BULLETIN

AEROSPACE EUROPE

INTERVIEW WITH PATRICK KY

EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY

March 2018 / The Bulletin of the European Aerospace Community / ww.ceas.org

CEAS
COUNCIL OF EUROPEAN AEROSPACE SOCIETIES

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:

- 12 Full Member Societies: 3AF (France), AIAE (Spain), AIDAA (Italy), AAAR (Romania), CzAeS (Czech Republic), DGLR (Germany), FTF (Sweden), NVvL (The Netherlands), PSAA (Poland), RAeS (United Kingdom), SVFW (Switzerland) and TsAGI (Russia);
- 4 Corporate Members: ESA, EASA, EUROCONTROL and EUROAVIA;
- 7 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) and KSAS (Korean Society for Aeronautical and Space Sciences).

The CEAS is governed by a Board of Trustees,
with representatives of each of the Member Societies.
Its Head Office is located in Belgium:
c/o DLR – Rue du Trône 98 – 1050 Brussels.
www.ceas.org

AEROSPACE EUROPE

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

WHAT DOES CEAS OFFER YOU ?

KNOWLEDGE TRANSFER:
- A well-found structure for Technical Committees

HIGH-LEVEL EUROPEAN CONFERENCES:
- Technical pan-European events dealing with specific disciplines and the broader technical aspects
- The European Air & Space Conference: every two years,

PUBLICATIONS:
- Position/Discussion papers on key issues
- CEAS Aeronautical Journal
- CEAS Space Journal
- Aerospace Europe Bulletin

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

EUROPEAN PROFESSIONAL RECOGNITION:
- Directory of European Professionals

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

YOUNG PROFESSIONAL AEROSPACE FORUM SPONSORING

NEW PUBLICATION: 'AEROSPACE EUROPE BULLETIN'

The previous CEAS Quarterly Bulletin since now becomes the quarterly publication entitled 'AEROSPACE EUROPE BULLETIN'. It aims to provide the European Aerospace community with high-standard synthetic information on the current major advancements in air and space activities, covering four main domains: Civil Aviation, Aerospace Defence & Security, Space and Education & Training, all topics being dealt with from a strong European perspective.

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■ EUCASS: European Conference for Aero-Space Sciences
www.eucass.eu
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Jean-Pierre Sanfourche
Editor-in- , CEAS

EDITORIAL

THE CEAS BULLETIN: A NEW START!

Since 1st of January 2018, the CEAS is closely linked with six European Aerospace Science and Research Associations: EASN, ECCOMAS, EUCASS, EUROMECH, EUROTURBO and ERCOFTAC, forming the platform so-called 'AEROSPACE EUROPE'. This new concept is the result of a work which was conducted under the aegis of the European Commission and under their initiative within the framework of the EU CSA E-CAero2 project, with the strong and permanent Dr Dietrich Knörzer's impulse.
In the logical continuation of this important step forward, it has been decided to change the title of our publication which henceforth becomes '**AEROSPACE EUROPE BULLETIN**'.

CEAS will of course remain the editorial organiser but the new concept of 'Aerospace Platform' will oblige us to open our pages to the other associations and to progressively provide the whole aerospace community with high-standard papers. This will be mission of the Editorial Committee which is being set-up.

The present number One of our publication first explains in detail the successive steps of our evolution process.

After this comes the interview with Patrick Ky, the Executive Director of the European Aviation safety Agency (EASA), highlighting the major issues being dealt with.

In the aeronautics technology section, in order to complement the report on the last CEAS Aerospace Europe Conference, published in the previous CEAS Quarterly Bulletin 4-2017, we have taken the initiative to publish the abstracts of some of the keynote speeches and of the technical papers which were presented during the event.

The aerospace defence and security section reports on very last news from OCCAR, with the recent A400M Ministerial Meeting and the MALE RPAS System Requirements Review, and from EDA, with the collaborative RPAS training, the status of EUROSWARM, SPIDER and TRAWA pilot projects, and also the cooperation agreements signed with ESA concerning Unmanned Maritime Systems, GOVATSCOM and Earth Observation.

Concerning space, the ESA contribution includes a scientific paper: 'JUICE', the first European mission to Jupiter and its icy moons, and a programmatic paper about the future 'Micro-Launchers'.

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PRESIDENT' MESSAGE

Christophe Hermans,
CEAS president

CEAS @WORK

On 5 and 6 February 2018 we held a Trustee Board meeting, hosted by AIDAA at Politecnico di Milano (Italy). Running business was discussed and we were briefed about the highlights of last year's successful Aerospace Europe 2017 conference in Bucharest. An important point on the agenda was the collaboration with PEGASUS, the European network of aerospace engineering faculties, about setting up an EU quality system in the higher education in aerospace and the role of CEAS.

CEAS MEMBER OF CLEAN SKY ACADEMY

CEAS is proud to announce that it has been invited to become a member of the "Clean Sky Academy". The CS Academy is a working group set-up to support the achievement of the Clean Sky 2 Joint Undertaking (CS2JU) objectives through strengthening the cooperation and involvement of Academia and Research Centers in the Clean Sky Program. Its purpose is to provide advice and support the dissemination of CS activities, by organizing and promoting dedicated events for students and by supporting the Clean Sky PhD Awards initiative. The call for nominations of distinguishes young scientists, who have recently completed a PhD thesis in the field of aeronautics, has recently been closed. The 3 winners will be invited to the ILA Berlin Air Show in Berlin (Ge) for the Award ceremony on 25 April 2018.

TECHNICAL COMMITTEE ON SPACEPLANE AND HYPERSONIC SYSTEMS

CEAS has decided to support the establishment of a new international committee on hypersonics. From 26–29 November 2018 the first edition of the International Conference on High-Speed Vehicle Science and Technology will be organized, in close collaboration with our corporate member ESA. The HiSST will promote open discussion between research institutions, academia and industry from around the globe on research and development of enabling technologies for supersonic to high-speed vehicles. In honour of TsAGi's 100th anniversary, the inaugural location of this international conference is chosen to be Moscow (Russia) and hosted by TsAGI.

CEAS BATCHED THEMATIC EVENTS

On a regular basis the CEAS Technical Committees, in close cooperation with our national member societies, organize international thematic events in several fields. This year's CEAS batched events in aeronautics are:

- 24^{th} AIAA/CEAS Aeroacoustics Conference (AIAA, Atlanta, US);
- 44^{th} European Rotorcraft Forum ERF (NVvL, Delft, NL);
- 22^{nd} Aeroacoustics Workshop;
- European Workshop on Aircraft Design Education EWADE 2018;
- International Conference on High-Speed Vehicle Science and Technology HiSST (TsAGI, Moscow).

E-CAERO2 PROJECT FINALIZED

As partner in the EU CSA E-CAero2 project, CEAS (in very close coordination with ECCOMAS, ERCOFTAC, EUCASS, EUROMECH and EUROTURBO) has created the '*Aerospace Europe*' brand and a collaboration structure for this community to support the extension of the partnership. Core of AE will be our biennial Aerospace Europe flagship event and the AE platform (http://aerospace-europe.eu/) as a valuable tool for advertising (and de-conflicting) of partnering events and Open Access publication of research results.

Major project benefits for CEAS are as follows:

- Expansion of our network, closer collaboration with partners:
  - Cross advertising of partnering events;
  - Organization & participation to partner Special Technology Sessions;
  - Partner experts in the Technical Committee;
  - Partner field editors for CEAS journals.

- Reduced # of European aerospace conferences through collaboration with EASN (common biennial conference).

- Use of the AE platform (event calendar, paper repository, use cases).

- Exchange of best practice:
  - CEAS journal fact sheets;
  - CEAS conference statistics;
  - Paper Open Access policy;
  - CEAS conference requirements.

CEAS ANNUAL REPORT 2017

By Christophe Hermans

CEAS Trustee Board and Officers,

" In 2017 we welcomed Elisabeth Dallo (AAAF), Paul Eijssen (NVvL) and Franco Bernelli (AIDAA) as new Trustee Board members, Torben Henriksen (ESA) as branch chair Space and Marc Bourgois representing the corporate member Eurocontrol.
We had to say goodbye to Amalia Finzi (AIDAA), who served CEAS for a very long period of time and Fred Abbink (NVvL), the outgoing president, who served CEAS for 7 years, the last 3 of which as president.
The CEAS board of officers was as follows:
- **Christophe Hermans** (president)
- **Cornelia Hillenherms** (VP finance)
- **Pierre Bescond** (VP external relations and publications)
- **Kaj Lundahl** (VP awards and membership)
- **Mercedes Oliver-Herrero** (director general)
- **Torben Henriksen** (branch chair space)
- **Christophe Hermans** (branch chair aeronautics)

CEAS @WORK

In 2017 we continued our efforts on harmonizing, strengthening, promoting and facilitating effective knowledge transfer and information exchange at a European level with engagement of students and young engineers. The Aerospace Europe dissemination platform, our top-class journals, thematic events and of course our Aerospace Europe CEAS 2017 conference in Bucharest are important means to strengthen the European aeronautics and space communities.
On 21 March we had our first CEAS officers meeting in the PolSCA Brussels office. Trustee Board meetings took place on 7 June at the Netherlands Aerospace Center NLR in Amsterdam, hosted by NVvL and on 17 October during the CEAS Aerospace Europe conference in Bucharest, hosted by AAAR. On 17 October 2017 also the CEAS General Assembly took place.
An important point on the agenda of the last meeting was the discussion about the CEAS strategy 2018 - 2021. It is our mission to be Europe's foremost aeronautics & space community (i.e. Aerospace Europe) bringing together member societies and corporate partners with the aim to further the advancement of aerospace sciences and engineering. The primary objectives of our strategy for the next 4 years are as follows:
- Obvious European focal point fostering knowledge dissemination in aerospace ;
- Active partner in European Aerospace Education, Research and Innovation ;
- Strengthen unique European label for aeronautical events and publications :
  - Coordination of biennial large scale European aerospace event with MoU partners and member society's support, attracting policy makers (European level), captains of aerospace industry and University scientists,
  - Support member societies and technical committees organizing thematic events with focus on mono-disciplinary engineering.

We furthermore defined the strategy to achieve those objectives.

CEAS HONOURS AND AWARDS

The CEAS award 2018 winner was unanimously selected by the board and we are honored that we can add Jean-Jacques Dordain, former ESA's Director General, to our list of distinguished award recipients.
During the CEAS Aerospace Europe Conference in Bucharest we hand-over the CEAS award 2017 to Eric Dautriat, former Executive Director of the Clean Sky Joint Undertaking.
Each year CEAS may bestow the highly recognized «CEAS Aeroacoustics Award». This year's recipient is prof. Daniel Juvé of Ecole Centrale de Lyon, ECL. At the AIAA/CEAS Aeroacoustics Conference in Denver, the award for the best student paper in aeroacoustics was granted to Benshuai Lyu (Ph.D. student, University of Cambridge, UK).

CEAS BATCHED THEMATIC EVENTS

On a regular basis the CEAS Technical Committees, in close cooperation with our national member societies, organize international thematic events in several fields. This year's CEAS batched and well attended events in aeronautics included:
- 4th Guidance, Navigation & Control Conference (GNC)
- 23th AIAA/CEAS Aeroacoustics Conference
- 18th International Forum on Aeroelasticity and Structural Dynamics (IFASD)
- 43rd European Rotorcraft Forum (ERF)
- 21st Aeroacoustics Workshop 'Aircraft Noise Generated from Ducted or Un-Ducted Rotors'
- European Workshop on Aircraft Design Education (EWADE 2017).

CEAS AERONAUTICAL AND SPACE JOURNALS

End of last year we have welcomed Hansjörg Dittus (DLR), who took over the position of Editor-in-Chief of the Space Journal succeeding Constantinos Stavrinidis. In addition Olga Trivailo (DLR) and Rafael Bureo Dacal (ESA) have joined the Managing Editor team of the Space Journal. We are very grateful for the effort and enthusiasm of Steve who significantly contributed to the success of the CEAS Space Journal from its first edition in 2011 onwards!
The two editorial teams again managed to attract and process 91 new interesting articles issued in four complete volumes of both our journals. Summaries of the CEAS Space Journal articles can be found following the link http://link.springer.com/journal/12567/9/ and for the CEAS Aeronautical Journal at: https://link.springer.com/journal/13272/8/.
The journals are truly prominent, successful and influential, as can be seen in the more than 10.000 full text articles downloads yearly!

CEAS AEROSPACE EUROPE CONFERENCE 2017

Where are we going? The theme of our flagship event, the CEAS Aerospace Europe Conference, inspired well over 300 speakers and 435 registered attendees to address challenges aerospace is experiencing. The Romanian society AAAR has offered the delegates a very attractive and exceptional environment: the prestigious Palace of the Parliament. A visual impression of the conference, its 35 keynotes and its social events can be found on the World Wide Web (http://ceas2017.org/galerie/).

25 YEARS OF CEAS

In 1986, the Deutsche Gesellschaft für Luft- und Raumfahrt (DGLR), the Royal Aeronautical Society (RAeS) and the Association Aéronautique et Astronautique de France (3AF) began a series of regular meetings to review and discuss European co-operation issues. This led to a more formal organization when, 25 years ago at the 1992 Farnborough Air Show, the three organizations, along with Associazione Italiana di Aeronautica e Astronautica (AIDAA), launched CEAS. CEAS was formally instituted one year later at the Paris Air Show. In 1995, AIAE (Spain) and NVvL (The Netherlands) came on board, followed by FTF (Sweden) and SVFW (Switzerland) in 1996. These eight bodies formed the core of the original Confederation of European Aerospace Societies (CEAS). Since then CEAS has changed its legal status into a council, now with 13 national aeronautical societies representing roughly 35,000 individual aeronautical professionals all over Europe.
To celebrate our 25th anniversary, we decided last year to publish a booklet about our history and asked prof. Keith Hayward to author the publication. First copies of the book were handed out to those past presidents present at the conference, being Georges Bridel (SWFW), Joachim Szodruch (DGLR), Pierre Bescond (3AF) and Fred Abbink (NVvL) as token of our appreciation for their efforts towards CEAS. Also all delegates at the conference received the book as a small present of CEAS.

COOPERATION

We have signed a Cooperation Agreement with EASN, represented by Spiros Pantelakis (as chairman of the European Aeronautics Science Network Association). Both our organisations provide services and conduct activities some of which are quite similar, others are rather complementary. By joining forces in certain areas I'm convinced we can reach out to more professionals, increase our impact and be more efficient in organizing events. Traditionally EASN has strong links with universities and thus scientists, where we as CEAS reach out more to industry, applied research and thus engineers, it shows that we can reinforce each other. This is why we have agreed from 2019 onwards to jointly organize the biennial European aerospace conferences with a joined technical committee.
As partner in the EU CSA E-CAero2 project, CEAS, in very close coordination with the other partners ECCOMAS, ERCOFTAC, EUCASS, EUROMECH and EUROTURBO, has created the 'Aerospace Europe' brand name, its mission statement and an image. A collaboration structure and business plan for this community has been established by CEAS to support the extension of the partnership. Core of AE will be our biennial Aerospace Europe flagship event and the AE platform. The Aerospace Europe platform (http://aerospace-europe.eu/) aims at providing a central hub for professionals with an interest in the development and applications of technologies in all areas relevant to Aeronautics and Astronautics. CEAS is using the platform for publishing the papers presented at our conferences and thematic events, as far as not issued in our journals. The platform also contains a rich overview of all relevant aeronautical events.

From left to right: Valentin Silivestru, Pierre Bescond, Fred Abbink, Christophe Hermans, Georges Bridel, Joachim Szodruch

CEAS is in contact with PEGASUS, the European network of aerospace engineering faculties, about setting up an EU quality system in the higher education in aerospace.
CEAS is proud to announce that it has become a member of the "Clean Sky Academy". The CS Academy is a working group set-up to support the achievement of the Clean Sky 2 Joint Undertaking (CS2JU) objectives through strengthening the cooperation and involvement of Academia and Research Centers in the Clean Sky Programme. Its purpose is to provide advice and support the dissemination of CS activities, by organizing and promoting dedicated events for students and by supporting the Clean Sky PhD Awards initiative."

Christophe Hermans, 22 January 2018

INTERVIEW OF PATRICK KY, EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY (EASA)

By Jean-Pierre Sanfourche, Editor-in-Chief

Patrick Ky became Executive Director of the EASA on 1st of September 2013 after having been in charge of the SESAR Programme at the European Commission since 2004. Previously he had held different managerial positions in the French Civil Aviation Authority. Graduate from Ecole Polytehnique and from Civil Aviation Engineering School, he also holds degrees in economics from the University of Toulouse and the Massachusetts Institute of Technology (MIT).
In 2013, Patrick Ky was the recipient of the Glen. A. Gilbert memorial Award of the Air Traffic Controllers Association as a recognition of his achievements in the field of aviation and for being an advocate of innovation and change in the air traffic control.
In 2015, he was designated 'Industry Leader of the Year' by the German publication Flügermagazine for his commitment to develop simpler, better and lighter rules for General Aviation.

Jean-Pierre Sanfourche: EASA Preliminary Analysis of the Commercial Air Transport Operations shows lowest number of fatal accidents in modern aviation history for worldwide commercial air transport with large aeroplanes in 2017 and NO fatal accidents or fatalities in EASA large commercial aeroplanes operations: could you comment?
Patrick Ky – Aviation continues to get safer every year and the fact that 2017 was the safest year at worldwide level in terms of fatalities is clearly positive. However, the accidents that have occurred already in 2018 show that there is no room for complacency. Efforts to identify and reduce the key safety risks such as loss of control, airborne collision and runway excursions are vital to continue this positive trend. Again, we must never become complacent and the European Plan for Aviation Safety is vital in ensuring that we are able to deal with the most important actions to further improve safety.

JPS: You have recently issued the 2018-2022 European Plan for Aviation Safety (EPAS). What are the most fundamental strategic orientations of this new plan?
PK – In the past two years we have been doing a lot of work to include clear strategic orientations in the EPAS, after discussing them with States and Industry. This makes it a true European plan.

The strategy of the EPAS is based on the European Commission's Aviation Strategy, EASA's strategic plan as well as the performance review published in the Annual Safety Review and the European Aviation Environmental Report. Our strategic priorities address the systemic safety (e.g. safety management or competence of personnel), the operational safety of fixed wings and rotorcraft operations but also general aviation and the operation of drones. They also address topics such as cybersecurity and conflict zones. I encourage you to read chapter 3 of the EPAS to see the full list.

In years with no fatalities like 2017, safety work still continues in all areas including for example human performance and training or safety management. For Commercial Air Transport Operations, the prevention of loss of control accidents as well as runway safety continues to be one of our strategic priorities.
This year's edition of EPAS includes also our strategy in the areas of International Cooperation and Technical Training, thus emphasising the need to coordinate more than ever safety actions at regional and international levels, and acknowledging the growing role of regional aviation safety oversight organisations (RSOOs).

In addition the EPAS 2018-2022 includes several new research projects, which illustrates the growing importance of Research in the EU policies as an enabler to enhance safety.

JPS: Is EPAS extended to non-EASA European States?
PK – The implementation of the EPAS is already extended to European states not under the EASA umbrella. All States that are members of the European Civil Aviation Conference (ECAC) have voluntarily committed to implement the EPAS. EASA is now working closely with ICAO to extend its scope to the 56 States that are part of the ICAO EUR/NAT region.

