CLEAN AVIATION

Hybrid Electric Regional Wing Integration Novel Green Technologies

HERWINGT

Project overview

14th EASN conference. Oct 2024

Sebastián Pellicer. Airbus Defence & Space

Co-funded by
the European Union

HERWINGT Objectives

01 Deliver an innovative wing design for a hybrid-electric regional aircraft (HERA)

02 Demonstrate a minimum fuel reduction of 15% due to wing improvements

03 Demonstrate a structural weight reduction of at least 20% when compared to a State-of-the-Art (SoA) wing

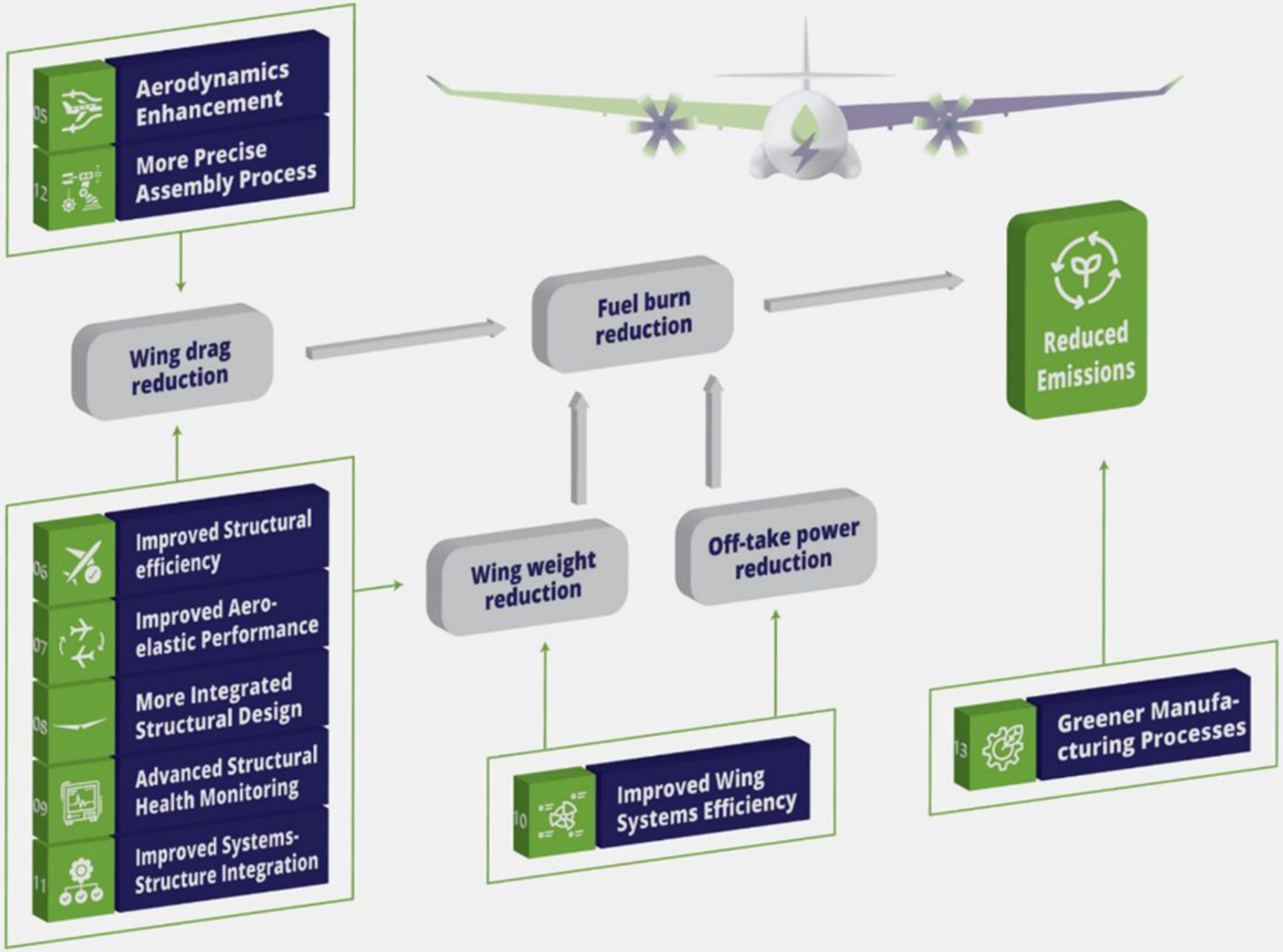
04 Analyze reduction potential CO_2 and all other relevant Greenhouse Gas (GHG) emissions

In addition, **HERWINGT** commits to delivering:

- A roadmap towards the wing full-scale demonstration at aircraft level with a first flight in 2028.
- Digital twins and a life cycle assessment of the components, subsystems, and full wing system compatible with the reference aircraft digital framework and requirements.

and proposes:

- A qualification and certification plan linked to the proposed activities and suitable for Hybrid-Electric Regional (HER) aircraft.



HERWINGT: Structure of the Consortium

Industries

AIRBUS
LEONARDO
ACITURRI
MTORRES
Fokker
GKN AEROSPACE
IAI
HELLENIC AEROSPACE INDUSTRY S.A.
ALESTIS AEROSPACE
ATR
SIEMENS
Applus+
Collins Aerospace
GOODRICH

RTO

ikerlan
aimen CENTRO TECNOLÓGICO
cea
DLR
INTA
FIDAMC
Fraunhofer
RAIL TEC ARSENAL
CIRA Italian Aerospace Research Centre

(28 partners over 11 countries)

Universities

POLITECNICO MILANO 1863
TU Delft
UNIVERSITY OF PATRAS
ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ

SME

easn

Associations

ain

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Work breakdown structure

HER-04 WING DESIGN

Concept definition | Concept Development | Concept Demonstration

- **WP0 Project Management (AD)**
  - WP0.1 Managmnt AD
  - WP0.2 Disseminat EASN
- **WP1 Wing Concept & Architecture (LDO)**
  - WP1.1 Wing Concept & trade offs LDO
  - WP1.2 Aerodynamic Refinement CIRA
  - WP1.3 Architecture and Configuration for wing AD
- **WP2 Wing Requirements (AD)**
  - WP2.1 Structural Requirements AD
  - WP2.2 Functionality definition and requirements LDO
  - WP2.3 Propulsion integration requirements ADS
  - WP2.4 Systems definition and requirements Coordinate with ACAP ADS
- **WP3 Wing Structural Design (AD)**
  - WP3.1 Design Requirements AD
  - WP3.2 Wing DMU and Digital Twin LDO
  - WP3.3 Wing Component Design AD
- **WP4 Technology Enablers (GKN)**
  - WP4.1 Materials and Manufacturing Enablers AD
  - WP4.2 Structural Design and Analysis Enablers LDO
  - WP4.3 Flight Physics and optimization Enablers TU Delft
- **WP5 Propulsion Integration (AD)**
  - WP5.1 Hybrid Pwp integration AD
  - WP5.2 Nacelle Integration LDO
- **WP6 Wing System (AD)**
  - WP6.1 New Fuel System integration AD
  - WP6.2 Ice Protection ADS
  - WP6.3 Flight Controls Integration Collins
  - WP6.4 Structural Health Monitoring DLR
- **WP7 Demonstrators (ALESTIS)**
  - WP7.1 Manufacturing ACITURRI
  - WP7.2 Assembly and Integration LDO
- **WP8 Testing and Validation (LDO)**
  - WP8.1 Non destructive Testing LDO
  - WP8.2 Structural and Functional Testing APPLUS
  - WP8.3 Wind tunnel Tests POLIMI
  - WP8.4 Virtual Tests UPat
- **WP9 Results Assessment (AD)**
  - WP9.1 EcoDesing and data collection AD
  - WP9.2 Impact Monitoring AD/LDO
  - WP9.3 Certification INTA

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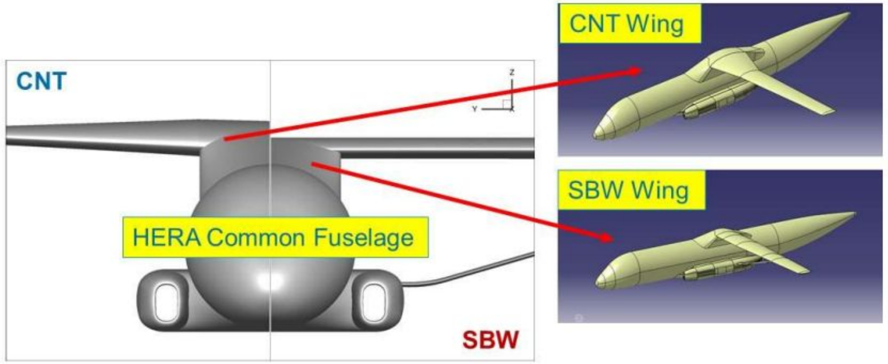
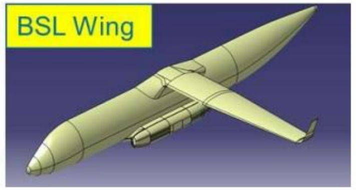
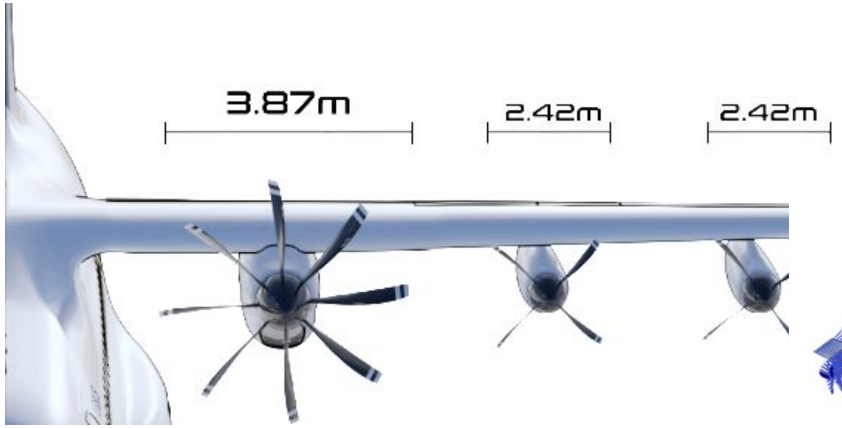
Wing Concepts & Trade Offs

