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THE FRENCH AEROSPACE LAB

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PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DTIS-2023-09**
(à rappeler dans toute correspondance)

Lieu : Palaiseau

Département/Dir./Serv. : DTIS/MACI

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DESCRIPTION DU STAGE

Thématique(s) : Conception et optimisation des systèmes

Type de stage : ☐ Fin d'études bac+5 ☒ Master 2 ☐ Bac+2 à bac+4 ☐ Autres

Intitulé : Shaping of a flexible aircraft wing with distributed thrusts and aerodynamic loads

Sujet : Distributed electric propulsion (DEP) is considered today as a feasible solution to increase the propulsive efficiency of a transport aircraft. ONERA for instance has developed the DRAGON concept of hybrid electric distributed propulsion (HEDP) where ducted fans connected to electric motors could be placed on the entire available span length of the aircraft wings, since this setting is expected to maximize the aero-propulsive effect. Power used to run the electric motors and their ducted fans is generated by gas turbines which could be core power-producing gas turbines without thrust-producing turbofans.

Besides, several wing warping concepts and studies have demonstrated the potential use of wing shaping control for aircraft performance, stability, and flight control; see for instance the NASA Active Aeroelastic Wing (AAW) program in the late 1990s. Wing shaping can be achieved by different approaches whereby a given profile is actively controlled by camber change, airfoil profile change, or twist control. They use actuation devices internal to a wing structure, although concepts constructed from digital composite materials have also emerged. Other concepts only consider a change of the trailing or leading edge areas. As shown in [1], the propulsive forces and moments induced by DEP on a wing span can be used to optimize the lift-to-drag ratio by modifying the wing twist and bending. In this research a multi-disciplinary approach has been adopted, which includes propulsor sizing and placement, wing structural design in terms of mass and stiffness distributions, wing aerodynamics with propulsion interactions, and aircraft flight control.

The objective of the proposed work is to improve a numerical model of the aeroelastic effects based on a classical beam theory for flexible wings. In addition to the thrusts generated by the distributed fans, the model should take into account the aerodynamic loads, the varying pre-twist angle imposed to the wing, and varying geometrical parameters. This study should start with a review of the existing aeroelastic models and DEP concepts, and then extend an existing beam model and its finite element formulation in a flexible environment such as Matlab or Python. Potential candidates should have a background in continuum and structural mechanics, computational mechanics, and the finite element method.

[1] N.T. Nguyen, K. Reynolds, E. Ting, N. Nguyen. AIAA J. Aircraft 55(3), 1122-1140 (2018).

Est-il possible d'envisager un travail en binôme ? **Non**

Méthodes à mettre en oeuvre :

☒ Recherche théorique ☐ Travail de synthèse

☒ Recherche appliquée ☒ Travail de documentation

☐ Recherche expérimentale ☐ Participation à une réalisation

Possibilité de prolongation en thèse : **Oui**

Durée du stage : Minimum : 4 mois Maximum : 6 mois

Période souhaitée : avril-septembre 2023

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Ecoles ou établissements souhaités :
Mécanique des structures, éléments finis	M2 recherche (écoles, universités)