JPS: Has EPAS been established independently from ICAO or on the contrary in close co-operation with it? And more generally, is Europe sufficiently represented within the ICAO authorities?
PK – The EPAS was created to support Member States to implement their State Safety Programmes (SSP) and the Global Aviation Safety Plan (GASP), therefore in line with ICAO's strategy. The cooperation with ICAO has become stronger over the years till the extent that Europe is now contributing to shape the next edition of the GASP, which is to be adopted in 2020. The EPAS is therefore directly feeding and contributing to the next iteration of the global aviation safety strategy.
Furthermore ICAO recognises the added value of regional organisations such as EASA. In Europe we have gai-

ned considerable experience in managing safety and efficiency through regional cooperation and economies of scale and therefore we are strongly supporting ICAO in developing a Global Aviation Safety Oversight System (GASOS). We are outlining the added value that RSOOs can bring to their Member States, to industry and how they can support ICAO's initiatives, particularly in the implementation of the GASP vision and mission at regional level.

As an example, EASA has seconded an expert to support ICAO in developing the GASOS. In addition we have a permanent representative in Montréal. European States also have permanent representations. Europe is certainly present within ICAO.

JPS: You want to initiate numerous new research projects: what are the most important and urgent?

PK – Yes we are convinced that our role as regulator is also to be efficiently connected with the aviation research actors and projects and when/where relevant lead or advise specific projects to support our main mission, i.e. maintaining the highest aviation standards in the fields of safety and environmental protection.

EASA has established an internal research committee to review and prioritise the research proposals coming from its experts but also from external stakeholders. The priorities in the field of safety-related research are part of the EPAS latest edition (2018-2022). Examples of key research addressing urgent needs are: Aircraft cybersecurity, Drones collision with aircraft, Improvements to helicopter designs and safety systems, Potential contamination of aircraft cabin air, Safety of Lithium batteries transported – just to name a few of them.

JPS: SESAR is launching a call to establish U-Space demonstrations across Europe: how is EASA going to be involved in this action?

PK – EASA will be involved as advisor in the call for U-Space demonstrators launched by the SESAR Joint Undertaking and also actively support the network of demonstrators launched by the European Commission.

Our contributions will mainly encompass the review of the preparatory work, the setting-up of the demonstrators as well as the outcome of the demonstration exercises (main lessons learned and assessment of rules and procedures used). In particular we are interested in knowing the application of risk assessment techniques used by the drone operators for the 'specific' category of operations as well as in the interoperability needs between the different U-Space service providers.

We are also interested in gaining knowledge on how the drone traffic will be managed amongst different operators on one side and with the manned aviation on the other side, in particular when the same portion of airspace is shared.

We wish to learn from the field experience before comprehensive regulations are issued.

JPS: You recently stated that partnership in cyber security has become a matter of urgency: how do you plan to update the organisation of your management team with a view to henceforth considering altogether safety and security questions, and no longer separately?

PK – As a matter of fact, the Agency has already updated its organisation in order to take into account the synergies and interfaces between safety and security. For that purpose, a "Cybersecurity in Aviation & Emerging Risks Section" has been established, which is responsible not only for aviation cybersecurity matters but also for those aviation matters where interdependencies between safety and security exist. This Section performs its activities coordinating across all the Directorates in the Agency,. This organisation places the Agency properly positioned to fully address the scope of activities contained in the upcoming new Basic Regulation, both from a strategic and operational point of view.

JPS: Do you already cooperate with ENISA (European Network Information on Security Agency), the centre of expertise for cyber security in Europe?

PK – The cooperation between EASA and ENISA is already very significant and is continuously increasing.

From a strategic point of view, ENISA is part of the European Strategic Coordination Platform (ESCP), which has been set-up by the Agency and which includes, in addition to ENISA, representatives from the different European Institutions, national authorities and stakeholders. This ESCP is the forum for discussing and defining the European Cybersecurity Strategy for aviation, as well as for discussing the future aviation cybersecurity regulatory framework.

In addition, EASA and ENISA are cooperating in the development and facilitation of cybersecurity awareness and training, including Pan-European cybersecurity exercises aimed at improving the reaction to cybersecurity attacks.

Finally, EASA and ENISA have been coordinating already for a long time the implementation of the NIS Directive by the Member States.

JPS: Is EASA working closely with military aviation, not only for ATM but also for safety and security?

PK – Certainly. The Agency is working closely on cybersecurity matters with the military aviation, not only in ATM but in all aviation domains. This is currently being performed through the European Strategic Coordination Platform (ESCP), where the European Defence Agency (EDA) participates as a member and NATO participates as an observer. This coordination will allow to take into account both the civil and military aspects when defining the European Cybersecurity Strategy for aviation.

JPS: CRM (Crew Resource Management) is one of the most important safety factors in the area of Commercial Air Transport airplanes operations: what are the main actions you plan to deal with this subject?

PK – EASA introduced new rules for CRM training in October 2016 following the entry into force of new CRM training requirements. This was further reinforced through the conduct of workshops and an EPAS action to promote best practices on CRM Training which is now available on EASA Website. In this context new elements related to CRM and its implementation have been introduced to better align CRM training with competency-based training and evidence-based training (CBT/EBT), such as Automation and philosophy on the use of automation, Monitoring and intervention, Resilience development, Surprise and startle effect or Cultural differences.

JPS: As regards Aircrew and Medical aspects, what are your main new initiatives?

PK –The agency has adopted a proportionate risk based approach for private aviation pilots with the introduction of Declared Training Organisation and the development of Basic Instrument Rating.

For Commercial pilots, the challenge to manage complexity of automated systems when facing unexpected situation lead to adopt more Competency Based Training tailored to the needs of today's pilots. This evolution is coordinated with the gradual implementation of Evidence Based Training (EBT) that enables to evaluate and train to proficiency the pilot competencies (knowledge, skills but also attitudes). Last, the development of Upset Prevention and Recovery Training for Commercial pilot licences builds up the resilience of the system and come together with the development of a new generation of flight simulator training devices adapted to the new training exercises.

We also look ahead in order to take benefit of virtual reality for new training devices and the digitalisation for aviation pilot licences.

JPS: How is EASA preparing for the entry into service of GALILEO?

PK – Beyond EGNOS, EASA will become the competent authority for the oversight of the performance of Galileo and the certification of the operator EGNOS. What is at stake is the safety of the Satellite Based navigation systems and the related augmentation systems. EASA will have to ensure that the level of performance of such systems match the Civil Aviation requirements for the different phases of flights. After the initial certification, we will also need to ensure the continuous monitoring of these systems. EASA experts accompany these innovations, and as for anything else, EASA has to stay on, or ahead of the curve to be ready for the new technologies.

JPS: Is EASA contributing to the studies and researches related to MH370 disappearance?

PK – EASA has been involved with the topic of aircraft localisation since the accident of Air France flight 447 in the Atlantic Ocean in 2009. As a result a number of rules have been adopted to address this issue. These rules put new requirements to have underwater locating devices with an extended range to facilitate the search missions, requirement to track the aeroplanes all along the flight (applicable as of December this year) and requirements to have all aeroplanes equipped with automatic means to locate the end point of any flight. The latter is for 2021 has the technologies have to be developed.

In addition, EASA is actively taking part to ICAO working groups involved with locating an aircraft.

JPS: To conclude our talk, would you accept to give us your three priorities for EASA in the year 2018?

PK – There are many priorities to address for EASA! If we have to pick three, I would mention:

1. the need for EASA to be prepared for the Drones challenges;
2. further develop our partnership with the international actors;
3. and prepare the Agency for supporting technological innovation.

■

EUROPEAN AVIATION SAFETY AGENCY - EASA

Established in 2002
- **800+ aviation experts & administrators**
- **32 EASA Member States = 28 EU + Switzerland, Norway, Iceland, Lichtenstein**
- **4 international permanent representations: Canada (Montréal), USA (Washington), China (Beijing), Singapore**

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http://www.easa.europa.eu

KEYNOTE ADDRESSES

THE 6th CEAS AIR & SPACE CONFERENCE (BUCHAREST, 16-20 OCTOBER 2017) WAS HONOURED BY THE PARTICIPATION OF 33 OUTSTANDING KEYNOTE SPEAKERS. HERE AFTER ARE PUBLISHED THE ABSTRACTS OF FOUR ADDRESSES:

EREA - OUTSTANDING IN CROSSING THE VALLEY OF DEATH IN AVIATION

Abstract of the keynote address by Bruno Sainjon, EREA Chairman

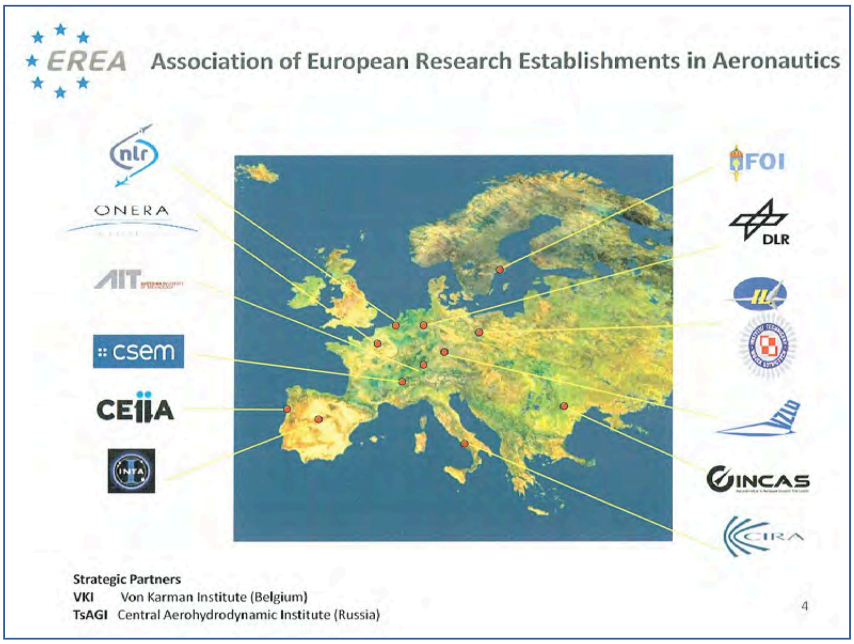
THE EREA, IN A FEW WORDS

The EREA is the association of European Research Establishments in Aeronautics, represented in 14 European Centres:

- NLR: Netherlands Aerospace Centre
- ONERA: French Aerospace Lab
- AIT: Austrian Institute of Technology
- CSEM: Swiss Research and Technology Organization focused on generating value for a sustainable world
- CEiiA: Centre for Engineering and Product Development (Portugal)
- INTA: Spanish National Institute of Aerospace Technology
- FOI: Swedish Defence Research Agency
- DLR: German Aerospace Centre
- ILOT: Institute of Aviation Technology (Poland)
- INCAS: National Institute for Aerospace Research' Elie Carfoli' (Romania)
- CIRA: Italian Aerospace Research Centre
- TWO STRATEGIC PARTNERS:

– VKI - Von Karman Institute (Belgium)
– TsAGI - Central Aerohydrodynamic Institute (Russia)

EREA is a non-for-profit association the objectives of which are: (i) to promote and represent the joint interests of its members; (ii) to intensify the co-operation between its members, aimed at further integration of their activities in the field of civil aeronautics, military aeronautics and space-related domains; (iv) to facilitate the ultimate



goal of the Members of an integrated management of joint activities, thereby contributing to Europe's role a global player in aeronautics.

Some EREA Key Figures (2015): € 0.5 Bln annual spent on research in aeronautics - 6,000 employees in aeronautics – 8,000 publications – 300 PhD theses

FROM INVENTION TO INNOVATION

On average about 20% of EREA work is used to build up new knowledge (Low TRL[1]s 0-3), technology development counts 70% work (TRLs 4-6) e.g. collaborative projects, and 10% is dedicated to direct support to industrial innovation (services, High TRLs), e.g. industrial contracts. The focus of EREA and its members is on TRL 2 to 6, therefore playing a vital role in maintaining and improving the competitiveness of European industry as well as in dealing with societal concern, in particular the environmental problems.
Multi-disciplinary Research covers a broad spectrum: Aerodynamics, Flight Mechanics, Materials & Structures, Ground Testing, Acoustics, Simulation, Flight Tests, Human Factors, Propulsion, Avionics, Aircraft Operations, safety, Environment, Air/Airport Traffic Management, Security.

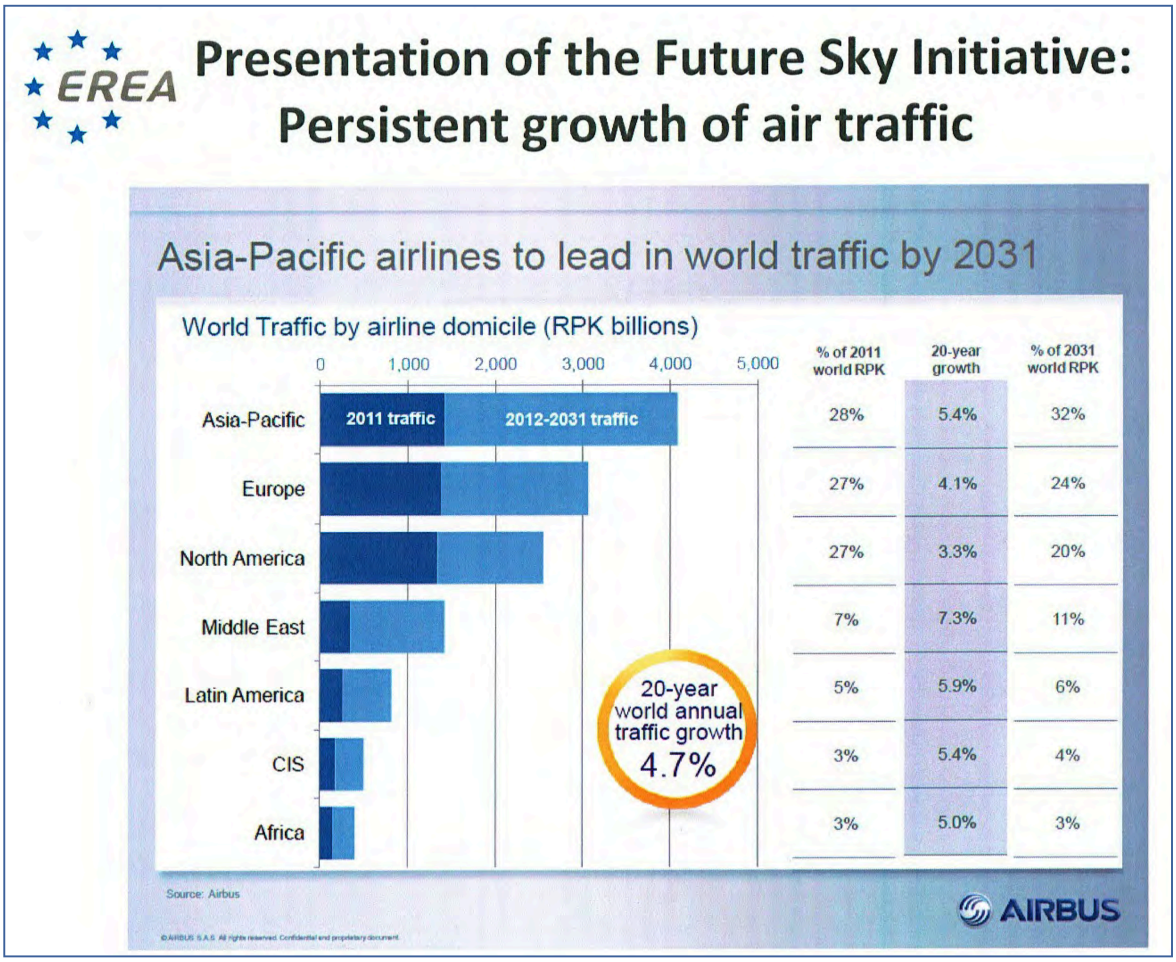
EREA takes up five challenges: (i) meeting societal and market needs; (ii) maintaining and extending industrial leadership; (iii) protecting the environment and the energy supply; (iv) ensuring safety and security; (v) prioritising research, testing capabilities and education.

EREA PARTICIPATES IN ACARE

EREA strongly supports ACARE and the new SRIA (Strategic Research and Innovation Agenda). It is represented in ACARE's Chair team, General Assembly and Working Groups.

THE FUTURE SKY INITIATIVE

This is a Joint Initiative taken in the general context of the persistent growth traffic, and in which development and integration of aviation technologies are considered at European level:
– Emissions/Climate Impact;
– Noise;
– Wake Vortex/ATM;
– Ground Processes/Turnaround.



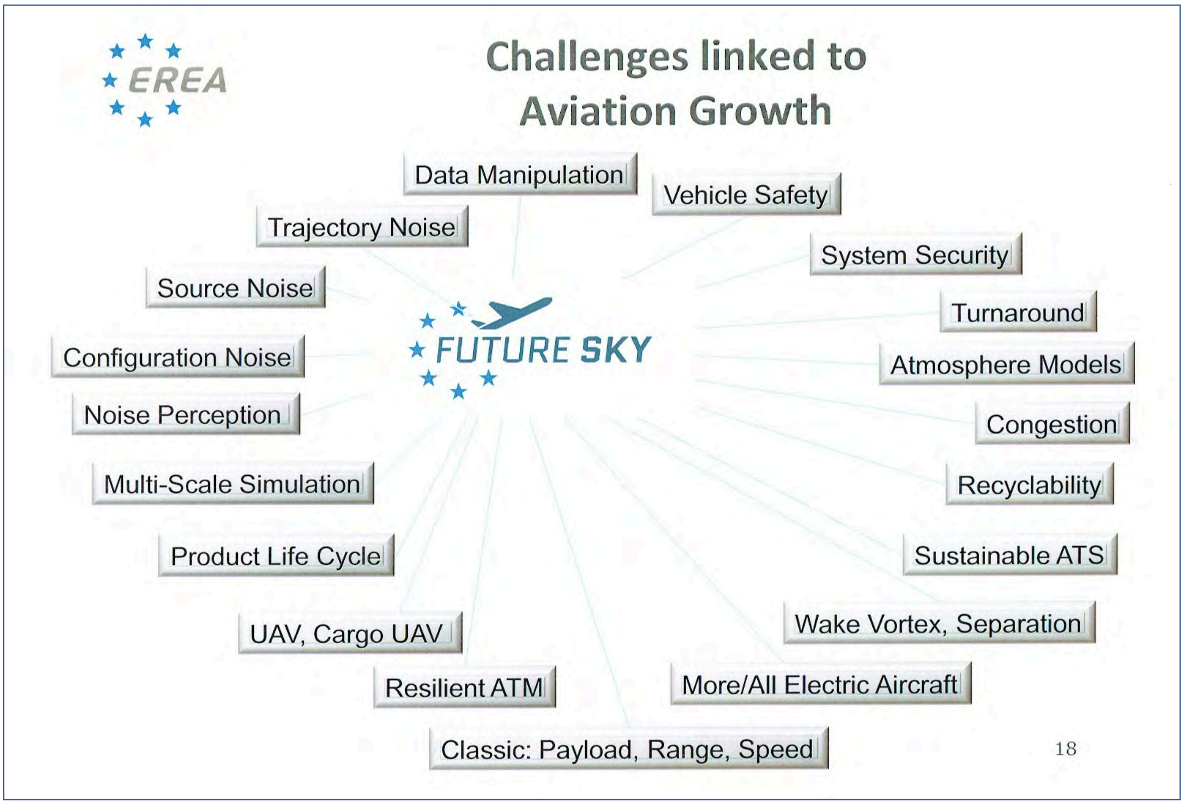
[1]. *TRL : Technology Readiness Level*

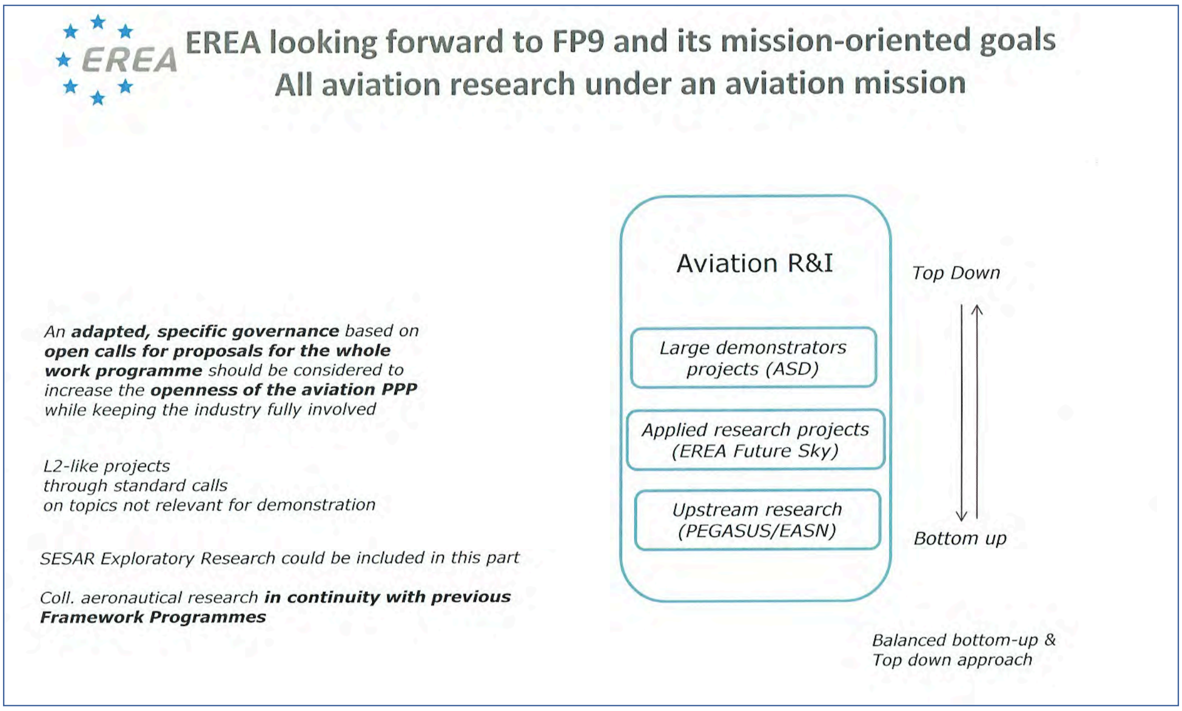
– All these subjects are being approached by opening up new perspectives in joint research together with SESAR and Clean Sky 2.

