AFLoNext

2ND GENERATION ACTIVE WING

NEWSLETTER N°5

October 2016

Welcome to the fifth 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 keep you up-to-date on progress made within AFLoNext. Whats' more, you are given a possibility to discover how the consortium partners cooperate to achieve the project objectives. You can 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

The third year of the project has come to an end but the AFLoNext partners continue relentlessly to run the activities to achieve the project objectives and deliver outstanding technical results!

The third Annual Review Meeting was held at the CIRA facilities in June this year. The EC Project Officer and Reviewers concluded that the highly motivated AFLoNext consortium had achieved a significant progress. We are now getting ready for the flight test activities scheduled for the second quarter of 2017. Our goal remains to show that flow control is a key technology for future aircraft drag reduction and other benefits.

In this fifth issue of our newsletter, you will find out the latest results achieved by the project partners. As usual, 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

Several AFLoNext partners participated in the 6th EASN International Conference on Innovation in European Aeronautics Research that was held on 18-21 October 2016 in Porto, Portugal. They delivered presentations in the session entitled "Design Challenges for Future Passenger Aircraft".

Read more >>>

CONTACT US

Mail : contact@aflonext.eu

Website : www.aflonext.eu

Project Coordinator :
Martin Wahlich (Airbus Operations GmbH)

Project Management Officer:
Ayla Kazanci (L-up)

Dissemination Manager :
Peggy Favier (L-up)

Follow us :

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.

WORK PROGRESS WITHIN THE PROJECT

HYBRID LAMINAR FLOW CONTROL

One of the ongoing activities is the assembly of a mini-demonstrator at the facilities of the partne Turkish Aerospace Industries Inc. (TAI). After several discussions around the manufacturability of the HLFC VTP LE2, it was decided to perform subscale DEMO components to see potential problems of the existing design. It was also aimed to provide feedback to improve design in terms of feasibility and to gain additional experience in forming and assembly process. The first trial, named PRE-DEMO, was performed with CRES material. CRES stiffeners were bonded on CRES skin. Bonded Outer Skin was cold formed with the DLR tool. Significant experience was obtained during that study. The developed air leakage test setup was also tried on the PRE-DEMO component. The obtained results were enlightening for the following trial.

For the second trail, named MINI-DEMO, BIAS provided a subscale LBW'ed (Laser Beam Welded) Outer Skin. The forming process of this Skin has been carried out much more carefully. The more detail planning of the forming process resulted in much better condition of outer skin. Moreover the transfer process of formed skin from forming tool to assembly fixture was much more detailed to improve the maintaining symmetricity of skin during transfer and installation in assembly fixture. The assembly operations of MINI-DEMO component has just been completed. The next steps are to perform an air leakage test and to measure the outer profile of component.

