Centre de Recherche
de l'Ecole de l'Air
09.401

ÉCOLE DE L'AIR
& DE L'ESPACE
SALON-DE-PROVENCE

CReA

RECRUIT

Job title: Postdoctoral position: Flutter control of very flexible drone wings by adding nonlinear absorbers.

Workplace: Salon de Provence – Bouches du Rhône - France

Main scientific domain: Structural dynamics, aeroelasticity

Category: Level I

Type of contract: CDD fixed-time contract **Period of the contract:** 24 months

Amount of work: full time

Remuneration: up to € 3000 gross

Desired date of assignment: 01 March 2022

DESCRIPTION OF ACTIVITIES

Key words

Nonlinear dynamics, aeroelasticity, damping, vibration control, modelling, numerical analysis.

Context

Considering CREA anchorage in the military aeronautical environment, and its geographical location within the 701 air base, which gives it privileged access to experimental facilities, research work on the multidisciplinary design and use of UAVs is a major focus of its scientific project.

This postdoctoral research project is part of the so-called HALION project, carried out in collaboration with ISAE-SUPAERO and funded by the French Innovation Defense Agency. ISAE-SUPAERO plans to design and manufacture a high-altitude long endurance drone demonstrator (called HALE drone) powered mainly by solar energy. The resulting very flexible structure leads to many technical challenges. The objective of the HALION project is to study the possibility of using active and passive stabilization systems to mitigate the effects of flutter that is currently an important cause of flight range limitation. By adding passive dampers to the structure, it may be possible to control this instability at an acceptable low level of vibration and/or to push back its occurrence in the flight range.

In the work planned at CREA, the researcher will focus on the use of a structural nonlinear absorber to control the global vibrational amplitude. This type of method has shown its efficiency on simple models, but its integration in a structure showing geometric nonlinearities and under nonlinear aeroelastic loading is a real challenge.

Work to be done

The first step will be to develop a numerical simulator based on a relatively accurate structural model of the wing, considering both geometric nonlinearities and aeroelastic forces. The proposed developments will be built on previous work focused on nonlinear beam models [1]. The approach used is an extension of Hodges [2] twisted and pre-bent beam model that includes the warping of cross-sections. To extend this simulator to a HALE flight simulator, the main difficulty will be to integrate the predominant aeroelastic effects into the model (see [3]). A validation by comparison with the GEBTAero code [4] currently being developed at CREA will be done. It is also expected to collaborate with researchers from ISAE-SUPAERO in order to implement their development in terms of active control of flutter stabilization within the HALE simulator.

After validation of the structural model of the wing under aeroelastic loading, the potential contribution of nonlinear passive damping will be studied. The nonlinear physics involved will first have to be mastered (see [5] for example). Then, the nonlinear absorber will be integrated into the HALE simulator to perform parametric studies and investigate the influence of both the added mass and the increased damping capabilities on flutter control.

Publication of scientific articles highlighting the innovative results is also expected.

[1] Di Palma, N., Chouvion, B. and Thouverez, F., 2022. https://hal.archives-ouvertes.fr/hal-03353678
[2] Hodges, D.H., Dowell, E.H., 1974. https://ntrs.nasa.gov/citations/19750005242
[3] Peters, D. A., Karunamoorthy, S., and Cao, W. M., 1995. https://doi.org/10.2514/3.46718
[4] Kirsch, B., Montagnier, O., Bénard, E. and Faure, T.M., 2020. https://doi.org/10.1016/j.jfluidstructs.2020.102930
[5] Y. Starosvetsky, O. V. Gendelman, 2009. https://doi.org/10.1016/j.jsv.2009.02.052

PROFILE / SKILLS REQUIRED

- Doctorate in structural mechanics, or in fluid mechanics with a component in aeroelasticity.
- Strong skills in numerical analysis tools (Matlab or equivalent) are required.
- Particular interest in communication and writing scientific articles.
- The applicant must be of European nationality.

PRESENTATION OF THE PROFESSIONNAL ENVIRONMENT

The Air and Space Academy is a major military school (with EPSCP-GE status) located in Salon-de-Provence, authorized to deliver the title of engineer. It is a member of the Conference des Grandes Écoles and the ISAE group (SUPAERO, ENSMA, ESTACA, The Air and Space Academy). It is responsible for the initial training of all Air Force and Space Force officers.

PRESENTATION OF THE HOST STRUCTURE

The Centre de Recherche de l'Ecole de l'Air (CREA) is the multidisciplinary research unit of the Air and Space Academy. It is closely linked to the 701 Air Force Base, which gives it the rare ability to access aeronautical resources such as aircraft or flight zones. It also maintains partnerships with major players in the defence and aeronautics sectors (DGA, CEA, ONERA, Dassault Aviation, SAFE competitiveness cluster) as well as academics (Aix-Marseille University, ISAE group schools, IRSEM, etc.).
The CREA is composed of about thirty research professors from many disciplines: history, sociology, political science, mathematics, fluid and structural mechanics, cognitive science, computer science, signal processing. Its members conduct academic research with a common object: the determinants of the evolution of the military use of aeronautical and space systems.

PRACTICAL INFORMATION

Restaurant on site. Nurseries and schools in the area. Access to the sports facilities of the Air and Space Academy. Sports and arts club: many activities for executives and families. Very active social and festival committees.

To apply

The documents listed below should only be sent to the contacts listed in the job description:

- An academic resume
- A cover letter
- A letter of recomandation (if possible),
- The report of the defence.

The first contact will be made by simply sending a CV to the scientific referent.

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CONTACTS FOR THE SUBMISSION OF APPLICATIONS:

- **Scientific advisor :** Benjamin Chouvion – Maître de conférences détaché au CREA
Email : benjamin.chouvion@ecole-air.fr

- **Head of department :** LCL Bertrand Viaud – Directeur du CREA
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- **Collective Management Office HR PC**
tél : 04.13.93.85.14 ou 04.13.93.84.88
Email : recrutement@ecole-air.fr et/ou ea-dgs-srh.recrutement.fct@intradef.gouv.fr

Deadline for applications: 15 january 2022