

## Thesis proposal for a Doctoral position 2026-2029

### PARTENAIRES



**Key words:** Artificial intelligence, fluid-structure interaction, flexible parachutes, numerical methods & simulations

**Department:** Structures and Materials Mechanics (DMSM)

### JOB DESCRIPTION:

PhD student

### MISSIONS:

#### **Research project description :**

**Context:** The complexity and unstable, uncertain, and nonlinear response of large flexible parachute canopies interacting with a surrounding fluid under maneuvering forces pose significant challenges for deterministic flight mechanics control models and algorithms. Classical, weakly or strongly coupled finite element simulation methods, which are costly and unstable, cannot be used to improve their design.

**Project:** To meet this modeling and simulation challenge, a research structural analysis code is being developed, based on a discrete method in the team [1]. This code is computationally efficient and allows for the evaluation of the influence of local fabric deformation effects on maneuvering forces. The aim of this thesis is to improve the existing tool and leverage the computational results to generate a training database for artificial intelligence (AI) algorithms [2,3]. The thesis seeks to

fulfill the ambition of fostering communication and interaction between structural mechanics, control theory, and mathematical AI algorithms.

**Planned work:** The first step involves enriching the code and performing simulations of certain stable attitudes within the flight envelope, followed by simulations of chosen attitudes likely to generate instabilities or a loss of controllability. The calculation results will be used to generate a database for training AI algorithms (particularly reinforcement learning). Once the algorithms are selected from this database, the second step involves using them to predict the risks of loss of stability or significant changes in aerodynamic coefficients during maneuvers within the simulation of fluid-structure interaction between the parachute and the surrounding air—that is, during numerically controlled variable attitudes. Based on the interaction between the numerical simulation, which deforms the canopy, and the AI algorithm, which indicates a risk of instability, the simulation is then used to correct the action on the lines and stabilize the canopy.

Location: Toulouse, Clément ADER Institute (CNRS UMR 5312), , ISAE-SUPAERO (DMSM)

### **Bibliography:**

[1] T. Lodies, M. Charlotte, N. Gourdain, 'A Fluid Structure Interaction Methodology to design Paragliders and Parachutes'. 26<sup>th</sup> AIAA Aerodynamic Decelerator Systems Technology Conference, Toulouse, Mai 2022.

[2] J. He, et al. "From physically-based to learning-based in cloth simulation: evolution and future—a scoping review: J. He et al." *The Visual Computer* 41.15 (2025): 12711-12742.

[3] G. Chen, et al. "Learning Simulatable Models of Cloth with Spatially-varying Constitutive Properties for Robotics." *Learning to Simulate Robot Worlds*.

### REQUIRED PROFILE/SKILLS:

Master's degree or engineer in mechanics or applied mathematics is required. A good aptitude or interest for numerical methods, programming and simulation is expected. Knowledge of machine learning would be desirable.

**EXPERIENCE/GRADE:** Master of sciences, Masters (BAC+5), possible exemption for engineers (cf. [https://adum.fr/candidature/index.pl?matricule\\_prop=](https://adum.fr/candidature/index.pl?matricule_prop=) ).



**COMPENSATION:** ~2000€ / MOIS

**DURATION:** 36 MONTHS

**RYTHM:** Full time

**LOCATION:** TOULOUSE, Clément ADER INSTITUTE (ICA) & ISAE-SUPAERO (DMSM)

**RESPONSIBLE OF THE SUBJECT:**

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TÉL. :

**APPLICATION PROCESS:** The candidate must hold a national master's degree or another degree conferring the rank of master, following a course of study or professional experience establishing their aptitude for research (cf. [https://adum.fr/candidature/index.pl?matricule\\_prop=](https://adum.fr/candidature/index.pl?matricule_prop=) ).

The official link to the PhD position offer announcement is:

[https://adum.fr/as/ed/voirproposition.pl?site=adumR&matricule\\_prop=70883](https://adum.fr/as/ed/voirproposition.pl?site=adumR&matricule_prop=70883)

Instructions for submitting your application can be found on the following page:

<https://adum.fr/as/ed/candidatureED.pl?mat=177&sec=mod>

**APPLICATION DEADLINE:** May, 15th 2026 (11 :59pm)

**REFERENCES:** N/A