ACASIAS

NEWSLETTER N°5

July 2020

Welcome to the ACASIAS project newsletter

ACASIAS' goal is to reduce the environmental impact of aircraft by improving its aerodynamics and weight reduction. ACASIAS will embed sensors and antennas into typical aircraft structures (i.e. fuselage panels, winglets and tails). The aerodynamic performance is improved by the conformal and structural integration of antennas. The noise reduction of Counter Rotating Open Rotor (CROR) engines inside the cabin is facilitated by installation of an Active Structural Acoustic Control (ASAC) system in the lining.

Word from the Coordinator

We started our three-year ACASIAS project in June 2017, with the aim to develop four prototypes of aerospace structures with integrated functionality. This was possible thanks to ACASIAS partners expertise and good collaboration. However, there were also unforeseen circumstances such as the relocation of production facilities at some partners, and even the discontinuation of production at planned subcontractors. As a consequence, some project delays were induced since coupons and elements required for the final design of the ACASIAS structures could not be manufactured and tested on time. In January 2020 we were very pleased as the EC approved a 6 month extension of the project, thus the project will final end 30th November 2020.

Early 2020, we produced two fuselage panels for conformal integration of antennas: (1) a composite orthogrid stiffened panel for the integration of electronically steerable antenna for satellite communication; (2) another Fibre Metal Laminate (FML) panel for the integration of a VHF communication antenna. In March 2020, our intention was to exhibit the orthogrid stiffened panel at the Composite JEC world in Paris, as well as to discuss the antenna properties of all ACASIAS concepts at the European Conference on Antennas and Propagation (EuCAP) in Copenhagen. But there were again unforeseen circumstances, notably the COVID-19 pandemic crisis, forcing the cancellation these conferences. Therefore, we were unable to present our results, which was a major setback for ACASIAS dissemination activities.

The measures to control the COVID-19 spread also led to the partial closure of production and testing facilities at ACASIAS partners and its suppliers' premises since mid-March 2020, again further delaying the ACASIAS activities. Despite these delays, ACASIAS team will do its utmost to complete all planned activities (testing, evaluation and completion) before the project ends. Most important, the ACASIAS team is healthy and still strongly motivated to bring the ACASIAS project to a great successful end. Dissemination of ACASIAS results is foreseen at the second European Conference on Multifunctional Structures (EMuS2020), which will be organised as an online event on 17th - 18th November 2020. During the second day of this event an Industrial Forum is organised with the intention to discuss further exploitation of the ACASIAS concepts.

In this Newsletter N° 5, you will find the latest results achieved by our project partners, as well as an interview with Zdenek Řezníček, R&D Engineer at EVEKTOR. Zdenek is involved in the development of the winglet with integrated VHF antenna and in the final assessment of the ACASIAS technology.

I wish you all a good reading.

Harmen Schippers

NEWS & EVENTS

Due to COVID-19 crisis, EUCAP2020 has been cancelled. All the ACASIAS presentations can be found on the following link:

>> Download the presentations

ACASIAS poster can be downloaded on the following link:

>> Download the pdf

ACASIAS presentation leaflet is downloadable:

>> Download the pdf

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Fuselage panel with integrated ASAC system for reduction of CROR cabin noise with minimal impact on weight: WP3 results

In our last contribution to this newsletter, we summarised our main challenge with the words: "Bring active systems for noise reduction closer to the market!" Now, one year later we are close to achieving of our objective. But more on that later. First, let's start to recapitulate on the topics of our work package.
CROR propulsion systems are a promising concept to reach a resource efficient transport demanded by the EC in the Horizon 2020 framework program. Due to their fuel efficiency, they are discussed as an alternative to common jet engines. Within ACASIAS, the active acoustic lining panel is seen as an enabler for the CROR technology. For sound pressure levels (SPL) of up to 148 dB in the nearfield of the engine and fundamental blade passing frequencies around 100 Hz, common insulation strategies fail in reducing the SPL in the cabin to an admissible level for the passengers. Many active methods like ASAC have been developed to reduce the noise transmission through single or double walled structures. In most of the contributions to this subject, laboratory equipment and rapid prototyping controls are used for the realisation of the active system. Bringing active systems into real world applications requires small, cost extensive devices and a straight-forward manufacturing concept. The objective of WP3 is to go the next step towards the integration of ASAC systems in aircraft linings.

