

ENVIRONMENTAL IMPACT

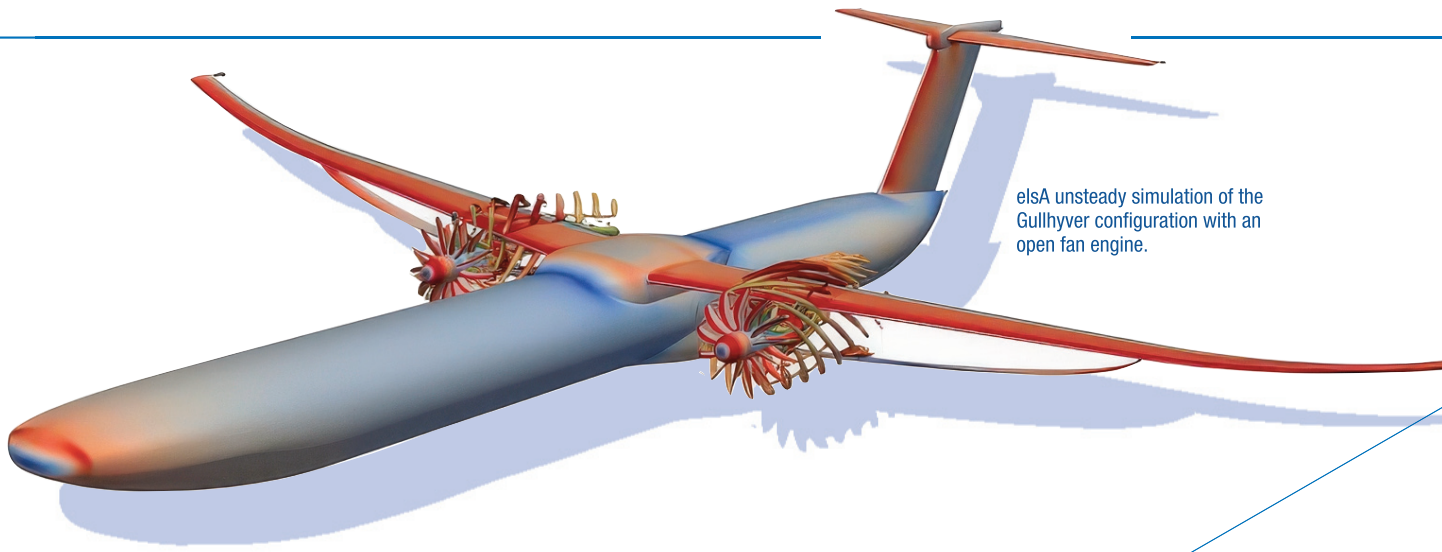
OPEN FAN AND HIGH ASPECT RATIO WING GULLHYVER



Reducing the climate impact of aviation requires the introduction of breakthrough technologies. Two major innovations for the next generation of commercial aircraft are the open-fan engine and the very high aspect ratio wing. The quest for maximum fuel efficiency also requires advanced optimisation and very high-accuracy design tools.

THE GULLHYVER CONFIGURATION

This configuration proposes the use of an open-fan engine and a very high aspect ratio wing designed by ONERA. To achieve maximum performance, the propulsion system integration into the airframe must be optimized taking into account the various interactions.



elsA unsteady simulation of the Gullhyver configuration with an open fan engine.

OPEN FAN

- Challenge: controlling noise emissions as there is no fairing to absorb the noise generated by the fan.
- ONERA assets: **numerical simulations** using the elsA code, developed at ONERA for aerodynamic and aeroacoustic simulation, combined with **multidisciplinary optimisation approaches** (MDO), enabled both the reduction of the noise generated by the fan by several dB and an aerodynamic performance improvement of 2.5%. This is essential for achieving the propulsive efficiency targets set for the cruise segment. The latest developments in the elsA code have also enabled the complete simulation of the installed engine with rotating blades, a simulation involving 123 million meshes and made possible by the HPC performance on a 49280-core computer. It represents a total of 10,000 CPU hours, which could be run in 28 hours on 357 computing cores.

HIGH ASPECT RATIO WINGS

- Challenge: because of its very large wingspan (keeping the same wing area), the high aspect ratio wing has to manage flexibility and loads issues. The **strut-braced wing** studied by ONERA is a solution that meets the various constraints. A critical point is the junction between the strut and the wing.
- ONERA assets: ONERA applies its **modelling** and **numerical simulation** skills. To limit drag and prevent vibrations, the know-how and tools developed by ONERA have been used in a detailed design process to eliminate aerodynamic separations or supersonic zones at the wing/strut junction, a crucial area for performance optimization.

AWATAR: ACTING ON A EUROPEAN SCALE

In the European context, the investigation of GULLHYVER technology bricks continues with ONERA leading the AWATAR project (Advanced Wing Maturation and Integration) in the Clean Aviation programme. The activity is dedicated to the maturation of a Very High Aspect Ratio, Strut-Braced Wing featuring laminar portions in the outer areas, advanced integrated leading edge systems and an optimized integration of an Open Fan propulsion system. In order to anticipate certification processes and enabling rapid implementation into products, the project plans high fidelity simulations, large Wind Tunnel Tests and a Ground Based Demonstrator. In addition to the overall coordination, ONERA will perform laminar flutter tests in transonic condition in the S2MA wind tunnel for a thorough and unprecedented characterization of the phenomena. This step is key toward certification of efficient future transport airplanes.

