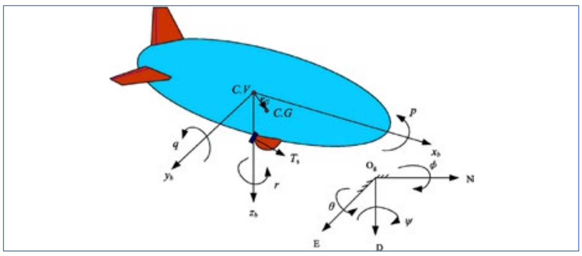
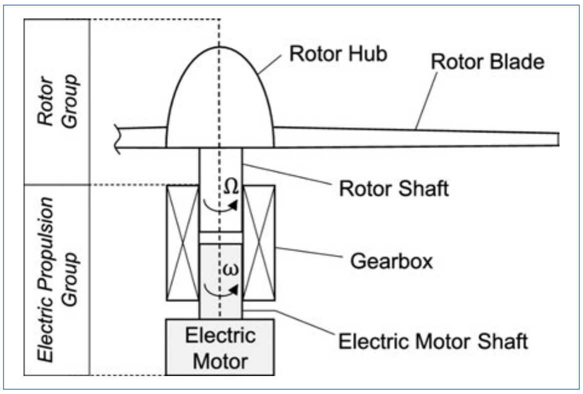


UNDERSTANDING THE FIXED PITCH RPM-CONTROLLED ROTOR MODELING FOR THE CONCEPTUAL DESIGN OF UAM VEHICLES

Kagan Atci, Peter Weiand & Feyyaz Guner / Published: 19 December 2023 (Open Access)



CORRECTION TO: UNDERSTANDING THE FIXED PITCH RPM-CONTROLLED ROTOR MODELING FOR THE CONCEPTUAL DESIGN OF UAM VEHICLES

Kagan Atci, Peter Weiand & Feyyaz Guner / Published: 31 January 2024 (Open Access)

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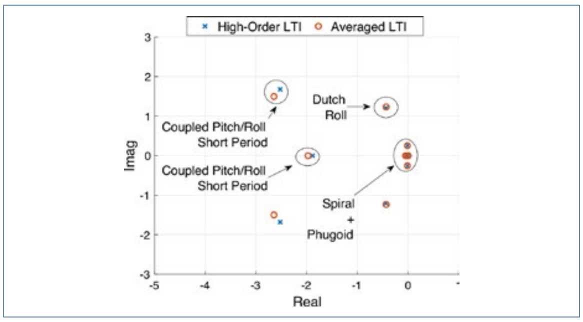

[UTILISATION OF SEMANTIC TECHNOLOGIES FOR THE REALISATION OF DATA-DRIVEN PROCESS IMPROVEMENTS IN THE MAINTENANCE, REPAIR AND OVERHAUL OF AIRCRAFT COMPONENTS]

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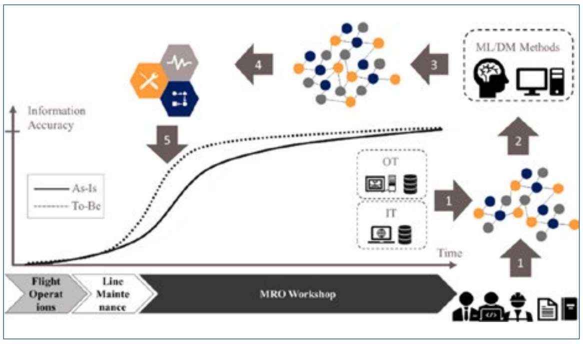
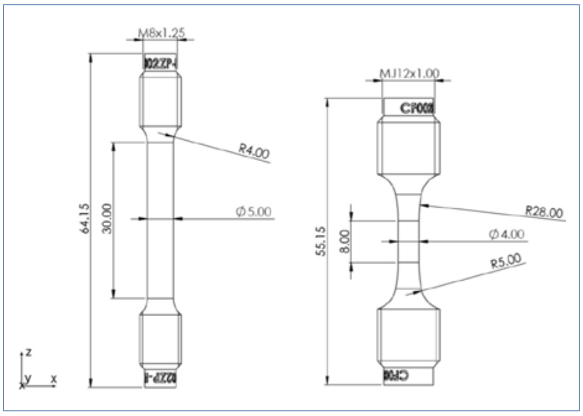


[STUDY OF THE INFLUENCE OF ADDITIVE MANUFACTURING APPLICABLE SURFACE TREATMENT METHODS ON MECHANICAL PART PROPERTIES FOR USE IN AEROSPACE APPLICATIONS]

