AFLoNext

2ND GENERATION ACTIVE WING

NEWSLETTER °3

April 2015

Welcome to the third newsletter from the AFLoNext project!

AFLoNext gathers forty European partners from fifteen countries for a period of four years, until May 2017. Our fundamental goal is to mature highly promising flow control technologies and to show their potentials for advanced eco-efficient aircraft design.

Our public newsletters will regularly keep you up-to-date on progress made within AFLoNext. Whats' more, you will be given a possibility to discover how the consortium partners cooperate to achieve the project objectives. You will also find out how and when we disseminate the AFLoNext results. This is in case you feel like meeting with us!

A WORD FROM THE COORDINATOR

In 2014 strong progress was observed in the fields of hybrid laminar flow, vibration control and noise reduction, where the contents of the oncoming flight tests and ground based demonstration have been defined and validated (e.g. by means of wind tunnel testing and detailed CFD studies).The active flow control on wing/pylon, on outer wing region and on wing trailing edges have made big steps forward, using intensive CFD calculations, hardware prototypes and wind tunnel testing with the aim to validate concepts and to prepare wind tunnel tests in future.

For 2015 one of the main focuses will be securing the planned flight tests in 2016. In addition to further maturation of elaborated concepts, ensuring the targeted TRLs will be one of the main objectives for this year.

In this third issue of our newsletter, you will find out the connection between AFLoNext and Clean Sky 2. The "Get together" section focuses on our AFLoNext Workshop to take place on 10 September 2015 in Delft, the Netherlands. Last but not least, the interview will let you discover the day-to-day life of the people involved in achieving the AFLoNext goals.I wish you all a good reading!

Dipl.-Ing. Martin Wahlich
Flight Physics Research and Technology
Airbus Operations GmbH

News & Events

Save the date! 1st AFLoNext Workshop will be held on 10 September 2015 in Delft, the Netherlands. Our Workshop is organised in collaboartion with CEAS 2015.

Read more >>>

The connection between AFLoNext and Clean Sky 2 is described in the Skyline magazine published in March 2015.

Read more >>>

AFLoNext will be represented by the coordinator at the AERODAYS 2015 on 20-23 October 2015 in London, UK.

Read more >>>

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AFLONEXT AND CLEAN SKY 2

AFLoNext is a forerunner and at the same time enabling project to Clean Sky 2, assuring the continuous and sustainable development of highly promising technologies like the HLFC technology applied on tails and wing or Active Flow Control applied on wing/pylon junction enabling the integration of large-sized future engines. Those technologies will be finally integrated and validated up to pre-serial level in the Development Platform "Large Passenger Aircraft" of Clean Sky 2, coordinated by AIRBUS Operations GmbH. A targeted and concerted approach of the European civil aviation sector enables to significantly shorten the time to market for these promising technologies.

WORK PROGRESS WITHIN THE PROJECT

HYBRID LAMINAR FLOW CONTROL

The aerodynamic design of the HLFC[1] -system for the A320 VTP[2] is being further matured, starting an iterative design task with the structural desig. The aim is to reach technical maturity of the structure as well as of the manufacturing process.

Regarding the flight tests, its administrative preparation is progressing by defining the road to obtain the neccessary permissions.

Work on the HLFC wing leading edge demonstrator has progressed significantly over the past months. The Krüger concept was selected from two at a design review held at Institutul National De Cercetari Aerospatiale Elie Carafoli (INCAS) in Bucharest in September 2014. A gooseneck folding bullnose design by Deutsches Zentrum Fuer Luft - Und Raumfahrt EV (DLR), Asco Industries N.V. (ASCO) and Innovative Verbundwerkstofferealisation Und Vermarktung Neuertechnologien GmbH (INVENT) was chosen and has since undergone significant detailed design to enable a comprehensive integration assessment in a digital mock-up. The main systems architecture was proposed by Airbus Group Innovations (AGI) at the same review meeting and has undergone further sizing and development. This system currently combines the hot air anti-ice system and HLFC suction systems which use a single trunk duct which runs the length of the leading edge. The third key element in the complex integration task is the Societe Nationale De Construction Aerospatiale SA (SONACA) super-plastic-deformed skin which incorporates a series of chambers to enable either suction or ant-ice functionality. Whilst this is the most mature or the other skin concepts being studied, the 3D laser drilling required remains a significant challenge.