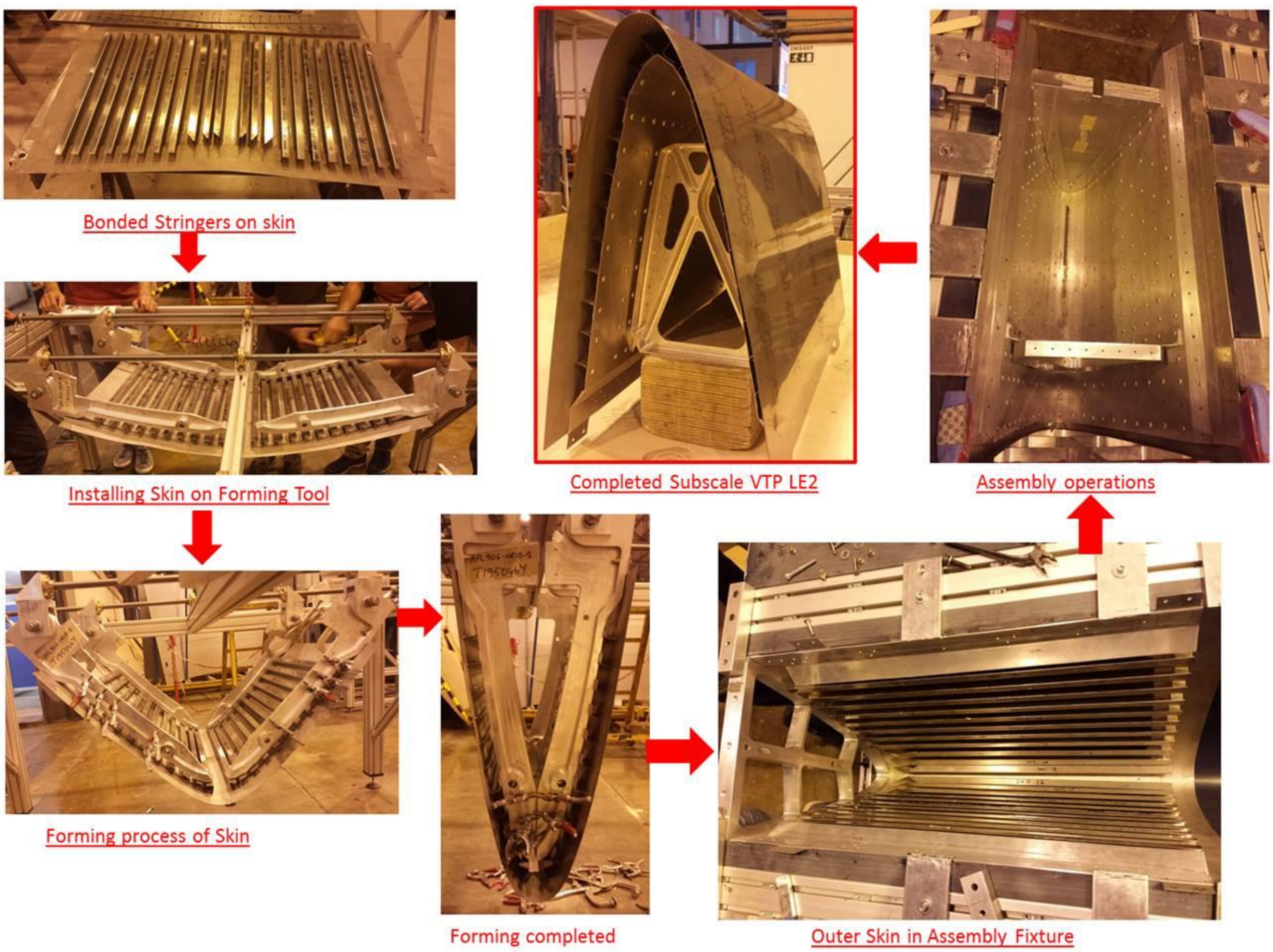


Figure 1: Courtesy of Turkish Aerospace Industries Inc.

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.

ACTIVE FLOW CONTROL ON AIRFRAME

During the last year, the work related to work package 2 "Active Flow Control on Airframe" was focused on maturing design proposals for actuators (synthetic jet, pulsed jet, hybrid jet) and also test set-ups maturation (wind tunnel and harsh environment experimental test benches) . This work-package has two main direction, one related to wing-engine pylon junction – where the main scope is to alleviate or if it's possible to eliminate flow separation at low speeds and high angles of attacks and the second one is studying the "outer wing" area in order to reduce the local separation by means of active flow-control devices.

Romanian National Institute for Aerospace Research (INCAS) is leading one of the Sub-Work Packages and the main activities developed in this task is to subject the tile actuators to a, as we are calling, "harsh environment" test campaign. To make it possible, we need to design and manufacture test-rigs for different types of actuators -an interface between actuators tiles and the test benches, e.g. shock & vibration machine- in order to ensure that the scope of the tests is secured. British Aerospace Systems (BAeS – Pulsed Jet) together with Airbus Group Innovation (AGI – Hybrid Jet) and Fraunhofer (Fraun – Synthetic Jet) are the main partners who will support and provide test articles on the test campaign which will start in October 2016.

Figure 2: INCAS Sand & Dust testing facility.

An aspect that is worth to mention is the sand and dust testing facility. This facility has to fulfil the requirements imposed by testing strategy, namely flow speed, air temperature, dust and sand concentrations. A former wind tunnel was rehabilitated and transformed into stand for this specific harsh environmental test. A solution to retain the sand and dust used during this experiment is to bypass the contaminated air through two cyclones. Numerical simulations were carried out and preliminary tests were performed to evaluate the capability of the cyclones to separate the sand/dust from the airflow.

CONTROL MEANS FOR VIBRATION AND AEROELASTIC COUPLING

Within the scope of defining devices to reduce the vibration levels on the aircraft's main landing gear (MLG) doors, further steps towards the definition of such devices and flight test have been achieved.

