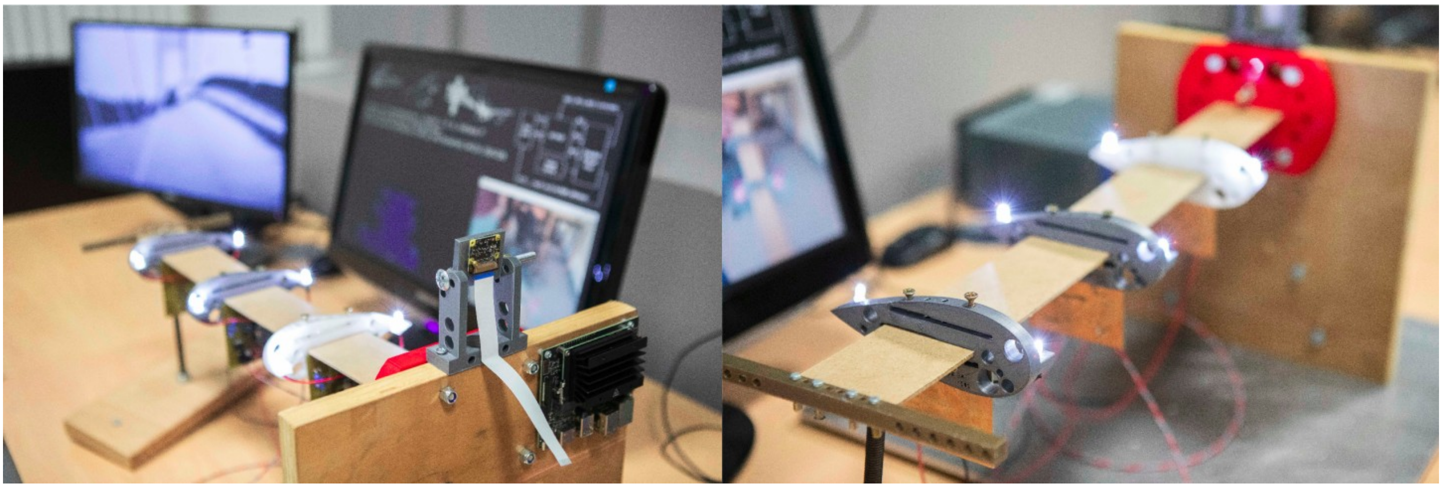
# Open Postdoctoral Position in Control Systems



**ISAE-SUPAERO – Department of Aerospace Vehicles Design and Control (DCAS)**
Toulouse (France)

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- **Research Project :** In-flight visual-inertial estimation of wing shape for high-aspect-ratio aircraft.

- **Work description** :

The aeronautic engineering community has long confronted reducing aerodynamic drag during aircraft design to lower fuel consumption. A known theoretical solution is to increase the wing aspect ratio (i.e., wingspan to chord lengths ratio). In practice, the resulting increased structural flexibility in high-aspect-ratio wing designs progressively couples aeroelastics with flight dynamics and generally gives rise to instability or poor handling qualities. Stable and safe piloting calls for stability augmentation systems that simultaneously account for elastic and traditional flight dynamics degrees of freedom.

High-altitude pseudo-satellite (HAPS) platforms provide notable motivating examples. They fly above the troposphere, thus avoiding atmospheric disturbances during cruise flight. This feature is desirable since current solar energy technologies provide limited power, which significantly motivates lightweight, flexible structures, which are, unfortunately, very susceptible to turbulence. However, HAPS aircraft still suffers from disturbances during climb and descend phases in the troposphere, significantly pushing the platform from its traditional linear envelope into nonlinear regimes. Such phenomena have been observed in recent mishaps in different platforms during tropospheric flight and reported in [1,2]. These mishaps expose the vulnerability to disturbances that quickly cause excessive deviation from the nominal flight set-points. Therefore, safer tropospheric flight calls for nonlinear robust stability augmentation and wing shape estimation systems.

More specifically, this research position assists the implementation of a state observer for a very flexible aircraft (namely, the **HAL**ION project) to estimate (during flight) its state configuration, including the shape of the wing and its derivatives for control purposes. We have previously developed a novel technique [3] that uses a combination of inertial engineering and computer vision. This project pursues additional answers to obstacles precluding its implementation in real-time using extended Kalman filtering, inertial navigation, and computer vision.

- **Candidate profile** :

We are looking for self-motivated team-player candidates that match the following profile:

- A PhD degree in Aerospace Engineering, Control Systems, Robotics, or Dynamic Systems-related disciplines with excellent grades;
- Excellent knowledge in dynamic systems;
- Numerical simulation and programming skills (e.g., MATLAB, C/C++, CUDA);
- Embedded systems knowledge;
- Excellent oral and written communication skills;
- English language mastery (writing and presenting) is mandatory.

- **Conditions of employment :**

A full-time employment for one year, including:

- A gross monthly salary and benefits in accordance to the ISAE-SUPAERO standard;
- A rich, diverse, and stimulating research group.

Candidates are expected to start around **September 2022**.

- **Application :**

All applications should be compressed (.zip, 5MB max.) and submitted by email to the addresses below, including:

- Cover letter including a statement of purpose and previous experiences;
- Detailed curriculum vitae;
- A scientific writing sample (PhD thesis, seminar paper, or equivalent);
- Contact information of two references.

Applications will be reviewed **on a rolling basis**. The current status of the position is updated in real-time on the group website: http://www.ionlab.fr.

For more information regarding this position, please contact:

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- **References :**

[1] Noll, T. E., Brown, J. M., Perez-Davis, M. E., Ishmael, S. D., Tiffany, G. C., and Gaier, M., "Investigation of the Helios prototype aircraft mishap Volume I: Mishap report," NASA Rept. 64317, 2004.
[2] "In-flight break-up involving Airbus Zephyr unmanned aerial vehicle," Australian Transport Safety Bureau, Transport Safety Report, Aviation Ocurrence Investigation (Short), AO-2019-056, 28 September 2020.
[3] Lustosa, L. R., Kolmanovsky, I., Cesnik, C. E. S., and Vetrano, F., "Aided Inertial Estimation of Wing Shape," Journal of Guidance, Control, and Dynamics, Vol. 44, No. 2, 2021, pp. 210–219. https://doi.org/10.2514/1.G005368