– Future Sky comprises four programmes:
- Safety
- Quiet Air Transport
- Energy
- Integration

TO REALISE FP2050 BEYOND 2020

EREA asks for dedicated aviation funding in FP9, covering the entire research and innovation chain, this FP9 also supporting aviation research in infrastructures for new products but also for education, with a budget – *via* grants – dedicated to the aviation sector in the field of research and innovation up to TRL6 and TRL7 via financial instruments.





FUTURE SKY & ANIMA: A COMPREHENSIVE EREA APPROACH FOR THE GLOBAL CHALLENGE OF AVIATION NOISE

Abstract of the keynote address by Laurent Leylekian, ONERA

THE GOVERNING GOAL OF FUTURE SKY IS "24/7"

This concept describes the full airside mobility, 24 hours a day, 7 days a week, resilient against any impacts, implying to address major challenges through 24/7 Enablers – Twentyfour-Seven Enablers (TSE).

The four major pillars of Joint Research infrastructures (JRI) are being started one by one every two years. The joint programmes, so-called TSE, under Future Sky are:

TSE 1 – Safety

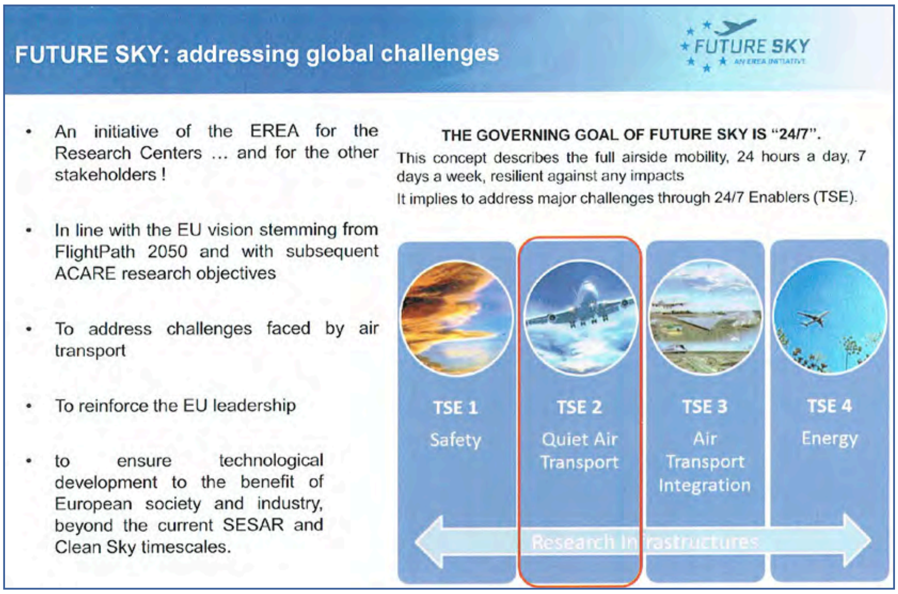
EREA takes the responsibility to provide the research and validation needed to guarantee the short term safety rules, regulations, measures and standards, and in the long term to fulfil the "Flightpath 2050" goals concerning safety.

TSE 2 – Quiet Air Transport

TSE 2 pushes forward research on thorough understanding of air transport noises and innovative low TRL (Technology Readiness Level) enabling technologies on the one hand and impact and perception on the other hand.

TSE 3 – Air Transport Integration

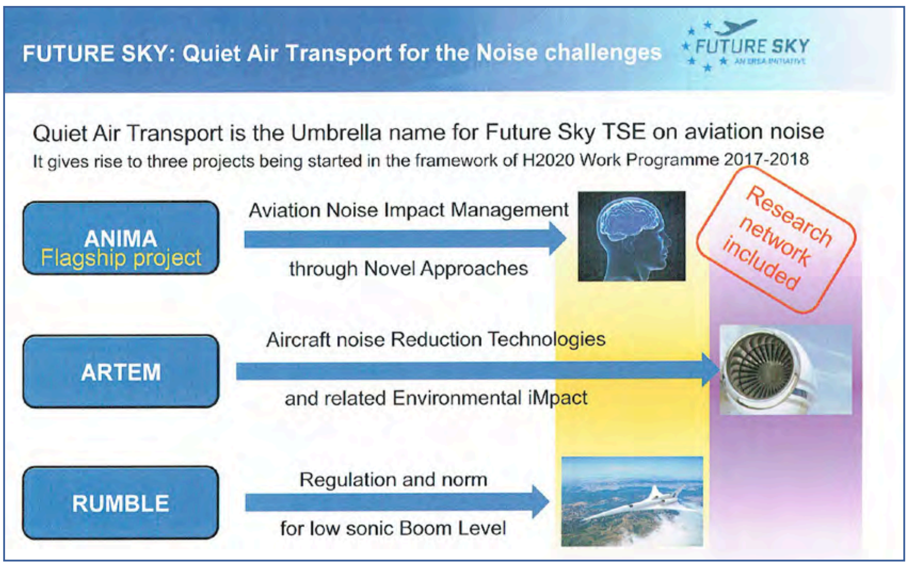
The objective of this TSE is to study in a broad system approach: technology integration into aircraft, aircraft integration into the transport system including regulatory requirements, integration of unmanned freighters and intermodal aspects integration into a future total system.



TSE 4 – Energy

As a consequence to TSE 2 and TSE 3 asking for new energy concepts, TSE 4 will address the system on-board and on-ground.

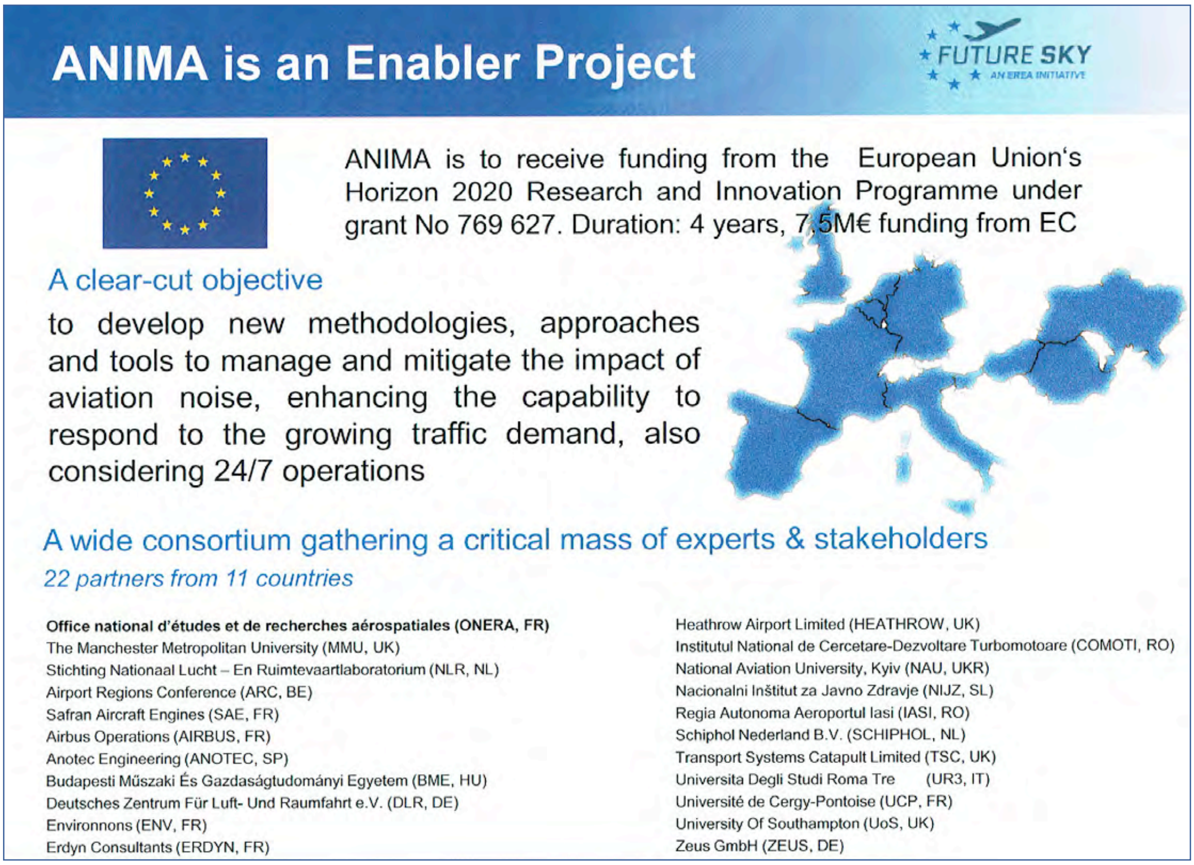
▶ Only with these four elements, the whole 24/7 goal can be gained, and the complete impact of aviation on the environment can be analyzed.

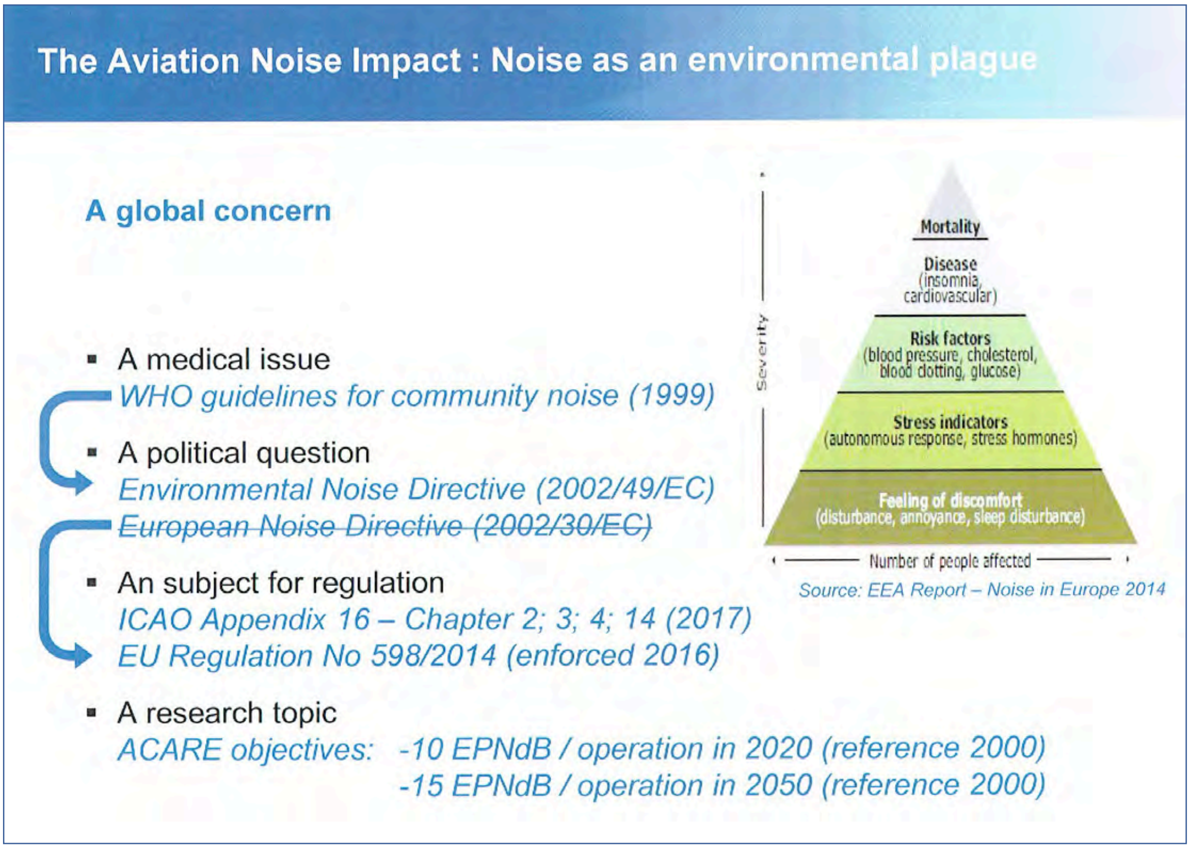


ABOUT TSE 2: QUIET AIR TRANSPORT FOR THE NOISES CHALLENGES

Future Sky TSE on aviation noise gives rises to three projects being started within the framework of H2020 Work Programme 2017-2018: ANIMA, ARTEM and RUMBLE.

ANIMA





EUROPEAN AERONAUTICS SCIENCE NETWORK (EASN)

Abstract of the keynote address by Zdobyslaw Goraj, EASN Vice-President

THE EASN, IN A FEW WORDS

EASN is an open Association, structuring and representing the European Academia in Aviation research related issues. It was established on 6 May 2008 by 22 founding members, with the support of the European Commission and several University professors throughout Europe. It is self-funded and self sustainable, international non-profit Association coordinated and run by a board of directors elected by the general assembly for a 3-year term.

Its long-term goal is build-up an open, unique European platform in order to structure, support and upgrade the research activities of the European Universities active in Aviation Research and to facilitate them to respond to their key role in realising the European Research Area (ERA).

EASN is acting as a communication platform between the European aeronautics Academia and the professional Associations of other stakeholders, governmental and state authorities, the European Commission, etc. (Fig. 1, 2 and 3)

EASN STRUCTURE

Figure 1

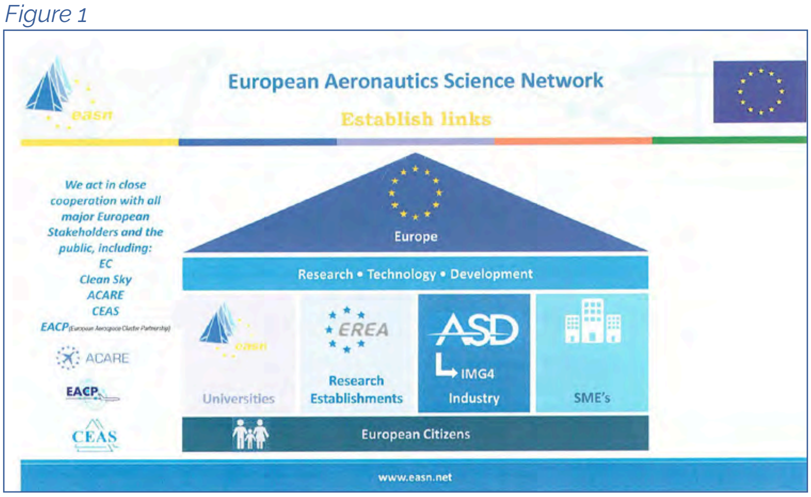
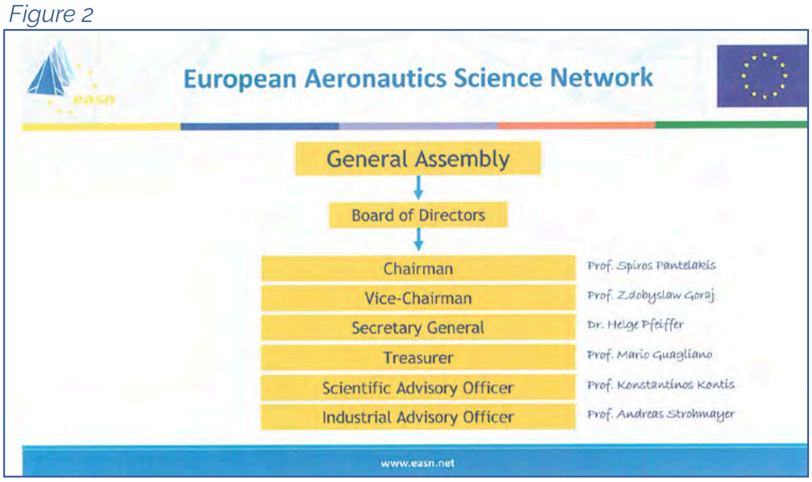


Figure 2



CREATE INNOVATION – INCUBATE BREAKTHROUGH TECHNOLOGIES

The development of innovation and breakthrough technologies is indispensable to pave the way on achieving the demanding goals of the 'Flight Path 2050 for Aeronautics'.

Research priorities

The main subjects concerned are:

- **Aerostructures:** advanced manufacturing process and technologies, and technologies, Additive manufacturing (AM), metallic materials, nanocrystalline materials, composite materials, adhesive bonding, structural analysis and design, Composite Lattice fuselage design, smart materials, structures behaviour and material testing, structural health monitoring (SMH).

- **Flight Physics:** integrated wing technologies. (Fig. 4)

- **Propulsion:** distributed propulsion hybrid - electric flight.

- **Maintenance, Repair and Overhaul (MRO):** health and usage monitoring and management.