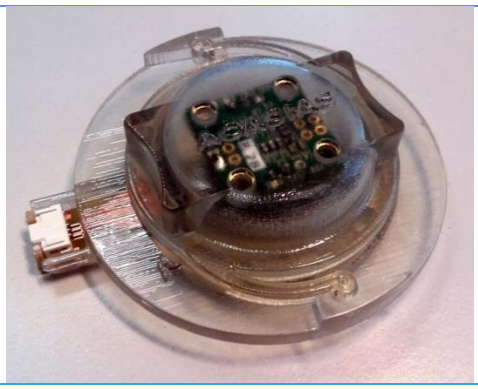

Figure 1: Insert with top part, including a sensor

The past year was marked by two major challenges: (1) pass the test readiness review (TRR) with our detailed design and (2) the lining panel had to be manufactured.
Our design includes the integration of actuators, sensors and wiring into the lining, as well as the manufacturing process for the lining. For a smooth integration of sensors and actuators, a concept with inserts is proposed. Each item is enclosed in a two-part insert (Figure 1). The base part is integrated into the sandwich panel of the lining. The removable top part houses the sensor or actuator. The mechanical connection of the two parts is achieved with a bayonet connector that is inserted and turned for fastening.

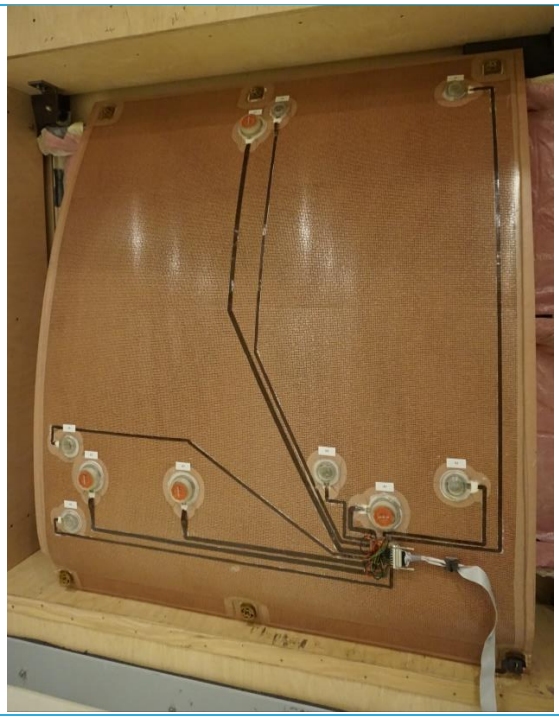

Figure 2: Active lining (backside) in acoustic lab @ DLR

Two snap connectors prevent the loosening of the parts. The electrical connection is achieved with spring contacts which connect the top with the base part during fastening of the bayonet connector. This concept allows the protection of actuators and sensors from moisture, etc. and allows a seamless integration into the manufacturing process. Repair and maintenance are addressed by the plug-and-play like insertion of the top parts.
All base parts of the inserts are connected via flexible printed circuits (FPC) to a central lining connector. Minimal FPC height and excellent bonding properties guarantee minimum impact on weight and maximum manufacturing efficiency.
This design finally passed the ACASIAS test readiness review and the manufacturing could start! All WP3 partners involved started the production of parts for a pre-version of the active lining. After validation of the manufacturing process and the produced pre-lining the manufacturing of the final lining could start. In the first quarter of 2020, the lining was delivered to DLR for experiments. Meanwhile, it is mounted in the acoustic transmission loss test facility (Figure 2). First tests are conducted and the actuators and sensors are fully operational!
Like all others, the WP3 partners are hit by COVID-19 crisis in March. Due to limited office/laboratory access and unforeseen circumstances the experiments on the active lining lag. Despites these interruptions we are hopeful that we can finish our experimental task in time and present the results to our readers in the final report!

