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U-HARWARD

AEROELASTIC ISSUES RELATED TO HIGH ASPECT RATIO WING CONFIGURATIONS AND PRELIMINARY EXPERIMENTAL RESULTS

S.Ricci & L.Marchetti (POLIMI)

CONTRIBUTORS: ONERA, IBK AND UNIVBRIS

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INTRODUCTION (1/2)

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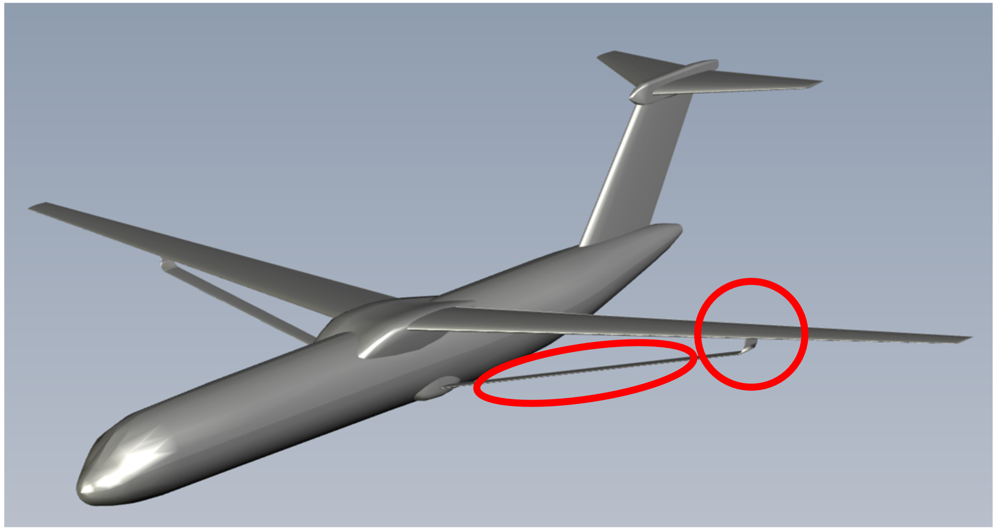
- Conceptual and preliminary results carried out during WP2 activities allowed to well characterize the HARW behaviour in three different configurations, CNT, SBW and FWT.
- Open issues still remain concerning:
  - Aerodynamic performances of SBW, investigated in WP3 (See Presentation 4)
  - Aeroacoustic performances of SBW, investigated in WP3 and WP4 (See Presentation 5)
- This presentation mainly focuses on the aeroelastic issues of SBW and FWT configurations, that require an integrated numerical and experimental approach.

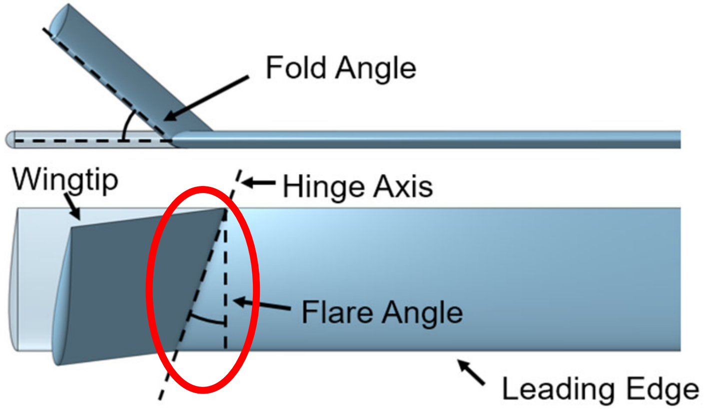
INTRODUCTION (2/2)

SBW



- Strut vs. Truss, lifting or not lifting component
- Shape and chord position of strut-wing connection (aerodynamic vs. aeroelastic requirements)
- Type of connection

FWT



- How to implement the free-blocked transitions
- How to recover the original position after activation
- Interaction among aeroelastic and flight mechanics requirements
- Local impacts of activation

