PhD position at ISAE-Supaero and ONERA

Analysis and optimization of a Blended Wing Body aircraft equipped with Ultra High Bypass Ratio turbofan

Europe faces a formidable challenge in reducing both energy consumption and pollutant emissions, especially for air transportation. The improvement of current propulsive systems approaches its limits (in terms of thermal and propulsive efficiencies), but there is still margins to improve the integration of the propulsive system within the airframe, by dramatically modifying the aircraft configuration.

The current PhD position proposes to investigate one disruptive aircraft architecture, the Blended Wing Body (BWB). The objective will be to use the fluid dynamics principles to identify the key technologies that can be used to improve this configuration. Several constraints will result in a compromise on the design, as aerodynamic performance, noise, propulsive and thermal efficiency, operability, weight, etc. The PhD will especially focus on the improvement of propulsive technology through the Boundary Layer Ingestion technology (BLI), which consists in ingesting part of the boundary layer with the engines.

The PhD will focus on a whole aircraft equipped with Ultra High By pass Ratio turbofans (UHBR). The first part of the PhD, which must include a large literature review, will be to determine the typical mission of such an aircraft (range, weight, cruise and take-off speeds, etc.), together with main stakes both in terms of technology steps and modelisation issues. The second part of the PhD will focus on the parametrization, improvement, and validation of the method used to represent the engine, including the intake, the fan and the outlet guide vanes, and the nozzle, based on a body force approach, Fig. 2 (Thollet et al., 2016). Both cruise and take-off conditions will be considered, together with some off-design cases. The last part of the PhD will deal with the full aircraft simulations and its optimisation, the challenge being to carefully choose the parameters for optimisation on such a complex configuration. A large part of the PhD will be dedicated to the understanding of key parameters that manage the performance of such an aircraft, through exergy balance analysis (Arntz PhD, Onera 2014). The final goal of the PhD is to demonstrate the feasibility of such innovative concepts and propose optimized integrated designs and innovative methods, especially in terms of engine integration, while keeping a rigorous outlook with respect to fundamental phenomena such as wing stall, BLI, fan surge.

Candidate: engineer school and/or Master with a background on fluid dynamics and aeronautics. Very good skills in propulsion and aerodynamics are mandatory. The trainee will be jointly supervised by ISAE-Supaero and ONERA, so a good capability to work in a multidisciplinary environment will be necessary. She (he) will have in charge the valorisation of her (his) work through reports, scientific papers and/or oral presentations. Interaction with industrial partners are expected such good communication skills are necessary.

Start scheduled in January 2018, candidates must apply before October 20th, 2017.

Doctoral school : MEGEP (Toulouse)

Location: ISAE-Supaero (Toulouse) and ONERA (Meudon). Time will be split between the two sites during the PhD.

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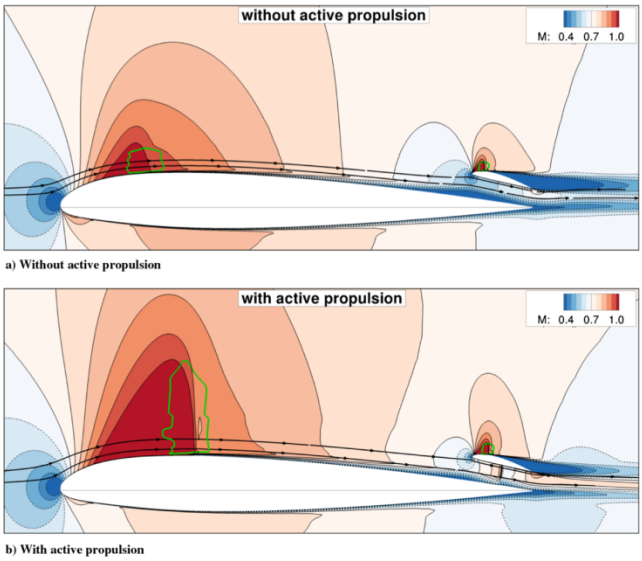
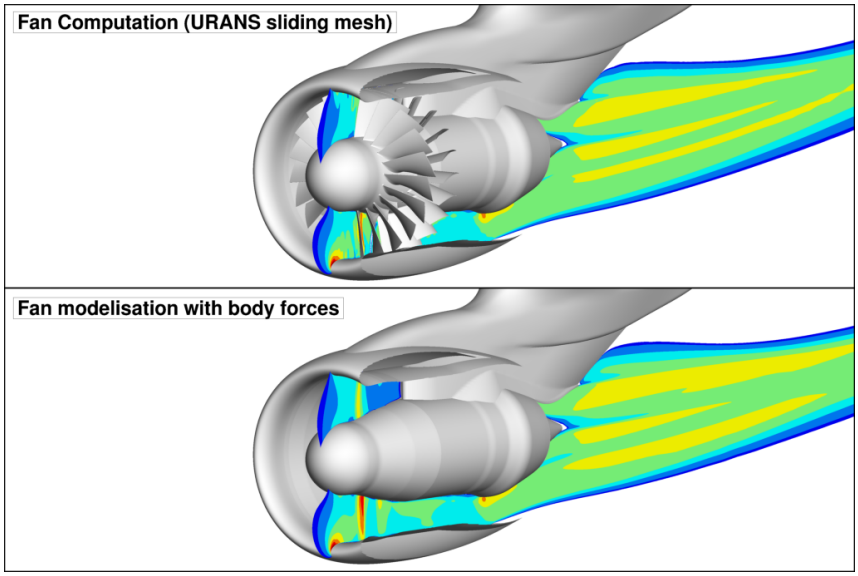


Numerical simulation of a propulsive system within the aircraft
(Arntz et Atinault, AIAA J., 2015)



Nuermical simulation of a turbofan with a body force approach
(Thollet and Dufour, 2016)