Computational Fluid Dynamics (CFD) simulations with and without aero-devices have been finished. Coupled fluid-structure analyses have been performed and the effect of vortex generators (VG's) on the MLG door displacement have been studied. As a result, VG's or spoilers on the MLG door have been selected as appropriate means to reduce vibration levels. These devices which will be flight tested in 2017.

The dynamic Finite Element model (FEM) of the MLG door as a key component of the coupled fluid-structure (CFD-CSM) prediction chain has been updated based on the results from Ground Vibration Testing (GVT) on the DLR ATRA A320. Currently, the model updating continues to enable a more accurate modelling and hence prediction.

Regarding the hardware, the manufacturing of the new nose landing gear door has started, and a preliminary definition of aero-devices to be fitted on one MLG door is available. Last but not least, flight test matrix and flight test instrumentation installation requirements for the AFLoNext flight testing in 2017 have been defined.

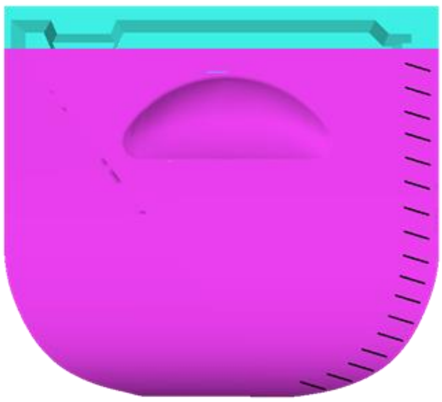


Figure 3 : Vortex generators (VG's) on A320 MLG door. Courtesy of FOI.

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.

NOISE CONTROL ON AIRFRAME

Regarding the task related to the reduction of landing gear/flap interaction noise, the final assessment of data from the wind tunnel test revealed dependencies of the measured noise levels on the flap deflection angle. The preparation of the low noise treatment of the landing gear for the flight test shows some delay in the design and qualification process, but will be ready for the acoustic flight test in summer 2017, according to the new overall planning.

For the porous flap side edge a big step towards the flight test has been made. The design was finalised in early 2016 and after a successful CDR meeting in February the final “go” for the manufacturing was given. Meanwhile the pair of flaps is modified and the relevant qualification documents are prepared. Since the flight test has been shifted, the PFSE will have to wait for its final proof of noise reduction on aircraft level.

An important achievement within the acoustic work package WP4 is that DLR performed the reference flight test with the DLR Airbus 320 ATRA at Cochstedt Airport, near Magdeburg. Noise measurements were done by using a microphone array to localise and rank the different noise sources of the aircraft in its baseline configuration. These data will be used later to evaluate the noise reduction achieved by the LG and flap low noise technologies.

Figure 4: ATRA passing microphones in low.

MULTIFUNCTIONAL TRAILING EDGE CONCEPTS

Time-dependent boundary condition simulating the oscillating flow from the nozzle exit is under development by CFD simulations. The purpose of this study is to simulate the effect of the actuator by boundary condition for future flow control simulations and to avoid modeling of the whole internal geometry of the actuator, nevertheless considering the realistic flow field at the nozzle exit as much as possible. It will enable to effectively simulate the row of actuator by the functional form fit of the oscillatory blowing jet exit profile. The isolated Suction and Oscillatory Blowing (SaOB) actuator is used for this study. The experimental data corresponding to the different supply pressures and still air ambient condition from TAU aerodynamic laboratory are available for validation of the CFD simulations. The supply pressure controls the velocity at the nozzle exit and also the frequency of oscillating flow. A very good agreement of the exit velocity and oscillating frequency in dependence on the supply pressure was achieved. Time-averaged velocity profiles are taken from exit of the nozzles where the top speed is achieved. This 2D velocity profile is used to construct a functional fit. The functional fit of the exit velocity by 3D surface will be done in a next step. CFD simulations of the housing SaOB actuator into the AR2 airfoil corresponding to the wind tunnel condition are ongoing to evaluate the effect of the cross flow on the behavior of the jet exit profile and the whole actuator.

