ACASIAS

NEWSLETTER N°1

JANUARY 2018

Welcome to the first newsletter of the ACASIAS project

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

Word from the Coordinator

It is a great pleasure for me to present you the ACASIAS project and its first newsletter. In this project, we will develop four innovative structures with embedded antennas and acoustic damping technology. These structures will replace protruding antennas and large radomes for the installation of satellite communication antennas. The fuselage panel with integrated sensors and actuators for reduction of cabin noise will enable the integration of new and efficient but noisy propulsion systems. The novel ACASIAS structures with embedded functions will certainly reduce the fuel consumption of future aircraft and will thus reduce CO2 and NOx emissions by aircraft. The goal of ACASIAS is to make aviation more sustainable in the future.

The ACASIAS project brings together numerous partners from aircraft industries, research institutes and SME's. The partners have complementary skills, high-level knowledge and technologies to solve multidisciplinary issues concerned with the development of the ACASIAS structures. The kick-off meeting (held at the Netherlands Aerospace Centre NLR in June 2017) was a great success. All partners were strongly motivated to achieve the project objectives and to deliver outstanding technical results.

I am convinced that a good team spirit and a strong motivation will help us with the realiszation of the ACASIAS objectives.

Dr. Harmen Schippers
Senior scientist
NLR – Netherlands Aerospace Center

NEWS & EVENTS

The ACASIAS Workshop will take place, the 6th of June 2018, at NLR premises, in Amsterdam. This event will bring together Aircraft industry stakeholders, aeronautics SMEs and suppliers to present the objectives and the content of the ACASIAS project.

>> Read more

ACASIAS presentation leaflet is now downloadable :

>> Download the pdf

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ACASIAS

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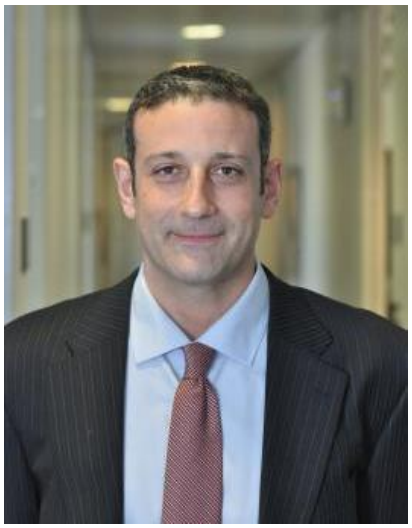
Word from the Project Officer



First of all, I would like to congratulate ACASIAS consortium with the selection of their proposal and the launch of the project in June 2017.

The main challenges that were mentioned under topic MG-1.1-2016 were the reduction of energy consumption in aviation, leading to high social, environmental and economic benefits and ensuring the sustainability of aviation. It leads to improved resource efficiency, reduction of CO2 and NOx emissions as well as decrease of the particulate matter. If no actions would be undertaken, the adverse impact of aviation on environment would significantly grow due to the expected increase of air transport traffic by 5% every year. Improvement of the environmental impact of the aircraft can be achieved for instance through better engine efficiency and advanced combustion technologies, improved aerodynamics or reduction of the weight of an aircraft.

During the 36 months of the duration of the project, my role as Project Officer will be focused on the management of the administrative, technical and financial aspects of the Grant Agreement. I will monitor the fulfilment of your contractual obligations and check the project deliverables.

After month 18 of the project, I will sit together at a Review Meeting with the ACASIAS consortium to assess the progress of the work. At the end of the project, another Review Meeting will be organised. I am fully confident that ACASIAS project will achieve all its main objectives and expected outcomes.

An important aspect that I will consider during the lifetime of the project will be the dissemination.

Miguel MARTI VIDAL

Project Officer - Aviation

PROJECT HISTORY

NLR started R&D about structural integration of antennas in 1998. Two national funded projects allowed NLR to develop conformal load-bearing antennas on aircraft structures and to investigate the integration of smart antennas in aircraft composites structures, until 2007.

