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Abstract
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Unsteady simulations of an aircraft with installed engine and rotating fan

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Abstract
Numerical simulations have been performed to reproduce the flow around an aircraft with installed engine and rotating fan, by modelling both the external aerodynamics of the plane and the internal aerodynamics in the secondary flow of the engine at high bypass ratio (Ultra High Bypass Ratio - UHBR), installed under the wing. On this type of configuration, the interactions between the engine and the airframe are reinforced compared to existing configurations because of the large diameter of the engine and its proximity to the wing.

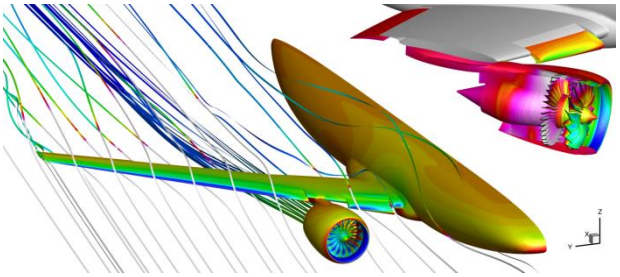

Figure 1: Result of a simulation in take-off coditions

These calculations take into account most of the elements of a civil transport aircraft: the wing, the fuselage, the slats and flaps when considering take-off condition, the engine pylon and nacelle, as well as the components inside the flow secondary of the UHBR engine, the rotating fan and the blades of OGV (Outlet Guide Vanes), including a heterogeneous part which allows the connection with the engine pylon. The numerical simulations, adopting Unsteady-RANS approach, were possible thanks to the many functionalities of the elsA code: use of non-coincident meshes and Chimera approach for the external part, sliding mesh and mixing planes to manage the interfaces between fixed part and rotating parts inside the engine. A significant meshing activity was necessary in order to generate each element taken into account in the simulations. The assembly of these elements was carried out with the Cassiopée tool developed by ONERA. This activity is part of the European Clean Sky 2 ADEC project, in the LPA (Large Passenger Aircraft) platform dedicated to innovative motorized aircraft configurations. The identified test case, named NOVASPIRE, is the result of collaboration between many European partners: it is the fusion between one of the NOVA configurations [1], the aircraft demonstrator designed by ONERA, with the ASPIRE engine [2], resulting from a previous collaboration between ONERA, Airbus, DLR and NLR [3].
These calculations allow to finely modelling the interactions between the engine and the aircraft cell. The analysis thus improves the prediction of the aerodynamic performance of civil transport aircraft configurations equipped with engines with very high bypass ratios.

References
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