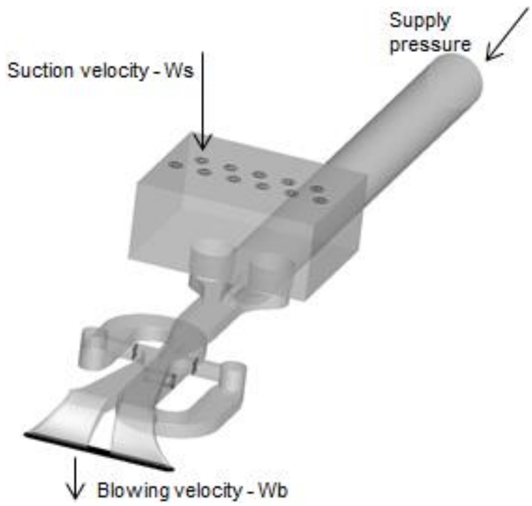


Figure 5: Isolated SaOB actuator used for CFD studies.

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.

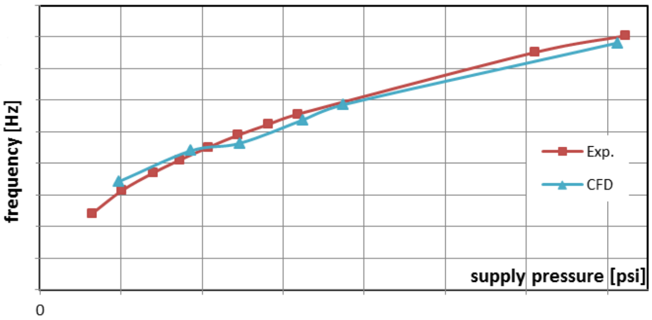


Figure 6: Comparison of the dependence of the frequency of the oscillation jet on supply pressure.

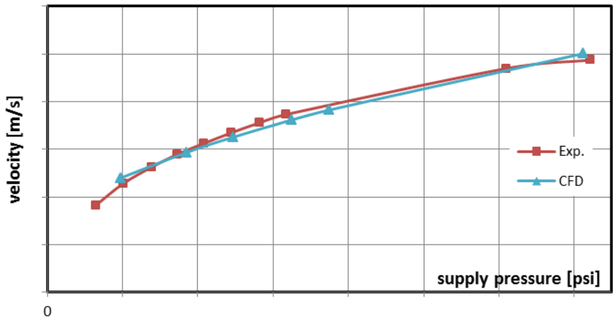


Figure 7 : Comparison of the dependence of the jet velocity on supply pressure.

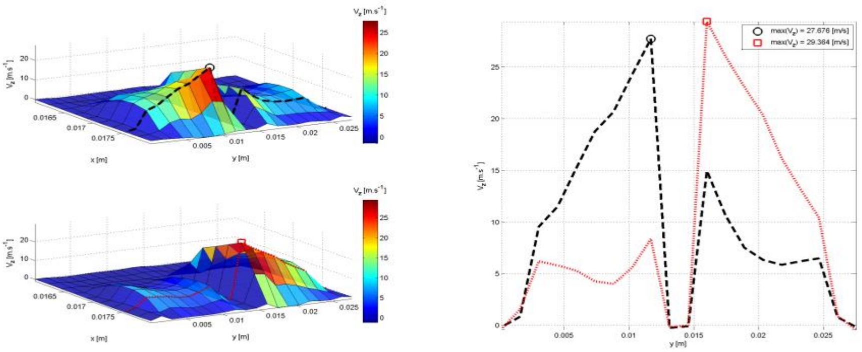


Figure 8: Time-average simulation result of the velocity at the nozzle exit.

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: Wind Tunnel (WT) tests – wind tunnel model – test matrix – integration.

VITALY SOUDAKOV, HEAD OF GROUP, AERODYNAMICS DEPARTMENT
NATALIA MIROSHNICHENKO, HEAD OF PROJECT DEVELOPMENT GROUP, INTERNATIONAL BUSINESS DEPARTMENT
CENTRAL AEROHYDRODYNAMIC INSTITUTE (TSAGI)

Q1: The objective of the activities in which TSAGI is mainly involved is to prove the Technology Readiness Level (TRL) 4 for the Active Flow Control (AFC) at the Engine-Wing junction. What were the steps required prior to the validation in large-scale **Wind Tunnel (WT) tests**?

