RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

ONERA
THE FRENCH AEROSPACE LAB

www.onera.fr

PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : DTIS-2026-12
(à rappeler dans toute correspondance)

Lieu : Toulouse

Département/Dir./Serv. : DTIS/COVNI
ENAC/OPTIM/SYSDYN

Tél. : 05 62 25 29 22/ 05 62 25 96 16

Responsable(s) du stage : Fabrice Demourant
Gautier Hattenberger

Email. : fabrice.demourant@onera.fr
gautier.hattenberger@enac.fr

DESCRIPTION DU STAGE

Thématique(s) : ICS

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

Intitulé: Modeling and integration of guidance laws on a convertible micro-drone

The general architecture of the Heewing T1 Ranger is a small foam plane with two motors that can tilt from horizontal to vertical position and a third placed on the tail boom. They ensure lift and controllability when the forward speed is insufficient and for vertical takeoff and landing. This configuration is particularly well-suited for operations in mountainous areas, where takeoff and landing sites are often constrained, and where its reduced sensitivity to rapidly changing weather conditions (such as gusts, slope winds, or thermal updrafts) provides a significant advantage.

HEEWING T1 RANGER in VTOL configuration

In previous works [1][2][3], the ONERA and ENAC research teams have investigated several types of control laws for the stabilization and guidance of such hybrid platforms. In particular, the Incremental Nonlinear Dynamic Inversion (INDI) is a promising solution to have a unified control scheme [4]. This architecture can be combined with a robust linear controller to meet some specifications, if necessary. Such solution has already been studied

for the stabilization control layer and should be extended to the guidance level. This controller is already implemented in the Paparazzi UAV System[1], as an open-source software and hardware platform designed for research on mini-UAV.

The objectives of this internship are to:

- To analyze the literature on the control of hybrid UAVs;
- To model this aircraft and identify the different parameters from flight test analyses;
- To enhance the INDI controller by incorporating robust control techniques in order to meet both stabilization and guidance objectives;
- To implement the solution within the Paparazzi UAV System;
- To perform flight tests to evaluate the performances of the control;

This 6-month Master 2 internship is in cooperation between ONERA and ENAC, both based in Toulouse, France. It will benefit from the Indoor Flight Arena located on ENAC campus for preliminary tests and the outdoor flight tests area of ENAC or ONERA.

This work might lead to a PhD thesis opportunity.

[1] Florian Sansou, Gautier Hattenberger, Luca Zaccarian, Fabrice Demourant, Thomas Loquen. Modelling and Hovering Stabilisation of a Free-Rotating Wing UAV. *2024 International Conference on Unmanned Aircraft Systems (ICUAS)*, Jun 2024, La Canée (Crete), Greece. pp.779-785, ⟨10.1109/ICUAS60882.2024.10556832⟩

[2] Armand-Ioan Curpanaru, Fabrice Demourant, Florian Sansou. Control of the DarkO Tail-Sitter Drone through an LMI-Based Static Output Feedback Design. *IMAV 2024*, Sep 2024, Bristol, United Kingdom. ⟨hal-04726253⟩

[3] Florian Sansou, Fabrice Demourant, Gautier Hattenberger, Thomas Loquen, Luca Zaccarian. Open wind tunnel experiments of the DarkO tail-sitter longitudinal stabilization with constant wind. *Automatic control in aerospace*, Nov 2022, Mumbai, India. pp.1-6, ⟨10.1016/j.ifacol.2023.03.001⟩

[4] E. J. Smeur, Murat Bronz, G. C. H. E. de Croon. Incremental control and guidance of hybrid aircraft applied to the Cyclone tailsitter UAV. *Journal of Guidance, Control, and Dynamics*, 2019, ⟨10.2514/1.G004520⟩

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

1 https://paparazziuav.org

☐ Recherche expérimentale ☐ Participation à une réalisation

Possibilité de prolongation en thèse : Oui

Durée du stage : Minimum : 5 mois Maximum : 6 mois

Période souhaitée : Début Mars-Avril 2025

PROFIL DU STAGIAIRE

Connaissances et niveau requis :

- Connaissances robotique ou drones
- Connaissances en automatique
- Connaissances en systèmes embarqués temps-réel
- Bonne maîtrise du C et de Python et/ou Matlab.

Ecoles ou établissements souhaités : Grandes Ecoles/Universités.