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A smart FML Glass Laminate Aluminium Reinforced Epoxy (GLARE) panel with integrated VHF communication slot antenna and GPS patch antennas: WP5 results

ACASIAS innovation in WP5 is all about integrating antennas into a FML fuselage skin panel – making the fuselage smooth and avoiding any parasitic aerodynamic drag of such protrusions.

The fuselage skin of an aircraft is load bearing, especially for aircraft with pressurised fuselages. Making the antenna function properly and maintaining structural strength of the fuselage skin are the key challenges for this development.

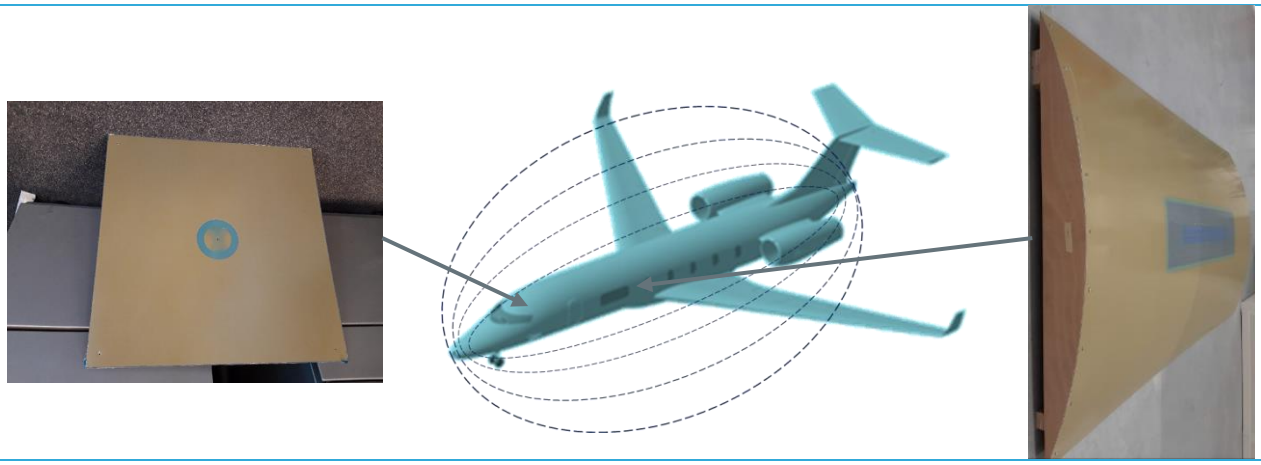

Figure 3: Manufacturing demonstrators

Since last time news about this ACASIAS innovation was published, in the Newsletter n°3, concept designs have been transformed into designs for full-scale demonstrators. Manufacturing demonstrators (Figure 3) proved valuable insight in the potential for manufacturing issues that can affect end quality of the product.