V. Soudakov: The main steps prior to WT tests are design and manufacturing of large-scale WT model that is suitable for the representation of the typical flow separation phenomena near the junction of Ultra High Bypass Ratio (UHBR) engine with the wing. This flow separation should be obtained in WT tests at low speed

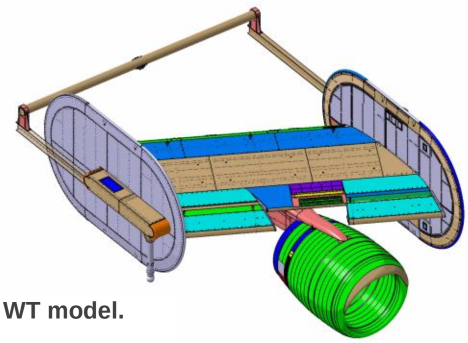


Figure 9: WT model.

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.

and high angles of attack for landing or take-off configurations. The baseline WT model consists of 2.5D swept wing with the DLR F15 airfoil in high-lift configuration. Sweep angle of the leading edge is 28º. The model includes also underwing mounted UHBR flow-through-nacelle attached to the wing by a pylon.

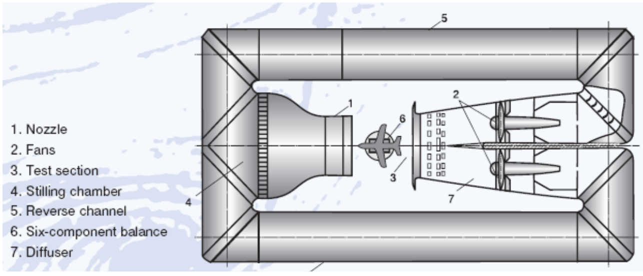
To reduce or suppress the separation AFC hardware were developed by partners. The next important step is the integration of AFC hardware into WT model together with corresponding equipment for WT tests. Two actuators with aircraft scale will be considered: pulsed jet actuator developed by Airbus and synthetic jet actuator developed by Fraunhofer and NLR. For pulsed jet actuator, compressed air will be supplied with stagnation pressure up to 6 atm and mass flow rate up to 5 kg/s.

Q2: What are the activities performed by TSAGI in regard with the **wind tunnel model**? What are the characteristics (Rn, size) of the TSAGI WTT facility?

V. Soudakov: The main difficulty with manufacturing of the WT model is a very big size of the model. For example, the mean aerodynamic chord (MAC) of the model is 3.259 m. The spanwise size of the model is approximately 6 m. WT test will be carried out in TsAGI T-101 facility (Fig. 2). T-101 is a subsonic continuous-operation, closed-layout wind tunnel with two reverse channels and an open test section. Two fans of total power 30 MW generate the flow. Test section of T-101 has elliptic cross section with axes 24□14 m and length 24 m. Flow velocity is up to 50 m/s. WT T-101 and the model allow to investigate actuation concepts at realistic scale and at industrially relevant flow conditions given by Reynolds number 11.4 Mio based on MAC and Mach number M=0.15 that allow to prove TRL=4 for considered AFC technologies.

Q3: You plan on perform possible measurements during the wind tunnel test. What techniques have you envisaged and how have your prepared the **test matrix**?

V. Soudakov: T-101 WT is equipped with a six-component electro-mechanical balance and different visualization techniques. The following measurements will be performed during WT tests: measurement of free-stream parameters and parameters of supplied compressed air; pressure measurements on the model surface (~400 points); balance measurements. Visualization by mini-tufts in the region of possible separation will be also performed. Moreover, special technique for surface streamlines visualization will be applied – particle image surface flow visualization (PISFV) to clarify presence or reduction of the separation due to application of AFC systems. All these techniques were integrated into test-matrix prepared by DLR and TsAGI for WT tests.



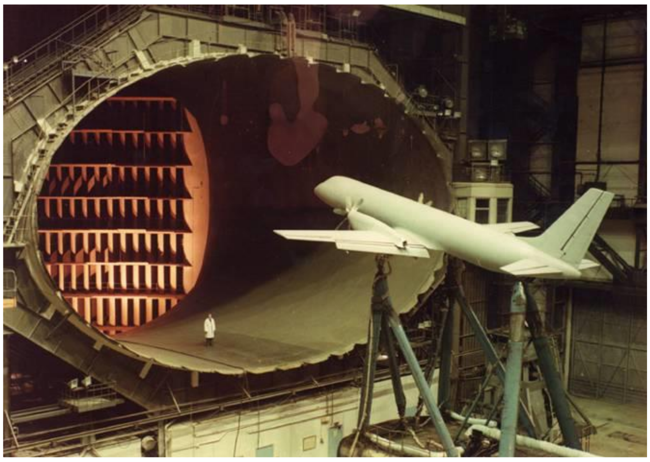


Figure 10: TsAGI WT T-101.