- **Innovative concepts & scenarios:** personal autonomous vehicles, air-to-air refueling for civil transportation, alternative energy sources (batteries, fuel cells, biofuels), unconventional aircraft concepts. (Fig. 5)

Figure 3

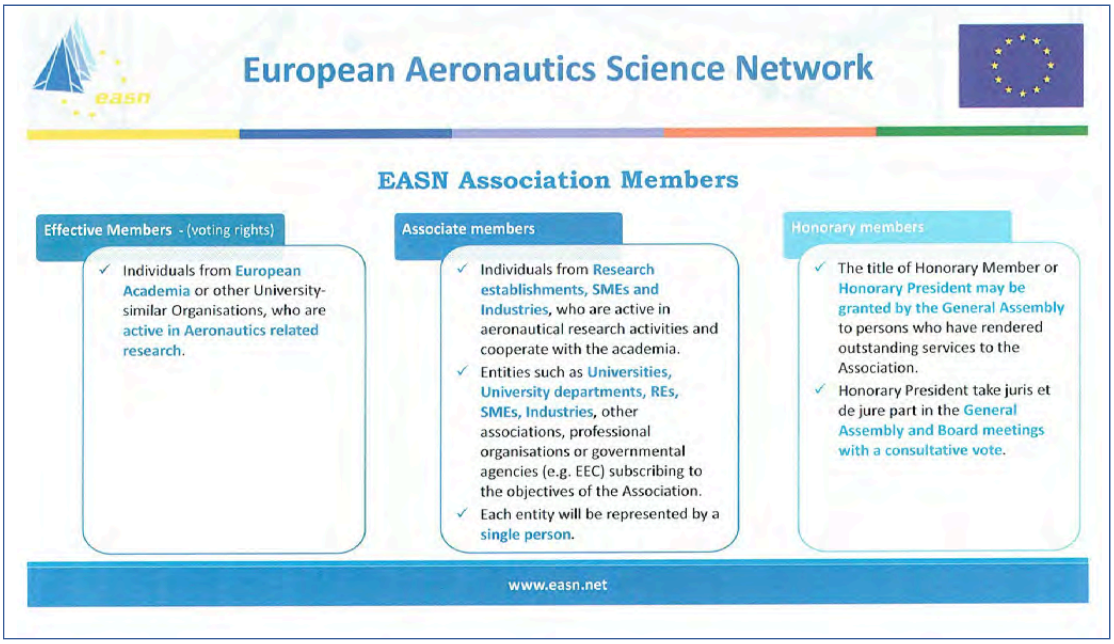


Figure 4

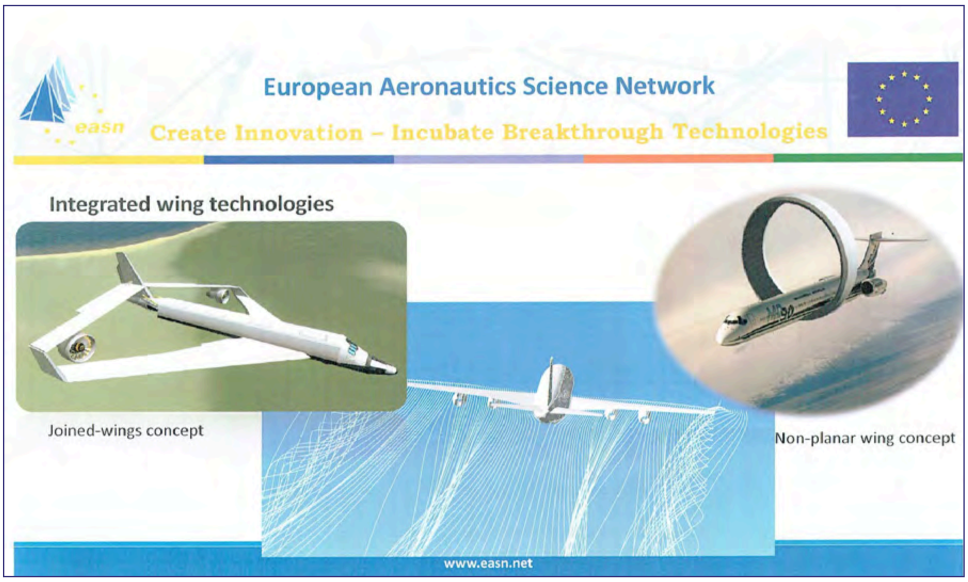
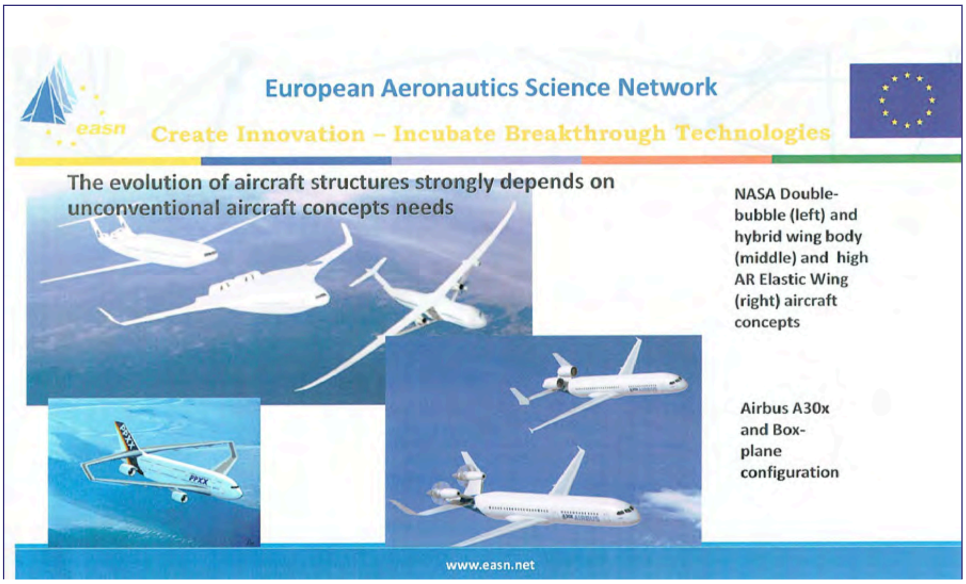


Figure 5

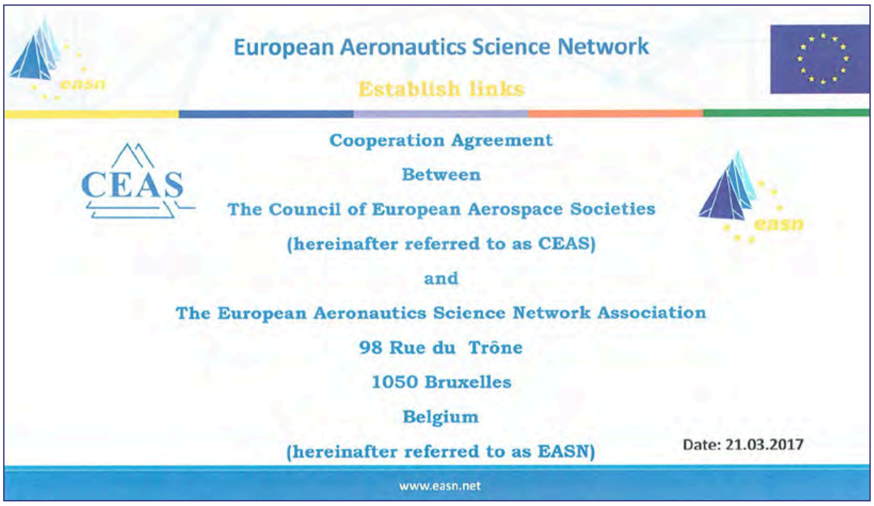


DISSEMINATION AND KNOWLEDGE

Figure 6

COOPERATION AGREEMENT BETWEEN CEAS AND EASN

Figure 7



This Cooperation Agreement is intended to serve for the development of a mutually beneficial scientific, technological and organizational cooperation between the Parties in aeronautical activities, promotion of developments in aeronautics and popularising the achievements and research in all areas of aeronautics. The cooperation includes in particular:

- Joint organisation of biennial Aerospace Europe CEAS-EASN congresses at the odd years, a joint Scientific Committee coordinating the programme, workshops, technical sessions and invited keynote speakers;
- Joint organisation of CEAS-EASN conferences on specific subjects on even years;
- Joint seminars on topics of mutual interest;
- Policy papers for the European Aerospace stakeholders;
- Coordination of activities and development of stream lined policies with respect to important issues and challenges raised by the European Commission (Framework Programmes, Joint Technologies Initiatives, ...);
- Organisation and promotion of Students Events;
- Encouraging scientists to publish the outcome of their researches in the CEAS Aeronautical and Space Journals as well as in the EASN supported Journals.

UPCOMING EVENT ILLUSTRATING THE CEAS-EASN AGREEMENT

8th EASN-CEAS International Workshop on Manufacturing for Growth and Innovation

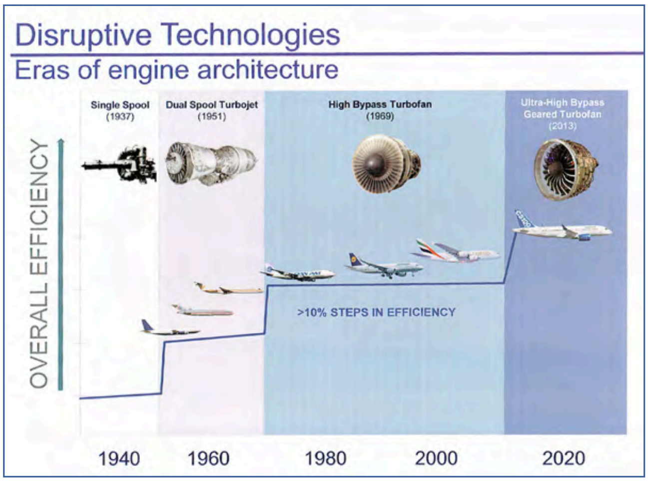
4-7 September 2018, Glasgow, UK

(see p. 40)

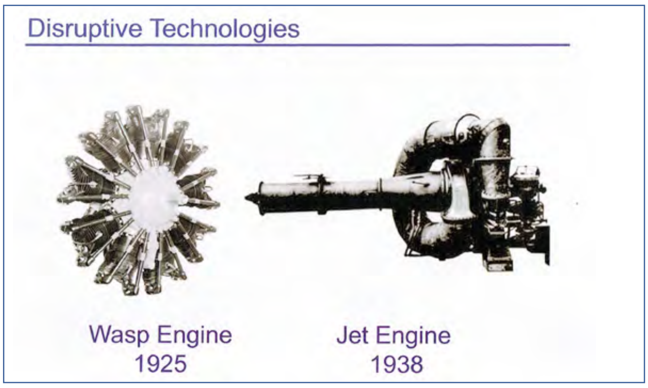
TECHNOLOGY & TRENDS IN AERO-PROPULSION FOR LARGE TRANSORT AND MILITARY AIRCRAFT

Abstract of the keynote address by Dr Michael Winter,
Senior Fellow, Advanced Technology
Pratt & Whitney – United Technologies Corporation

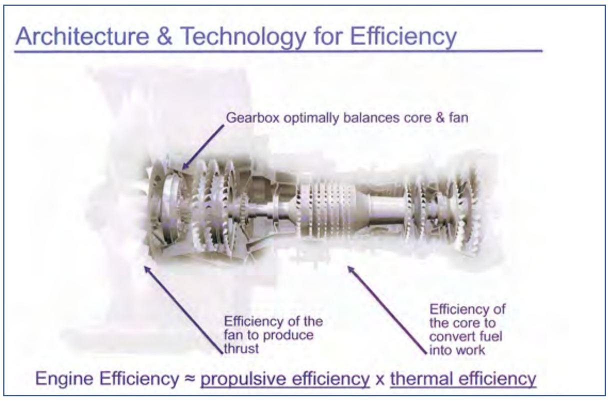
Michael Winter began his presentation by giving a brief history of Pratt & Whitney, showing the evolution of the disruptive technologies from 1940 to today:



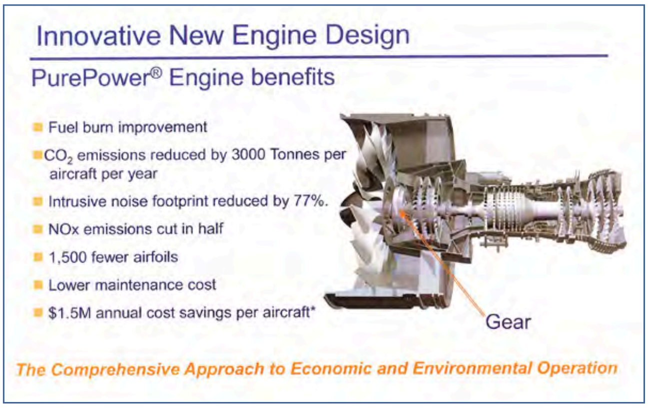
He dealt with several technology subjects among which:



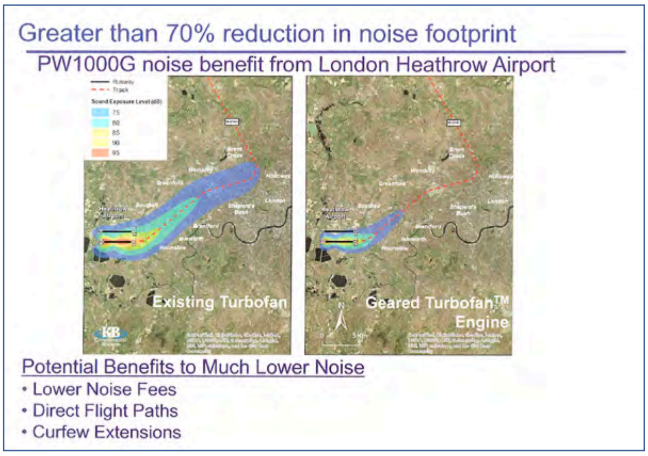
Part Shape and Materials Properties:



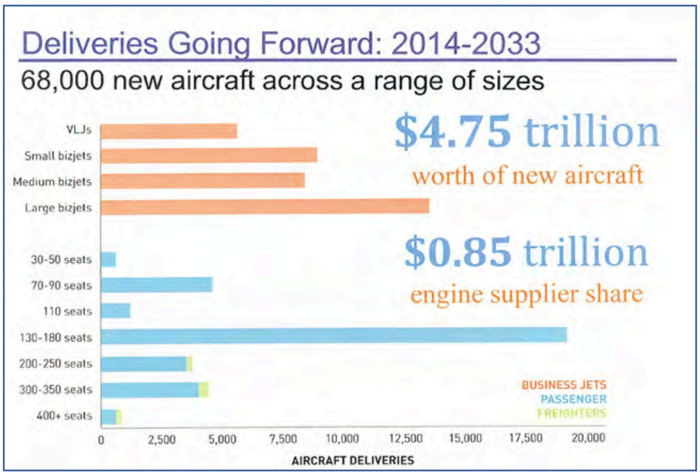
Engine Efficiency:



PurePowerR Engine benefits:



Noise reduction:



He also highlighted some commercial forecasts:
He concluded by pointing that a substantial runway still exists to improve the performance of aircraft propulsion systems and that Airframe and Propulsion System Integration is a key-enabler for future-generation aircraft configurations and architectures.

TECHNICAL PAPERS

THE 6TH CEAS AIR & SPACE CONFERENCE (BUCHAREST, 16-20 OCTOBER 2017) INCLUDED 307 ORAL PRESENTATIONS, OF WHICH ABOUT 240 PEER REVIEWED PAPERS WERE PRESENTED. WITH THE AIM TO GIVE OUR READERS AN IDEA OF THE EXTENDED RANGE OF SUBJECTS COVERED, WE HAVE CHOSEN TO PUBLISH THE ABSTRACTS OF NINE PRESENTATIONS:

GRAPH-BASED ALGORITHMS AND DATA-DRIVEN DOCUMENTS FOR FORMULATION AND VISUALIZATION OF LARGE MDO SYSTEMS

• **Benedikt Aigner[1], Eike Stumpf[2].**
Institute of Aerospace Systems, RWTH Aachen University, Aachen, Germany.
• Imco van Gent[1], Gianfranco La Rocca[3],
Leo L.M. Veldhuis[2].
Faculty of Aerospace Engineering, Delft University of Technology, Delft, Netherlands.

Abstract

A new system is presented that enables the visualization of large multidisciplinary design optimization (MDO) problems and their solution strategy. This visualization system is the result of a cooperation between RWTH Aachen University and Delft University of Technology (DUT) within the EU project AGILE. In AGILE, collaborative MDO is performed in large, heterogeneous teams of experts by solving MDO problems using a collection of design and analysis tools. The two main phases of such a collaborative MDO project are the formulation and the execution phase. This paper focuses on the visualizations required to support the formulation phase of the MDO problem. In this phase three main steps have been identified: the set-up of the repository of interconnected tools, the definition of the MDO problem at hand, and the determination of the solution strategy to solve that MDO problem. KADMOS, an open-source MDO support system developed by DUT, uses graph-based analysis to formulate an MDO problem and its solution strategy, based on the disciplinary analyses available in a repository. The results of KADMOS are stored in a standardized format called CMDOWS, which is eventually used to trigger the execution phase by means of a simulation workflow platform of choice. Although based on XML, the readability of the CMDOWS file is quite poor also for MDO experts, especially for large MDO systems involving thousands of variables, thus preventing visual inspection of the formalized MDO problem. Providing visualization capabilities to thoroughly inspect the outcome of the three aforementioned formulation steps becomes a key factor to enable the specification of large MDO systems in a heterogeneous team. Therefore, one of the main hurdles for using MDO as a development process can be removed. Conventional visualization methods (such as N2-charts, functional dependency tables, and design structure matrices) have major scalability limitations. Therefore VISTOMS, a dynamic visualization package based on the open-source visualization library D3.js, was

1. Ph.D. Student
2. Full Professor
3. Assistant Professor

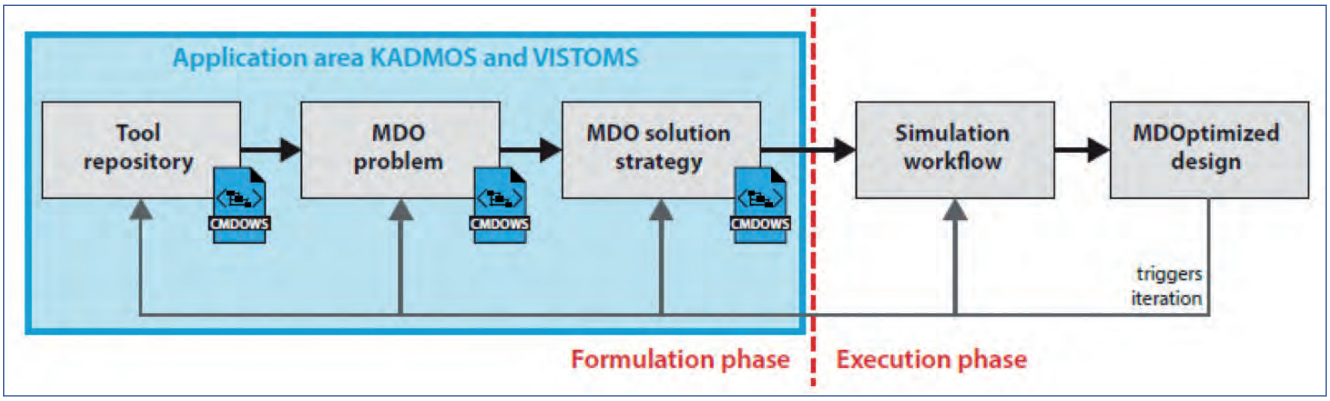


Figure: Overview of the MDO development process and its two phases

developed by RWTH Aachen to enable the visualization and inspection of the different MDO system specification steps. The developed visualization capabilities are demonstrated by means of a wing design optimization problem performed at DUT. As shown in this use case, VISTOMS enables the visualization and inspection of a large MDO system containing more than ten different aircraft design tools, interlinking thousands of variables.

