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PROPOSITION DE SUJET DE THESE

Intitulé : Colibri : Design, Optimization and Data Driven Control of small VTOLs

Référence : **TIS-DTIS-2021-12**
(à rappeler dans toute correspondance)

Début de la thèse : octobre 2021	**Date limite de candidature :**

Mots clés

Multidisciplinary Design and Optimization, VTOL, Surrogate models

Profil et compétences recherchées

Bac+5, ingénieur ou université

MSc degree in Aerospace, Mechanical Engineering, Physics, Mathematics, or equivalent.

Présentation du projet doctoral, contexte et objectif

Popularity of Vertical Take-Off and Landing vehicles (VTOL) increased with new mission requirements such as package delivery or urban air mobility. The applications are not limited to those, several scientific research projects can benefit from the resultant vehicles. Such an example can be given for Atmospheric Researchers, who need advanced autonomous capabilities from take-off to landing, fly at relatively high flight speeds (up to 25m/s) and for long flight duration (2-3 hours). Their operation environment does not always allow additional crew member such as an experienced safety pilot. These requirements favor the potential offered by unconventional vehicle configurations that combine the VTOL capability of rotary-wings with the fast and efficient forward flight capacity of fixed-wings. These 'transitioning' or 'hybrid' vehicles come in many different forms, such as tail-sitters, quad-planes, tilt-wing and more. In this thesis, we will try to consider most of them briefly, but focus particularly on the Tilt-Wing configuration as it offers several operational advantages for atmospheric researchers, such as:

- Horizontal fuselage orientation for payload,
- Clear separation and distance of the payload from wing and propeller influence,
- Can be designed for easy to take-off and land-on on belly without the need of landing gear,
- Rapid gust rejection by tilting the wing only (smaller inertia) compared to full vehicle,…

Figure 1: Colibri VTOL concept (ENAC)

The main objective of this thesis is the development of an agile design methodology to optimize a tilt-wing vehicle according to a mission while taking into account not only the classical disciplines that are involved such as aerodynamics, structures, propulsion system, avionics, ... , but also the manufacturing techniques, flight control and robustness to atmospheric conditions as these vehicle configurations are susceptible to wind gusts. This methodology will benefit from experimental data incorporated in the model generation and fine-tuning, and from advanced adaptive optimization strategies.

Practical implementations within the OpenMDAO framework (an open source MDO framework developed by NASA) are expected.

Collaborations envisagées

PhD supervised between ONERA and ENAC. Ongoing collaboration between TU-Delft on control and flight testing will continue.

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