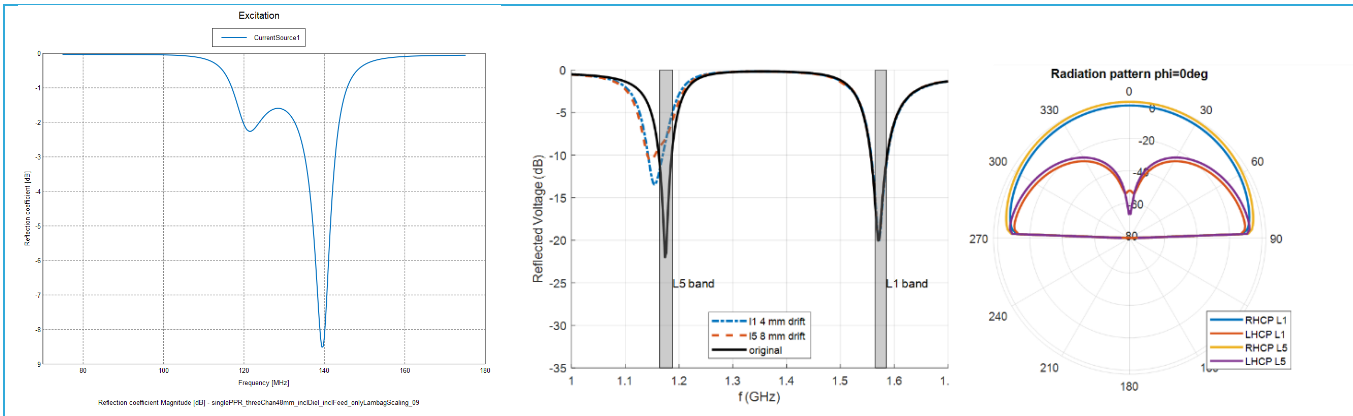

Figure 4: Computational models results

Defining computational models for structural and antenna analysis and design adaptation by CIMNE and IMST, have been instrumental for these designs (Figure 4).

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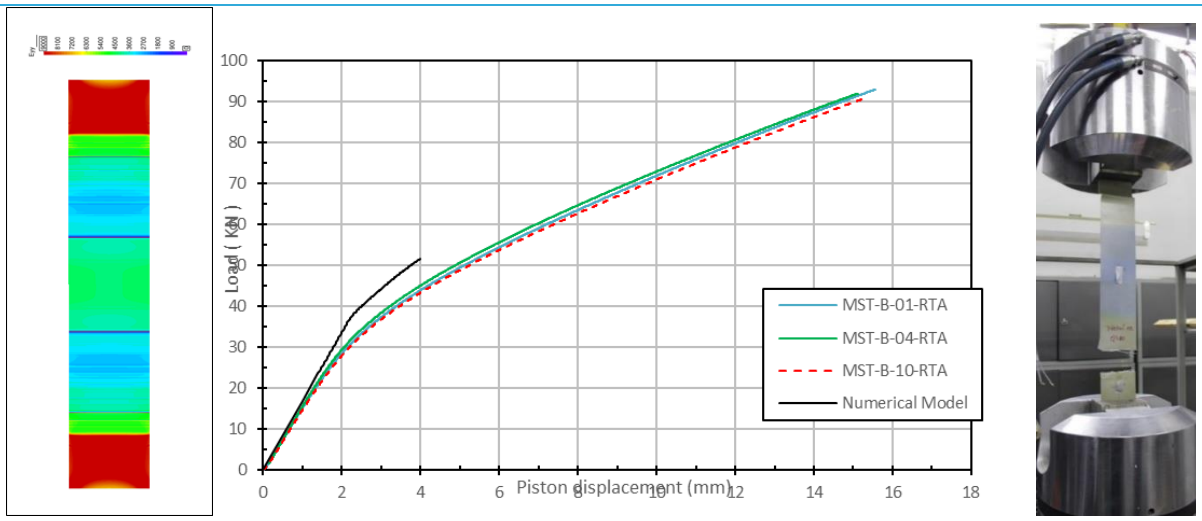

Figure 5: Comparison of the numerical model and demonstrators' behaviour

Through validation of these computational models, and some iterations to calibrate these models to factual coupon and breadboard test results, optimisation of the demonstrator design geometry is made possible with confidence (Figure 5).

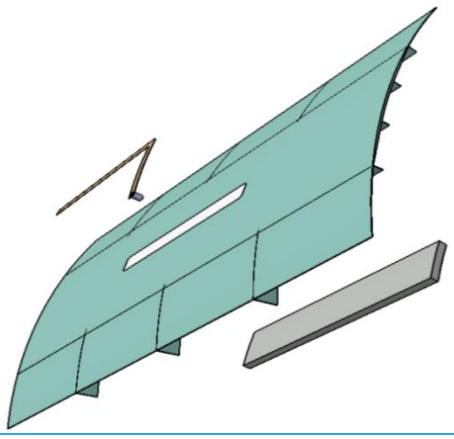

Figure 6: Integrated antenna slot design for the VHF

The integrated antenna slot design for the VHF communication system now features an RF transparent window in the FML skin, with an RF wave reflector mounted on the inside and an electrical feed to activated the metallic slot edges on the outside (Figure 6). The original plan was to integrate the electrical feed into the FML skin as well, but this is now investigated separately to avoid additional complexity in modelling, design and testing.