Keywords
MDO, visualization, KADMOS, CMDOWS, VISTOMS

PITCH STABILIZATION WITH TAILORED CANARD COMPLIANCE

• Petter Krus
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• Birgitta Lantto
Saab AB, Sweden.

Abstract

The aircraft design problem is an example of a highly integrated design, which calls for a multidisciplinary approach from the very beginning. With every generation of aircraft, it gets more difficult to make substantial improvements since so much already have been done to produce as efficient aircraft as possible. Next generation civil aircraft needs to take every possibility to increase efficiency. One potential area of improvement is to reduce drag due to the requirement of positive stability. The stability requirement is a result of safety regulations, and with the present state of the art, it is difficult to get a system certified that can artificially stabilize an aircraft. If this can be overcome, there are potential gains in drag, since all horizontal surfaces can be used for lift, and hence total planform area, and hence parasitic drag, can be reduced. Another advantage is that a wider cg range can be allowed.

In this paper we propose a configuration with dynamic load canards, suitable for business aircraft (biz jet and biz prop), as well as large next generation transport aircraft, with prop fans that have to be located in an aft position. The approach used here is to look at control surface actuators and different means to utilize force control, possibly together with position control, to introduce compliance in proper positions of the system. As a side effect, excessive loads on control surfaces can also be avoided, which can translate into weight reduction. There is also scope to reduce gust sensitivity, for e.g. passenger comfort.

Keywords
Aircraft design, flight control, canard, force control

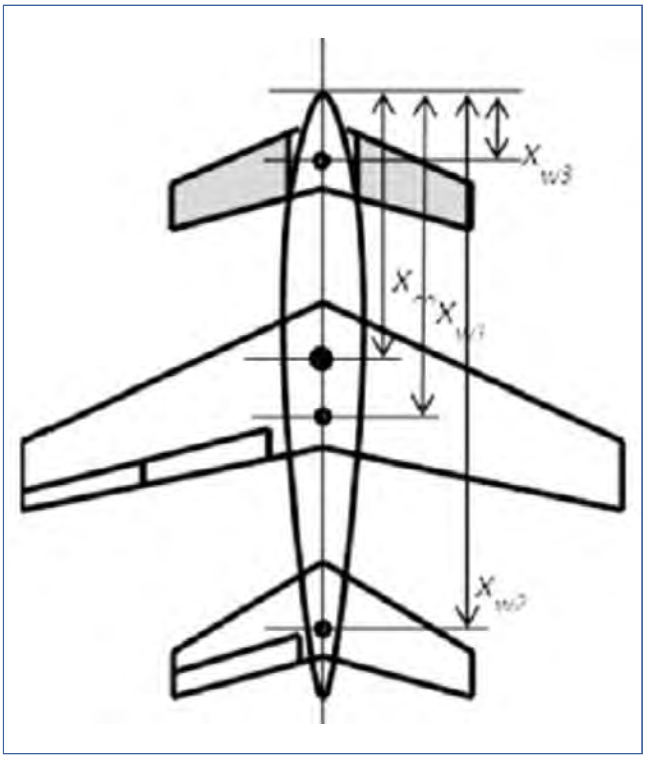

Figure: Three wing transport aircraft configuration

AN IMPROVED METHOD FOR TRANSPORT AIRCRAFT FOR HIGH LIFT AERODYNAMIC PREDICTION

• **Pierluigi Della Vecchia[4], Fabrizio Nicolosi[5], Manuela Ruocco[6], Luca Stingo[6], Agostino De Marco[4].**
Department of Industrial Engineering (DII) – University of Naples "Federico II", Naples, Italy.

Abstract
The aim of this work is the development of a methodology to predict lift characteristics for transport aircraft in the whole flight envelope, useful in the preliminary aircraft design stage. The purpose is an attempt to improve the classical methodologies for wing load distribution and lift prediction, considering the airfoils aerodynamic characteristics until stall and post stall conditions during the process, and modifying 2D characteristics in case of high lift devices to take into account 3D effects introduced by the devices themselves. The method is a modification of Nasa Blackwell procedure, capable to predict wing stall aerodynamic characteristics for both clean and flapped configuration. As far the high lift devices effect is concerned, the improved method works substituting clean airfoil aerodynamic characteristics with the flapped aerodynamics ones, and introducing a correction to evaluate the 3D effects induced by high lift devices geometrical discontinuities. The results of the developed method have been compared with CFD and experimental data showing good agreement, making available a fast and reliable method, useful in preliminary aircraft design.

Keywords
Aircraft design, high lift aerodynamic, transport aircraft, span lift coefficient distribution, extended lifting-line theory.

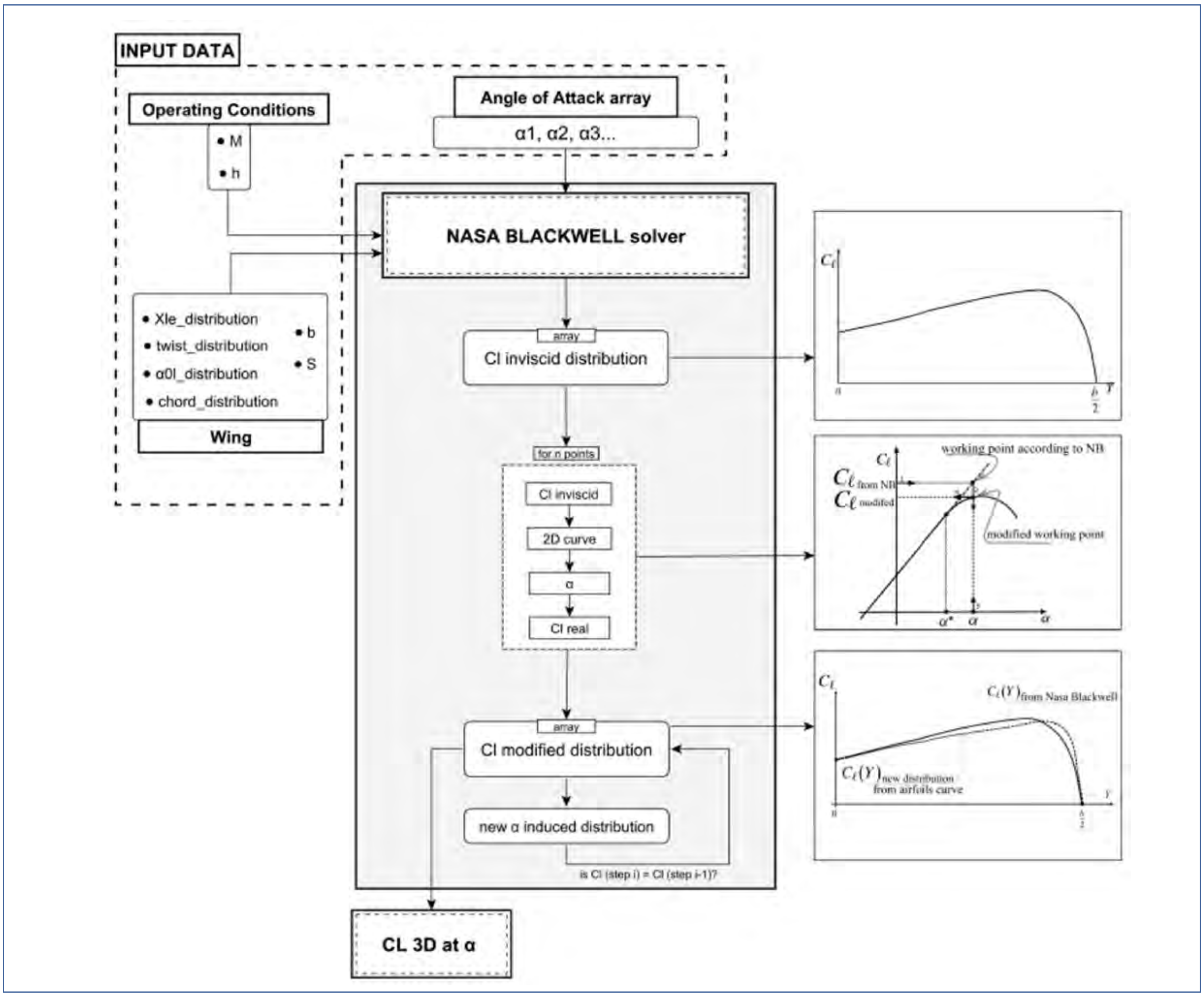

Figure: Improved method flow chart

4. Assistant Professor
5. Associate Professor
6. PhD Student

DATA-DRIVEN OPTIMISATION OF CLOSURE COEFFICIENTS OF A TURBULENCE MODEL

• Andrea Da Ronch[7], Jernej Drofelnik[8].
University of Southampton
• Marco Panzeri[9], Roberto d'Ippolito[10].
Noesis Solutions N.V.

Abstract

The solution of the Reynolds-averaged Navier-Stokes equations employs an appropriate set of equations for the turbulence modelling. The closure coefficients of the turbulence model were calibrated using empiricism and arguments of dimensional analysis. These coefficients are considered universal, but there is no guarantee this property applies to test cases other than those used in the calibration process. This work aims at revisiting the universality of the closure coefficients of the original Spalart-Allmaras turbulence model using machine learning, adaptive design of experiments and accessing a high-performance computing facility. The automated calibration procedure is carried out once for a transonic, wall-bounded flow around the RAE 2822 aerofoil. It was found that: a) an optimal set of closure coefficients exists that minimises numerical deviations from experimental data; b) the improved prediction accuracy of the calibrated turbulence model is consistent across different flow solvers; and c) the calibrated turbulence model outperforms slightly the standard model in analysing complex flow features around the ONERA M6 wing. A by-product of this study is a fully calibrated turbulence model that leverages on current state-of-the-art computational techniques, overcoming inherent limitations of the manual fine-tuning process.

Keywords

Machine-learning, closure coefficients, calibration, turbulence model, Sobol indices, design of experiments.

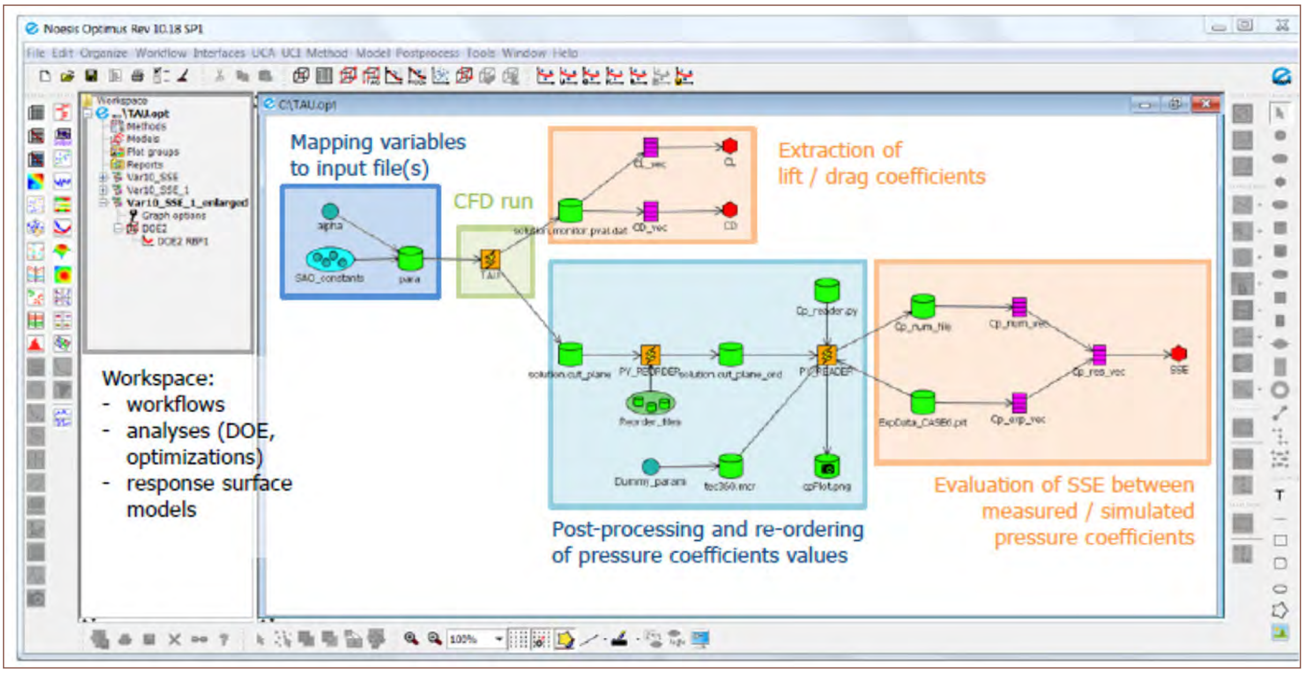

Figure: Optimum workflow for job submissions on the high-performance computing (HPC) facility and for running the adaptive design of experiments (ADOE) and optimisation analyses

7. Lecturer
8. Research Associate
9. Research Engineer
10. Research and Innovation Manager

STUDIES ON LOW-NOISE LAMINAR WING AIRCRAFT FOR REGIONAL AND SHORT RANGE ROUTES

• A. L. Bolsunovsky
Head of aerodynamic department
• N. N. Bragin
Head of aerodynamic group
• N. P. Buzoverya
Leading research scientist
• I. L. Chernyshev
Head of perspective layouts department
Central AeroHydroDynamic Institute (TsAGI), Zhukovsky, Moscow, Russia.

Abstract
Presented are recent studies conducted in TsAGI on regional and short range low-noise aircraft with natural laminar flow (NLF) transonic wings. At designing of such wings a distinct trade-off between laminar and turbulent mode of a flow, between viscous and wave drag amount and also between NLF and high lift characteristics has to be considered. A description of the special multicriterion optimization procedure for aerodynamic design of laminar wings developed by the authors is given. Several aerodynamic models were designed and manufactured for transonic wind tunnels testing including configurations with over-wing-trailing-edge engine arrangement which can reduce community noise and open the road to fuel-efficient ultra-high-bypass-ratio turbofans with large fan diameter on short range planes. Selected experimental results are also presented.

Keywords
NATURAL LAMINAR FLOW, OVER-WING-TRAILING-EDGE ENGINE ARRANGEMENT, AERODYNAMIC DESIGN, MULTICRITERIAN OPTIMIZATION PROCEDURE, WIND TUNNEL TESTS

Figure: Aerodynamic model with low-sweep wing

APPLICATION OF A VISUALIZATION ENVIRONMENT FOR THE MISSION PERFORMANCE EVALUATION OF CIVILIAN UAS

• E. Fokina
Research Associate & Ph.D. Candidate
• J. Feger,
Research Associate & Ph.D. Candidate
• M. Hornung
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Abstract
Future unmanned aerial vehicle applications require the development of new advanced design environments. In order to get an effective Unmanned Aerial System, UAS, solution it is necessary to take into account all elements of the system, e.g. to bring together aircraft design, payload, communication and other elements into one multidisciplinary design process. Compared to manned aircrafts, an Unmanned Aerial Vehicle, UAV, interacts with the environment through the onboard sensors. Therefore the sensor and communication performances as well as their implementation in the whole system play an important role for a mission fulfillment. An UAV design is then strongly driven by the mission, sensors and communication systems requirements. In the classic aircraft design approaches the sensor and communication performances are not part of the primary requirements and are taken into account on the operational analysis stage only, when the aircraft concept is already quite detailed. In order to take into account the sensor and communication requirements early enough an operational environment has to be simulated and implemented into the design loop.

Keywords
UAV, visualization, operational analysis, aircraft design, mission performance analysis.

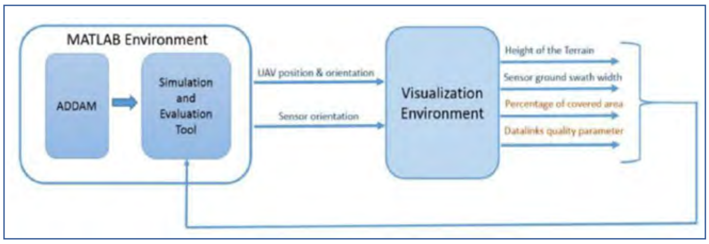


Figure: Structure of the mission simulation and evaluation tool chain

AIRCRAFT GROUND OPERATIONS: STEPS TOWARDS AUTOMATION

• Diego Alonso Tabares
Senior Engineer, Airbus SAS, Toulouse, France.
• Felix Mora-Camino
Professor, Laboratoire ENAC-Optim, ENAC, Toulouse, France.

Abstract
This paper introduces and analyses the state of the art of aircraft ground handling at airports. The main opportunities for automation of these activities are pointed out. This leads to identify different challenges to be overcome to build safe and efficient automated ground handling operations. Greatest opportunity for automation lies with automated docking of ground support equipment to aircraft in the short term, with further autonomous vehicles moving around the aircraft and automated systems within the aircraft later on. An autonomous fleet management formulation for automated vehicles is also presented.

Keywords
Turnaround time, ground operations, ground handling, automation

TESTING OF EXPERIMENTAL AND NUMERICAL METHODS FOR INVESTIGATION OF THE UNSTEADY FLOW INDUCED BY ROTOR INFLUENCE ON HELIPORT

• Wit Stryczniewicz, Paweł Ruchała, Grzegorz Krysztofiak, Wiesław Zalewski, Adam Dziubiński, Małgorzata Wojtas, Kazimierz Szumański.
Institute of Aviation, Aerodynamics Department, Warsaw, Poland.