A design review covering the integrated leading edge, held in early 2015 and supported by key Airbus experts, highlighted several risks and issues which are now defining the priority tasks for maturing this challenging leading edge concept.

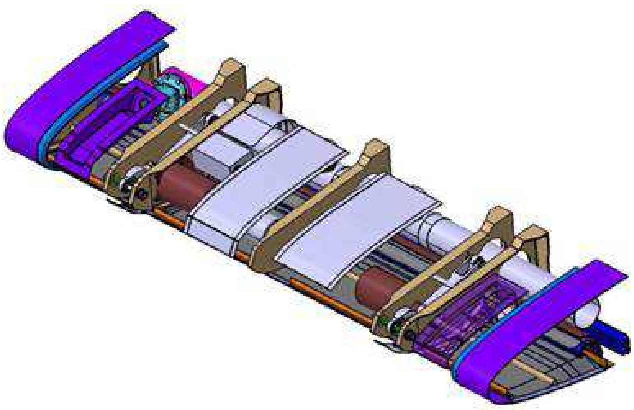

Fig. 1: The AFLoNext HLFC Leading Edge Demonstrator Digital Mock-Up (DMU), with suction skin removed.

[1] HLFC stands for Hybrid Laminar Flow Control
[2] VTP stand for Vertical Tail Plane

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ACTIVE FLOW CONTROL ON AIRFRAME

In the framework of novel aircraft configurations and wing designs, 18 partners are addressing Active Flow Control “AFC” technologies in order to minimize performance deficits due to locally separated areas, such as: i) wing/pylon junction when integrating upcoming Ultra High By-pass Ratio “UHBR” engines; ii) the outer part of an “aggressive” wing-tip extension in the vicinity of the missing slat.

A good overall progress has been obtained in the last 6 months. Computational Fluid Dynamics (CFD) computations have been almost completed for both baseline configurations but faced difficulties due to the challenging baseline geometries. Moreover, the aerodynamic effectiveness of pulsed and synthetic jets emerging through circular holes or slot outlets has been investigated. For their design work the Active Flow Control (AFC) hardware developments are constantly updated, with the most recent flow control parameters, in a close dialog with the CFD partners. This dialog has also allowed to start the preparation of the complementary tests (wind tunnel, laboratory and ground demonstration tests) to achieve Technology Readiness Level (TRL) 3-4 for the technology demonstration.

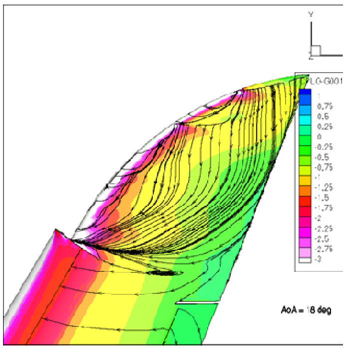

Fig. 2: Computed Flow Topology with “AFC” through slots in the wing tip extension.

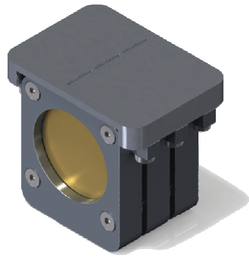

Fig. 3: Actuator Development and Integration.