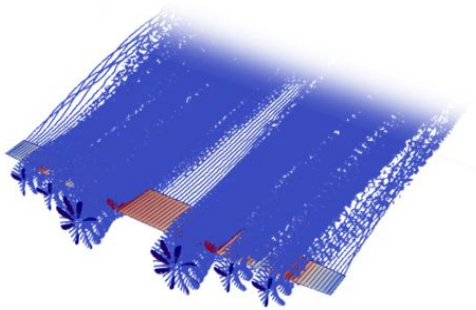
Twin engine configurations:
Trade off: Cantilever vs strut braced wing





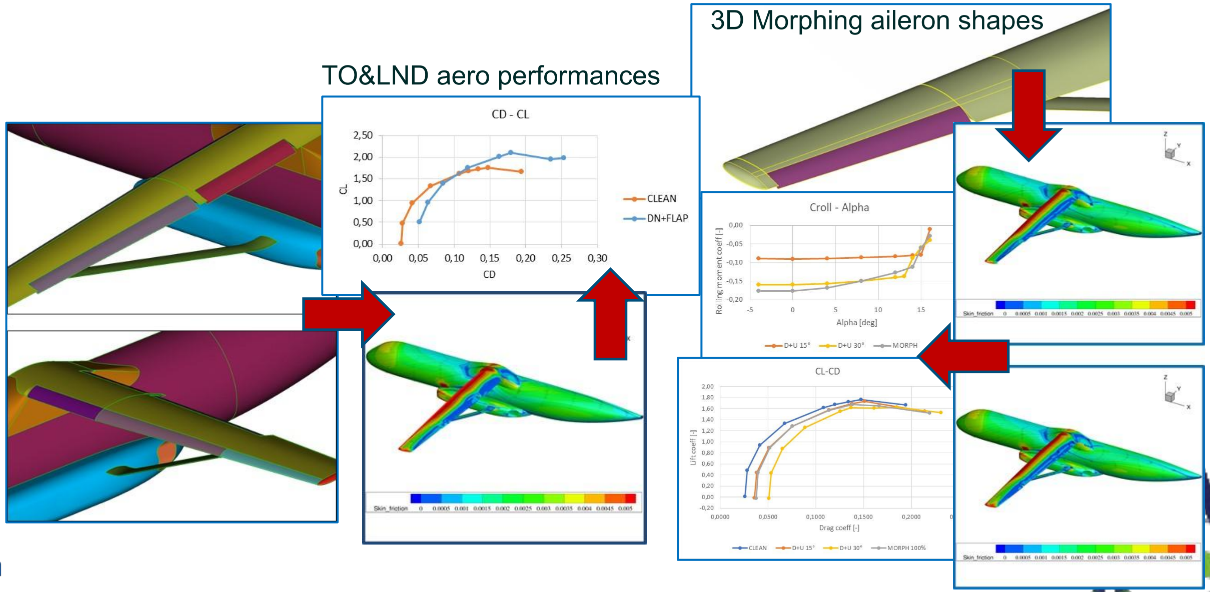
Distributed propulsion configuration:





Aerodynamic & structural optimization:

- High Lift configuration
  (Droop Nose and Morphing Flap)
- Morphing Aileron
  Final trade off for aileron configuration



HERWINGT Key Technologies

Key Technologies

Global Architecture

T2 Development of new structural concepts and architecture.

T23 Virtual Testing.

Structural and Manufacturing

T1 New materials selection for aeronautical use.

T3 LRI Thermoset for sandwich-monolithic High Structural Integration.

T4 LRI Thermoset for monolithic multifunctional substrate integration.

T5 LRI with modified epoxy resin to increase Tg and lighting strike performances.

T6 Thermoplastic ISC for low curvature monolithic structural integration.

T7 Thermoplastic ISC for high curvature monolithic structural integration.

T8 Thermoplastic ISC for multifunctional monolithic high curvature structural integration.

T9 Thermoplastic Welding for repairs and structural integration.

T11 High rate Automatic fibre placement for TP.

T12 Fast curing thermoset.

T14 Non-destructive testing for highly integrated structures.

Aerodynamic

T18 Aerodynamic drag reduction due to high aspect ratio.

T19 Aerodynamic drag reduction due to morphing LE & flap.

T20 Aerodynamic drag reduction due to morphing control surfaces.

T21 Aerodynamic drag improvement and load alleviation due to flight control laws optimization.

T22 Control of external surface wing tolerances in benefit of improved laminarity.

Systems

T13 SHMS development for structural integrity prevention.

T15 Ice Protection System Structural Integration.

T16 Erosion protection.

T17 New Sensors, Sealants and Materials technologies for SAF.

DEMONSTRATORS TIMELINE STATUS

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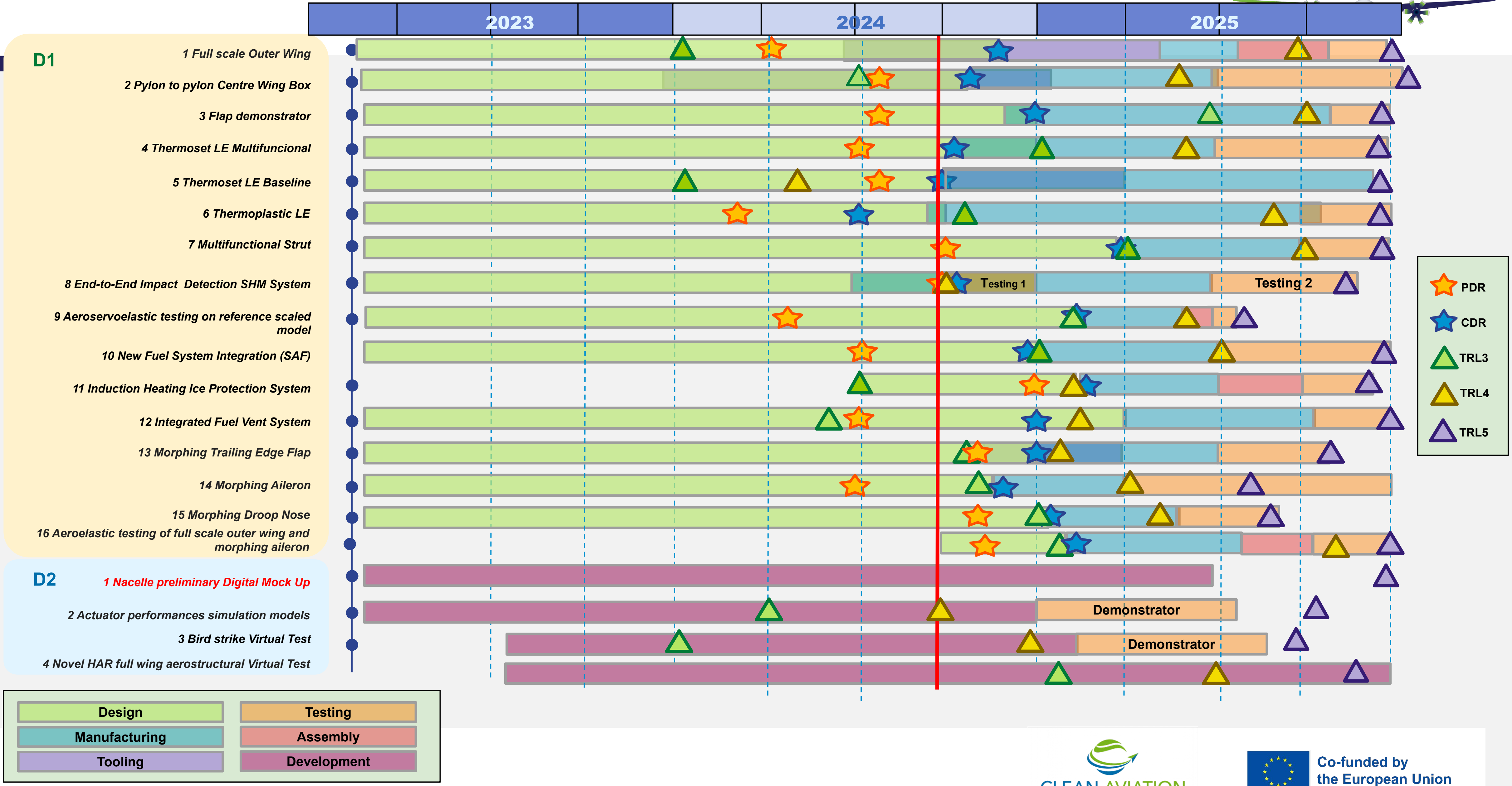