In 2007, NLR and partners started R&D activities to develop broadband low-profile airborne Satcom antennas. Seven european and national projects achieved the development of broadband Ku-band antenna tiles with optical beamforming (see Figure 1). The design of this antenna requires the development of a novel fuselage panel for the integration of 32 Ku-band antenna tiles. The development of this novel fuselage panel is addressed in WP2.

Since 2007, many projects related to the ACASIAS have been launched on:

- Manufacturing of composite structures (FP7: CHANGE; COEUS – TITAN; SARISTU; LOCOMACHS; H2020: ECO-COMPASS);
- Modelling and simulation (FP7: AFLoNext, HIRF-SE, NUMEXAS);
- Noise reduction (German national projecst: CENT and SYLVIA);
- Steerable antenna (FP7: MEMS-4-MMIC; SANDRA; ESA ARTES: NATALIA; Retro-directive antenna).

In parallel of these activities, NLR has set-up eight collaborative project proposals about structural integration of antennas in aircraft in answer to FP6, FP7 and H2020. After 13 years of maturation, the project ACASIAS was funded and started the 1st June 2017.

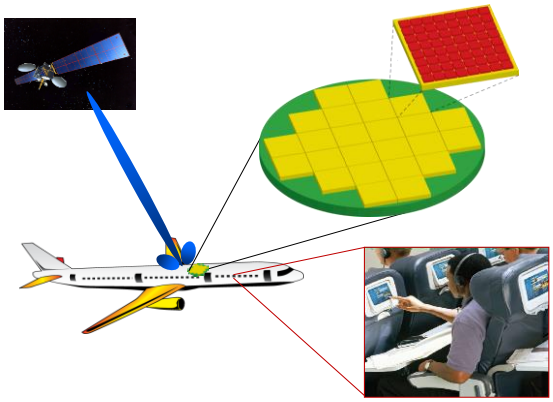


Figure 1: Broadband Ku-band antenna tiles with Optical beamforming.

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ENVIRONMENTAL CHALLENGE ADDRESSED BY ACASIAS

If no action is undertaken, the adverse impact of aviation on environment will significantly grow due to the expected increase of air transport traffic by 5% every year. Improvement of the environmental impact of the aircraft are needed and an be achieved through better engine efficiency, improved aerodynamics or reduction of the weight of an aircraft, for instance.

Figure 2: Toward a sustainable air transport system

The replacement of protruding antennas (blades and radomes) by integrated conformal antennas will reduce the aerodynamic drag. The installation of a Ku-band Satcom antenna requires nowadays the use of a radome on top of a fuselage. The estimated height of these radomes is about 18 inch. The use of such radomes increases the aerodynamic drag by at least 2%. The presently installed Ku-band systems weigh more than 100 kg. The installation of add-on conventional antennas and radomes requires structural build-ups and support structures. The aerodynamic drag and overall airframe weight and cost for installation of antennas and radomes can be reduced by the structural integration concepts of ACASIAS.

Contra-rotating open rotor (CROR) propulsion systems are a promising concept to reach a resource efficient transport demanded by the European Commission in the Horizon 2020 framework program. CROR engines are able to realize up to 25% fuel and CO_2 savings compared to equivalent-technology turbofan engines. Due to their fuel efficiency, they are actually discussed by Airbus as an alternative to common jet engines. Nonetheless, the CROR engines present a main disadvantage: the radiation of annoying multi-harmonic noise which leads to high sound pressure levels in the cabin.

Active noise reduction systems, in an experimental state, achieved a 8 dB decrease in the CROR frequencies in a laboratory environment. Once installed in a plane, this system could allow a reduction of the perceived noise in the cabin by almost a factor 3. The integration of such a system will enable the installation of CROR engines at a large scale, enabling considering fuel reduction and $C0_2$ savings.

Within ACASIAS project, the smart acoustic panel, as well as smart winglet and smart FML panel will be integrated as layers (i.e. flexible dielectric substrates with printed circuits and attached sensors and actuators) into composite layered structures which can have different material layers: glass fibre and carbon fibre prepregs, epoxy, honeycombs, thin metal layers and foams.
The fuselage panel for the integration of Ku-band SATCOM antenna tiles uses a load-bearing ortho-grid stiffened RF transparent skin to be integrated into the fuselage.