Abstract
The paper presents results of experimental and numerical investigations of the rotor wake in ground effect. Vibrations caused by unsteady pressure fluctuation in the rotor wake are believed to be dangerous for construction of the heliports and services performed in the buildings, eg. in hospital operating room. The purpose of the research was to develop methodology for investigation of rotor influence on helipads and buildings. In the proposed approach the full scale and model test were combined. The numerical simulations and full scale tests were performed on two blade full scale rotor. The unsteady flow filed in the rotor wake was investigated in model scale with use of Particle Image Velocimetry and pressure measurements. The results of both full and model scale investigations were consistent. The unsteady flow struc-

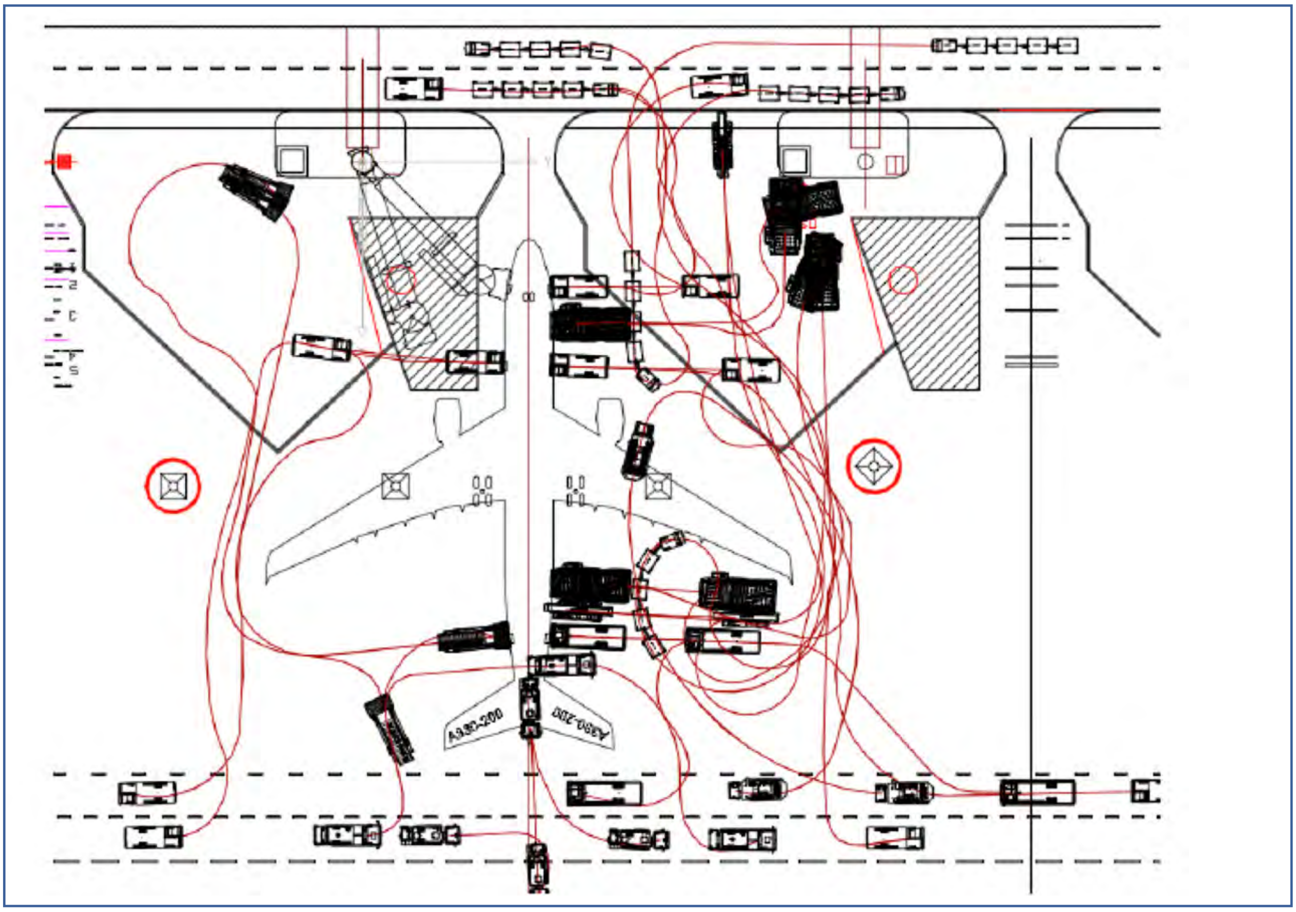


Figure: Ground Support Equipment (GSE) GSE trajectories for a full aircraft turnaround for a long range aircraft tures, hypothesized to be responsible for the vibrations propagations, were visualized in the model scale. The pressure fluctuations were measured both in model and full scale. The performed research proved the feasibility of proposed approach and has paved the way for detailed investigations leading to development of a general model of the phenomenon.

Keywords
Turnaround time, ground operations, ground handling, automation

Figure: View of helicopter model and pressure rake

SPACE PROPULSION: FINITE ELEMENT MODELLING AND PERFORMANCE OPTIMIZATION OF AN ION THRUSTER DEPENDING ON THE NATURE OF THE PROPELLANT

• Ionuț-Florian POPA[11], Anna-Maria Theodora ANDREESCU[11], Dan IFRIM[12], Radu MIHALACHE[13], Dragoș MIHAI[13].
Romanian Research and Development Institute for Gas Turbines COMOTI, Bucharest, Romania.
• Grigore CICAN[11]
"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania.

Abstract
The electrostatic propulsion is a class of space propulsion which make use of electrical power and this kind of systems are characterized by high exhaust velocities and specific impulse, enhancing the propulsive performances of thrusters compared to conventional chemical thrusters. Since the ionized particles exhaust velocity is a function of the ration between the electrical charge and their molecular mass, the obvious solution is to use ions with low electrical charge-molecular mass ratio. Currently, the most used propellant for the space propulsion is the Xenon gas, as it has a series of important advantages, but is quite expensive when compared to other propellants. This paper aims to make an optimization of the ideal ion propulsion systems depending on the nature of the propellant, like common used substances in the space propulsion, but also other substances which are potential candidates for this application. A variety of ion thruster performances will be analyzed, such as: force, specific impulse, efficiency for the same power available onboard, the same accelerating voltage, and the same ion current. Also, for the Xenon case a numerical simulation was performed to highlight the behavior and trajectory of the ionized particles and their velocity. The conclusion obtained following the study is that a reasonable ion thruster regarding the dimensions should use an accelerating potential of at least 4000 V and 2 A of ion current.

Keywords
Ion thruster, propellant, optimization, exhaust velocity, numerical simulation

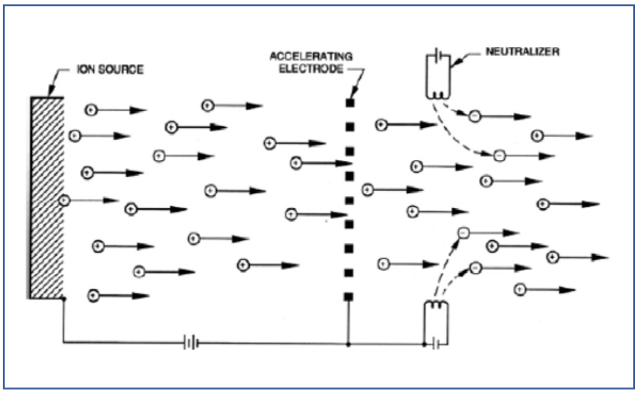


Figure: Schematic diagram of the ion thruster

11. Assistant Researcher
12. Technical Development Engineer
13. Scientific Researcher
14. Lecturer PhD Eng.

A400M MINISTERIAL MEETING COMMUNIQUE

OCCAR - 26 January 2018

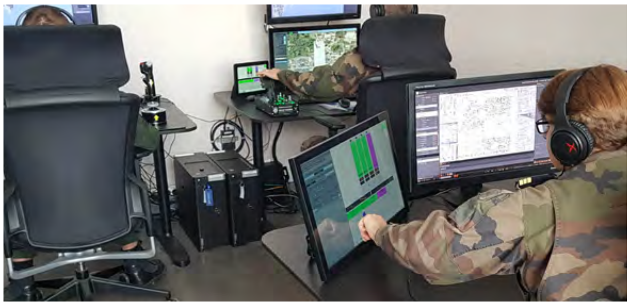
"Ministers from the **A400M** Partner Nations had a productive meeting with industry. We discussed the progress and the next steps on the **A400M** Programme which is already delivering much welcomed initial operational capability to several of the Partner Nations' Air Forces. All Nations and Airbus have signed a high level Declaration of Intent to re-baseline the A400M Programme reflecting the latest status of the production and capability delivery plans."

Attendees at the A400M Ministerial meeting: Back Row (L-R): Arturo Alfonso-Meiriño (OCCAR-EA Director), Serdar Demirel (TR), Lt Gen Rudy Debaene (BE), Augustin Conde Bajen (ES), Col Patrick Fautsch (LU).
Front Row (L-R): Dr Katrin Suder (DE), Guto Bebb (UK), Gen (Armt Corps) Joël Barre (FR).
Photo: PO Owen Cooban MoD Crown Copyright 2018.

EDA SETS-UP COLLABORATIVE RPAS TRAINING

On Thursday 18 January 2018, the European Defence Agency (EDA) achieved a significant milestone within its Education, Training and Education portfolio with the deployment and linking of Medium Altitude, Long Endurance, Remotely Piloted Air Systems (MALE RPAS) desktop simulators in France and Italy. The deployment to Italy completes the first tranche of up to nine systems, which will be distributed across European military RPAS Schools and Centres of Excellence that will allow networked collaborative training. The aim is to build over time a European MALE RPAS community of interest to improve procedures, tactics and to harmonise training approaches.

The project was developed by the EDA under the mandate of the European MALE RPAS Community (DE, EL, ES, FR, IT, NL and PO) and is a joint effort with the European Air Group (which also includes BE and UK) in which the EDA is delivering the RPAS training technology



Rome - 18 January, 2018

demonstrator equipment and the EAG is producing training schedules to exploit the new system. This will enhance interoperability between Member States who currently field MALE RPAS platforms and those that aspire to the capability within a 5-10 year timeframe. The roll-out of the systems will run in parallel with an increasingly ambitious virtual exercise programme that will provide opportunities for joint training and the cross-fertilisation of training approaches as instructors will teach lessons across the network to students at the dispersed sites. The project will run for four years initially as a Training Technology Demonstrator and has already attracted additional interest from other Member States.

PILOT PROJECT EUROSWARM AND SPIDER ACTIVITIES COMPLETED

EDA - BRUSSELS, 23 February 2018

Two research activities of the Pilot Project on defence research, SPIDER and EuroSWARM, finance by EU budget, were brought to a successful closure at their respective final meetings on the 20 and 21 February 2018. The last activity, TRAWA, is due to be completed by May 2018.

The Pilot Project aims at exploring how the European Union can support building defence capabilities relevant for the Common Security and Defence Policy and Member States. It was proposed by the European Parliament and launched by the European Commission in response to multiple political calls from EU institutions, Member States and NATO to improve Europe's defence capabilities. This objective is also enshrined in article 42 (3) of the Treaty on the European Union.

This Pilot Project had been entrusted to the European Defence Agency (EDA) by the European Commission through a Delegation Agreement, which was signed on 16 November 2015. The EDA proposed to the European Commission a list of topics, for the preparation of the work plan of the Pilot Project. The call for proposals, the

submission of proposals, the evaluation and the awarding of the grant agreement were organised and coordinated by EDA. After the signature of the grant agreements, three research activities were launched, executed by the awarded consortia and monitored by EDA.
With a budget of 1.4 million Euros from the European Union, the three research activities received a grant in the order of € 430.000 each. All projects were launched in November 2016, namely: EuroSWARM, SPIDER and TRAWA.
The successful outcome of the Pilot Project, as a predecessor to the Preparatory Action for Defence Research and a future European Defence Research Programme (EDRP), is to be seen in proving the feasibility of defence research funding through the EU budget. The initial rationale and objectives of the Pilot Project, which along with the on-going Preparatory Action on Defence Research was set-up to pave the way for a fully-fledged EDRP in the next Multi-Annual Financial Framework after 2020, have already been met. It has supported the demonstration that EU funding can effectively support EU defence research needs, based on a structured cooperation and joint work between the European Commission and the EDA. The successful handling of the Pilot Project by the European Commission and the EDA has been an excellent preparation for the Preparatory Action on Defence Research and a future EDRP.

UNMANNED HETEROGENEOUS SWARM OF SENSOR PLATFORMS (EUROSWARM)

EuroSWARM aimed to test and demonstrate that efficient and effective operation of unmanned swarm systems can bring a profound impact to the military arena. The key focus was the minimisation of uncertainties in situational awareness information for surveillance operations through a swarm system of systems composed by static and mobile heterogeneous sensors.

The main objectives of the activity were to:

- develop key techniques for adaptive, informative and reconfigurable operations of unmanned heterogeneous swarm systems, namely: optimal task allocation and resource management, sensor fusion, cooperative guidance, robust sensor network;
- integrate the developed enabling techniques;
- validate the developed enabling techniques based on empirical simulation studies;
- demonstrate the proposed solutions based on a small scale of experiments.

EuroSWARM was carried out by a consortium led by the University of Cranfield (UK) which also included the French aerospace research agency ONERA (Office National d'Etudes et de Recherches Aérospatiales), the Swedish Defence Research Agency FOI and the University of Patras (Greece).

INSIDE BUILDING AWARENESS AND NAVIGATION FOR URBAN WARFARE (SPIDER)

SPIDER aimed to develop an innovative system to support Urban-Warfare operations by providing improved situational awareness to operational forces entering an unfriendly building. It focused on the use of radiofrequency (RF) stationary sensors and mobile ground robots.

The main objectives of the activity were to:

- develop and analyse a framework comprising the use of multiple sensors to perform indoor mapping and human detection in an Urban Warfare context;
- consider the choice of a data fusion strategy to process and combine sensor data;
- explore the advantages and constraints of using each solution as well as solutions encompassing autonomous robots combined with static RF sensor networks.

SPIDER was carried out by a consortium led by TEKEVER, a Portuguese technology company, and composed of IT Aveiro - Instituto de Telecomunicações (Portugal), Aralia (UK) and the Bulgarian Defence Institute (BDI).

STANDARDISATION OF REMOTELY PILOTED AIRCRAFT SYSTEM (RPAS) DETECT AND AVOID (TRAWA)

The TRAWA activity, which is still ongoing, aims to contribute to the development of standards for a performant and affordable detect and avoid (DAA) system usable on-board Remotely Piloted Aircraft Systems (RPAS). It is focused on the Remain Well Clear (RWC) function and contributes to the standardisation activities in cooperation with other international efforts in full alignment with EUROCAE WG 105 Terms of Reference.

The main objectives of the activity are to:

- specify Remain Well Clear in quantitative terms and obtain validation via simulations;
- specify sensor types, detection ranges and position estimation accuracy;
- develop requirements for remote pilot HMI (Human Machin Interface) characteristics.

TRAWA is carried out by a consortium led by the Netherlands Aerospace Center (NLR) with the following partners: the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR), Deep Blue (Italy), Tony Henley Consulting (UK) and EuroUSC (Italy).

EUROPEAN MALE RPAS PASSES SYSTEM REQUIREMENTS REVIEW

OCCAR, 28 January 2018

The European MALE RPAS (Medium Altitude Long Endurance Remotely Piloted Aircraft System) has successfully passed its System Requirements Review (SRR) in January 2018. The successful SRR also initiates the second phase of the definition study, which will lead to a consolidated preliminary design.

The current review ensures that operational requirements of involved Air Forces are properly transferred into top-level system requirements. The resulting documentation is the basis for the mutual understanding of the system requirements between OCCAR, the Co-Contracting Group (Airbus Defence and Space, Dassault Aviation and Leonardo s.p.a.) and the Participating States (France, Germany, Italy and Spain).

The following system Preliminary Design review is scheduled by the end o 2018.
Preparing for next stage (development, production and initial in-service support) is already well under way.
The entry into service of European RPAS is planned for 2025.

EDA CHIEF EXECUTIVE DOMECQ AT ESA

On 2 February 2018, Jorge Domecq, Chief Executive of the European Defence Agency (EDA), met with Johann-Dietrich Wörner, Director General of the European Space Agency (ESA).

At the bilateral meeting, Chief Executive Domecq and director general Wörner discussed ongoing and future cooperation between the two Agencies. EDA and ESA signed an Administrative Agreement in June 2011 with the aim of providing a structured relationship and ensuring beneficial cooperation through coordination of their respective activities.

This cooperation fosters coordinated research, technology and demonstration activities and facilitates the realization of synergies between existing EDA and ESA programmes and their future evolution. The Administrative Arrangement has led to the agreement of a number of Implementing Arrangements on a variety of topics.

Between December 2017 and January 2018, three implementing Arrangements were signed:
Between December 2017 and January 2018, three implementing Arrangements were signed:

- **Unmanned Maritime Systems (UMS):** A joint study will assess the technical and business viability of potential services based on space and UMS that could support a variety of operational activities such as the protection of critical maritime infrastructure or maritime surveillance and explore the combination of UMS and space technologies in terms of service provision as compared to other existing technologies.

- **GOVSATCOM:** EDA and ESA aim to maximize synergies between their respective activities in the field of the Governmental Satellite Communications (GOVSATCOM) and support the European Commission in its efforts for preparing an EU GOCSATCOM initiative. EDA activities focus on operational aspects and on the acquisition and implementation environment of GOVSAT via its GOVSATCOM Pooling & Sharing Demonstration Project.

- **Earth Observation:** A joint study will elaborate mission concepts and a roadmap of technologies needed for future security Earth observation missions.

JUICE: THE FIRST EUROPEAN MISSION TO JUPITER AND ITS ICY MOONS

Giuseppe Sarri, JUICE Project Manager, ESA (European Space Agency)

EUROPE GOES TO JUPITER

Galileo Galilei's discovery of four large moons orbiting Jupiter four centuries ago hasted the Copernican Revolution and forever changed our view of the Solar System and Universe. Today, Jupiter and its diverse collection of moons is seen as the archetype for giant planet systems both in our Solar System and around other stars throughout our Galaxy. A comprehensive characterisation of the Jovian system, from the churning gas giant and its enormous magnetosphere to the orbiting ice worlds in all their complexity, will allow us to unravel the origins of the giant planets and their satellites and search for evidence of potentially habitable environments in the cold outer Solar System. By dedicating a mission to explore the Jovian system with particular focus on Ganymede as a planetary habitat, JUICE will significantly deepen our understanding of the conditions for the emergence of life and how our Solar System works, two themes at the heart of ESA's Cosmic Vision.

JUICE (JUpiter ICy moons Explorer) is a European mission led by ESA with payload contributions from the ESA Member States and with international participation. The JUICE Mission was selected in 2012 as the first Large Mission (L1) within the Agency's "Cosmic Vision 2015-2025" element of the Science Programme, with a foreseen launch date in 2022. Following the selection and the completion of the preparation activities the mission was adopted, which means that the decision to implement it was confirmed, in November 2014. This allowed starting of the build-up of the industrial consortium in charge of the design, manufacturing, assembly and test of the spacecraft. The kick-off of the industrial phase took place in July 2015. The design of the mission and of the spacecraft is now completed and the manufacturing and test of the first prototypes of the spacecraft and instruments equipment are on-going. Figure 1 shows an artistic view of the JUICE spacecraft touring within the Jovian system.

The focus of the mission is on the study of the icy satellites of Jupiter, with special emphasis on the three ocean-bearing worlds: Ganymede, Europa, and Callisto. **Ganymede** has been identified for detailed investigation since it provides a natural laboratory for analysis of the nature, evolution and potential habitability of icy worlds in general, but also because of the role it plays within the system of Galilean satellites, and its unique magnetic and plasma interactions with the surrounding Jovian environment. JUICE will determine the characteristics

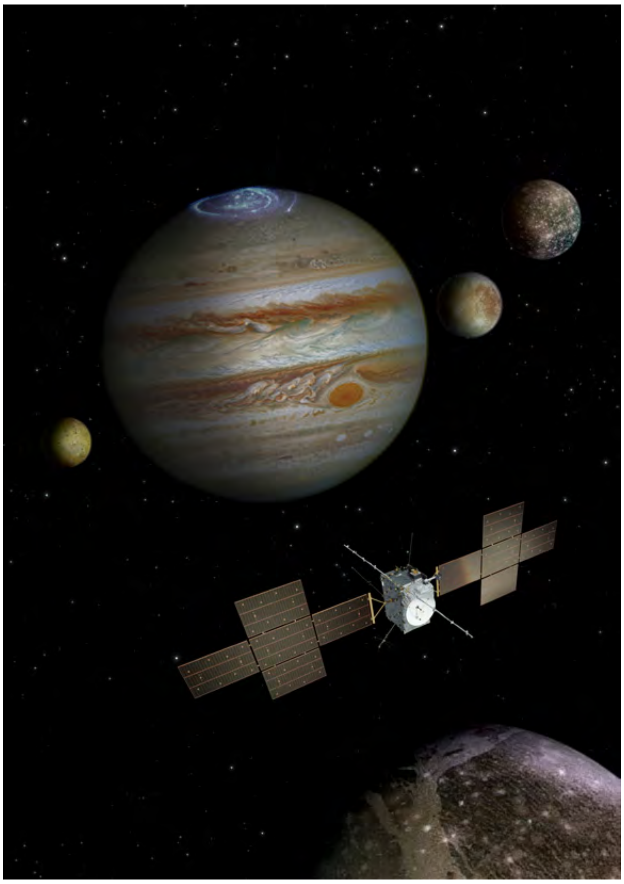


Figure 1: Artistic impression of the JUICE spacecraft in the Jovian system (Courtesy of ESA)

of liquid-water oceans below the icy surfaces of the moons. The mission will also characterise the diversity of processes in the Jupiter system that may be required in order to provide a stable environment at Ganymede, **Europa** and **Callisto** on geologic time scales, including gravitational coupling between the Galilean satellites and their long term tidal influence on the system as a whole. The spacecraft will embark ten state of the art instruments to perform remote sensing, geophysics and in situ particles and fields measurements. A summary description of the JUICE instrument suite is in figure 2.