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D1-1 Full scale Outer Wing Box

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Partner	Demo Leader	Mail Demo Leader	Status
LDO	Giuseppe Totaro	giuseppe.totaro02@leonardo.com	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
HAI, FOK	7.2 <3.3, 4.1, 7.1, 8.1, 8.2>	3.5 M€	€	€	€	€

Description (test description)

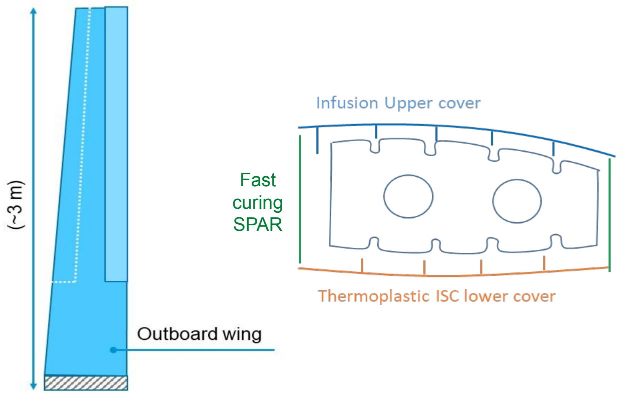
Outer wing box component (about 3.2m span) will be used to demonstrate Structural and manufacturing technologies aimed to reduce weight and cost. The Outer Wing Box components are:

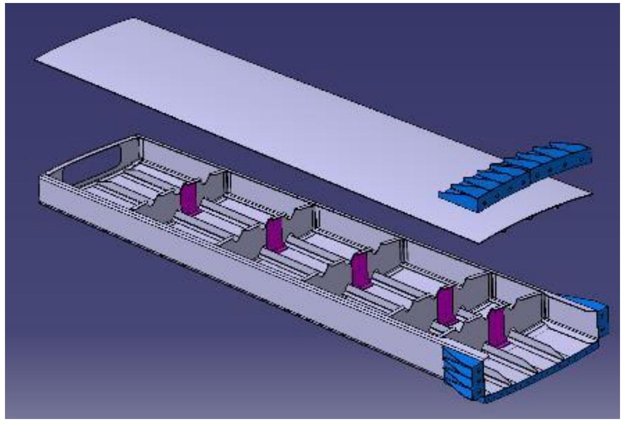
- Metallic Closure Ribs
- Thermoplastic Internal Ribs
- Thermoplastic Lower Stiffened Panel
- Fast curing Prepreg spars
- Infusion technology Skin Panel

Objectives

Full Scale Structural Tests to validate design, manufacturing and assembly process for an High Aspect Ratio (HAR) outer wing section. Target TRL 3 -> 5

Images





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D1-2 Pylon to pylon Centre Wing Box

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Partner	Demo Leader	Mail Demo Leader	Status
AD	Miriam Agúndez, Ana Rodriguez Henche	miriam.agundez@airbus.com , ana.r.rodriguez@airbus.com	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
MTORRES, APPLUS	5.1 <3.3, 8.2>	4.3 M€	2209 k€	849 k€	643k€	730k€

Description

Design of a semi pylon to pylon multi-spar centre wing box section, including lower skins, spars and stringers, plus upper skin, interface with the hybrid-electric propulsion mounting system. Based on such design, manufacturing and assembly of semi-span (up to the pylon) demonstrator.

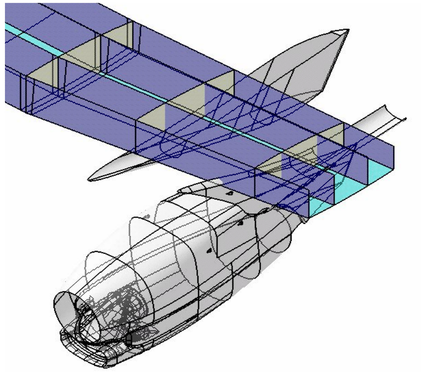
- Lower part manufactured in one shot LRI including the skin, the stringers, the spars and stiffeners.
- One shot LRI Upper cover (skin with stringers).

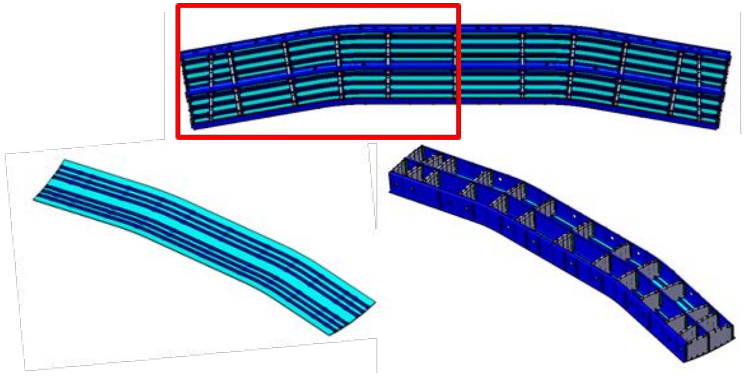
Objectives

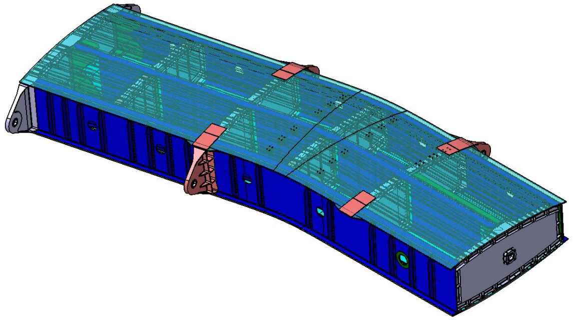
The challenge of this innovation is to:

- Explore multispar configurations for HAR.
- Manufacturing challenges of high integrated sections of centre wing: dihedral, sweepback angle so as the steering allows the study of the curvature limits during the manufacturing process.
- Structural Testing.

Images







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D1-3 Flap demonstrator

Partner ACITURRI	**Demo Leader** Antonio Almenara	**Mail Demo Leader** antonio.almenara@aciturri.com				**Status**	
Other contributors ACISTR, ACIENG, FIDAMC	**WP involved** 7.2 <3.3, 7.1, 8.1>	**Budget** 2.1 M€	PM	Subcontracting	ODCs	IKAA	
			1.02 M€	0€	1.08M €	0€	

Description

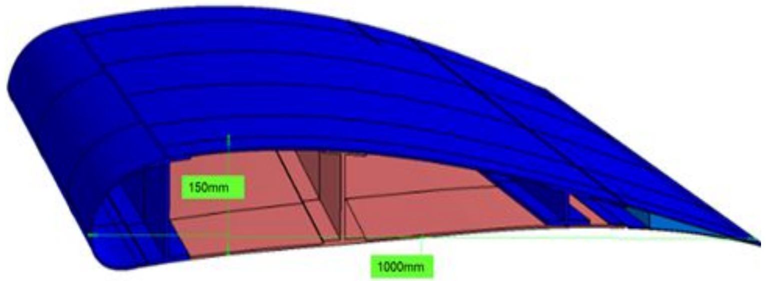
High lift inner flap to be assembled in full demonstrator:

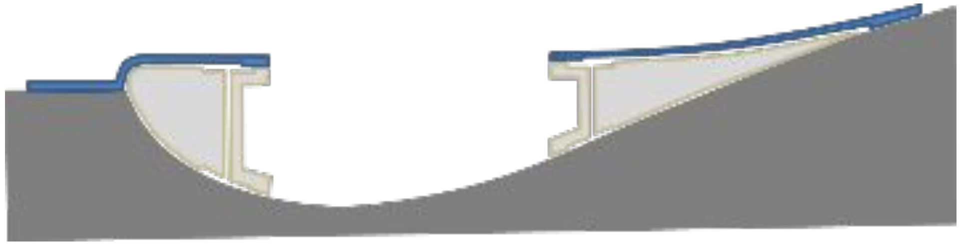
- Upper cover Liquid Resin Infusion (LRI) integrating leading edge and trailing edge (ALESTIS).
- Lower cover in Thermoplastic In Situ Consolidation (TP-ISC) with welded thermoplastic centre spar (ACIENG and FIDAMC), with the center spar manufactured using TP Stamp Forming.

Objectives

Demonstrate novel manufacturing processes and concept for high integrated structures:

- Multispar concept.
- Leading Edge upper cover integration to understand challenges of its applicability to natural laminar flow.
- Lower cover integration with “C” shape spar with TP material to understand the technological and material challenges of its applicability on aerospace structures.
- Maturation of highly integrated one shot manufacturing processes.
- The testing considered to perform is in the part as a “Shop Trials” to evaluate and improve the demonstrator inner quality.





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D1-4 Thermoset Leading Edge (LE) Multifunctional

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Partner	Demo Leader	Mail Demo Leader	Status
IAI	Adam Sawday	asawday@iai.co.il	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
IK, AD, HAI	7.1 <3.3, 4.1>	795 k€	670 k€	35 k€	90 k€	High

Description

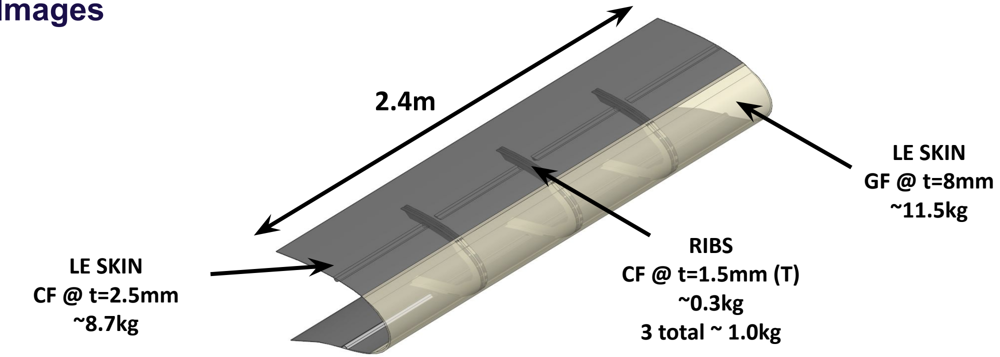
Leading Edge demonstrator with multi-functional capabilities, including bird-strike virtual test, Ice Protection System (IPS) and erosion protection.