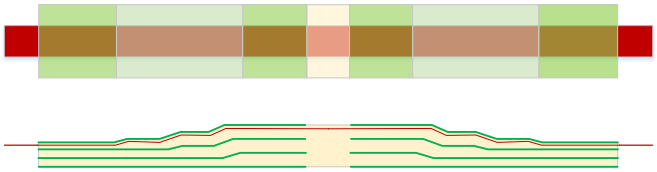

Figure 7: internally reinforced FML coupons with integrated FPC *Board*

Mechanical strength and fatigue tests will be performed on internally reinforced FML coupons with integrated FPC Board, to investigate and quantify the effects of the inclusion of such 'foreign' material in FML (Figure 7).

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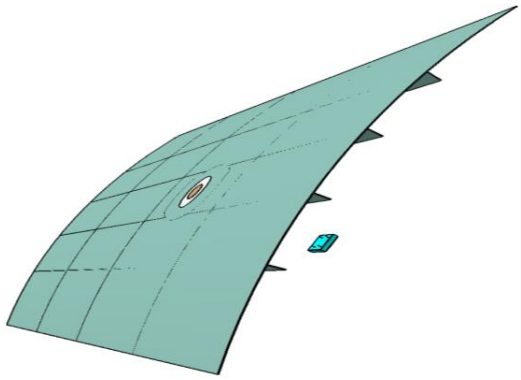

Figure 8: Integrated patch antenna for the GNSS navigation system design

The integrated patch antenna for the GNSS navigation system now features two circular discs positioned in circular holes in the outer and intermediate aluminium layers of the FML skin panel, stacked concentrically on top of each other, and separated by a layer of glass fiber (Figure 8). Mounted on the fuselage skin panel is an RF signal splitter device that puts out four RF signals separated by quarter phases, to the most outboard antenna patch.

The integrated VHF demonstrator for RF testing has been manufactured and is currently set up for antenna performance tests at NLR (Figure 9). The other demonstrators – structural and RF – are being assembled at Fokker Aerostructures, affected by some delay due to the effects of the pandemic on production capacity.

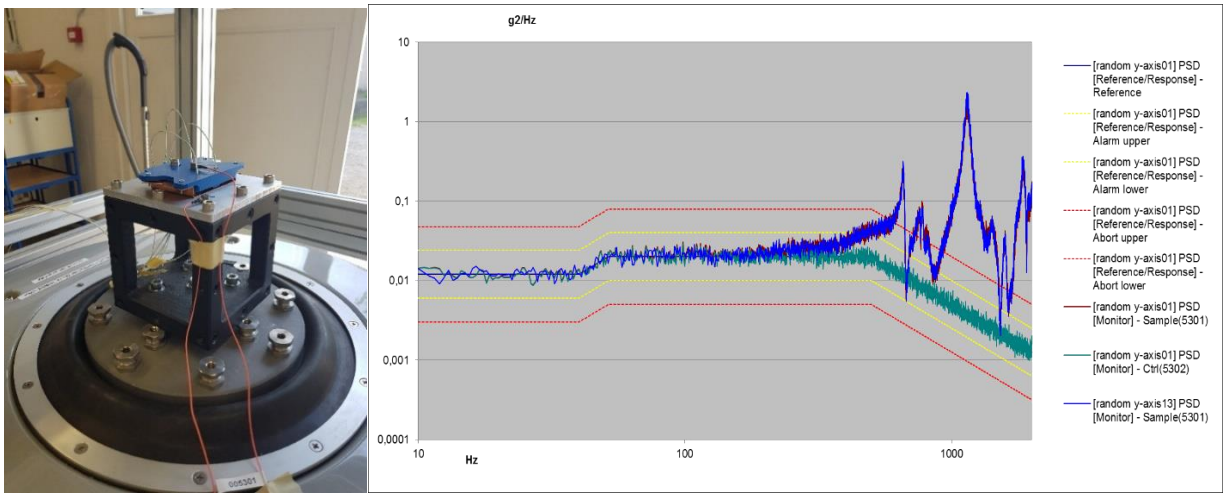

Figure 9: VHF demonstrator for testing

Testing, of structural elements and electrical components continues, with good first results; no unexpected issues have been identified yet – boosting confidence that the full-scale demonstrators will perform as expected.

