ACTIVE FLOW- LOADS & NOISE CONTROL ON NEXT GENERATION WING

OVERVIEW AND RESULTS AFTER 2ND PROJECT YEAR
• The worldwide traffic will significantly grow within the next decade.

• This makes it inevitable to reduce the ecological footprint of passenger aircrafts.

• AFLoNext tackles following lever arms towards more ecological aircrafts:
  → laminarity to reduce aircraft drag during cruise flight to reduce fuel burn.
  → active flow control on local applications to increase aerodynamic performance during take-off and landing and to allow installation of more efficient engines.
  → passive noise control technologies to reduce aircraft noise during take-off and landing.
  → vibration mitigation & control to allow design of optimized airframe components to reduce overall aircraft weight.
Objectives

To mature and demonstrate promising flow control technologies up to high maturity levels (TRL 4-5) to validate them later in a fully integrated large scale demonstrator approach such as in Clean Sky 2 (TRL 6 and higher).

**Hybrid laminar flow technology (HLFC)**
for aircraft drag reduction

**Active flow-control technologies**
for local applications for performance increase and improved environmental compatibility

**Passive vibration- and noise-control technologies**
for local applications for performance increase and improved environmental compatibility
AFLoNext – Overview of Technology Areas & Streams

**TS1** Hybrid Laminar Flow Control (HLFC) on wing and fin
- Up to 9% fuel saving

**TS2** Active Flow Control on outer wing
- Up to 2% fuel saving

**TS3** Active Flow Control on wing / pylon
- Enables integration of Efficient Ultra High Bypass Ratio (UHBR) engines

**TS4** Active Flow Control on wing trailing edges
- Up to 1-2% fuel saving

**TS5** Noise reduction on flap and undercarriage
- Significant A/C noise reduction during approach and landing

**TS6** Vibrations mitigation / control in undercarriage area
- Significant weight reduction on landing gear door and components
Hybrid Laminar Flow Control (HLFC) / TS1
- Major Objectives & Achievements after 2nd Project Year -

- Flight Test demonstration of advanced HLFC technology on a Vertical Tail Plane (planned in Q2/2017).
- Ground based demonstration / Validation of HLFC integration on a wing leading edge.

- Aerodynamic and system layout of VTP has been finished.
- Structural design & sizing of VTP are about to be completed soon.
- Preliminary Design Review & Critical Design Review are imminent.
- Manufacturing process has started.
- Flight test preparation is ongoing and will meet project targets.
**Hybrid Laminar Flow Control (HLFC) / TS1**

- **Major Objectives & Achievements after 2nd Project Year** -

- Flight Test demonstration of advanced HLFC technology on a Vertical Tail Plane (planned in Q2/2017).
- **Ground based demonstration / Validation of HLFC integration on a wing leading edge.**

- Aerodynamic design is finished (suction system & wing ice protection system).
- double curved & micro perforated skin concepts have been evaluated.
- Krueger design has been finished.
- System architecture has been chosen.
- System design is finished.
Active Flow Control (AFC) / TS2, TS3, TS4
- Major Objectives & Achievements after 2nd Project Year -

- Experimental demonstration (large scale wind tunnel tests) of Active Flow Control technologies for local application on the wing (planned in Q4/2016).
- Definition and validation of realistic system integration and system architecture related to application on real Aircraft.

- CFD studies for baseline & realistic configuration have been completed.
- Actuator type, size and location have been investigated.
- Wind tunnel tests preparation are progressing well.
- System architecture design and integration progressing well on wind tunnel model and on outer wing.

Wind tunnel model to be tested at TsAGI WT T-101

Active Flow Control (AFC)
Flight Test demonstration of passive noise control technologies on flaps and main landing gear (planned in Q2/2016).

• Wind Tunnel tests at DLR-AWB & DNW-NWB facilities have been successfully conducted.

• Analysis of wind tunnel results show high potential for noise reduction on real aircraft.

• Selection of landing gear- and flap modifications are completed.

• Flight test preparation has started. - definition of way to get permit to fly - design of flight test modifications
Vibrations mitigation / control on airframe / TS6
- Major Objectives & Achievements after 2nd Project Year -

- Development of prediction methods for vibration topics at the landing gear (structural and aerelastic coupled models).
- Design of passive devices to reduce vibration level at landing gear area.
- Flight Test validation of the numerical model (planned in Q2/2017).

- Numerical analysis of main landing gear door vibrations have been finalized.  
  coupling of CFD & FEA approach to understand vibration phenomena.
- Aerodynamic and structural modification on landing gear designed.
- Ground vibration test (GVT) on A320 main landing gear door successfully conducted to validate CFD/FEA models.
- Flight test preparation has started.
The European Footprint of the Consortium
40 Partners in 15 countries

Approx. 37 M€ total cost
20.5 M€ proposed funding
23.6 M€ effective funding

Project top level ranked and assessed as “excellent”

Project duration: 4 years (2013-2017)

Project start: 1st of June 2013
Conclusion

• The project is well on track after 2nd year of operation.

• The consortium collaborates very well by providing world-class capabilities to AFLoNext. A strong team spirit and the will to deliver results is permanently present.

• In the oncoming 3rd year the project will face challenges such as:
  → Preparation of flight test campaigns in-time (Delivery of hardware and get the permit to fly).
  → Prepare large wind tunnel tests and ground-based demonstrations.

• In summary, AFLoNext will deliver technologies, which will meet customers needs to reduce the overall ecological footprint of future aircrafts.

• The next logical step will be the handover of the most promising flow control technologies to research programs like CleanSky2 in order to further mature them to make this technologies available for serial aircraft within the next decade.
Thank you for your attention

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