



MADELEINE

2nd European Workshop on MDO

19-20 November 2019

Toulouse, France



Coordinator:
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MADELEINE project,
Grant Agreement No 769025

Consortium MADELEINE



<p>MADELEINE</p>	<p>Multidisciplinary ADjoint-based Enablers for Large-scale Industrial design in aEronautics</p>
<p>Call H2020-Transport 2017-MG 1.3</p>	<p>Industrial competitiveness</p>
<p>Coordinator</p>	<p> ONERA THE FRENCH AEROSPACE LAB</p>
<p>15 partners</p>	<p>  </p>
<p>Duration</p>	<p>36 months (June 2018 – May 2021)</p>
<p>EU funding</p>	<p>5.8 M€</p>

Current use of MDO in industry

MDO and/or **adjoint-based optimisation** using **high-fidelity** simulations

Often **limited** to **single disciplines**:

- ✓ *Aerodynamics*
- ✓ *Acoustics*
- ✓ *Thermics*
- ✓ *Structural analysis*

Multi-Disciplinary analysis during **design** campaign

Iterative process from **one discipline** to the other



Limitations and **drawbacks** of the current approach

Significant **time delays** to the overall process


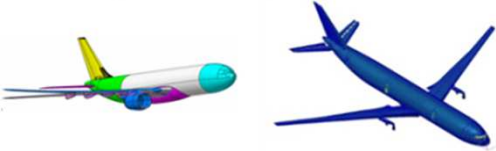

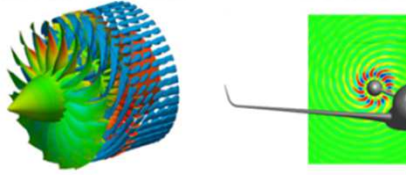
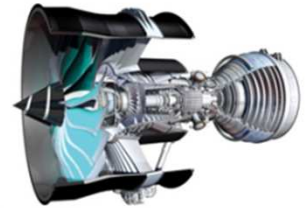
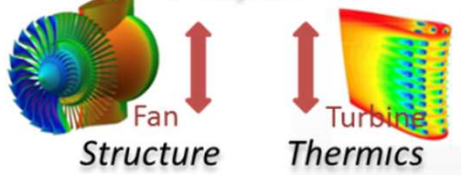
Difficulties to exploit **multi-disciplinary trade-off**

Overall objectives of MADELEINE

<p>Meet short, medium and long-terms industrial objectives</p>	<ul style="list-style-type: none">✓ Competitiveness - <i>By reducing development time and costs (incl. manufacturing)</i>✓ Environment - <i>By designing more efficient configurations with better multidisciplinary compromises</i>
<p>Address the industrial needs of competitive design</p>	<ul style="list-style-type: none">✓ Extend the scope of MDO to include HiFi simulations (<i>CFD, CSM, CAA, CHT</i>)✓ Fully exploit the adjoint capability to solve design problems with hundreds or thousands of design parameters✓ Increase the reliability of the adjoint solvers✓ Extend MDO to efficiently include manufacturing criteria

Overall objectives of MADELEINE

Demonstrate the **benefits of adjoint-based MDO**

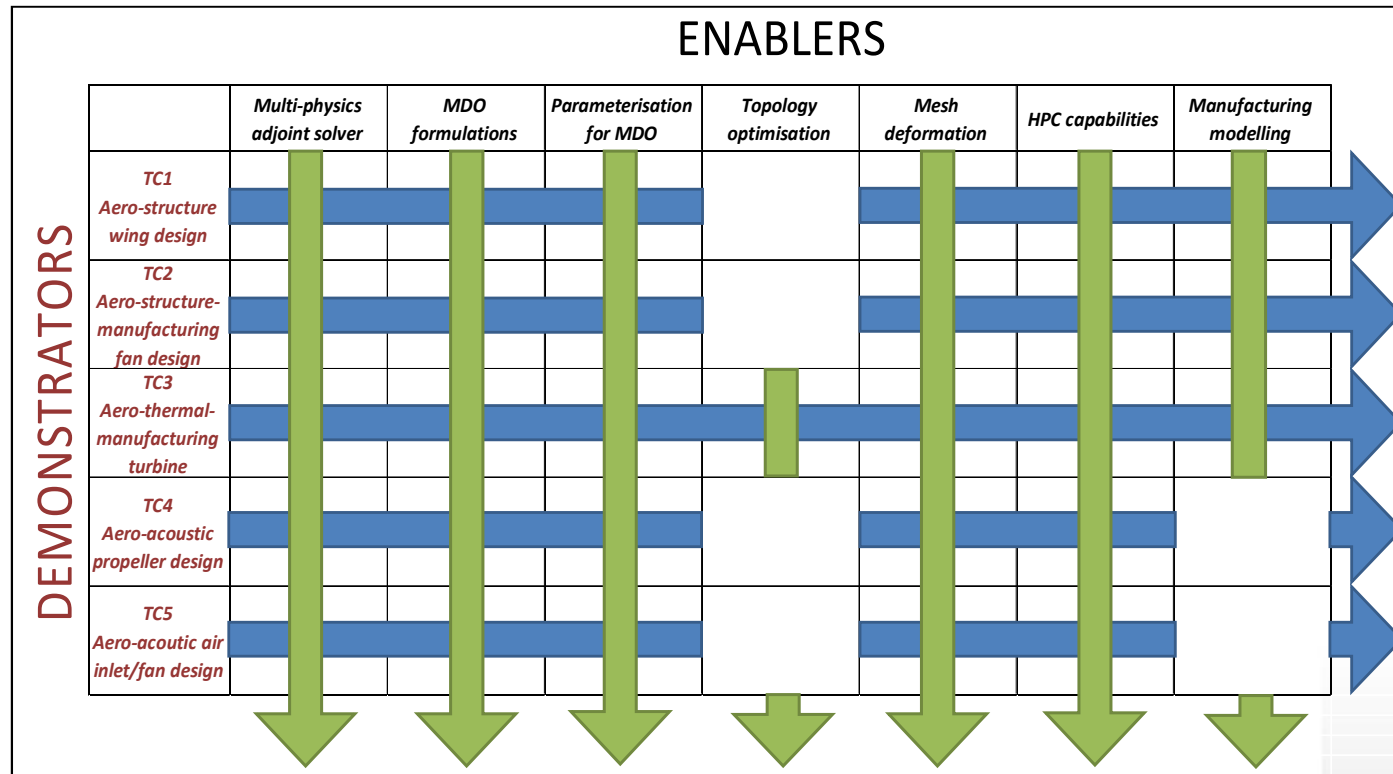
Airframe <i>Wing/fuselage aero-structure interactions</i>	Airframe/engine interactions <i>Air inlet, propeller or fan blades aero-acoustics interactions</i>	Engine <i>Fan and high-pressure turbine with very stringent aero-structure and aero-thermal interactions</i>
 <p>Aerodynamics ↔ Structure</p> 	 <p>Aerodynamics ↔ Acoustics</p> 	 <p>Aerodynamics ↔ Structure ↔ Thermics</p> 