A COMPLEX MISSION

Following a launch with Ariane 5, JUICE will make extensive use of gravity assist manoeuvres for reaching the Jupiter system while minimising the impulse changes to be achieved by the spacecraft propulsion system. Considerable effort was, and will be in the future, dedicated to the optimization of the two elements of the mission profile: the cruise phase to reach Jupiter after the launch and the tour in the Jovian system. This is an optimization process based on celestial mechanics with multiple constraints, i.e., the mission core science objectives; the maximization of the useful mass inserted at the Jupiter system by minimizing the fuel consumption; the minimization of the transfer duration; the minimization of the total radiation dose accumulated until the end of the mission. The mission profile optimization resulted in

		Instrument Name	Scientific purpose
Remote Sensing	1	Jovis, Amorum ac Natorum Undique Scrutator (**JANUS**)	Moons geology, cloud morphology and dynamics
	2	Moons And Jupiter Imaging Spectrometer (**MAJIS**)	Chemistry - Atmospheric & surface composition
	3	UV Spectrograph (**UVS**)	Atmosphere of moons & Aurora of JUPITER
	4	Sub-mm Wave Instrument (**SWI**)	JUPITER Wind + JUPITER Moons atmospheric temperatures and composition
Geophysics	5	GAnymede Laser Altimeter (**GALA**)	Moons shape & topography
	6	Radar for Icy Moons Exploration (**RIME**)	Moons sub-surface study
	7	Gravity & Geophysics of Jupiter and Galilean Moons (**3GM**)	Gravity field and moon interiors (S/C position)
	11	***PRIDE***	*Ephemerides of the Jovian system*
In situ Particles and Fields	8	JUICE Magnetometer (**J-MAG**)	Magnetic field (& Ganymede ocean)
	9	Particle Environment Package (**PEP**)	Plasma environment & Study of the neutral and ion composition of exospheres
	10	Radio & Plasma Wave Investigation (**RPWI**)	Plasma environment

Figure 2: Instrument suite on board of the JUICE spacecraft (Courtesy of ESA)

a nominal profile featuring a launch on May 20th, 2022, arrival at Jupiter in October 2029 and final orbit around Ganymede in 2033. There are few back-up launch opportunities in 2022, 2023 and 2024 (Jupiter can basically be reached every year), with various arrival dates over the period 2031-2033. However, the nominal scenario has the merit to provide the shortest transfer duration and the earliest delivery date at Jupiter. The nominal mission profile with cruise using an Earth-Venus-Earth-Mars-Earth gravity assist sequence and the Jupiter tour is summarized in figure 3. After insertion into Jupiter orbit, JUICE will use multiple gravity assists via flybys of the Galilean satellites to shape a comprehensive orbital tour over a little more than 3 years. After reducing the orbit period with Ganymede flybys, this tour will implement two close Europa flybys, followed by a series of Callisto flybys so as to rise the orbit inclination with respect to the equatorial plane of Jupiter. A dedicated series of Callisto and Ganymede gravity assists will then make it possible to approach Ganymede at a low velocity. During this unprecedented tour, Jupiter's magnetosphere and atmosphere will be continuously monitored. At the

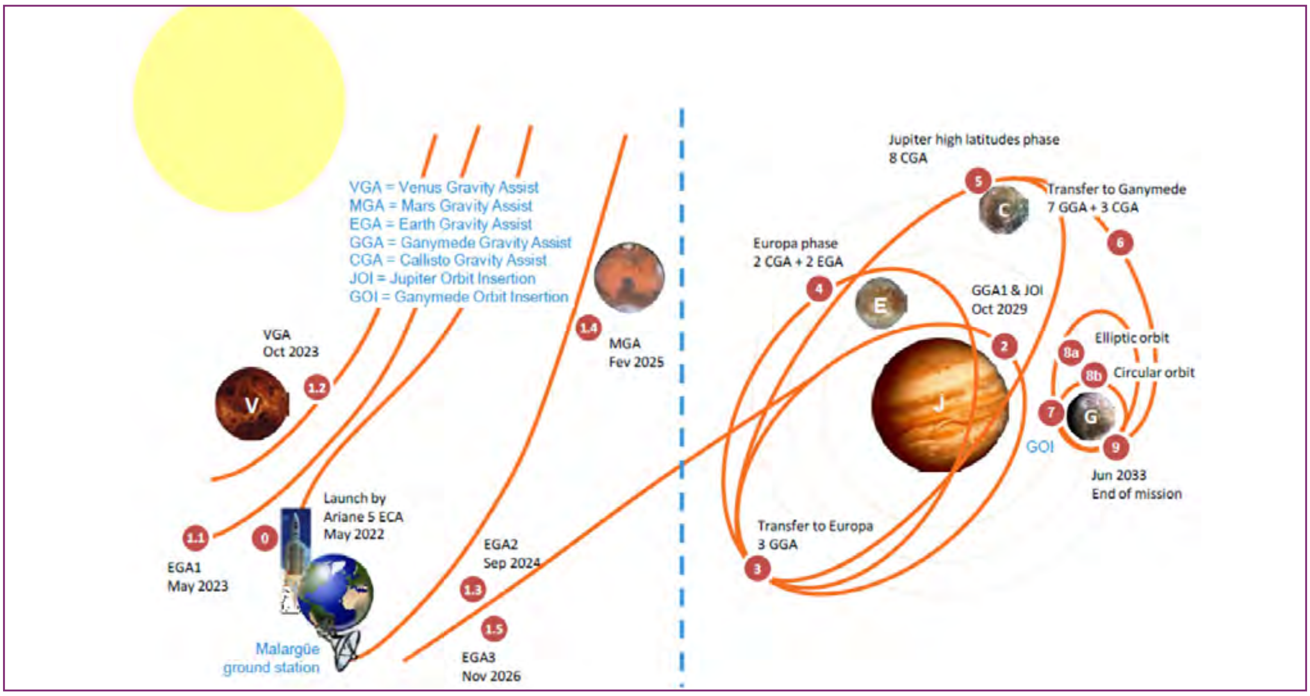


Figure 3: JUICE nominal mission profile (Courtesy of Airbus Defence & Space).

end of the tour, JUICE will be set in a polar orbit around Ganymede, becoming the first spacecraft ever to enter orbit around an icy satellite in the outer solar system. The current end of mission scenario involves spacecraft disposal on Ganymede.

SPACECRAFT DESIGN CHALLENGES

Although JUICE can be viewed as a classical spacecraft in terms of conception and functional requirements, it includes numerous specific features that result directly from the mission needs. These are briefly highlighted hereafter providing an overview of the challenges for the development of the space segment. Figure 4 shows and exploded view of the spacecraft with the key elements identified.

Radiation environment

The radiation environment at Jupiter is harsh, dominated by electrons and with an important proton contribution. Significant effort was spent for improving the radiation environment model at Jupiter and the spacecraft shielding model so as to derive realistic figures for the shielding mass and the radiation dose at the end of life. The total ionising dose around the various electronics boxes shall not exceed 50 krad by the end of the mission. Moreover, the long cruise duration must be taken into account for the reliability of critical components, such as thruster latch valves and reaction wheels.

Power availability

At Jupiter, the solar constant is about 27 times lower than on Earth, thus implying a very scarce solar flux on the solar array active area. The solar array surface is 85 m^2 – comparable to that used for the most demanding telecommunication spacecraft – however providing only 725 W by the end of life. The lack of power is one of the major design driver since it has numerous implications on the spacecraft design, in particular: need for a multi-deployment of the solar array in orbit; need for a solar array drive mechanism for maintaining quasi-normal sun illumination conditions on the solar panels; need for rotation of the spacecraft when in orbit around Ganymede; limits on communication and associated data rate; instrument power limitations, constraining the operations with impact on the on-board software; last but not least, need for a large battery on board for coping with sun eclipses and operations during flybys where, to achieve the required instrument pointing, the solar panels cannot be optimally oriented.

Propulsion

The overall ΔV to be achieved by the spacecraft is 2.6 km/s, leading to a substantial amount of propellant, in the range of 3 tons for an overall spacecraft mass a little more than 5 tons. The highest ΔV manoeuvres are the orbit insertion when arriving at Jupiter (900 m/s) and the orbit insertion around Ganymede ending with the

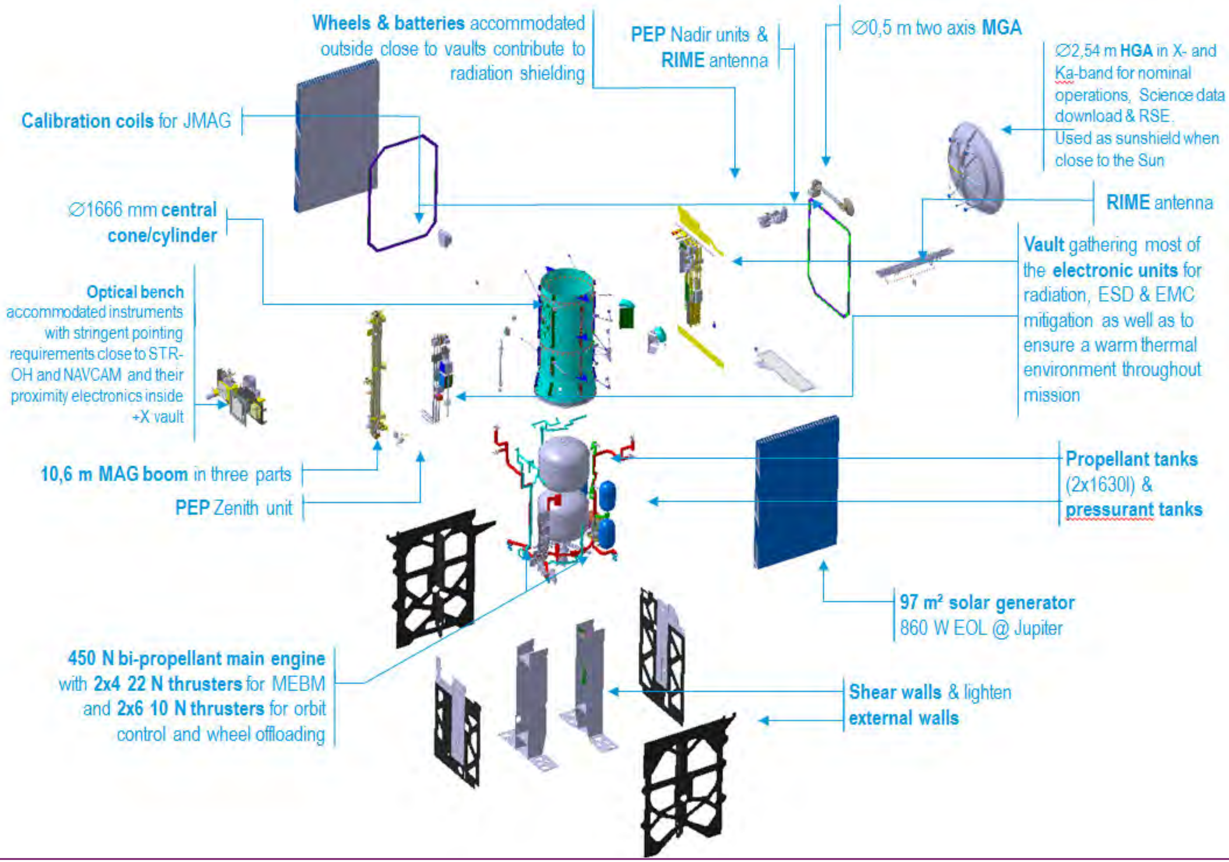


Figure 4: Exploded view of the JUICE spacecraft (Courtesy of Airbus Defence & Space)

500 km altitude polar orbit (660 m/s for orbit insertion and altitude reduction). The impact on the spacecraft architecture is the accommodation of a large volume of propellant tanks and associated structure.

Thermal aspects

The spacecraft must cope with a large dynamical range of solar flux, being hottest during the Venus gravity assist fly-by, and coldest during long sun eclipses at Jupiter, which can last almost five hours. The entire spacecraft will be designed for operations in the very cold environment at Jupiter with minimum heating power consumption, and will be covered by multi-layer insulation. During the Venus gravity assist, the high gain antenna will be used as sun-shield, so as to avoid forcing the spacecraft design to accommodate for this hot case in full (a method which was also used in the Cassini mission). The solar cells of the solar array have to withstand a large temperature range (from -230°C during eclipses at Jupiter to +160°C at Venus).

Navigation and autonomy

When at Jupiter, the distance from Earth to the spacecraft varies from about 4.2 AU to 6.4 AU. These large distances result in long round-trip communication delays, varying from about 1:10 hr to 1:47 hr, which affects the spacecraft and operations concepts. Some on-board autonomy is required, with direct implication on the spacecraft avionics and on-board software development and verification. A dedicated optical camera is implemented on board to allow autonomous software controlled navigation during the critical fly-by operations.

Electromagnetic cleanliness

JUICE will be one of the most electromagnetically clean spacecraft ever built. The instruments measuring fields and particles are very sensitive to electromagnetic disturbances. For example they are designed to measure extremely tiny fluctuation of the magnetic fields which will give hints of the amount of salty liquid water below the icy crust of the moons. Therefore they must measure the space electric/magnetic fields and not the disturbances generated by the spacecraft. As an example the spacecraft generated magnetic field shall be less than 1 nT (10^{-9} Tesla) which is 50000 times less than the Earth magnetic field.

CONCLUSION

Following the kick-off of the industrial activities, the JUICE mission has completed the design phase and the prototyping of the spacecraft and instruments equipment has started. The activities are proceeding as planned for a launch in May 2022. After a long voyage the spacecraft will start the exploration of Jupiter and its icy moons in 2029. Figure 5 summarises the overall mission schedule.

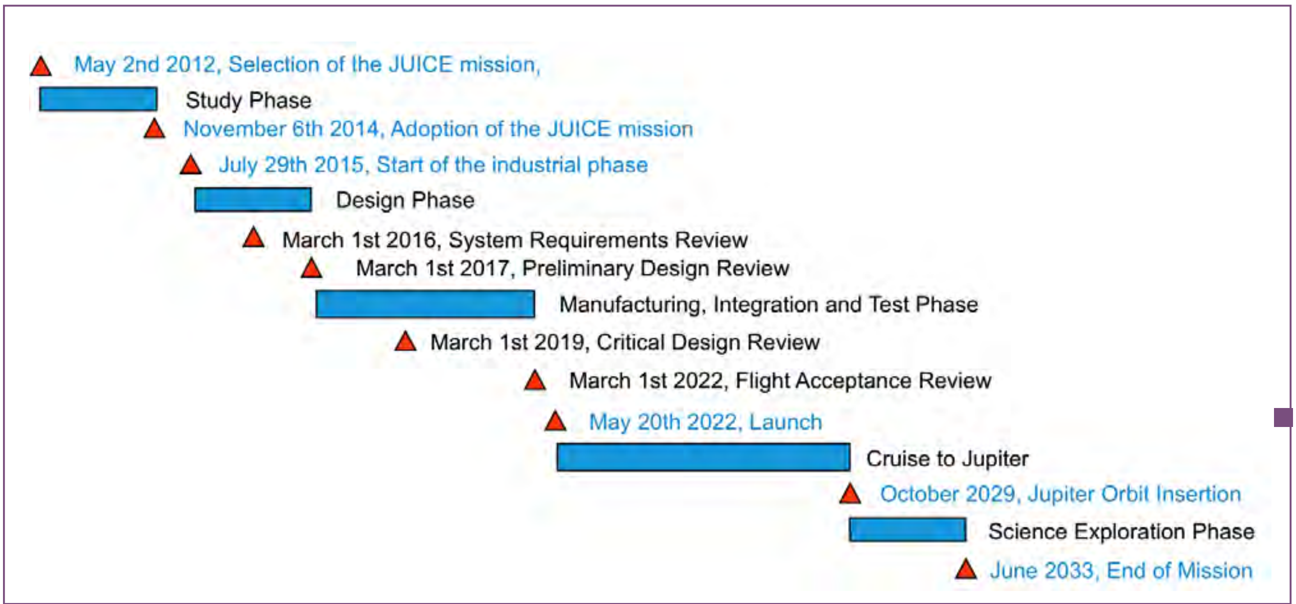


Figure 5: Overall planning of the JUICE mission (Courtesy of ESA)

MICRO-LAUNCHERS

Jérôme Breteau, Head of Future Launchers Preparatory Programme, ESA
Wenzel Schoroth, Future Launchers Preparatory Programme integrated Team, DLR

Today's space transportation landscape becomes more and more dynamic, with new players, technologies and approaches to the subject entering the field. This leads to an acceleration of development and in some parts a disruption of classical structures and processes.
One development with the potential to significantly change the way space is used in the future is the emergence of small- and micro-satellites (ca. 10-500 kg). These make faster product cycles, as well as more reactive, cheaper and less risk adverse satellite projects possible.
Accompanying this development, though slightly trailing behind, is the development of small- and microlaunchers. These are specifically designed to launch small payloads into custom orbits in line with the customer's demand.
The Future Launchers Preparatory Programme (FLPP) within the Space Transportation Directorate (STS) of the European Space Agency (ESA) is fostering European capabilities to launch small- and micro-satellites and ensure European competitiveness in that rapidly developing field.

THE SITUATION

In the past, most satellites were large custom built machines (several 100 kg to several 1000kg) made from specifically developed hardware and extensively tested. In recent years, the continued miniaturisation of hardware, especially electronics, together with the increased commercialisation and change in potential business models has led to a boom in small- and micro-satellite applications. An exact consensus on the definitions of those satellite classes has not yet been established, but a typical classification is that small satellites correspond to satellites under 500 kg, with micro-satellites as a subgroup having a weight from 10 to 100 kg.
On the commercial side, this boom is driven by a fast increasing number of start-up companies, like Planet and Spire. The intended applications of the satellites and satellite constellations often concern earth observation, but there are many other fields in which they could be useful and profitable.
Nearly all of those satellites are currently launched together with other satellites on conventional launch vehicles, with an overall payload capacity of several tonnes. This can be either with one or more big satellites as prime customer or with many other small satellites. Though very efficient in terms of cost per kilogram of payload, the launch with other payloads means limited to no flexibility concerning orbit or schedule deployment and often, especially if launching with large, expensive prime payloads, very high safety requirements and extensive testing.
This problem is addressed by a large number of start-ups and established companies developing small launch vehicles (10-500 kg). These would offer much more flexibility concerning the above mentioned factors. In addition, they could be launched from new, smaller launch bases.