MAP OF RELATED ACTIVITIES

SBW

- Strut vs. Truss, lifting or not lifting component
- Shape and chord position of strut-wing connection (aerodynamic vs. aeroelastic requirements)
- Type of connection

→

- MDO including aeroelastic constraints for different strut shape and strut-wing connection (POLIMI)
- HIFI Aeroelastic analysis (ONERA-Presentation 4)
- Dedicated wing-strut model for wind tunnel flutter test (POLIMI-IBK-UNIVBRIS)

FWT

- How to implement the free-blocked transitions
- How to recover the original position after activation

→

- Dedicated aeroelastic hinge to be implemented on AE2 aeroelastic model for gust response test @POLIMI (POLIMI-IBK-UNIVBRIS)

- Interaction among aeroelastic and flight mechanics requirements
- Local impacts of activation

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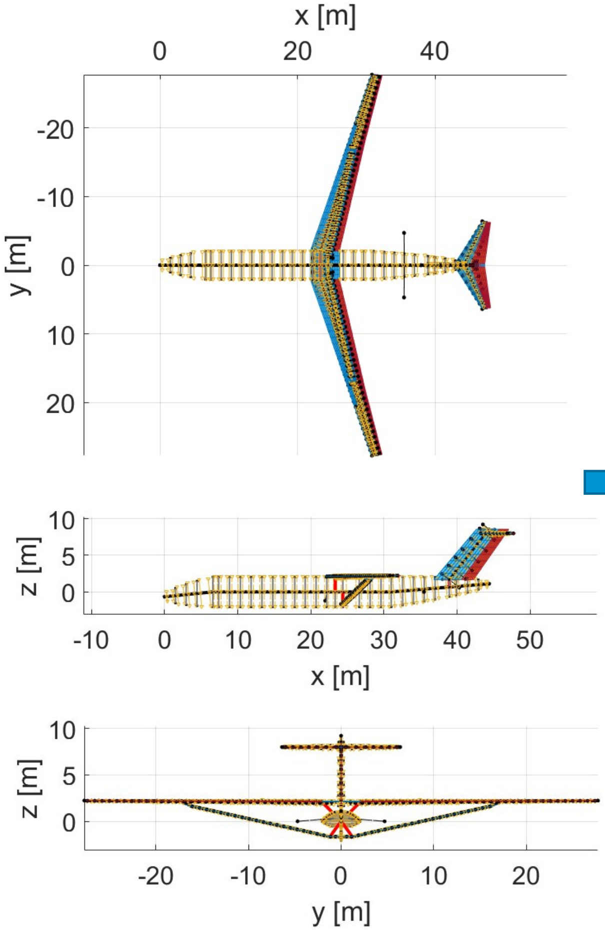
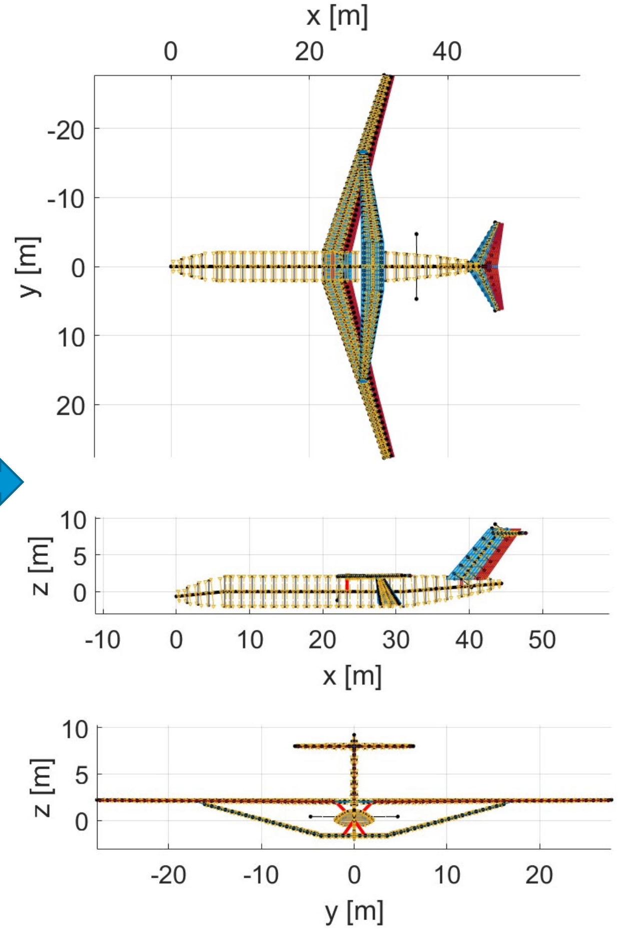
- HIFI Aeroelastic analysis in WP3 (UNIVBRIS-SIEMENS)