Concept of MADELEINE



Focus on synergies between enablers and demonstrators

Enablers: methods and tools required to apply adjoint based MDO processes

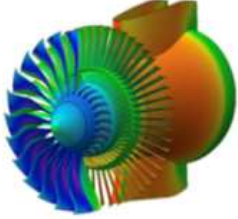
Demonstrators: test cases representative of multi-physics industrial design problems



Aero-structure aircraft wing design

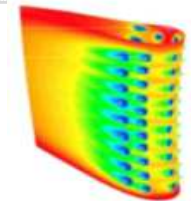
Challenge	Perform aero-structure flexible wing optimisations of modern transport aircraft in a real industrial context
Strategy	Apply of aerodynamic, aero-elastic and aero-structure adjoint solvers to measure the impact of multiphysics phenomena on the performance of optimised configurations
Configurations	<p>A large passenger aircraft configuration (Airbus) <i>Partners: Airbus, ONERA, DLR, IRT</i></p>  <p>A business jet configuration (Dassault) <i>Partners: Dassault, ESI, National Technical University of Athens</i></p> 

Aero-structure-manufacturing fan blade design

Challenge	Perform aero-structure-manufacturing fan blade optimisations of a Ultra-High-By-pass-Ratio modern engine
Strategy	Progressively include manufacturing aspects on the MDO process to avoid accumulation of deviations that can cause the blades to deviate from the design intent in terms of optimal efficiency
Configurations	<p>3 levels of complexity from generic configuration (NASA rotor 37) to complex industrial geometry (confidential Rolls-Royce)</p>  <p>All configurations are representative of modern aircraft engine (Low-Pressure Fan)</p> <p><i>Partners: Rolls-Royce, University of Sheffield, University of Cagliari</i></p>

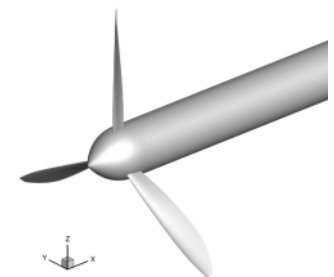
Aero-thermal-manufacturing turbine blade design

Challenge	Perform aero-thermal-manufacturing turbine blade optimisations of a Ultra-High-By-pass-Ratio modern engine
Strategy	Use topology optimisation methods for the definition cooling passages Integrate of specific manufacturing process or uncertainties in the MDO loop to design configuration robust to geometry deviations
Configurations	3 levels of complexity from generic configuration (MT1) to complex industrial geometry (confidential Rolls-Royce) All configurations are representative of modern aircraft engine (High-Pressure Turbine) <i>Partners: Rolls-Royce, University of Sheffield, University of Cagliari, ESI, OPTIMAD, National Technical University of Athens</i>

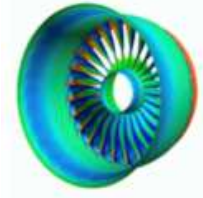


Aero-acoustic isolated propeller blade design

Challenge	Perform aero-acoustic propeller blade optimisations of modern turbo-propulsor engine
Strategy	Use vertex morphing approach to open the design space Apply steady and unsteady aero-acoustic adjoint solvers to minimise the acoustic noise while considering strong aerodynamic constraints (in terms of performance)
Configuration	Generic design complying with the requirements of an electrical or hybrid CTOL/VTOL concept using light propellers (ONERA) <i>Partners: ONERA, NLR, Technical University of Munich</i>



Aero-acoustic air inlet and fan blade design

Challenge	Perform simultaneously aero-acoustic air inlet and fan blade optimisations of a Ultra-High-By-pass-Ratio modern engine
Strategy	Optimise the air inlet (including acoustic liners) and the fan blade in parallel with a specific coupling interface Apply steady and unsteady aero-acoustic adjoint solvers to improve both aerodynamic and acoustic performance
Configuration	Generic air intake adapted to the VITAL fan blade geometry  <i>Partners: Rolls-Royce, University of Southampton, National Technical University of Athens</i>

Meet with us

Next Minisymposium at the 14th World Congress in Computational Mechanics and ECCOMAS Congress 2020

Paris, 19-24 July 2020

ADJOINT METHODS FOR MULTI-PHYSICS, INCLUDING APPLICATIONS

Deadline for abstracts: December 15, 2019

And stay tuned!

Website: <https://www.madeleine-project.eu/>



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