These integration concepts will contribute to:

- The overall airframe weight reduction by eliminating structural build-ups and support structures required for conventional antennas;
- The increase in aerodynamic performance of the aircraft by lowering the aerodynamic resistance caused by protruding blade antennas.

The reduction of drag (estimated to be about 2% to 4%) and the reduction of overall aircraft weight have a positive effect on fuel consumption (between 2% and 4%), and thus on the environment in terms of pollution and noise.

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EXPECTED INNOVATION

The R&D activities carried out during the ACASIAS project will lead to important innovations on future aircraft. The concept of integration of antennas and Active Structural Acoustic Control (ASAC) system into aero-structures is one such innovation. These innovations will encompass several domains and disciplines involved in the project such as Antenna design, Composite process manufacturing, Radio-Frequency (RF) and Structural analysis. The innovations are:

- New technology manufacturing process for assembling two different materials carbon and transparent dielectrics into a hybrid composite structure for the realization of RF transparent skins and embedded antennas;
- New process for manufacturing of grid stiffened panels for fuselage structures with integrated antennas and smooth aerodynamic quality;
- New concepts for installation of antennas integrated into composite structures with a very high MTBF (Mean Time Between Failures);
- New concepts for integration of wiring, sensors and actuators in composite fuselage panels for active structural acoustic noise level reduction with minimal impact on weight.

FIRST RESULTS ON SMART FML FUSELAGE PANEL

The smart fuselage panel is defined in the ACASIAS project work package as being a FML (Fiber Metal Laminate) aircraft fuselage panel that integrates a GPS patch antenna and a VHF slot antenna in such ways that they are part of the fuselage panel and provide a smooth fuselage exterior surface (see Figure 3)

Figure 3: The Fiber Metal Laminate aircraft fuselage panel integrates a GPS patch antenna, a VHF slot antenna and provide a smooth fuselage exterior surface

Work on the smart FML fuselage panel has been done as a truly collaborative effort to integrate GPS patch antenna and a VHF slot antenna in an FML aircraft fuselage panel, by three different organisations. Each organization contributing with their specific expertise, skills and knowledge to arrive at a joint concept that includes the various aspects of RF (antenna) performance, structural integrity, electrical interface and system performance, and operational environmental conditions and events.

The activities performed in this first period focussed on:

- Execution of performance simulations based on antenna functional models, and adapting the antenna geometrical requirements for optimum performance;
- Defining structural boundaries, constraints and arrangements for a reference aircraft;
- Assessment of environmental conditions and lightning strike effects based on the envisioned antenna locations;
- Defining concepts for electrical interfaces with aircraft systems and means for lightning strike protection.

This resulted in encouraging simulation results and a threesome of structural integration concepts that need to be explored a bit further to choose the final concept development.

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FIRST RESULTS ON SMART FUSELAGE PANEL WITH ACTIVE NOISE REDUCTION

The smart fuselage panel is an active acoustic lining panel, that reduces the noise level, generated by the CROR engines, for the passengers. Its integrated sensors will detect the transmitting noise while the controller calculates control signals for the integrated counteracting actuators. The manufacturing must be cost efficient within an industrial integration process.

Since the beginning of the project the following work is conducted:

- Preliminary design of an active lining structure considering limitations due to manufacturing and testing capabilities;
- Market survey of candidate sensors and actuators;
- Study about the performance of different actuator types on a carbon fiber reinforced structure.

The next steps for the following six months are:

- Setup of a detailed simulation model of the active lining;
- Selection of appropriate actuator and sensor types;
- Consideration of manufacturing issues.

GiD PRESENTATION

GiD is a graphic pre and postprocessor for numerical simulations in science and engineering. It has been designed to cover all the common needs in the numerical simulations field from pre to post-processing:

- CAD systems;
- Mesh generator;
- Connection to solvers;
- Visualization of results.

GiD can be used to perform many different analysis in different fields (Structural analysis, Computation fluid mechanics (CFD), Geomechanics, Industrial forming processes, Electromagnetics, Acoustics, …), covering the main disciplines needs, (composite) structures, advanced antennas and miniaturised sensors, gathered in the ACASIAS project.