For the next year or so, the 18 partners are aiming to: complete the numerical studies for the baseline and realistic configurations w/o and with “AFC” actuators, define the sizing and location of AFC actuators, adapt their integration to the wind tunnel model or the ground test bench and thus prepare the demonstration tests

CONTROL MEANS FOR VIBRATION AND AEROELASTIC COUPLING

Within the scope of defining devices to reduce the vibration levels of the main landing gear door, the CFD and FEM[3] community have achieved important results. On the CFD side, most of the unsteady calculations have been completed and are currently being analysed, with only a few calculations currently still underway. Simulations have been performed with and without the nose landing gear and also at take-off and approach conditions with different landing gear positions, in order to cover the important conditions during the landing gear cycle. The FE model has been simplified and distributed and the coupling of the already available CFD results with the FE[4] model is currently underway. The next steps will be to complete the CFD runs and the analysis of the results as well as providing the input to the FEM community for coupling.

The definition of the flight test instrumentation has been completed and the preparation of the ground vibration test is currently underway, with the test being scheduled for February this year.

The design and manufacturing concept of the monolithic nose landing gear door has also progressed further. Several concepts of door were studied (by design and/or analysis) to select the most suited concept for final design. At this stage, the main concept is based on a door composed of a lower skin with several longitudinal cells and a second concept with transversal cells.

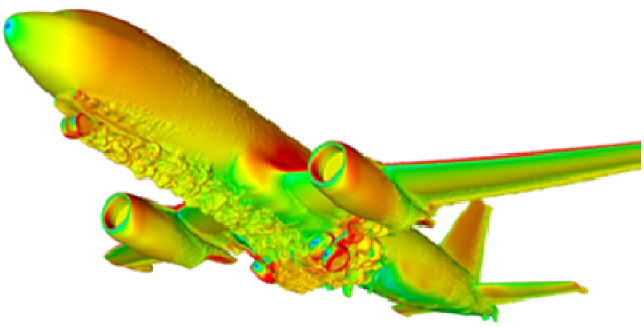

Fig. 4: RANS-LES CFD simulation obtained for Nose Landing Gear in Take-Off condition of α=10.5, 180kt, sea level M=0.272. Courtesy of Totalforsvarets Forskningsinstitut (FOI).

[3] FEM stands for Finite Element Model
[4] FE stands for Finite Element

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NOISE CONTROL ON AIRFRAME

The preliminary design of low noise devices for the main landing gear of the A320 test aircraft has been done by Messier-Bugatti-Dowty SA (MBD). Furthermore DLR conducted a gear swing test in order to avoid interferences of those devices with the functionality of the landing gear during its operation. Isolated and installed tests have been conducted in two different wind tunnels, and were concluded in December 2014. The data from those tests are currently being analysed, but first initial results prove the importance of gear wake flap interaction noise for the overall airframe noise signature.

Successful wind tunnel tests with the flap side edge treatment by using a scaled A320 flap geometry have been performed (*already reported in Newsletter #2*). Now the main steps towards the manufacturing and the modification of a pair of original flaps for the use on the test aircraft have to be taken next. After the last design details and the related technical questions for this modification will be finalised and answered during early spring of 2015, the preparation of the necessary hardware - flaps and porous side edge treatment - can be initiated to make these parts available for the flight test in 2016.

Fig. 5: Model set-up in German-Dutch Wind Tunnels-NWD (DNW-NWB) with the landing gear installed and a completely lined floor.

MULTIFUNCTIONAL TRAILING EDGE CONCEPTS

The numerical assessment of two potential trailing edge devices (TEDs) is underway. These devices, which are designed for achieving micro-circulation or buffet control, are being evaluated against the numerical benchmark data which was obtained from the previous EC project AVERT. Both 2D and 3D experiments are in progress or planned. A number of 2D test cases have been applied to the fluidic TED by several partners, with close correlation of results between partners observed. Some minor compensatory factors are now being applied for comparison to the baseline data before a final appraisal of results is reported. Some corrections are being applied to the 3D benchmark data which will account for the specific wall configuration.