Q4: In AFLoNext TSAGI is one of the partners involved within the international cooperation with the EU. Could you tell us the benefits of such a participation? Have you (or any of the AFLoNext partners) taken any special steps to ensure TSAGI good **integration** in the project work plan, different activities and exchange of information and knowledge?

N. Miroshnichenko: TsAGI has a long-term history of participation in projects of European Framework Programmes. The benefits of such participation is that TsAGI is getting involved in world-class aeronautics research developments, our specialists have the possibility to exchange advanced ideas with European researches and young scientists get unique experience in working in cooperation with European partners. Our good integration in the project is ensured by the excellent team of project partners as well as by TsAGI capabilities in aeronautics research and large experience in participation in EU-funded projects.

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.

GET-TOGETHER

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.

ICAS 2016, 25-30 SEPTEMBER 2016, DAEJEON, SOUTH KOREA

Chris Atkin from City University London delivered a presentation entitled "AFLoNext – Active Flow Loads And Noise Control On Next Generation Active Wing". Conference website: http://www.icas.org/Pro2016.html

6TH EASN INTERNATIONAL CONFERENCE ON INNOVATION IN EUROPEAN AERONAUTICS RESEARCH, 18-21 OCTOBER 2016, PORTO PORTUGAL

Markus Fischer (Airbus Operations GmbH) delivered an invited keynote lecture entitled "CleanSky2, Large Passenger Aircraft, Platform 1" that opened the session "Design Challenges for Future Passenger Aircraft" on Tuesday 18 October 2016. In this session, AFLoNext partners from Airbus Operations GmbH, Airbus Defence and Aspace and Airbus Operations Ltd. introduced the participants to "Large turbofan engine integration into civil aircraft via active flow control" Another session closely linked with the AFLoNext research areas was the "Active Flow Control" on Wednesday 19 October in which we can highlight the presentation by the AFLoNext partners (Airbus Defence and Aspace and Fraunhofer Institute for Electronic Nanosystems) entitled "Optimization and testing of fluidic actuators for active flow control at the engine/wing junction" based on the epnymous paper. Conference website: https://easnconference.eu/

STAB SYMPOSIUM, 08-09 NOVEMBER 2016, BRAUNSCHWEIG GERMANY

The STAB Symposium aims to encourage networking between researchers and industrials involved in the German aerospace sector. Symposium website: https://www.tu-braunschweig.de/stab2016

SEVENTH ANNUAL AIRBUS DIPART 2016, 21-23 NOVEMBER 2016, BRISTOL AND BATH SCIENCE PARK UK

DiPaRT was created in 2010 by Airbus Operations Ltd. as a mechanism for engaging and collaborating with the UK Flight Physics R&T community. Supporting the UK centred capability in design and integration of wings, landing gear and associated systems, the DiPaRT network of organisations and partners identify potential technologies and research aligned with Airbus R&T strategy. Source: http://cfms.org.uk/news-events/news/2016/may/seventh-annual-airbus-dipart-2016-event-dates-announced/

AIAA SCITECH FORUM 2017, 09-13 JANUARY 2017, GRAPEVINE USA

The 2017 AIAA Science and Technology Forum and Exposition (AIAA SciTech 2017) will be structured around the topic "Addressing Full Spectrum Disruption Across the Global Aerospace Community". More than 2 500 technical presentations will be delivered in diverse aerospace fields. Conference website: http://www.aiaa-scitech.org/

57TH ISRAEL ANNUAL CONFERENCE ON AEROSPACE SCIENCES, 15-16 MARCH 2017, TEL AVIV & HAIFA, ISRAEL

The AFLoNext partner Tel Aviv University will present project results in the publication entitled "Active Flow Control Implementation for Mitigating Outer Wing Flow Separation" submitted in the proceedings of the IACAS 2017. Conference webiste: http://iacas.net.technion.ac.il/

This project is supported by the European Community's Seventh Framework Programme for research, technological development and demonstration, under grant agreement n°604013.