The schedule for the remainder of the testing phase is realistic, and a challenge nonetheless. The main reason being uncertainty of resource capacity to manufacture the final test articles and complete testing. The outlook is still an optimistic one, expecting interesting and good test data, and trusting in the effort and support given by all of the work package partners.

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GET-TOGETHER

EMUS2020, VIRTUAL, 17TH 18TH NOVEMBER 2020

The second European Conference on Multifunctional Structures (EMuS) is a forum for the scientific and the industrial community to share recent advances made on mechanical structures with multiple functions, including their manufacturing. This two-day online conference includes a technical-scientific meeting as well as an Industrial forum. The program contains convened sessions, where ACASIAS R&D results achieved during the last 18 months of the project will be presented. Other European projects funded by H2020 or CleanSky2 are encouraged to submit papers or convened sessions to EMuS2020.

The aim of the EMuS2020 Industrial Forum is to present the ACASIAS innovations to the potential customers, with the support of our Industrial Advisory Board members. The proposal is to focus on the presentation of the ACASIAS innovations and exhibition of the structures with integrated antennas and ASAC system.

This event will be organised as a "virtual" online event, to avoid cancellation risk due to the COVID-19 crisis.

2020 AIAA AVIATION FORUM, VIRTUAL, 15TH – 19TH JUNE 2020

The AIAA AVIATION Forum is the only aviation event that covers the entire integrated spectrum of aviation business, research, development, and technology. The 2020 forum will bring together experts to share ideas on aeroacoustics; applied aerodynamics; fluid dynamics; multidisciplinary design optimization; air traffic operations, management, and systems; and much more.

Source: https://www.aiaa.org/events-learning/event/2020/06/15/default-calendar/2020-aiaa-aviation-and-aeronautics-forum-and-exposition-(2020-aiaa-aviation-forum)

SUBCON 2020, BIRMINGHAM, 28TH - 30TH SEPTEMBER 2020

The Engineer Expo and The Manufacturing Management Show is the must attend event for subcontract manufacturing professionals across all industry sectors. Subcon will once again be co-located with The Engineer Expo and new for 2020, they will also be joined by the very popular Manufacturing Management Show. Together they will deliver a unique and relevant event for the manufacturing and engineering industry. Bringing the best suppliers, latest innovations and practical advice to help build new partnerships and optimise business strategies.

Source: https://www.subconshow.co.uk/

AEROSPACE AND DEFENSE MEETING, SEVILLE, 9TH - 11TH SEPTEMBER 2020

The fifth edition of the most important BtoB event in Spain, the A&DM Sevilla, will be held from September 9 to 11, 2020. This is an opportunity for leaders in the aerospace industry to meet with potential industry partners.

The aeronautical industry in Andalusia is prepared to meet the demand for the next years. Its high-level competitiveness offers a real potential for developing new partnerships and projects.

Source: https://sevilla.bciaerospace.com/index.php/en/

WORLD AVIATION FESTIVAL, LONDON, 23RD - 25TH SEPTEMBER 2020

The World Aviation Festival is an exhibition and award-winning conference that has grown to become one of the largest and most established aviation shows in the world today. The festival continues to grow and attract a large audience of airlines, airports and travel technology companies from around the world.

