

## PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DTIS-2025-64**  
 (à rappeler dans toute correspondance)

Lieu : Salon de Provence

Département/Dir./Serv. : DTIS/RFDS

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### DESCRIPTION DU STAGE

Thématique(s) : Conception et Optimisation des Systèmes (COS)

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

#### Intitulé : Towards a better modeling of the Vortex Ring State

Sujet : The Vortex Ring State on Helicopters and any aircraft using rotary wings for its Vertical Take-Off and Landing (VTOL) capability is a dangerous unstable phenomenon.

The main goal of the Master thesis is detailed hereafter:

1) The modeling of the induced velocities through the rotor:

On the one hand, the modeling is complex for capturing this wake instability, e.g. one difficulty is that the Momentum Theory is no longer applicable. On the other hand, a rapid model (i.e. low computational time) is needed for realtime piloted simulation. A previous model based on Vortex Rings developed by ONERA could be a good candidate. The internship will contribute to test it and to develop it for VRS realtime simulation.

Depending on the developments and their implementation in the considered flight mechanics code, additional activities could be envisaged. Hence:

2) Once the VRS modeling will be in a suitable tradeoff between fidelity and rapidity, the pilot-machine interface will be studied with several levels of safety with respect to the VRS, for examples: avoidance of entering into the VRS domain, alert when entering, pilot assistance for recovery and exit from VRS.

Helicopters will be the first main topic, but the Master Thesis could also consider or report on the applicability of these developments for more complex aircraft combining multi rotary wings (e.g. electric VTOL new aircraft concepts).

The main focus will be on 1) because step 2) is depending not only on 1) but also on the possibility to use this aerodynamic model on our piloted simulation system.

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

#### Méthodes à mettre en oeuvre :

- |   |  |
|---|--|
| <input type="checkbox"/> Recherche théorique            | <input checked="" type="checkbox"/> Travail de synthèse      |
| <input checked="" type="checkbox"/> Recherche appliquée | <input checked="" type="checkbox"/> Travail de documentation |
| <input type="checkbox"/> Recherche expérimentale        | <input type="checkbox"/> Participation à une réalisation     |

Possibilité de prolongation en thèse : Oui

Durée du stage : Minimum : 5 Maximum : 6

Période souhaitée : 1<sup>er</sup> semestre 2025

### PROFIL DU STAGIAIRE

Connaissances et niveau requis :

Niveau bac+5 (école ingénieur ou Master  
aéronautique)

Ecoles ou établissements souhaités :

Ingénieur généraliste, spécialité aéronautique (ISAE,  
ESTACA, aerospace M.Sc.)

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