Christin Rümmler, Gregor R. H. Neumann, Wolfram Groh, Falk Hähnel, Gundis Grumbt, René Tropschuh, Tom Schiemann & Johannes F. C. Markmiller/ Published: 09 March 2024 (Open Access)



[TYRE HEAT OF MULTI-WHEEL BOGIE UNDERCARRIAGE AT TOUCHDOWN]

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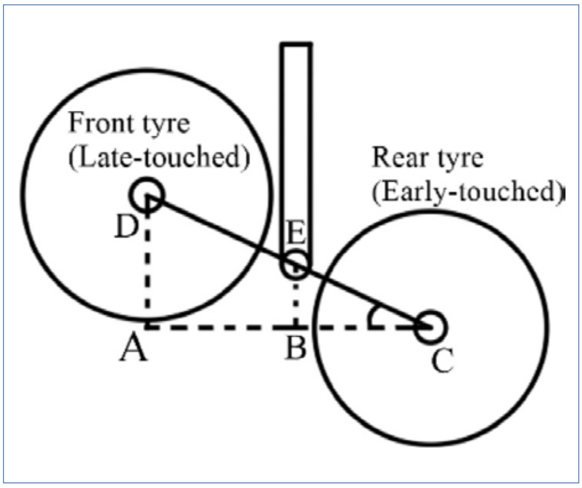


2024

AMONG UPCOMING AEROSPACE EVENTS

JULY

02-03 July – EASA – **EASA Artificial Intelligence Days** – High-Level Conference - Hybrid Event – Cologne (Germany) – EASA/HQ - https://www.easa.europa.eu/

02-04 July – ACI EUROPE – **34th ACI Europe Annual Congress & general Assembly 2024** – Istanbul (Turkey) – Swissotel The Bosphorus – https://www.aci-europe/events.html

13-21 July – COSPAR 2024 – **45th Scientific Assembly** – Busan (Korea) – https://www.cospar2024.org

22-26 July – Farnborough – **Farnborough International Air Show** – Pioneer the Future – Farnborough, Hampshire (UK) – https://farnboroughairshow/com

22-26 July – EUROMECH – **ENOC11- 11th European Nonlinear Oscillations Conference** – Delft (NL) – https://euromech.org/

29 July - **02** August – AIAA – **AIAA Aviation Forum** – Las Vegas, NV (USA) – www.aiaa.org/events

30 July - **02** August – ASCEND powered by AIAA – **ASCEND Conference** – Las Vegas, NV (USA) – www.aiaa.org/events

26 July - **06** September – ICAO – **14th Air Navigation Conference** – SAFE SKIES "Performance Improvement Driving Sustainability" – Montréal (Canada) – ICAO/HQ – https://www.icao.int/meetings/

SEPTEMBER

09-13 September – ICAS – Hosted by AIDAA – **34th Congress of the International Council of the Aeronautical Sciences –** Florence (Italy) – www.icas2024.com

10-12 September – 3AF/CEAS – **ERF2024 – 50th Edition of the European Rotorcraft Forum** – Marseille (France) – Palais du Pharo – https://www.3af-erf2024.com

10-13 September – ERCOFTAC – **FMC2024 – XXVI Fluid Mechanics Conference –** Warsaw (Poland) – https://fmc2024.pl.edu.pl

16-20 September – EUROMECH – **EFD1 – 1st European Fluid Dynamics Conference** – Aachen (Germany) – https://euromech.org/

17-19 September – EASA/FAA – **Additive Manufacturing Workshop 2024** – Wishita, KS 67260 (USA) – Wishita State University National Institute for Aviation – https://www.easa.eu/ JONAS.VOMWEK@easa.europa.eu

18-19 September – ESA – **ISD 2024** – Industry Space Days - - Space for business opportunities – Noordwijk (NL) – ESA/ESTEC – https://atpi.eventsair.com/

24-25 September – RAeS – **UK Space Command Defence Space Conference 2024 –** leading UK Conference for Space Professionals – London (UK) – IET, Savoy Place – https://airspacepower.com/defence-space-2024-2/

24-25 September – IATA – **World Sustainability Symposium (WSS) –** "Key enablers for aviation's successful decarbonization" – Miami, FL (USA) – Loews Coral Gables Hotel – https://www.iata.org

25-27 September – ICAS – **SESECA 2024 – 11th International Systems & Concurrent Engineering for Space Applications Conference –** Noordwijk (NL) – ESA/ESTEC – https://api.eventsair.com/

30 September-**02** October – DGLR – **DLRK2024 –** Deutscher Luft und Raumfahrt Kongress– Hamburg (Germany) – Hamburg Universität – www.dglr.de