Source: https://www.tradefairdates.com/World-Aviation-Festival-M603/London.html

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7TH AIRCRAFT STRUCTURAL DESIGN CONFERENCE, LIMERICK, 7TH – 9TH OCTOBER 2020

The Royal Aeronautical Society's 7th Aircraft Structural Design Conference will provide a forum for speakers and delegates to address the complexities of stricter environmental constraints with relatively short, cast-iron deadlines are being internationally imposed. In addition, pressure for reductions in manufacturing and life-cycle costs coupled with a requirement for continual improvements in overall performance/efficiency factors are important influences.
The conference will delve into current research on the design and manufacture of future civil and military air-vehicles both manned and uninhabited including both airframe and engines.
The key developments of interdisciplinary, dynamically interactive software supporting the design of modern aircraft in complex environments will be identified and analysed.
Source: https://www.aerosociety.com/events-calendar/7th-aircraft-structural-design-conference/

COMPOSITE FOR EUROPE 2020, STUTTGART, 11TH – 12TH NOVEMBER 2020

Composite for Europe is an international industry meeting point in the largest composites market in Europe, Composites for Europe combines proven solutions and efficient innovations. The trade fair reflects the variety of services and innovative strength of the entire industry. The main focus of the fair is on state-of-the-art production and processing technologies, including lightweight construction concepts and automotive applications.

Composites for Europe is the business summit for Germany, Austria & Switzerland. It comprises an Impulse Forum, a Conference, a Networking Platform and a Trade Fair. Audience from 70 countries comes to visit more than 200 exhibitors.

Source: https://www.composites-europe.com/en/

AEROMART TOULOUSE, 1ST – 3RD DECEMBER 2020

AEROMART Toulouse is an international business convention for the aerospace industry that will propose Bespoke one-to-one meetings, a one-day high level conference devoted to innovation and the supply chain & procurement policies of large OEMs.
AEROMART Toulouse offers a must-attend conferences program. These are excellent opportunities for professionals to share experiences and better comprehend the market scientific, industrial, technical and commercial evolutions.
Source: http://toulouse.bciaerospace.com/en/

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INTERVIEW

ACASIAS newsletters offer you the possibility of getting to know some of the project partners a little better… Thus, the Interview section give the opportunity to discover the daily life of the people involved in achieving the ACASIAS goals.

In this edition of the ACASIAS Newsletter N°5, Zdeněk Řezníček is interviewed from EVEKTOR, ACASIAS WP6 Leader. Zdeněk Řezníček received his Dipl. Ing. (2006) and Ph.D. (2014) degrees in electrical engineering from the Brno University of Technology, Czech Republic. Since 2008, he is working as an R&D Engineer in EMC & CEM division at Evektor spol. s r.o. in Kunovice, Czech Republic. His research interests include numerical analysis of electromagnetic fields with focus on EMC and thermodynamic sensorics used for detection of electrical transients and electromagnetic fields.

The tags leading the interview are **technology assessment – CEM simulations –Smart winglet – Impact of the project on aeronautic field**.

ZDENĚK ŘEZNÍČEK
EVEKTOR - CZECH REPUBLIC

Q1: You are the WP6 leader, technology assessment, which aims to assess all of the technologies and systems developed within the project. What criteria are you assessing?

In general, it is possible to say that we are trying to cover all main engineering areas related with each of the ACASIAS solutions. In case of smart integrated antenna designs (Satcom, VHF and GNSS antennas developed under WP2, WP4 and WP5), the main attention is almost equally dedicated to the RF and structural aspects of the designs. The reason behind is simple: we cannot deliver a successful design of an antenna integrated into a specific part of aircraft structure without considering both the impact of antenna element on the surrounding structure and the structural impact of the whole design (winglet or pressurized fuselage panel) on the rest of the aircraft. On the other side, a good structural design does not save us from potentially poor antenna performance. This is why it is crucial to keep in mind the whole idea through the whole design and assessment process.

Another aspect considered during the assessment process is the expected aerodynamic performance of some of the proposed solutions (Satcom, VHF and GNSS antennas integrated into fuselage panels).

The smart active acoustic lining panel developed under WP3 is not included in structural assessment due to its specific nature of the design. However, together with other ACASIAS designs, we are considering the panel in other important areas like integration and certification aspects of the designs and resources needed to bring the concepts to market.

As you can see, we are trying to leave nothing to chance with respect to technology assessment of the ACASIAS designs.