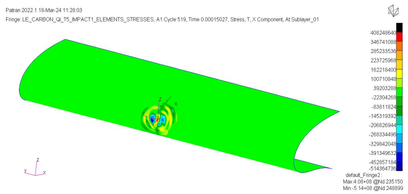
Solid laminate, thermoset structure, Out of Autoclave (OoA) materials and processes.

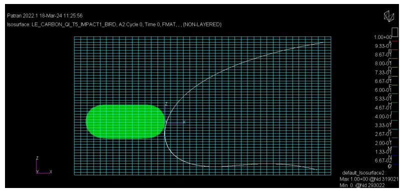
Objectives

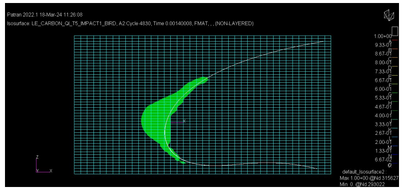
- Design concept for the LE structure, compatible with specific requirements of the multifunctional Thermoset Leading Edge – Bird-strike, IPS and erosion.
- Tooling and assembly approach that focuses on minimizing assembly and maximizing integral structure.
- OoA material and process approach.
- Material selection that promotes energy absorption while minimizing weight.
- Building block test campaign, including basic dynamic material properties.
- Cost effective solutions.
- Final LE demonstrator manufacture and supply, including IPS system integration.

Images









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D1-5 Thermoset Leading Edge (LE) Baseline

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HERWINGT

Partner	Demo Leader	Mail Demo Leader	Status
HAI	Karachalios Evangelos	KARACHALIOS.Evaggelos@haicorp.com	(green)

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
AD	7.1 <3.3, 4.1>	871.460 €	446.688 €	13.100 €	240.000 €	33.816 €

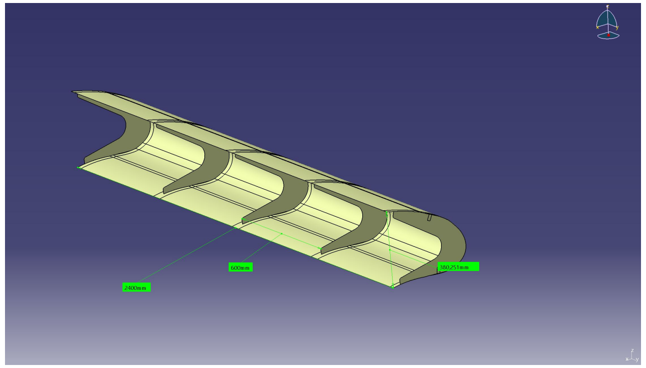
Description

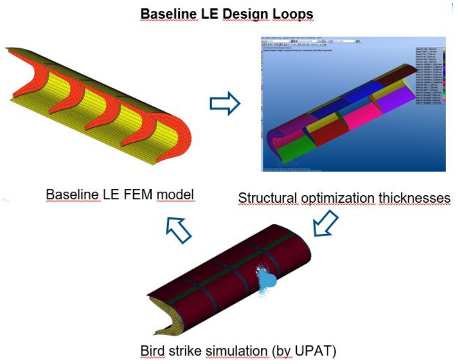
Leading Edge fabricated following a hybrid manufacturing methodology by integrating sandwich / Liquid Resin Infusion (LRI) construction concept.
Bird-strike simulation of the demonstrator.
No structural testing foreseen for this demo.

Objectives

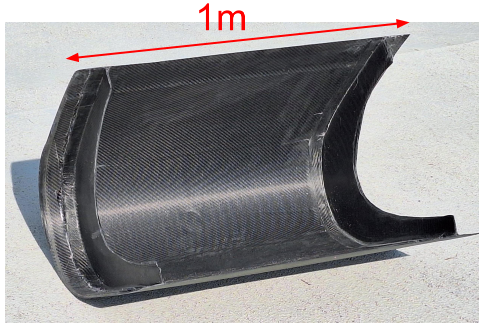
- Advance Liquid Resin Infusion (LRI) process for complex / integrated parts manufacturing.
- Contribute to the Center Wing Box (CWB) assembly.
- Show realistic weight savings and evaluation of the manufacturing route in terms of sustainability.
- Contribution to Virtual testing against bird strike (WP 8.4 Lead by UPAT).

Images





Demo scaled LE mfg trail in WP4.1



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D1-6 Thermoplastic Leading Edge (LE)

Partner	Demo Leader	Mail Demo Leader	Status
AD	David García	david.garcia.benzal@airbus.com	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
ACIENG, ACISTR, FIDAMC, AIMEN	7.1 <3.3>	1.8 M€	1,6M€	N/A	200k€	N/A

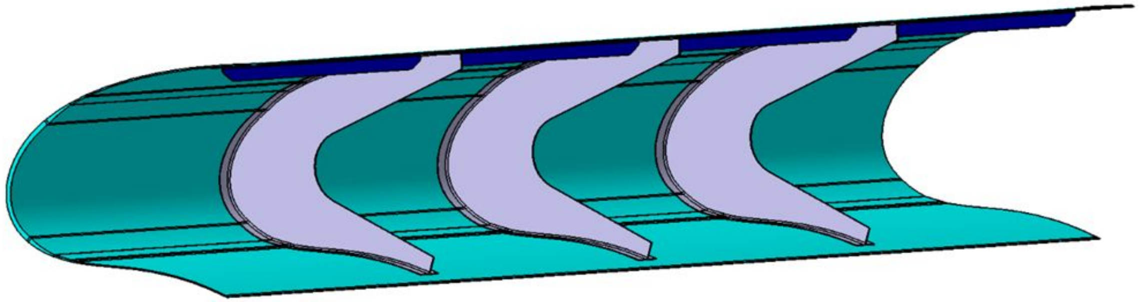
Description

Develop a Leading Edge in thermoplastic to maturate technology.
Development components with high curved shape with most of its component integrated in thermoplastic using in-situ consolidation technology.
Use same geometry to test new welding processes.

Objectives

Two main goals have driven the LE demonstrator's architecture: minimum structural weight and maximum space available for systems installation and routing.
Different technologies will be maturated from TRL3 to TRL5.

Images



D1-7 Multifunctional Strut

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Partner	Demo Leader	Mail Demo Leader	Status
TUD	Jurij Sodja, Ilias Tsatsas	j.sodja@tudelft.nl, i.tsatsas@tudelft.nl	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
LDO	1.3, 4.2, 8.2 and 8.3	750 k€	260 k€	€	40 k€	450k€

Description

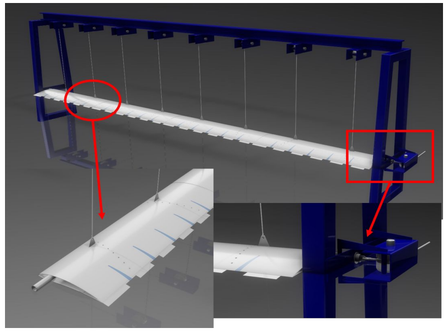
Functional test of a multifunction strut under representative loads in lab conditions:

- Equivalent shear force application via Whiffletree/cables
- Equivalent axial loads (tensile/compressive)
- Demonstrate that the morphing mechanism can operate as expected

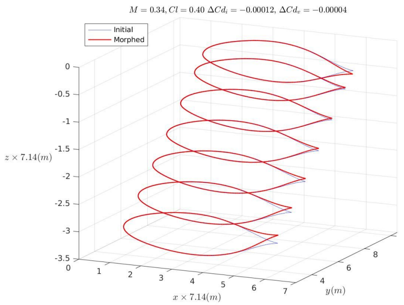
Objectives

Demonstrate that the multifunctional strut can be operated under representative shear and axial loads.