OCTOBER

8-11 October – EASN – **14th EASN International Conference –** Innovation: Aviation and Space towards sustainability today and tomorrow. Thessaloniki (Greece) – Concert Hall – https://www.easnconference.eu

14-18 October – IAF/IAC – Hosted by AIDAA – **75th International Astronautical Congress –** Milan (Italy) – www.iac2024.org

15-18 October – ESA – **SPCD 2024 – 5th Space Passive Components Days –** Noordwijk (NL) – ESA/ESTEC – https://atpi.eventsair.com/

22-23 October – RAeS – **RAeS Flight Simulation Conference 2024 –** London (UK) – RAeS/HQ – https://www.aerosociety.com/events/

30-31 October – EASA – **EASA Annual Safety Conference 2024 –** "Safety – Technology – and the Human Dimension" – In-Person event - Budapest (Hungary) – https://www.esas.europa.eu/

30-31 October – Advanced Engineering/RAeS – **Advanced Engineering 2024 –** Bridging the gap sectors for the entire engineering and manufacturing supply chain – London (UK) – Adavanced Engineering 2023 Stand E 132 – https://www.advancedengineeringuk.com/ - https://www.aerosociety.com/events/

AMONG UPCOMING AEROSPACE EVENTS

NOVEMBER

05-07 November – FSF – **IASS 2024 – International Aviation Safety Summit** - Rio De Janeiro (Brazil) – Grand Hyatt Rio De Janeiro – https://flightsafety.swoogo.com/BASS2024

06-08 November – PSAA – **READ 2024** - Rearch and education - Warsaw (Poland) – https://read2024.meil.pw.edu.pl/

12-15 November – SESAR JU – **SESAR Innovation Days 2024** - Rome (Italy) – Aeroport di Roma ENAV and Leonardo – https://www.sesarju.eu/

12-17 November – China – **AirshowChina 2024 –** China International Aviation & Aerospace Exhibition – Zhuhai Guangdong (China) – www.airshow.com.en

13-14 November – AAE – **International Conference – AI Applications in Aeronautics, Defence and Space –** Paris (France) – DGAC/HQ – https://academieairespace.com/ai-conference

13-15 November – Bahrain – **BIAS2024 –** Bahrain International Airshow 2024 – 10-Year Anniversary – Sakhir Air Base (Bahrain) – https://www.bahraininternationalairshow.com

19-21 November – ADAIrexpo – **Aviation & Aerospace Exhibition Expo 2024 –** Join the leaders in the aviation industry - Abu Dhabi (UAE) – https://www.adairexpo.com

25 November – RAeS – **Light Aircraft Design Conference –** London (UK) – RAeS/HQ – https://www.aerosociety.com/events/

DECEMBER

16 December – EREA – **EREA Annual Event** – Brussels (Belgium) – Double Tree by Hilton Brussels City Hotel – https://erea.org/event/erea-annual-event-2024/

2025

06-10 January – AIAA – **AIAA SciTech Forum** – Orlando, FL (USA) - www.aiaa.org/events

28-29 January – EC – **17th Space Conference – Meet the leaders – Shape Europe's Future** – Brussels (Belgium) – SQUARE – Meeting Centre, Pont des Arts – https://space-conference.eu

28-30 January – 3AF – **TSAS2025 – Towards Sustainable Aviation Summit** – Toulouse (France) – https://www.3af.fr/agenda

15-17 April – AIAA – **AIAA DEFENSE Forum – Secret/NOFORN** – Laurel, MD (USA) – www.aiaa.org/events www.aiaa.org/defense

13-15 May – CANSO – **AIRSPACE World 2025** – Bringing together the entire aviation community to define our future skies – https://airspaceworld.com

13-15 May – 3AF – **IAMD 2025** – Integrated Air and Missile Defence – Thessalonique (Greece) – https://3af.fr/agenda/

16-22 June – SIAE – **Paris International Air Show** – Paris-Le Bourget (France) – https://www.siae.fr

21-25 July – AIAA – **AIAA AVIATION Forum** – Las Vegas, NV (USA) – www.aiaa.org/events

22-24 July – **ASCEND/powerd by AIAA** – Las Vegas, NV (USA) – www.aiaa.org/events

22-26 September – 3AF/ESA – **HiSST2025** – High-Speed vehicle Science and Technology – Tours (France) – https://www.ffrägenda/

29 September - **09** October – IAF/IAC – **76th International Astronautical Congress** – Sydney (Australia) – www.iac2025.org