In parallel to the numerical activity, the design, prototyping and test of two conceptual TEDs is progressing well. Two ‘Suction and Oscillatory Blowing’ (SaOB) actuator arrays have been installed and tested in Tel-Aviv University’s (TAU) wind tunnel (WT), with encouraging results showing performance as expected. The design of the ‘Supercritical Coanda Prototype’ device has been progressing, with early bench top tests conducted and providing valuable feedback into the design process.

The next steps for this study will be to finalise results of the 2D micro-circulation and fluidic Gurney-flap models, and complete the wall corrected 3D flow conditions for analysis. The physical prototyping activity will move into a detailed data analysis phase to allow design refinement, as well as the design of the forthcoming wind tunnel experiments.

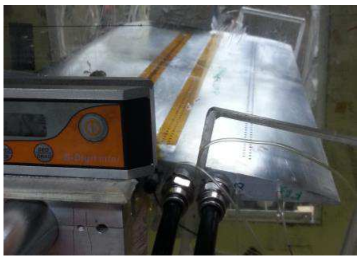

Fig. 6: SaOB assembly in TAU WT.

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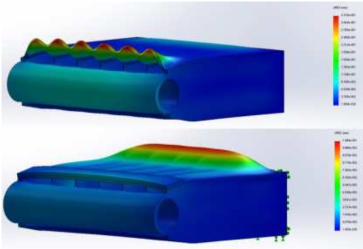

Fig. 7: Coanda Device before and without throat reinforcement.

GET-TOGETHER AT THE 1ST AFLONEXT WORKSHOP

The list of scientific and technological events related to the AFLoNext research areas can be found on our website. The file is regularly updated. Don't hesitate to inform us of any other event likely to interest the members of the AFLoNext community.

CEAS 2015 AND FIRST AFLONEXT WORKSHOP

You might want to save one date in particular: the **1st AFLoNext Workshop** will be held on 10 September 2015 in Delft, the Netherlands. Our Workshop is organised in collaboration with CEAS 2015.

Attending the 1st AFLoNext Workshop will give you a wonderful opportunity to:

- Find out the achievements and results of the AFLoNext project presented by the industrial and academic experts who are developing novel aircraft configurations.
- Expand your knowledge, as the expert engineers and scientists involved in AFLoNext share their latest research and development findings.
- Network, discuss challenges and share ideas all along the Workshop and especially throughout the "Discussion corners" organised during the lunch break.

Date: 10 September 2015

Venue: Delft University of Technology, Congress Center, Mekelweg 5, Delft, the Netherlands

Fee: EUR 125 including:

- CEAS 2015 conference book of abstracts
- Conference programme
- List of attendees
- Conference bag
- Lunch and coffee / tea at 2 breaks

Please note that the participants to CEAS 2015 will not pay the fee for participation in the AFLoNext Workshop.

The Workshop programme at a glance is available here. Registration is now open.

AERODAYS 2015

The 7th European Aeronautics Days is the European flagship event in aviation research and innovation which takes place once during each EU Research Framework Programme. Designed to present strategic perspectives for aviation, the goal is to share achievements of collaborative research and innovation in aeronautics and air transport within Europe and world-wide international co-operation. Aerodays 2015 will take place in Central London, UK from 20-23 October 2015.

Source : http://www.aerodays2015.com/

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EUCASS 2015

The 6th European Conference for AeroSpace Sciences is to improve the scientific communication and to stimulate exchanges between researchers and industry end-users worldwide. EUCASS 2015 will be held in Krakow, Poland from 29 June to 3 July 2015.

Source : http://www.eucass2015.eu/

INTERVIEW

AFLoNext 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 AFLoNext goals.

In this edition of the AFLoNext Newsletter # 3, we propose you three tags which will lead the interview: **flight test – design – integration – wind tunnel test – high maturity level.**

CEDRIC LECONTE
JET AND AIRFRAME NOISE SPECIALIST
AIRBUS OPERATIONS SAS

Q1: You are involved in the activities dedicated to the reduction of landing gear noise. The developed solutions are to be investigated in full scale during flight test. Could you please explain us the preparatory work performed by the partners before the flight tests?