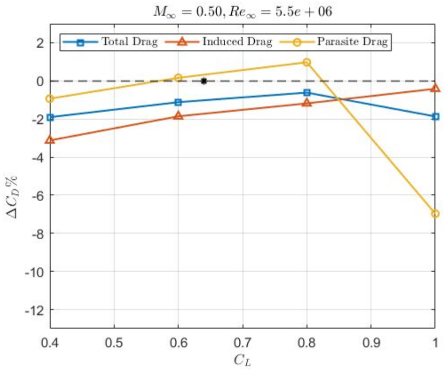
Images



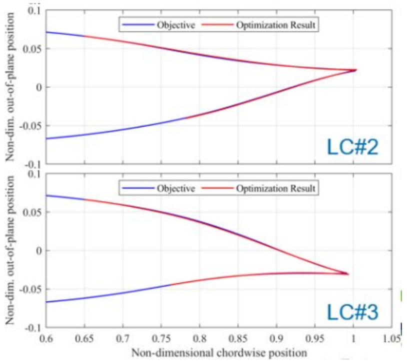
Concept of test set up



Optimised strut deflection



Drag reduction in cruise



Comparison of objective shapes and actual deformed shapes

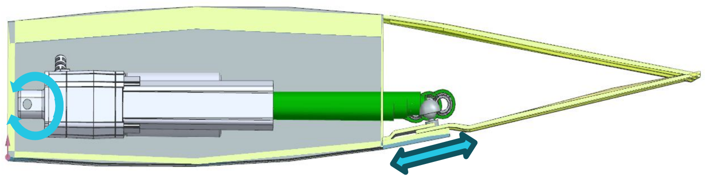


Illustration of skin sliding due to actuator movement

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D1-8 End-to-End Impact Detection SHM System

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Partner	Demo Leader	Mail Demo Leader	Status
AD_G	Siegfried Hlasek	siegfried.hlasek@airbus.com	

Other contributors	WP involved
FHG, DLR, CEA	6.4 <7.2, 8.1>

Budget	PM	Subcontracting	ODCs	IKAA
945 k€ (345 FHG/150 DLR /200 CEA/250 AD_G)	710€	0 €	235€	€

Description

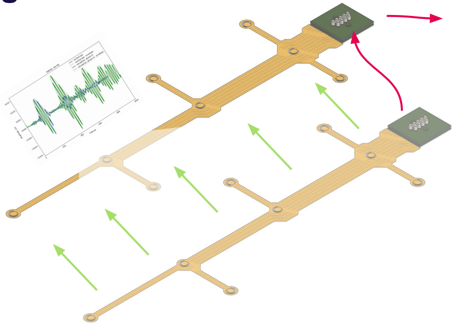
Development of an the End-to-End Impact Detection SHM System and perform End-to-End Integration, Validation and Verification of Impact Detection and Damage Detection SHM System up to TRL5.

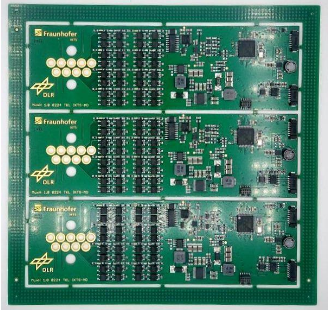
Objectives

The DLR will develop SHM arrays with piezoceramic transducers and electronic components. The FHG will develop a Data Acquisition hardware (DAQ) and software for integration into structures. AD_G will do development of a catalogue of requirements in coordination with SHM-System Development ,Coordination the project partners and develop the Impact Detection SHM System. CEA will set up and do verification of the virtual testing framework for the damage detection-SHM for CBM on the wing.

A test campaign, under basic different environmental conditions, impacts and artificial damages. This system is expected to be installed, tested on a internal- and final demonstrator (Pylon to pylon Centre Wing Box / Shear Panel). The test campaign will include Non- and Damage impacts. High Energy Impacts resulting in damage will only be introduced on the internal demonstrator.

Images





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D1-9 Aeroservoelastic testing on high aspect ratio wing scaled half model

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Partner	Demo Leader	Mail Demo Leader	Status
POLIMI	Sergio Ricci, Francesco Toffol	sergio.ricci@polimi.it; francesco.toffol@polimi.it	

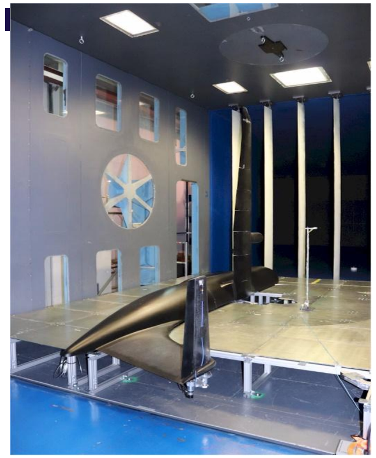
Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
LDO	8.3 <3.3, 7.1, 7.2, 8.2, 8.3>	170.98 k€	58.73 k€	€	102.25 k€	€

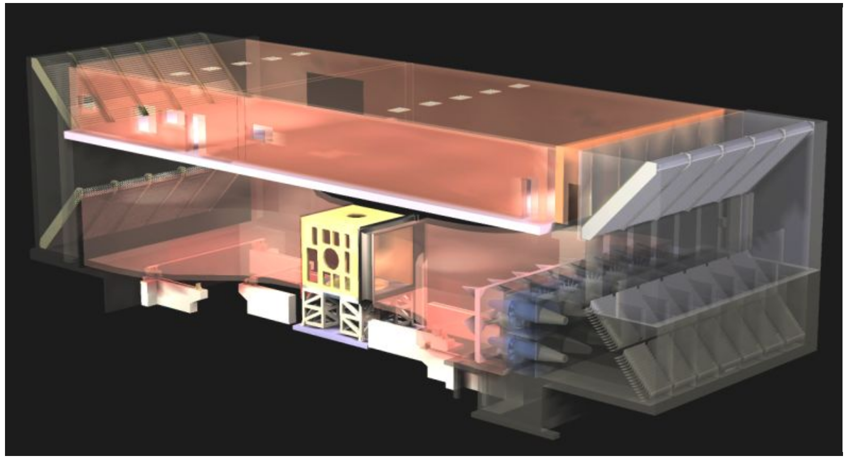
Description

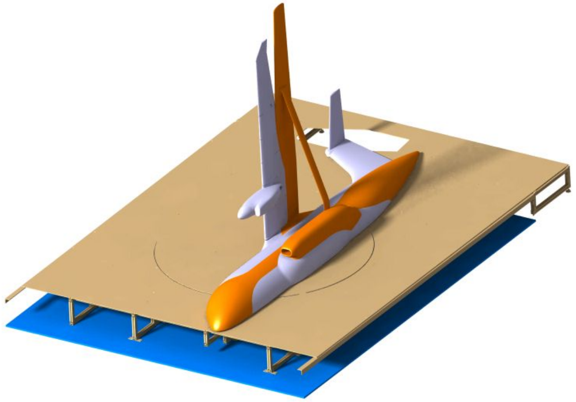
Scaled aero-servo-elastic half model of the aircraft to assess the Gust and Maneuver Loads Alleviation technologies aiming at wing structural weight reduction.

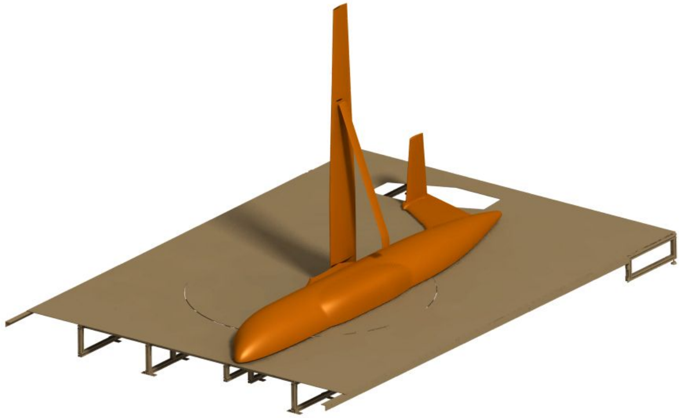
Objectives

Validation of Loads Alleviation technologies by means of simulated tuned gust excitations in wind tunnel on a aeroelastic scaled (1:8) half model. Target TRL 3 –> 5









D1-10 New Fuel System Integration (SAF)

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Partner AD	**Demo Leader** Francisco Cantos	**Mail Demo Leader** francisco.cantos.galan@airbus.com			**Status**	
Other contributors	**WP involved** 6.1	**Budget** 200 k€	PM 30k€	Subcontracting €	ODCs 170k€	IKAA €

Description

FQI System (sensors and computation algorithms) will be tested on a test bench.

The bench will consist of a fuel tank with some capacitive probes and actuators to modify the tank attitude.

There will be two sets of tests, static and dynamic, each of them tested with multiple fuel quantities and in many different attitudes of the fuel tank.

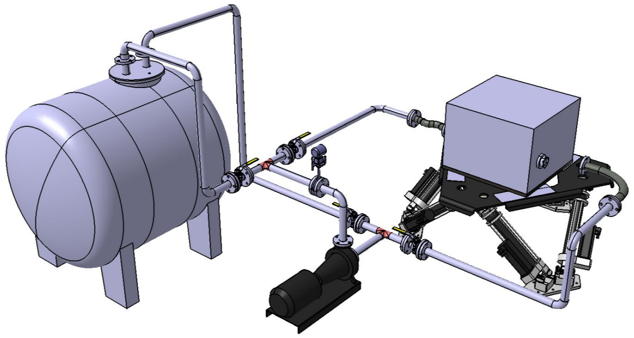
Objectives (system test plan)

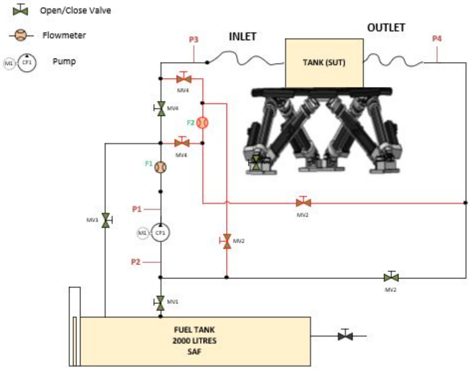
To test capacitive probes behavior with Sustainable Aviation Fuel (SAF)

- Statical and dynamical tests
- Refueling and defueling
- Different attitudes (pitch and roll)

Test will be performed in ADS Getafe facilities. Complex due to flammability issue, but no delay is foreseen.