01-04 December – CEAS – **AEC 2025** – AEC2025 – CEAS biennial Conference 2025 – Torino (Italy)

CEAS
Council of European Aerospace Societies

BULLETIN
AEROSPACE
EUROPE

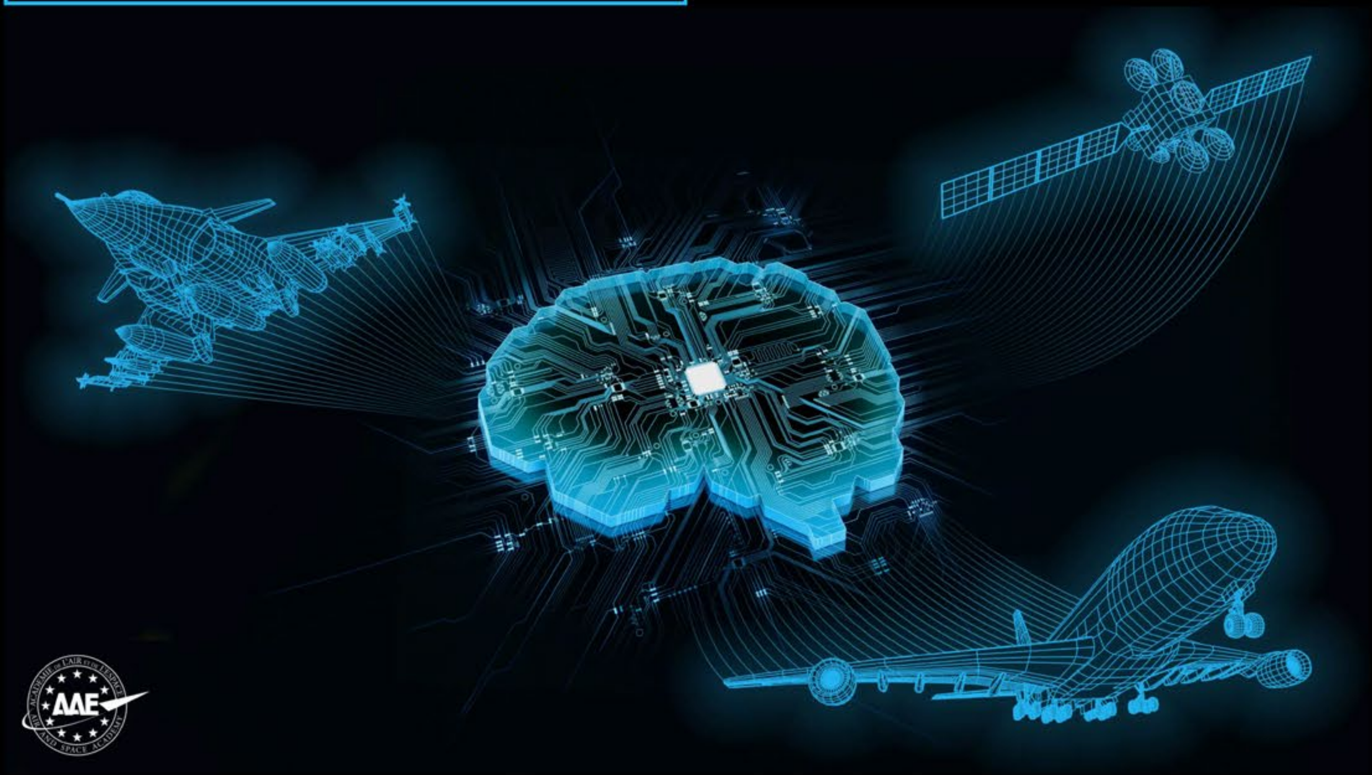
SYMPOSIUM ORGANISED BY THE AIR AND SPACE ACADEMY

Artificial Intelligence Applications in aeronautics, defence and space

International conference

13-14 November 2024

DGAC – Paris or Remotely



Objectives

We are currently witnessing a real wave of Artificial Intelligence which, although invented in 1956, has intensified particularly since the 2000s, with peaks linked mainly to the various corresponding inventions.
The aim of this conference is to bring together the key players to take stock of current developments in civil aeronautics, defence and space and to identify the corresponding future critical systems capable of making the most of industrial and trustworthy AI, both on the development side and in operations. Advantages and disadvantages will be discussed, including risks and ways of managing them, particularly in sensitive applications.

The conference is directed at operators of civil and defence aerospace systems, their contractors and industrial developers, research bodies, as well as public services and regulators.

A concluding round table will analyse common developments and constraints to be considered in the three sectors of aeronautics, defence and space.

CONFERENCE PROGRAMME