A1: The sources of landing gear noise are identified and the different technologies in AFLoNext to reduce landing gear noise have already been evaluated. Therefore, the first task was to select the low-noise treatments for flight tests. Comparing both their potential of noise reduction, their complexity and the associated costs allowed us to select a set of four to five technologies that are promising to provide significant noise reduction at aircraft level. This treatments were designed and manufactured at model scale to prove their low-noise potential in a wind tunnel test using an realistic model that represents the flight test platform (ATRA aircraft). The results of this test supported by numerical data will provide last information to design the treatments for flight tests. This process is coupled with the certification loop including loads and stress verification, material verification and airworthiness checks before the permit to fly may be received to start flight tests.

Q2: What are the challenges of the design of the low-noise treatments and their integration on the landing gear? Are you aim to suppress/reduce the landing gear noise itself or also any interference noise that caused from interaction of the landing gear with any other aircraft component?

A2: The challenges of design and integration are manifold and slightly different for flight test and wind tunnel test. The design on the wind tunnel model is strongly handicapped by model scale. Parts that are easy to manufacture at full scale may cause an issue at model scale due to their small size. Since noise generation is size-dependent additional aspects for wind tunnel test model design have to be taken into account.
For flight tests, there are a lot of integration constraints to be accounted for, such as weight, reliability, maintainability and non-interference with the functionalities of landing gear systems.
Low-noise add-on treatments generally aim at reducing landing gear itself after landing gear design is frozen.
Ideally, acoustic criteria would have to be incorporated at the landing gear design stage for new development. The landing gear and wing system should even be considered as a whole for global optimisation of aircraft noise.
Regarding the interference between landing gear with the wing system, the objective within the frame of AFLoNext is to investigate the optimisation of flap deflection angle to minimise landing gear noise and landing gear flap interaction noise.

Q3: A wind tunnel test proving the low noise treatments efficiency was conducted and ended in December 2014. What were the conditions in which the wind tunnel test was performed? What are the main results and conclusions which you can draw from the wind tunnel test? To which extent do they influence the flight tests?

A3: The wind tunnel test was performed in NWB configured in anechoic open test section. The model tested was an A320 1/11th scale wing equipped with slats and flap and a main landing gear. Several slats and flaps settings were tested for flow velocity and angle of attack representative of approach condition, in order to assess installation effect on landing gear noise as well as landing gear flap interaction noise.
Both a baseline landing gear configuration and a low-noise landing gear configuration (landing gear equipped with noise reduction technologies) were tested in order to assess low-noise technology benefit on aircraft noise in installed configurations.

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Data appraisal has yet to be conducted but on-line data preliminary analysis show evidence of the importance of the contribution to overall noise of the landing-gear flap interaction noise source.
These wind tunnel test results will be confronted to flight tests that will be performed next year.

Q4: It is planned that the investigated technologies reach a high maturity level because of the flight test preparation and the flight test itself. Could you please explain if and how the results of the flight tests could be further developed and exploited?

A4: First of all, flight test data will be analysed and used for proper technology evaluation. This will cover the assessment of the technologies separately and all together on the aircraft platform selected for flight test. A sufficient noise reduction at aircraft level has to be proven to trigger a way forward for further development.
In case of any unexpected shortfall re-designs may be necessary. Even in case the technologies do provide the overall noise reduction level expected, further optimisation of the tested technologies or the coupling with further low-noise treatments could be conducted. The availability of the AFLoNext flight test data is a very valuable item in this process. This is also the case for the complete loop of technology certification to make the technologies available for serial aircraft.
A further step will arise afterwards, to adapt the technologies that proved their potential of noise reduction to other aircraft platforms.

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