Images





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D1-11 Induction Heating Ice Protection System

Hybrid Electric Regional Wing Integration Novel Green Technologies
HERWINGT

Partner	Demo Leader	Mail Demo Leader	Status
AD	Ana Cardenas, Laura Hernando Gomez, Francisco José Redondo Carracedo	ana.cardenas@airbus.com, laura.hernando@airbus.com, francisco.r.redondo@airbus.com	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
IK, AIN, RTA	7.2 <3.3, 7.1, 8.2, 8.3>	1.5 M€	€	€	€	€

Description

Ice protection system based on electromagnetic heating to be integrated and tested on the multifunctional thermoset leading edge demonstrator (D1-4).

Objectives

The aim of the demo is to test the functionality of an ice protection system based on electromagnetic heating, integrated on a composite leading edge.
In addition, the integration of the system on a real leading edge taking into account its structural elements will be assessed.
System tests will be performed at RTA Ice Wind Tunnel in a representative icing environment.

Images

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D1-12 Integrated Fuel Vent System

Partner AD_G	**Demo Leader** Siegfried Hlasek (preliminary)	**Mail Demo Leader** Siegfried.hlasek@airbus.com	**Status**
Other contributors DLR	**WP involved** 3.3 <4.1, 7.1, 7.2, 8.2, 8.3>	**Budget** 850 k€	

PM	Subcontracting	ODCs	IKAA
700€	€	150€	€

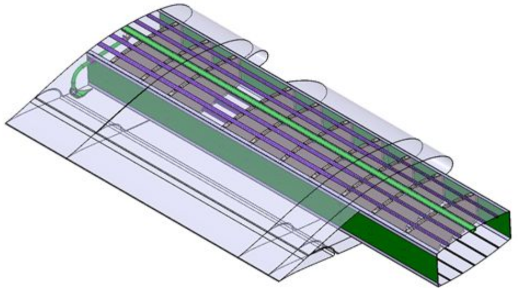
Description

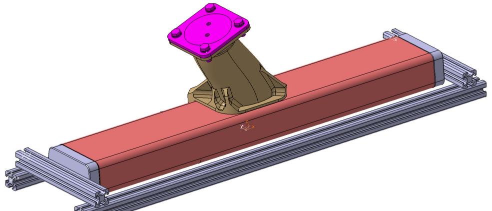
Multifunctional, structural integrated fuel vent system in thermoset composite. The demonstrator contains two omega ducts that are bonded onto a surface. Both ducts are connected via special couplings that will be 3D printed onto the ducts. This demonstrator will be tested under pressure.

Objectives

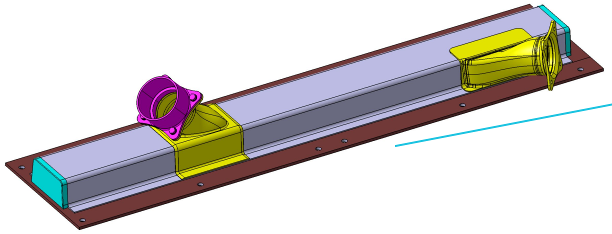
The main objective is to use hollow shaped structural stiffener elements for additional functionalities than pure structural. This additional function is the fuel vent application. The objective of the demonstrator is to provide appropriate design concepts, prove their manufacturability and demonstrate the performance.

Images

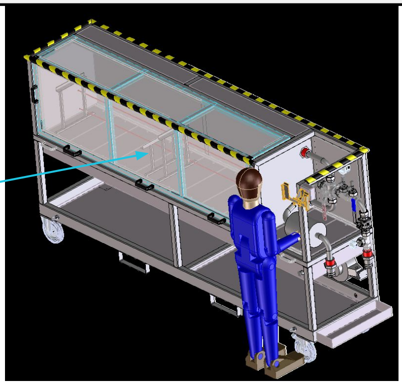




Principle of pressure tightness test stand



Principle of fuel flow test



D1-13 Morphing Trailing Edge Flap

Hybrid Electric Regional Wing Integration Novel Green Technologies
HERWINGT

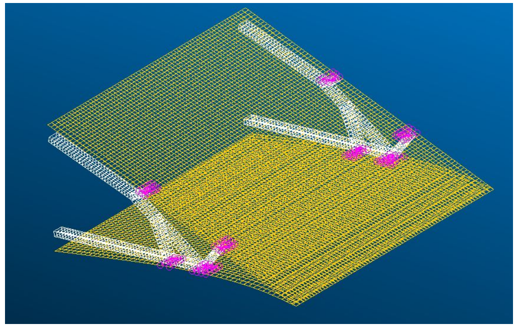
Partner CIRA	**Demo Leader** Maria Chiara Noviello	**Mail Demo Leader** m.noviello@cira.it	**Status**

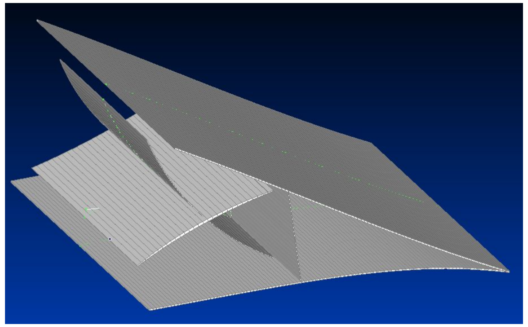
Other contributors LDO, TUD	**WP involved** 8.2 <1.2, 1.3, 2.2, 4.2, 7.1, 7.2>	**Budget** 210 k€	PM	Subcontracting	ODCs	IKAA
			95 k€	85 k€	30 k€	€

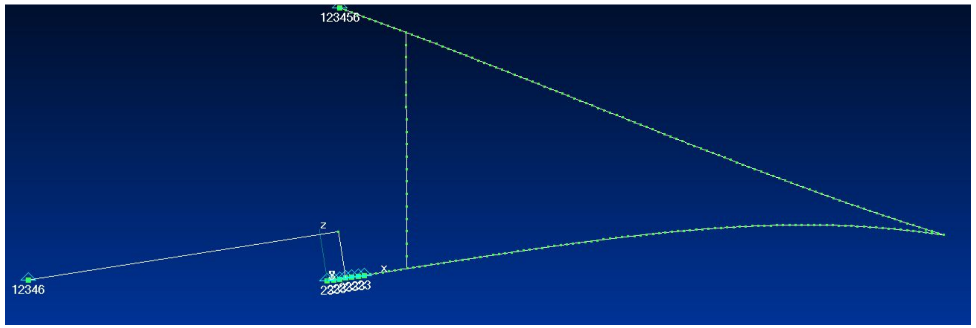
Description
Camber morphing flap demonstrator to be integrated into a single-bay assembly (about 0.5 m span) for ground demonstrations (static tests, dynamic tests, fatigue).

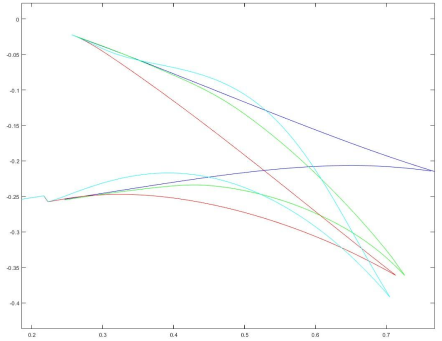
Objectives
Experimental validation of camber morphing flap concept on 0.5 m. span demonstrator. Mechanical and functional tests will be conducted at CIRA. Morphing flap manufacturing will be managed by CIRA.
Target TRL 3 –> 5

Images









D1-14 Morphing Aileron

Hybrid Electric Regional Wing Integration Novel Green Technologies
HERWINGT

Partner
POLIMI

Demo Leader
Sergio Ricci, Alessandro De Gaspari

Mail Demo Leader
sergio.ricci@polimi.it, alessandro.degaspari@polimi.it

Status

Other contributors
LDO, TUD

WP involved
7.2 <3.3, 4.2, 4.3, 7.1, 8.2, 8.3>

Budget
113.72 k€

PM	Subcontracting	ODCs	IKAA
48.72 k€	0 k€	65 k€	0 k€

Description

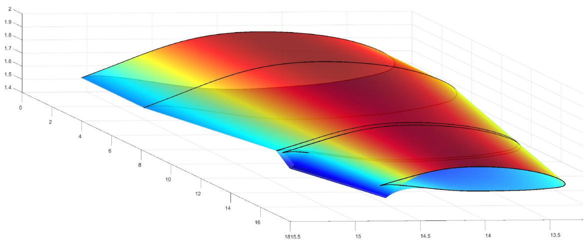
Full scale, large bandwidth, morphing aileron integrated into outer wing demonstrator, to be applied on innovative high aspect ratio wing. The morphing aileron concept aims to replace a traditional hinged aileron with the potentialities of better aerodynamic efficiency (no gap, potential laminar flow), better structural efficiency (reduced size and weight of the actuators).