UPDATED SBW CONFIGURATION



Strut re-designed:

- Sweep from positive to negative;
- Chord increased;
- Inner portion horizontal
- Aluminum vs. Composites



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MODEL AE1 TEST OBJECTIVES

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- Investigate the low speed aeroelastic behavior of a strut-braced wing
- Assess its dynamic stability up to the maximum reachable speed inside POLIMI's wind tunnel (54 m/s, around Vc)
- Wing+strut model: geometrical scale 1:10, constant Froude number

AE1 TESTING CONFIGURATIONS

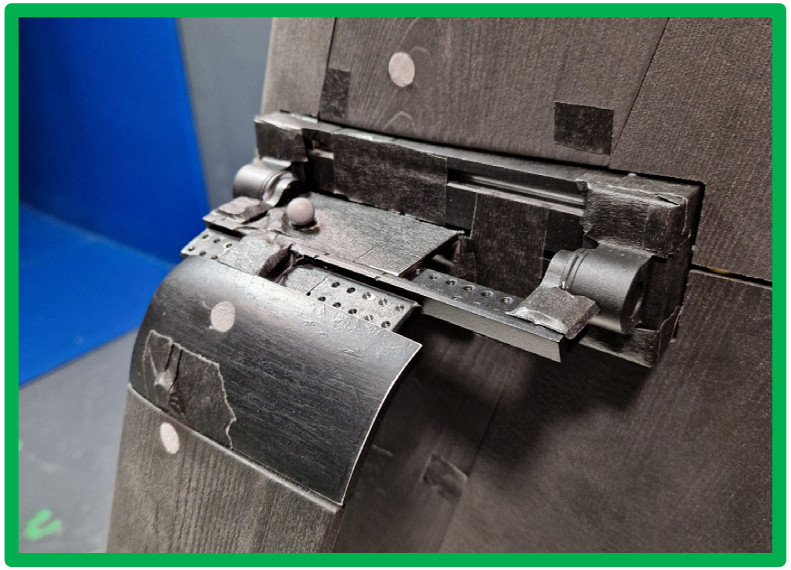
2 Strut options:

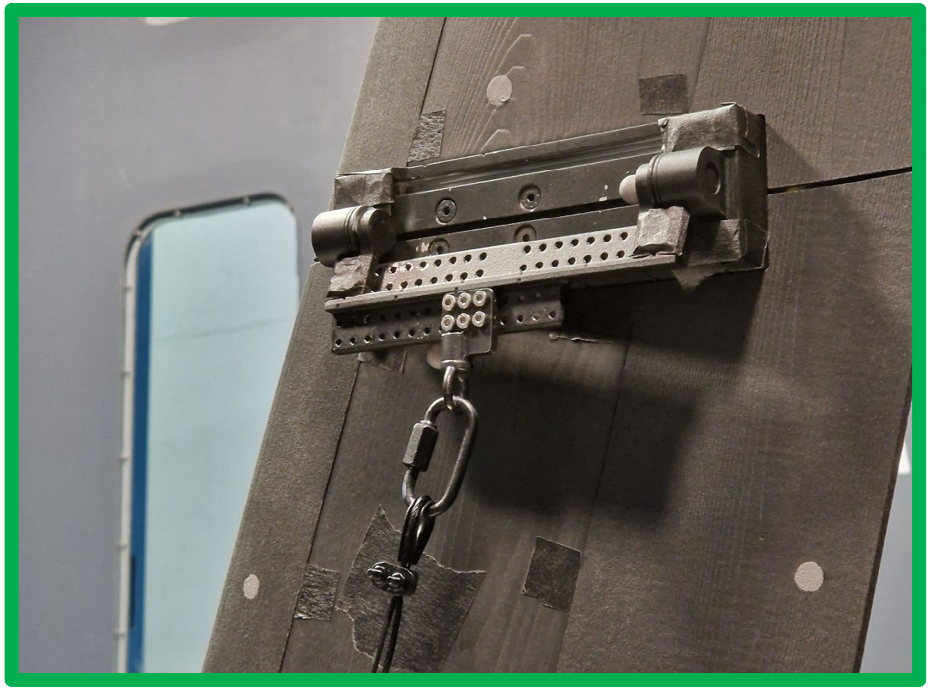
- With aerodynamic sectors, but stiffer than reference (Left)
- With correct scaled stiffness, but without aerodynamic sectors and bent connection (Right)

AE1 TESTING CONFIGURATIONS

For both strut options:

- 4 chordwise attachment positions





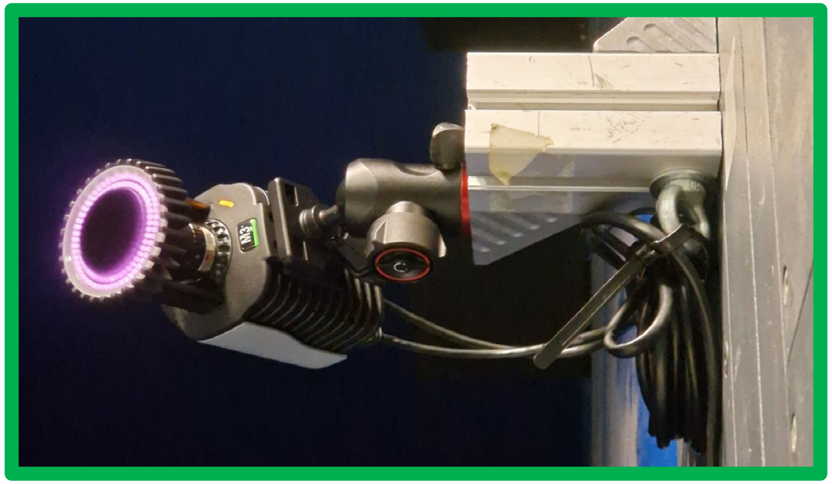
Just for the aerodynamic sectors version:

- Hinge blocked configuration

AE1 MEASUREMENTS

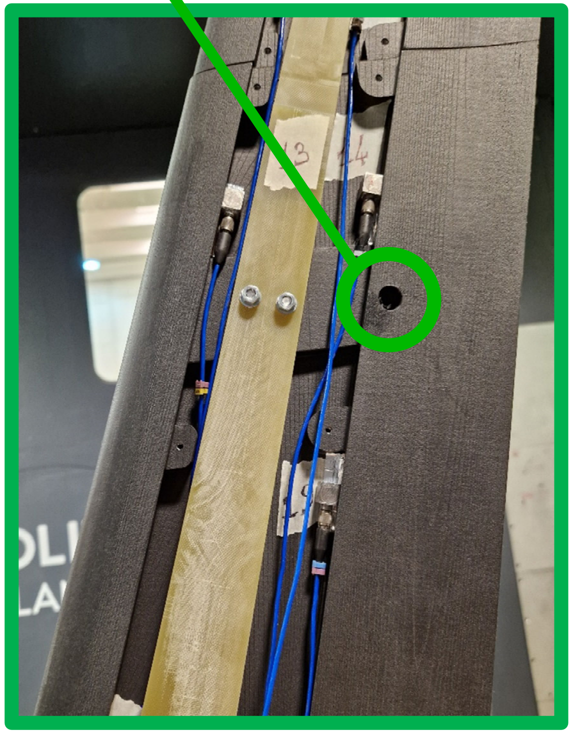
2 measurement systems:

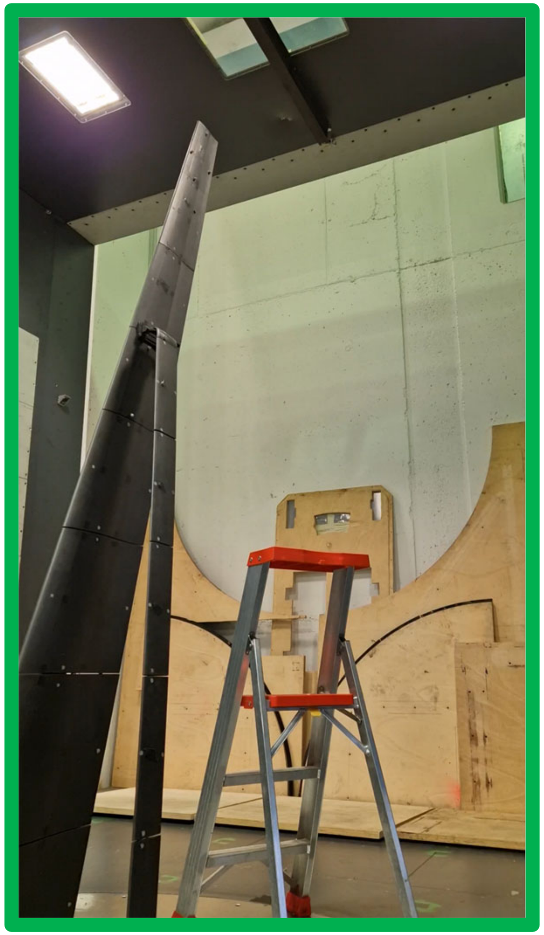
- Accelerations at different points of the model
- Displacements of each aerodynamic sector and other notable positions using a photogrammetric system (Qualisys)