Q2: What are the benefits you aim to demonstrate for the developed innovations?

We are addressing the work programme topic "MG.1.1-2016. Reducing energy consumption and environmental impact of aviation" of the call "Mobility for Growth" (Smart, green and integrated transport). The challenge defined for this topic is to improve the environmental impact of aircraft with improved aerodynamics and reduction of the weight of the aircraft.

This is where we aim to demonstrate main benefits of all systems proposed under ACASIAS project. Structurally integrated antennas cause less drag,

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noise and turbulence than protruding ones. This naturally leads to lower CO_2 and NO_x emissions. To minimise the overall airframe weight, we eliminated typical structural build-ups and support structures required for conventional antennas and tried to integrate and miniaturize sensors and antenna elements as much as possible. In addition, we are aiming to keep estimated maintenance and operational costs of the systems at reasonably low levels.

Q3: You are also involved in the development of the smart winglet with integrated VHF antenna. What are the challenges encountered in this work?

The biggest challenge was to keep in mind multidisciplinary nature of the design when finding optimal solution that fits all the necessary technical requirements. In short, there are three main engineering areas to be considered in parallel: aerodynamics, structural design of the winglet and electromagnetics parameters. The situation has been more challenging due to the fact that the winglet is designed for relatively small aircraft (Evektor's small twin turboprop EV-55 Outback).

In addition, winglet parts, as structural extremities, tend to attract lightning and hold the lightning channel (at its trailing edge), so there is a high possibility that winglet will become a major part of the lightning channel. This means that the integrated VHF antenna shall withstand more severe and hazardous electromagnetic environment than the usual VHF antennas situated on aircraft fuselage.

Q4: What are the strengths of EVEKTOR in the ACASIAS consortium?

Despite the fact that Evektor is a relatively small and young company (Evektor has 300+ employees and was founded in 1991), we have already participated on several interesting aircraft designs (L-159 ALCA, Ae 270, L610) and developed several of our own airplanes (SportStar RTC and EPOS+, VUT100 Cobra, EV-55 Outback). Although Evektor origins and goals are closely tied to aviation industry, our actual engineering activities encompass automotive and general engineering areas too. Such a broad range of engineering activities helps Evektor to adopt and transfer acquired design experience from all the mentioned areas effectively. Besides our experience with design and certification of small transport or sport airplanes, this can be seen as the main strength of Evektor in general sense.

Within the ACASIAS project, Evektor is mainly participating on numerical analyses of antennas performance, considering the whole aircraft structure (WP2, WP4 and WP5), development of the smart winglet with integrated VHF antenna (WP4), and technology assessment of all the systems developed within the project (WP6). Therefore, besides our engineering versatility mentioned above, we bring to the ACASIAS project our experience to prepare and analyse robust and complex models for specific electromagnetic problems.

Q5: EVEKTOR is a leading design company in the Czech aerospace industry. What are the expected impacts of the ACASIAS project for your company? For the whole aeronautic industry?

Every similar project represents an opportunity to learn something new and broaden our experience about how to solve specific technical problems and cooperate with each other across the whole Europe. My personal experience from similar projects is that we tend to classify this specific impact as some sort of "fringe benefits". Benefits that we all know but usually forget to highlight, but I see it as a particularly important aspect of our work.

Of course, there are other more tangible outcomes of the ACASIAS project for Evektor. One of them is the smart winglet with integrated VHF antenna. Structural and aerodynamic design of the winglet has been tailored specifically to be used in our next prototype versions of the EV-55 Outback.

Possible impacts for the whole aeronautic industry have been already outlined in my first answer (Q1). In addition, know-how and technologies developed or adopted in designs of ACASIAS systems can be transferred to other systems and antennas too. Future SATCOM and other communication systems will only worsen the actual situation with overcrowding the surface areas of the aircraft that are suitable for locating the antennas. For smaller aircraft, integration of similar systems into a carbon fibre and metal laminate fuselage panels or other parts of aircraft structure may represent one of few effective ways to overcome such problems.

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