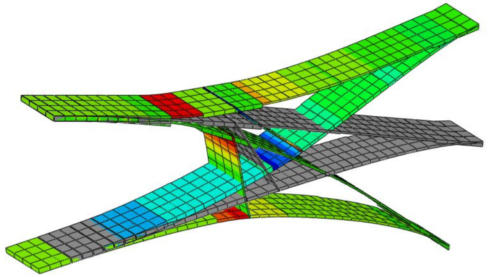
Objectives

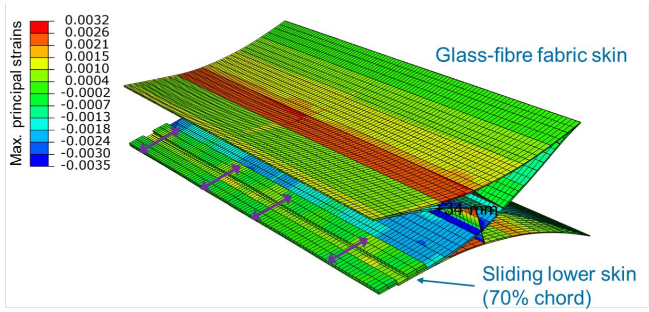
Experimental validation of morphing aileron fixed on a rig (unluaded condition) and integrated into outer wing demonstrator D1-16 (loaded condition). Mechanical structural and functional tests will be conducted at PoliMi aiming at verify the capability to reproduce target morphed shape and bandwidth.

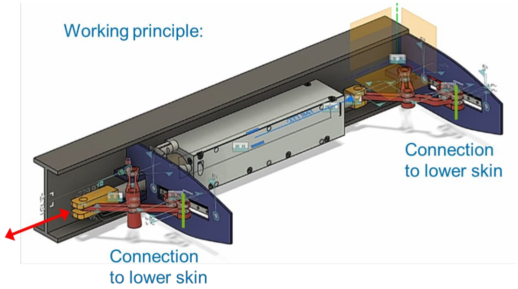
Target TRL 3 –> 5

Images









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D1-15 Morphing Droop Nose

Hybrid Electric Regional Wing Integration Novel Green Technologies

HERWINGT

Partner	Demo Leader	Mail Demo Leader	Status
POLIMI	Sergio Ricci, Alessandro De Gaspari	sergio.ricci@polimi.it, alessandro.degaspari@polimi.it	

Other contributors	WP involved
LDO, TUD	7.2 <3.3, 4.2, 4.3, 7.1, 8.2, 8.3>

Budget	PM	Subcontracting	ODCs	IKAA
59.58 k€	29.58 k€	0 k€	30 k€	0 k€

Description

Fully compliant morphing droop nose demonstrator for high lift-flight conditions, to be integrated into a single-bay assembly for ground demonstrations (static tests, fatigue).

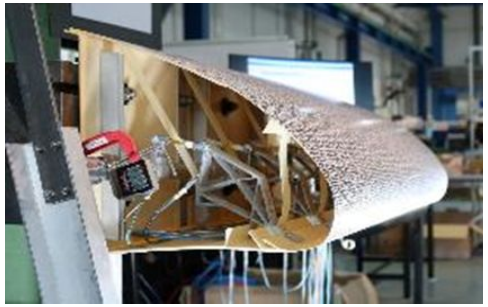
.

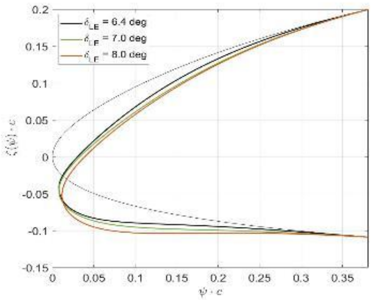
Objectives

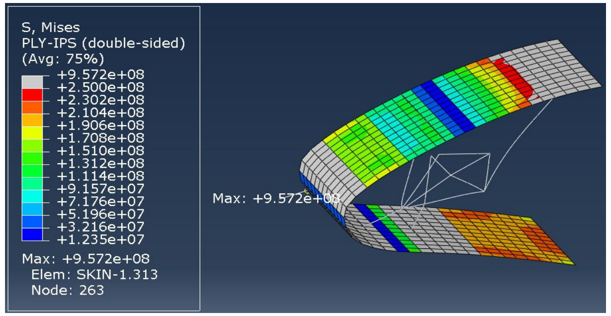
Experimental validation of structural design by mean of structural and functional tests on 0.5 m. span demonstrator aimed to verify the performance to reproduce target morphed shape and assessing structural elements fatigue issues.

Target TRL 3 -> 5

Images







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D1-16 Functional testing in Wind Tunnel of full scale outer wing and morphing aileron

Partner	**Demo Leader**	**Mail Demo Leader**	**Status**
POLIMI	Sergio Ricci	sergio.ricci@polimi.it	

Other contributors	**WP involved**	**Budget**	PM	Subcontracting	ODCs	IKAA
HAI, FOK, LDO	7.2 <3.3, 4.2, 4.3, 7.1, 8.2, 8.3>	65 k€	35 k€	€	30 k€	€

Description

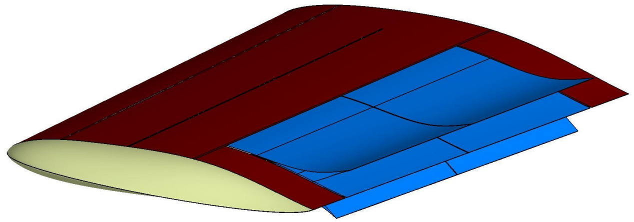
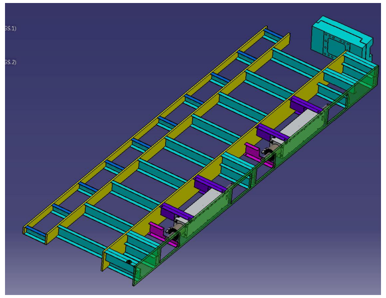
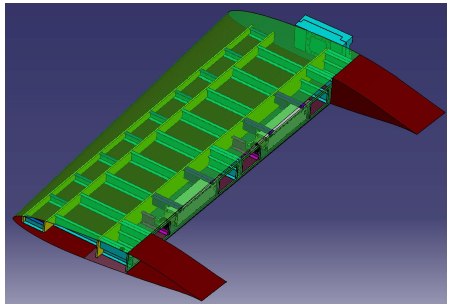
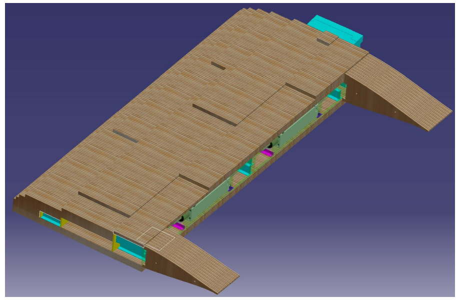
Dummy wing box representative of the outer wing part (for a length of about 3m span), assembled with morphing aileron active demonstrator, will be used to demonstrate functionality of morphing aileron wind tunnel air flow conditions (low speed). The replacement of the actual structural wing box with a dummy affers the advantage to avoid any time constraint between the finalization of the structural wingbox and the final wind tunnel testing. This wind tunnel test campaign aims at validate the morphing aileron under low-speed aerodynamic load conditions.

Objectives

Functional Tests aimed to verify the performance (rotation angle, bandwidth) of the morphing aileron correlated to the actuation system (i.e. power consumption) under wing loads (wind tunnel).

Target TRL 3 -> 5

Images

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D2-1 Nacelle preliminary Digital Mock Up

Hybrid Electric Regional Wing Integration Novel Green Technologies

HERWINGT

Partner LDO	**Demo Leader** Giuseppe Totaro	**Mail Demo Leader** giuseppe.totaro02@leonardo.com	**Status**

Other contributors SIEMENS	**WP involved** 5.2 <3.3>	**Budget** 29 k€	PM	Subcontracting	ODCs	IKAA
			€	€	€	€

Description

Nacelle digital model for aerodynamic and structural verify simulation.

Objectives

Define regional nacelle configuration in order to improve technological solution linked to design development.
Evaluate the aerodynamic impact of nacelle/wing integration as well as nacelle aerodynamic design optimization.
Execute structural simulation of the nacelle integration and mounts need.
Define an acoustic liner treatment for the propeller-nacelle interaction noise mitigation.

Images

Planning

2023	2024	2025

Development phase

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D2-2 Actuator performances simulation models

Partner	**Demo Leader**	**Mail Demo Leader**	**Status**
COLLINS	Shruthi Shreedharan	shruthi.shreedharan@collins.com	

Other contributors	**WP involved**	**Budget**	PM	Subcontracting	ODCs	IKAA
GAE, COLFR, COLUK	6.3 <2.4, 3.3, 7.1, 8.2, 8.3>	360 k€	€	€	€	€

Description

Connected to POLIMI data for Aileron & CIRA data for Morphing Flap (To be confirmed), the following simulation models/data are to be provided:

- 3D lay out including weight data, main geometry & dimensions for installation compliance verification into the wing structure.
- Performances models to get dynamic performances, additional data may be provided upon identified need such as Thermal limitations based on provided on Aircraft Duty Cycles, Reliability Data based on technologies and configurations.