ACCELERATIONS MEASUREMENT

Exhaust nozzle

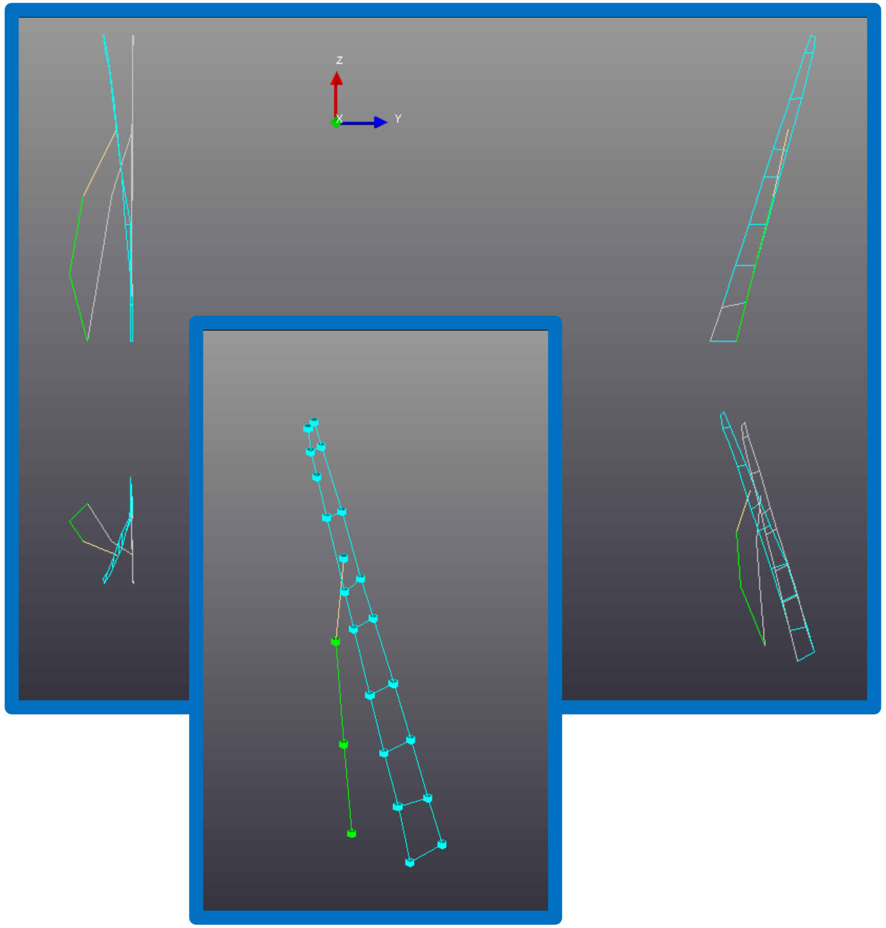




Excitation:

- Usually by wind tunnel turbulence
- When not enough, compressed air pulse

MODAL IDENTIFICATON



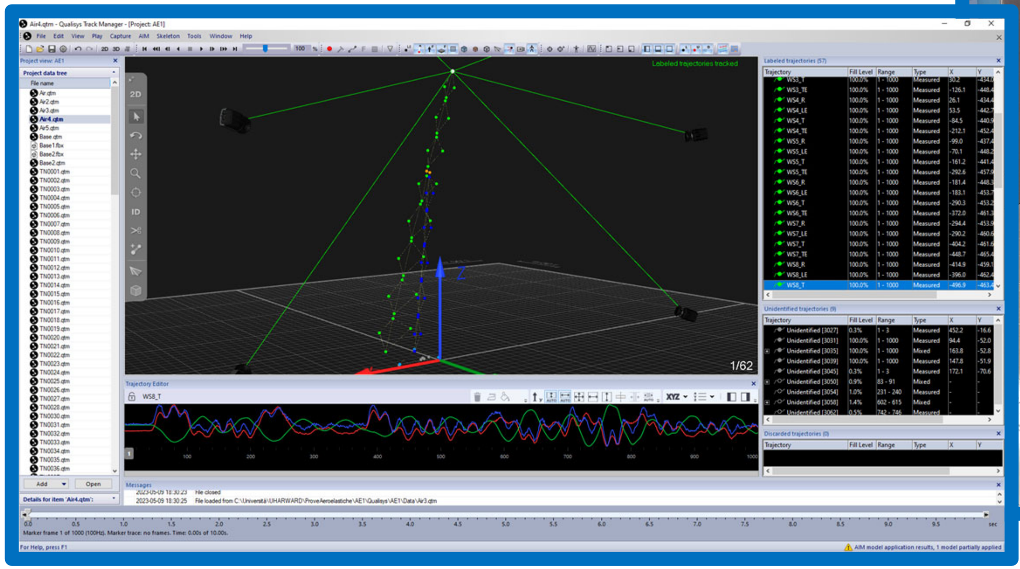
Modal identification using SIEMENS Testlab Operational Modal Analysis:

- Data analysis performed just for a few conditions to be sure the levels of excitation were enough for a correct identification
- Complete analysis to be done, still

MODE SHAPES IDENTIFICATION

Performed using Qualysis Optical System:

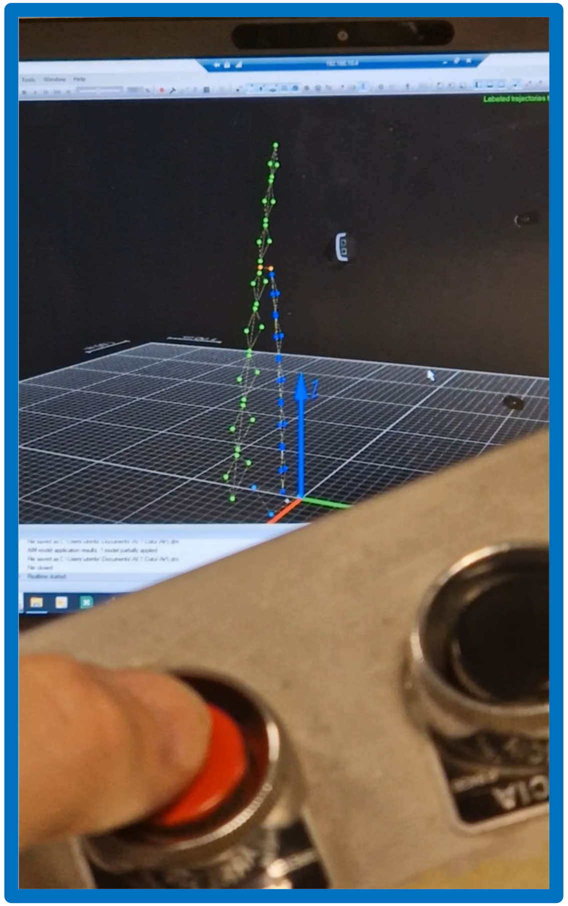
- 6 infrared cameras
- Reflective markers on the model



MODE SHAPES IDENTIFICATION

Used for:

- Realtime monitoring of the tests
- Compare deformed shapes to numerical results



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FWT ON AE2 AEROELASTIC MODEL

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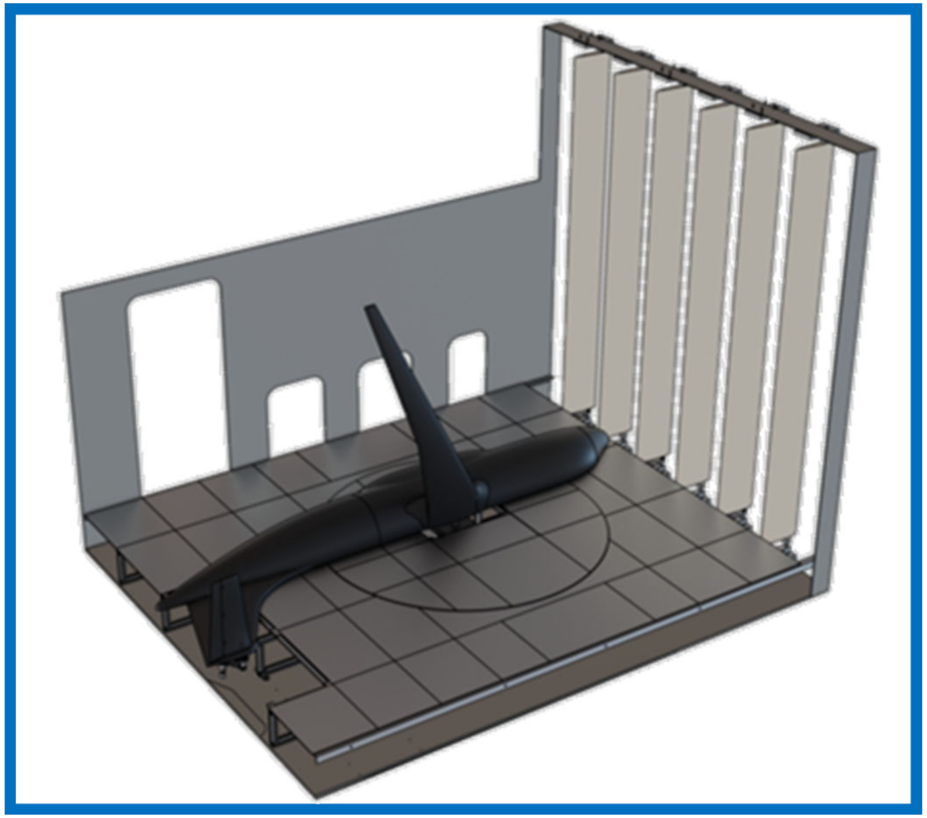