Preprocessing

As a CAD system, a complete set of tools is provided for quick geometry definition including typical geometrical features such as transformations (translations, rotations, etc.), intersections and Boolean operations.

GiD allows the generation of large meshes in a fast and efficient manner for surfaces and volumes, using meshers based on different techniques. It also includes tools to convert any surface mesh into a NURBS surfaces representation.

Postprocessing

All the widely used visualisation options for numerical results from simulations are included in GiD. Each visualization option can be applied either to the original mesh, to an isosurface or to a cut of the mesh.

Users can take advantage of advanced external editing tools to create animations, videos or snapshots. Auxiliar surface meshes are generated by GiD for cuts and isosurfaces visualisation, and any visualisation option of a result can be applied to them.

2D graphs can be plotted with GiD based on the 3D results and advanced visualisation tools, together with the efficient management of data, provide GiD with the capability of visualising large models with large results files in a fast and user-friendly way.

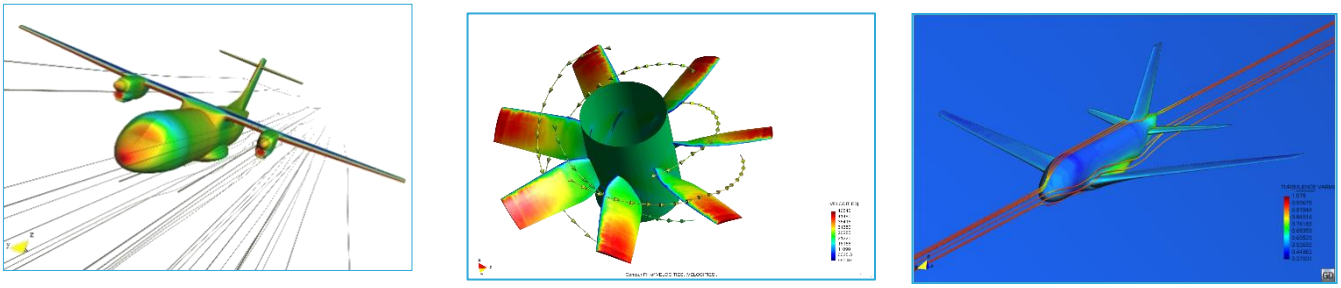

Figure 4: GiD pre and postprocessor numerical simulation

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GET-TOGETHER

ACASIAS WORKSHOP 6TH JUNE 2018

The ACASIAS Workshop will take place at NLR premises, in Amsterdam. This event will bring together Aircraft industry stakeholders, aeronautics SMEs and suppliers to present the objectives and the content of the ACASIAS project. This will be the occasion to present the innovative concepts developed in the scope of the ACASIAS project, the firsts results and future applications.

9TH EDITION OF THE GID CONVENTION 6TH-8TH JUNE 2018

The 9th edition of the GiD Convention will bring together, in Barcelona, users and developers of GiD pre/post processing system in order to exchange ideas and experiences on the generation of data for computer simulation and the graphic visualisation of numerical results.

Source: https://www.gidhome.com/gid-convention/gid-convention-2018/

EUCAP 9TH-13TH APRIL 2018

The EuCAP 2018 is the 12th European Conference on Antennas and Propagation, run under the auspices of the European Association on Antennas and Propagation (EurAAP). EuCAP is one of flagship conferences on antennas and propagation, attracting all researchers across the world. With approximately 1200 attendees it is the largest conference of its type outside of the USA. In 2018, London is chosen to be the venue to host the conference this year.

Source: http://www.eucap.org/

JEC WORLD 6TH-8TH MARCH 2018

The JEC World is the leading international show for composites and advances materials, which provides a world-class opportunity to meet the rght people through planned events and programs (B2B, meetings, conferences and presentations, innovation planets, startup booster, innovation awards, leadership circle). The leading international composites show will take place in Paris-Nord, Villepinte.

Source: http://www.jeccomposites.com/events/jec-world-2018

INTERNATIONAL PARIS AIR SHOW 17TH-23RD JUNE 2019

The International Paris Air Show is organised by the SIAE, a subsidiary of GIFAS, the French Aerospace Industries Association.