THE FUTURE

Up to now, there have been very few launches of small launch vehicles, with even fewer that could be classified as currently operational launch service (e.g. Pegasus by Orbital ATK, Electron by RocketLab). Nevertheless, there are a large number of companies (several dozen) in various stages of development of small launchers. Different concepts such as classical rocket launches from ground as well as launches from aircraft (airplanes, balloons) are explored. To keep cost down and increase flexibility, new launch sites are considered, alongside the utilisation of existing sites.
Many of the companies in the field are start-ups, employing a fast and agile approach to their developments. This contrasts to a more consolidated, risk-adverse approach of traditional space companies and will pose a certain challenge to them to keep up with this acceleration.
The sheer number of developed small launchers and respective launch sites makes a significant consolidation in both areas very likely.
The potential market for small launchers (i.e. small satellites) is likely to grow significantly in the future. The market share between dedicated launches on small launchers and larger launchers bringing many satellites to orbit in one go is unknown.

THE CHALLENGES

The future of the small launch market is uncertain, both on the demand as well on the supply side. They are seen as a commercial endeavour by most stakeholders and thus have to have solid business cases without largescale government support. At the moment, there is no small launcher company with a fully stabilised commercial service. Thus the profitability of a fully commercial micro-launcher is yet to be proven.
Concerning the business case, the main challenges for companies developing a small launch system (launcher and launch site) are:

Identification of the actually obtainable market share
The amount of growth of the small satellite market is afflicted by large uncertainties, especially when it comes to the capability to pay for a launch. The small launchers will compete with existing launch services using proven large launchers, which due to scaling laws tend to be significantly more efficient and thus likely cheaper per

kilogram than small launchers. So a question to answer is how many satellite owners would pay which amount of premium on the launch price to have the increased flexibility of a dedicated launch (i.e. SAM-serviceable available market). Due to competition with other small launcher services and other potential restrictions (e.g. export control on satellites) the actually obtainable market share (SOM- serviceable obtainable market) will be even smaller. This competition situation is just developing with many unknowns (e.g. number of competitors, regional distribution) likely remaining for the next couple of years.

Determination of launch cost and profit

Profitable operation of a small launcher and corresponding launch site depends significantly on keeping the overall launch cost to a minimum. Most companies have the advantage here that they are developing their vehicles from scratch and can thus streamline manufacturing, operations and quality control using the newest technology to keep cost down. Nevertheless, the determination of the cost of a completely newly developed launch service with little current precedent is plagued with large uncertainties. In addition, different amortisation strategies for the development cost are available to be taken into account.

To succeed in establishing a viable business, the companies have to face many technical/organisational challenges to minimize launch cost and maximize the value to potential customers. Some major challenges are:

- Find a launch sites or several which offer access to the relevant orbits (esp. polar and SSO), with maximum flexibility and minimum cost. This is highly affected by accessibility and launch range (e.g. ship traffic).
- Create a design both for the launcher as well as the launch base to minimize cost and maximise launch flexibility, while keeping high standards concerning safety and reliability.
- Establish processes and operations which minimize cost and maximize flexibility.

FLPP'S SMALL LAUNCHER ACTIVITIES

The Future Launchers Preparatory Programme (FLPP) is an ESA programme focused on future space transportation preparation. Within this role, FLPP is exploring ways to foster the commercial development of European small launch vehicles and the corresponding launch services with an eventual objective of competitiveness of European access to space. This shall allow European companies to be at the forefront of this revolution, with competitive solutions and sound business models.

Apart from several projects to develop specific advanced technologies enabling high-performance, low cost small launchers, FLPP has at the beginning of this year started a project, planned to last 6 months, to explore potential business cases for small launch services. ESA wanted to investigate the feasibility of an economically viable, commercially self-sustainable approach for access to space of satellites with a mass up to 200 kg. The proposed approach should provide competitive commercially self-sustainable launch services to worldwide customers with missions in the mass categories listed above. Customer requirements should be put at the forefront to deliver the launch service at a worldwide competitive price. Identification of the necessary key technology maturations and innovation processes is expected as an outcome of the study, in order to prepare subsequent technology maturation support by ESA. It shall be noted that only technologies/processes at TRL (Technologiy Readiness Level) ≥3 shall be eligible for possible ESA support for a follow-on phase.

The new launch service shall:

- Be totally self-sustaining, i.e. without any ESA funding in exploitation;
- Not rely on a guaranteed European institutional market;
- Serving customer requirements.

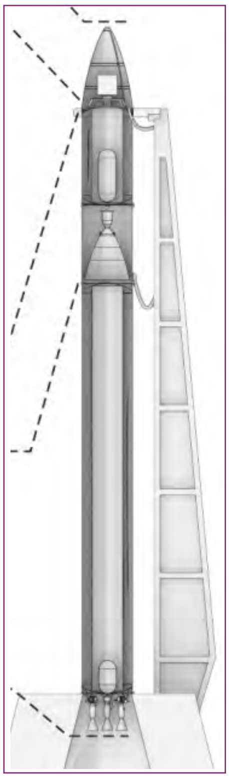
Six industrial consortia developing small launchers have been chosen from a large pool of applicants, and contracted to study the creation of a launch service with focus on economic aspects and a commercially viable business case. The consortia are led by companies ranging from start-ups to major legacy players in the launcher business. The five prime contractors are ArianeGroup (FR), Deimos (PT), ELV (IT), MT-Aerospace (DE) and PLD Space (ES), complemented by INCAS (RO).

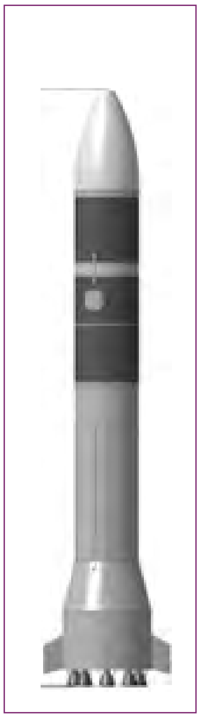
Their technical proposals represent a way of different approaches to the topic of a small launcher, for example concerning propulsion (liquid, hybrid, solid), launch method (classical launch site, aircraft) and technology choice (completely new development, flight-proven hardware…).

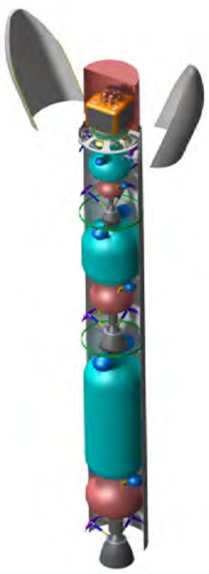
The results from these studies will lead to a refined understanding on the potentials and challenges for European small launch services and will be used to refine the strategy to foster competitive European small launch services.

In addition, the results will be fed into the technology strategy for future developments of larger launch systems.

With the launch landscape changing not only at the small end, but all the way to super heavy payloads and new competitors arising for European launch services, FLPP will investigate the spin-in of disruptive technologies and processes developed by small launch system providers along the whole range of space transportation applications. This will help European companies succeed in this fast developing environment.







Different proposed Micro-Launcher concepts

(Courtesy : ArianeGroup, Avio, Dassault Aviation, Deimos, MT-A, PLD Space, INCAS)

FLPP in short

Inception: 2003
Directorate: ESA Space Transportation
Yearly budget: ca. 50M€
Participating states: Currently 16
Contact point : Jérôme Breteau, ESA STS-FF
Web page : http://www.esa.int/Our_Activities/Space_Engineering_Technology/About_Future_Launchers_Preparatory_Programme_FLPP

2018 AMONG UPCOMING AEROSPACE EVENTS

MARCH

26-28 March – 3AF – **53rd International Conference on Applied Aerodynamics** – AERO2018 – Salon-de- Provence (France) - Ecole de l'Air – www.3AF-aerodynamics2018.com

26-28 March – EUROMECH – **16th European Mechanics of Materials Conference** – Nantes (France) – www.euromech.org/

APRIL

04-06 April – ICAO – **ICAO Aviation Data and Analysis Seminar** – Paris (France) – ICAO European and North Atlantic (EUR/NAT) Office – https://www.icao.int/Meetings

16-19 April – EC – **European Transport Research Arena (TRA)** – A digital era for transport – Vienna (Austria) – https://www.traconference.eu/infos/welcome-to-vienna

16-19 April – Space Foundation – **34th Space Symposium** – Colorado Springs, Colorado (USA) – Conference Hotel The Broadmoor 1, Lake Ave. – Premier global, commercial, civil, military and emergent space conference – https://www.spacesymposium.org

17-19 April – IATA – **Safety and Flight Operations Conference 2018** – Montréal (Canada) – Fairmont The Queen Elizabeth Hotel – Theme: Technical progress and safe operations embracing technology driven change – www.iata.org/events

17-19 April – RAeS – **World Aviation Training Conference and Tradeshow 2018** – 21st World Aviation Training summit - Orlando,FL (USA) – www.wats2018.com

18-21 April – AERO Friedrichshafen –**Global Show for General Aviation – 25th anniversary** - Friedrichshafen (Germany) – Messe Friedrichshafen www.aero-expo.com/

24 april – RAeS – **Human Performance of Pilots Conference** – London (UK) – RAeS/HQ – www.aeosociety.com/events

25-27 April – ESA – **2nd international Mars Sample Return Conference** – Berlin (Germany) – AXICA – https://atpi.eventsair.com/ MSR.2018@atpi.com

25-29 April – BDLI – **ILA Berlin 2018** – Expo-Centre Airport – Schönefeld – Berlin (Germany) – https://www.ila-berlin.de/

25-29 April – **EURASIA AIRSHOW** – Antalya (Turkey) – https://www.eurasiaairshow.com/en

MAY

08-10 May – AIAA – **AIAA DEFENSE Forum** – Laurel, MD (USA) – Missile Sciences – Weapon System Effectiveness – Strategic and Tactical Missile Systems – https://www.defense.aiaa.org

14-18 May – 3AF – **6th Space Propulsion International Conference** – Seville (Spain) – Barcelo Renacimiento Hotel – https://www.spacepropulsion2018.com

28-30 May – **25th Saint Petersburg International Conference on Integrated Navigation Systems** – Saint Petersburg (Russia) – Concern CSRI Elektropribor, JSC – www.elektropribor.spb.ru

28 May – **1** June – CNES/AIAA - **SpaceOps 2018 – 15th International Conference on Space Operations – Inspiring Humankind's Future** - Marseille (France) – Palais du Pharo – www.spaceops2018.org

28 May-**1** June – ESA- **15th European Conference on Spacecraft Structures, Materials and Environmental Testing** – Noordwijk (NL) – ESA/ESTEC – https://www.esaconferencebureau.com

28 May-**1** June – ESA – **Small Satellites Symposium – Sorrento (Italy) – Hilton Sorrento Palace** – https://www.esaconferencebureau.com

29-30 May – FSF – **6th Annual Safety Forum** – Brussels (Belgium) – EUROCONTROL/HQ – Rue de la Fusée 96 – https://flightsafety.org/event/

29-31 May – EBAA/NBAA – **EBACE 2018 – European Business Aviation and Exhibition** – Geneva (Switzerland) – Geneva's Palexpo – http://ebace.aero/2018/

JUNE

04-05 June – ERCOFTAC – **Computational Aeroacoustics III, 2018 – Third Course on Computational Aeroacoustics** – ONERA – Paris/Châtillon (France) – www.ercoftac.org/events/comp-aero-2018

04-06 June – ESA – **i-SAIRA 2018 – International Symposium on Artificial Intelligence, Robotics and Automation in Space** – Madrid (Spain) – Hotel Ayre Gran hotel Colon – https://atpi.eventsair.com/

07-09 June – **France Air Expo** – Paris Le Bourget – France Air Expo – General Aviation – https://milavia.net/

11-15 June – ECCOMAS – ECCM-ECFD Conferences – Glasgow (UK) – Scottish Exhibition & Conference Centre – **18th European Conference on Computational Mechanics (Solids, structures and Coupled Problems) and 7th European Conference on Com-**

AMONG UPCOMING AEROSPACE EVENTS

putational Fluid Dynamics – 25th Anniversary of ECCOMAS – http://www.eccm-ecfd2018.org/

18-20 June – ACI Europe – **ACI World Annual Congress & 28th ACI EUROPE General Assembly Congress & Exhibition** – Brussels (Belgium) – Square, Brussels – The annual meeting for air transport chief executives and industry leaders – www.aci-europe-events.com

25-29 June – AIAA – **AIAA Aviation and Aeronautics Forum and Exposition** – Atlanta, GA (USA) – Hyatt Regency Atlanta - Aeroacoustics – Aerodynamics – Fight mechanics – Atmospheric and Space Environment s – Aviation Technology, Integration and Operations – Flight Testing – Flow Control – Fluid Dynamics – Thermophysics and Heat Transfer – Modeling and Simulations – Multidiciplinary Analysis and Optimization – Plasmadynamics and Lasers - https://www.aviation.aiaa.org

25-29 June – AIAA/CEAS – **Aeroacoustics Conference** – Atlanta, GA (USA) – Hyatt Regency Atlanta https://www.aviation.aiaa.org - www.aiaa.org/Aeroacoustics/

JULY

02-06 July – EUROMECH- **10th European Solid Mechanics Conference** – Bologna (Italy) – www.euromech.org/ www.esmc2018.org/drupal18

09-11 July – AIAA – **AIAA Propulsion and Energy Forum and Exposition** – Cincinnati, Ohio (USA) – Duke Energy convention Center - Propulsion – Energy Conversion Engineering - www.aiaa.org/events - https://www.propulsionenergy.aiaa.org

12-13 July – AIAA/IEEE – **EATS – Electric Aircraft Technologies Symposium** – Cincinnati, OH (USA) – Duke energy Convention Center – https://propulsionenergy.aiaa.org/EATS

14-22 July – COSPAR – **COSPAR 2018** – Pasadena, California (USA) – **42nd COSPAR Scientific Assembly – 60th anniversary of COSPAR's creation** – Theme: Expanding the knowledge frontier of space for the benefit of humankind– https://cosparhq.cnes.fr/ http://www.cospar-assembly.org/ http://cospar2018.org

24-26 July – RAeS – **Biennial RAeS Applied Aerodynamics Research Conference** – Bristol (UK) – www.aerosociety.com/events/

16-22 July – **Farnborough International Airshow 2018** – International Exhibition and Conference Centre – Farnborough, Hampshire (UK) – https://www.farnboroughairshow.com/

AUGUST

19-23 August – AAS/AIAA – **Astrodynamics Specialist Conference** – Snowbird, UT (USA) – http://www.space-flight.org

27-29 August – AIAA – **AIAA Space and Astronautics Forum and Exposition** – New Orleans, LA (USA) – www.aiaa.org/events

SEPTEMBER

04-06 September - DGLR – **DLRK Congress** – Friedrichshafen (Germany) – www.dlrk2018.dglr.de

04-07 September - EASN-CEAS – **8th International Workshop** – Glasgow (UK) – University of Glasgow – Theme: Manufacturing for Growth and Innovation – https://easnconference.eu

09-13 September - EUROMECH – **12th European Fluid Mechanics Conference** – Vienna (Austria) – www.euromech.org/

09-14 September – ICAS – **31st ICAS Congress** – Belo Horizonte (Brazil) – Av. Augusto de Lima, 785 – Centro – www.icas.org – icas@icas.org

17-19 September – AIAA – **AIAA SPACE and Astronautics Forum and Exposition 2018** – Orlando, FL (USA) – Hyatt Regency Orlando - Complex Aerospace Systems – https://www.space.aiaa.org

18-21 September – ERF – **ERF 2018 – Delft (NL) – 44th European Rotorcraft Forum** – www.erf2018.org

26-28 September – ESA – **SECESA 2018** – Glasgow (UK) – Technology & Innovation Centre (TIC) - Systems Engineering and Concurrent Engineering for Space Applications Conference – https://www.esaconferencebureau.com

OCTOBER

01-05 October – IAF – **IAC 2018 - 69th International Astronautical Congress** – Bremen (Germany) – Exhibition & Conference Centre, Bremen – Theme: IAC2018 involving everyone – https://www.iac2018.org www.iafastro/bremen-germany

03-05 October - 3AF – **IES 2018 – 14th European Forum – Economics Intelligence Symposium** - Chartres (France) – CCI – www.aaaf.asso.fr www.ies2018.com

09-11 October – RAeS – **6th Aircraft Structural Design Conference** – Bristol (UK) – Bristol Science Centre – www.aerosociety.com/events/

AMONG UPCOMING AEROSPACE EVENTS

16-18 October – Aviation week – **MRO Europe 2018** – Amsterdam (NL) – RAI Convention Centre Amsterdam – Theme: Maintenance, Repair and Overhaul - www.mroeurope.aviationweek.com - www.rai.nl

23-25 October – 3AF – **AEGATS'18 – Advanced Aircraft Efficiency in a Global Air Transport System** – Toulouse (France) – www.aaaf.asso.fr

NOVEMBER

06-08 November – SAE International – **SAE Aerospace Systems and Technology Conference** – London (UK) – www.sae.org/events/

06-08 November – Dubai – **Helishow Dubai 2018** – Al Maktoum International Airport, Dubai South (United Arab Emirates) – https://www.milavia.net/

06-11 November – China – **Air Show China 2018** – Zhuhai, Guangdong (China) – https://www.milavia.net/

14-16 November – Bahrain – **BIAS 2018 Bahrain International Air Show** – Sakhir Air Base, Bahrain – https://www.milavia.net/

2019

JANUARY

07-11 January – AIAA- **AIAA SciTech Forum (AIAA Science and Technology Forum and Exposition)** – San Diego, CA (USA) – www.aiaa.org/Events

03-05 April – CEAS – 2019 EuroGNC – **5th CEAS Conference on Guidance, Navigation & Control** – Milan (Italy) – www.eurognc19.polimi.it

8TH EASN-CEAS INTERNATIONAL WORKSHOP ON MANUFACTURING FOR GROWTH & INNOVATION

The **EASN Association**, the **Council of European Aerospace Societies (CEAS)** and the **University of Glasgow** are inviting you to the **8th EASN-CEAS International Workshop on "Manufacturing for Growth & Innovation"**. In 2018 the annual gathering will be the first joined event of EASN and CEAS and it will be held at the Sir Charles Wilson Building and Gilmore Hill Center Rooms of the University of Glasgow between **04 and 07 September 2018**.

Over the years the EASN conference has been established **as a major European Dissemination event**. The **7th international gathering of the EASN Association** has been attended by more than **300 participants from various disciplines** who presented their high quality recent achievements and new upstream research ideas. The **8th EASN-CEAS International Workshop** aims to build on the success of the series of EASN and CEAS events by becoming an even broader and even more comprehensive gathering.

The conference will include a number of **Plenary Talks** by distinguished personalities of the European Aviation sector from the academia, industry, research community and policy makers. It will also include **Thematic Sessions** on a series disciplines of the A&AT Manufacturing domain, along with **Technical Workshops** where evolving ideas, technologies, products, services and processes will be discussed. Research projects are invited to exploit the opportunity and disseminate their results and achievements in dedicated Sessions.

As always, the **8th EASN-CEAS International Workshop** is designed to foster the cooperation and interaction between participants on a multidisciplinary basis serving as a platform for sharing your research activities and exchanging novel ideas for future research with a relative pan-European and global audience. The event is structured in a way that enhances the interaction and presents an excellent opportunity for networking and creating new synergies for future collaborations on a bilateral basis or in the frame of multilateral projects.