Aeroelastic FWT half model AE2
To Be Tested @ POLIMI

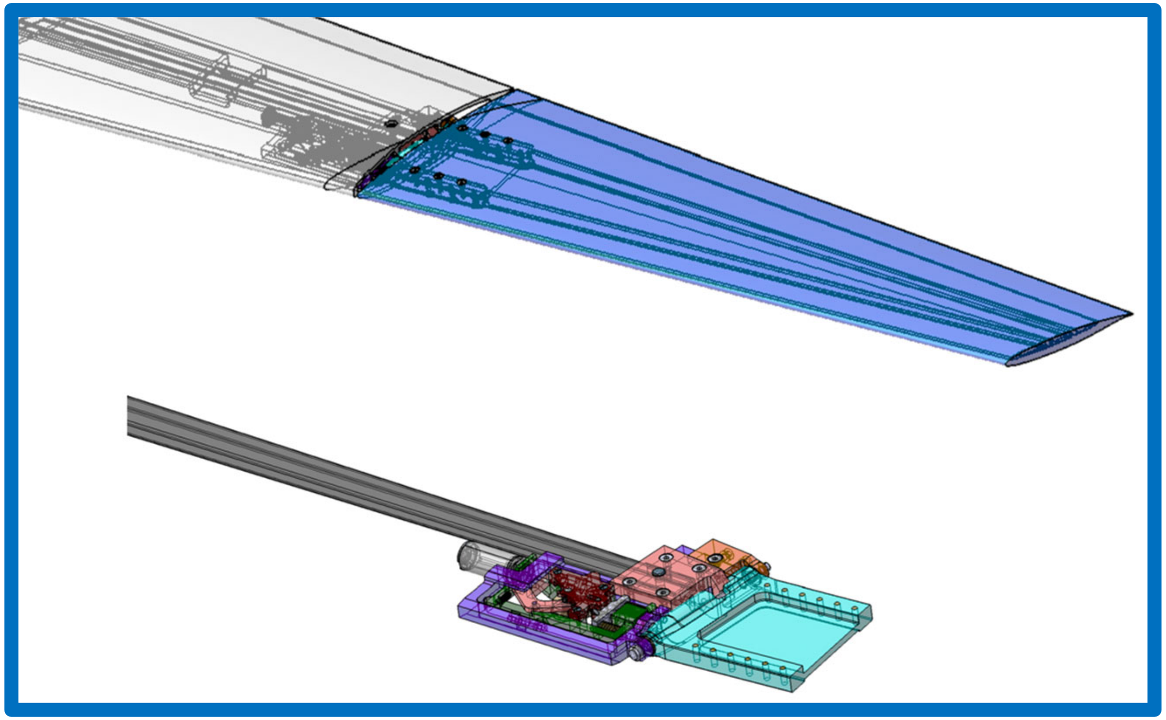
Co-funded by the European Union

POLITECNICO MILANO 1863 Innovation IBK University of BRISTOL

FWT VALIDATION PLAN

Main characteristics:

- Geometrical scale: 1:10, wing representative of Reference Aircraft AR=15
- Scaling approach: iso-frequency
- Pitch + plunge rigid + elastic modes
- Elevator for pitch control



Test goal:

- Experimental validation of FWT concept under gust excitation

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CONCLUSIONS

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- The potential aerodynamic benefits of SBW configuration associated with the potential weight saving of both SBW and FWT configurations are very evident.
- Aeroelastic issues could become the actual design drivers.
- A combined numerical and experimental approach is a must.
- Relevant margin of trade-off studies using MDO approaches.

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THANK FOR YOUR ATTENTION!

ANY QUESTIONS?

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https://cleansky.virtualfair.be/

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