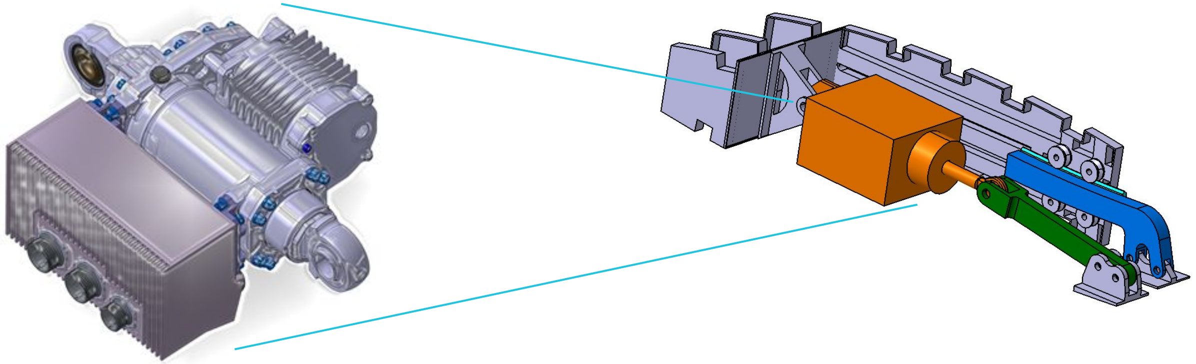
Objectives

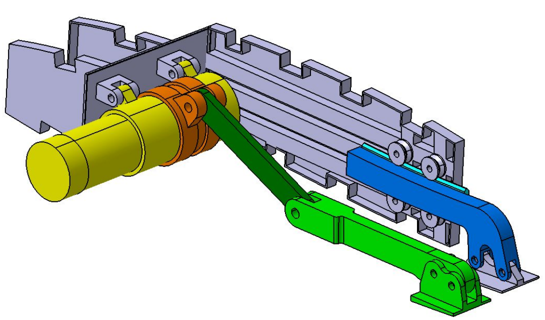
Assess data set required for sizing the Actuation Systems (WP6.3) such as

- Weight,
- 3D envelope,
- Speed, frequency response,
- Risks and issues for the concept of EMA for morphing wing (including thermal , reliability data,…)

And Support other WPs for physical demonstration of Actuation systems.

Images





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D2-3 Bird strike Virtual Test

Hybrid Electric Regional Wing Integration Novel Green Technologies
HERWINGT

Partner	Demo Leader	Mail Demo Leader	Status
UPAT	George Lampeas	labeas@upatras.gr	

Other contributors	WP involved
CEA	8.4 <3.2>

Budget	PM	Subcontracting	ODCs	IKAA
112 k€	112k€	0€	0€	0€

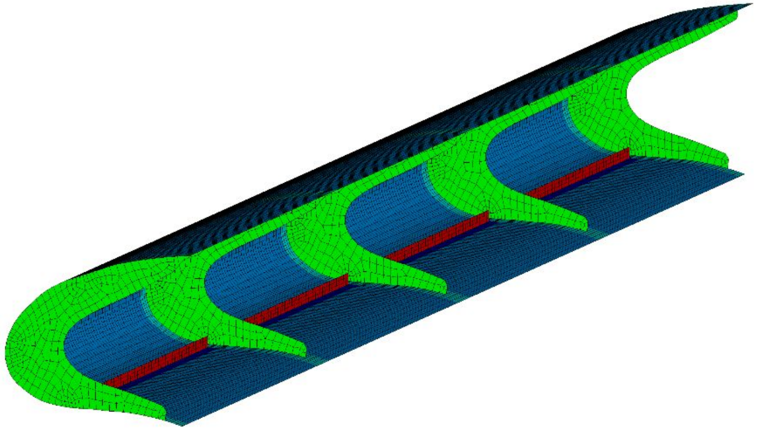
Description

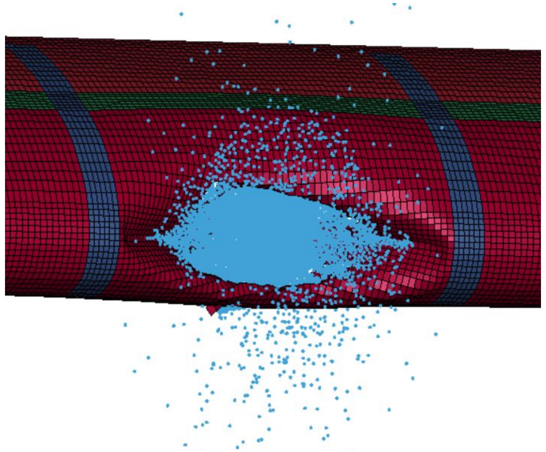
Virtual testing methodology based on a building block multi-scale approach that will be demonstrated in the case of bird-strike simulation of demonstrators D1-5 Thermoset Leading Edge (LE) Baseline and, as a second target, D1-4 Thermoset Leading Edge (LE) Multifunctional.

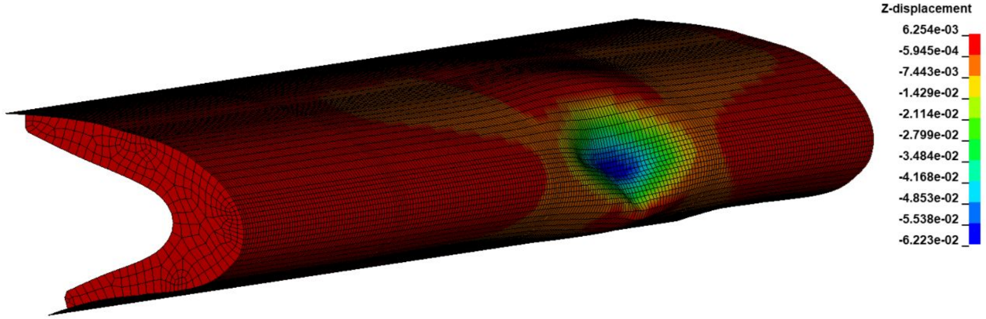
Objectives

To develop a bird-strike simulation methodology including all structural details and demonstrate the modelling methodology.

Images







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D2-4 Novel High Aspect Ratio (HAR) full wing aero-structural Virtual Test

Hybrid Electric Regional Wing Integration Novel Green Technologies HERWINGT

Partner	Demo Leader	Mail Demo Leader	Status
SIEMENS	Philippe Barabinot, Luiz Lima	philippe.barabinot@siemens.com, luiz.gustavo.lima@siemens.com	

Other contributors	WP involved	Budget	PM	Subcontracting	ODCs	IKAA
LDO, POLIMI, TUD, COLUK, COLFR	8.4 <8.2, 8.3>	130 k€	100 k€	€	€	30 k€

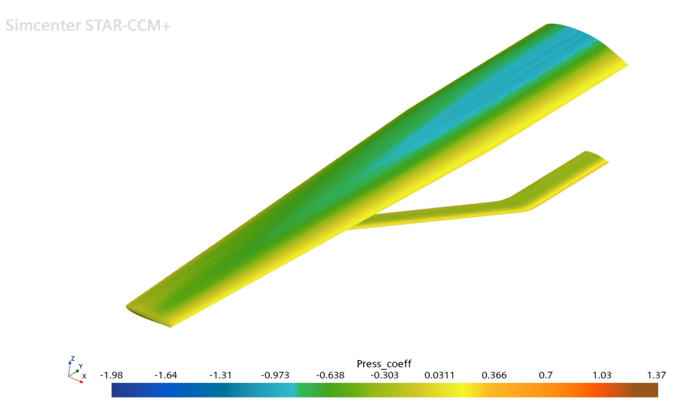
Description

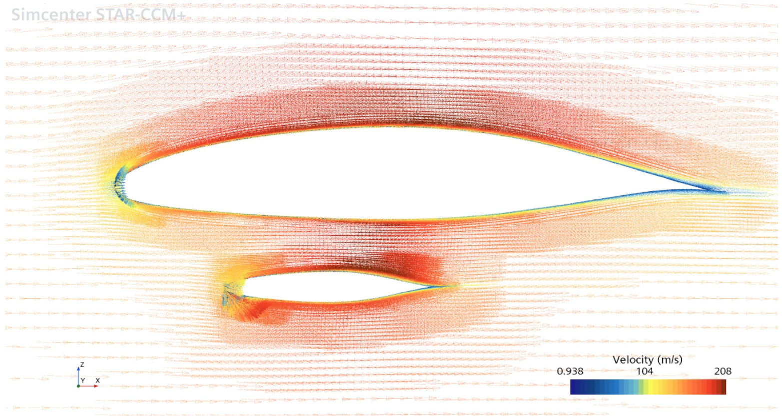
Virtual test demonstrator: High Aspect Ratio (HAR) full wing, High-fidelity assembled, for aerodynamic performance (drag reduction) and structural weight assessments.

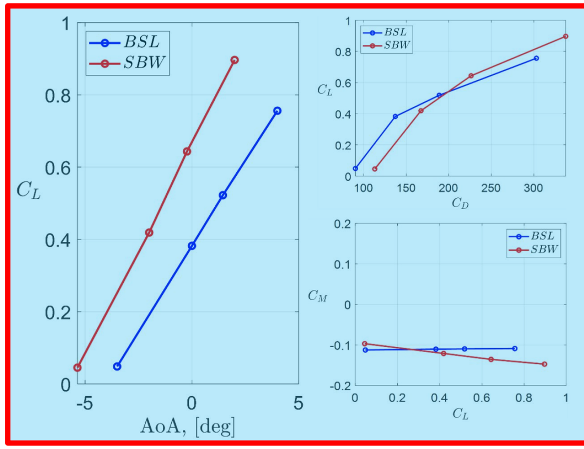
Objectives

Aerodynamic drag reduction assessment due to new morphing technologies + HAR wings under various flight conditions.

HAR wings: structural weight assessment using nonlinear quasi static finite element analysis with a structural solver (Simcenter Nastran).







From TU Delft – comparison of CFD results in progress

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Acknowledgements

The project is supported by the Clean Aviation Joint Undertaking and its members.

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