The 53rnd show will take place at the Le Bourget Parc des Expositions from 17 to 23 June 2019, and once again will bring together all the players in this global industry around the latest technological innovations. The first four days of the Show will be reserved for trade visitors, followed by three days open to the general public.

Source: https://www.siae.fr/en/the_show/presentation.htm

INTERVIEW

ACASIAS newsletters offer you the possibility of getting to know some of the project partners a little better… Thus, the Interviews section will let you discover the day-to-day life of the people involved in achieving the ACASIAS goals.

In this edition of the ACASIAS Newsletter n°1, we propose you several tags which will lead the interview: **CROR –Integrated antenna – benefits**.

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DR. HARMEN SCHIPPERS
SENIOR SCIENTIST
NLR – NETHERLANDS AEROSPACE CENTER

Q1 :You work for a long time on the embedding of antennas in aerostructures topic: what are the advantages of such structures in the aeronautic field? What are the challenges for the ACASIAS project?

The main advantages of embedded antennas are fuel reduction and less maintenance costs. Some years ago, I have observed the installation of a Ku-band hybrid satcom antenna on board of a KLM aircraft. Such a hybrid antenna uses phased array antenna technology and mechanical rotations to steer the antenna bundle instantaneously to a geostationary satellite when the aircraft is flying. This satcom antenna was protected by a huge radome on top of the fuselage. We estimate that such a radome will increase the aerodynamic drag by at least 2%, and will thus also require more fuel. The installation of such a huge radome can be avoided by the structural integration of an antenna that only uses only phased arrays with electro-optical beamforming. In the FP7 SANDRA project, NLR and partners developed phased array antenna tiles with electro-optical beamforming of size 10x10cm and with a height of 3cm. So far, no housing was developed for airborne application, which requires an aero-structure for embedding 6cmx6cm antenna tiles of 10cm x 10cm. The challenge in the ACASIAS project is to develop a novel fuselage panel with orthogrid cells that can contain these antenna tiles. The cells of the orthogrid panel are then used for two functions: structural stiffening and embedding of antenna tiles.

Embedding antennas in aerostructures

Challenges in the ACASIAS project are to develop aerostructures with embedded antennas: a novel fuselage panel with orthogrid cells that can contain Ku-band antenna tiles for satellite communication, a stiffened fuselage panel with integrated VHF antenna and a winglet with integrated VHF antenna, where the availabe space for the integration of VHF antennas is limited.

Furthermore, engineers of KLM maintenance informed us that VHF blade antennas on the lower side of the fuselage are sometimes damaged due to collisions with ground cargo. The integration of antennas into the aero-structure will certainly contribute to a reduction of maintenance costs. Therefore, we investigate in ACASIAS whether VHF antennas can be integrated into a fuselage panel and into a winglet. The challenge here is to embed

the antennas in the limited space that is available for integration in the winglet and the panel with its existing frames and stringers. Fuel reduction is also expected from the installation of efficient CROR engines. But such engines make an awful noise inside the cabin. Our colleagues at DLR have shown

in recent years that this noise can be reduced by the installation of an Active Structural Acoustic Control system in the fuselage. This system requires the structural integration of a lot of sensors, actuators and wiring.

Q2: What is the advantage of an international cooperation to adress these challenges?

The required knowledge and tools for design, manufacturing and testing for the ACASIAS innovations are scattered over Europe. Therefore, the ACASIAS project team is composed of experienced research scientists and engines of research centers, industrial organiszations and SMEs, from 6 countries in Europe. They are contributing the different disciplines needed for this multi-disciplinary research, including mechanical engineering, composite structures, antenna engineering, aerodynamics, aero-acoustics, aeronautical engineering and thermal research.

Q3: Why did you chose to develop 4 different innovations?

The four innovations were chosen because they will contribute to the reduction of CO2 and NOx emissions by aircraft and will thus help to make aviation more sustainable. Furthermore, the innovations will certainly enable the industrial partners and SME's to exploit the ACASIAS structures in the future.

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