PhD Project: Robust Estimation & Control of Aerial Co-Manipulators

Labs	*U2IS (SyRRo team), ENSTA Paris-Saclay & ONERA Paris-Saclay*
Supervisors	*Mario GLEIRSCHER & Julien ALEXANDRE DIT SANDRETTO, ENSTA* *Nicolas MERLINGE, ONERA*
Doctoral school	*Institut Polytechnique de Paris (IP Paris)*
Start date	*November 2026*
Duration	*3 years (fixed-term contract, CDD)*
Location	*ENSTA Paris-Saclay, France*
Salary	*According to regulations*
Keywords	*Autonomous robots, multi-robot collaboration, decentralised nonlinear model-predictive control, high-dimensional signal processing*

About the Academic Environment. ENSTA is a founding member of the Institut Polytechnique de Paris (IP Paris). The Computer Science & Systems Engineering lab (U2IS) at ENSTA Paris is known internationally for its expertise in robotics and autonomous systems, with applications in transportation, defence, and energy. The lab's focus is on fundamental challenges in vision, robotics, intelligent decision & control, embedded systems, signal & image processing, and system design & analysis. U2IS is embedded into an ecosystem of excellence in artificial intelligence. It maintains strong relationships with partners, such as the CIEDS and Hi!Paris centres, as well as INRIA and ONERA, with which joint teams have been created.

This PhD project will be funded by the AID via the CIEDS 2026 grant "RoCAM".

Context and Motivation. Robust control of multiple aerial robots collaboratively manipulating non-rigid payloads is an extraordinarily complex problem, especially under partial observability, estimator imprecision, perturbed control, noisy communication, and other disturbances and control modes.

Research Objective. The RoCAM project aims at designing an adaptive estimation and optimal control technique for multi-AAV systems transporting non-rigid payloads, exceeding the performance of state-of-the-art approaches while guaranteeing precise control.

Approach and Envisaged Procedure. For stable control of multiple AAVs that (dis)engage in transportation tasks, the project builds on recent advances in robust estimation and optimal control. Robustness can be increased by considering uncertainties (e.g., imprecise state estimation, wind). Real-time capabilities can be supported by using adaptive approximations. The research challenges in the RoCAM project include (i) dealing with non-linearities in the estimation and control models, (ii) compensating for ambiguities in estimating unobservable quantities, (iii) establishing precise enough predictions for decision making, and (iv) employing real-time capable and efficient estimation and control techniques.

The offered PhD project will contribute to a recently initiated multi-AAV research activity at U2IS under the lead of Mario Gleirscher, with the aim to develop (a) a robust payload estimation concept for fast stabilisation of multi-AAV dynamics [M24] , and (b) an improved robust optimal control concept based on adaptive abstractions for online use [GH25] , both based on an improved multi-AAV model for precise aerial co-manipulation of non-rigid payloads under

collision avoidance [AC+21]. A comparative evaluation will be performed in the simulator and be transferred into a real-world demonstrator.

Characteristics of a Good Result. The estimation and control models are accurate, the algorithms match or supersede state-of-the-art performance, the algorithms are suitable for being used online in the lab demonstrator.

Candidate Profile.

- University or engineering degree in applied mathematics (statistical and numerical methods), control theory (robotics), electrical engineering (signal processing, mechatronics), or computer science (digital control).
- Graduate-level knowledge in at least one of the following domains: robust estimation, model-predictive control, digital control.
- Interest in control of autonomous robots and multi-agent systems in aerial logistics and transportation.
- Good knowledge in programming with C, C++, and Python; including state-of-the-art packages related to the above topics.
- Interest in scientific writing and publishing; willingness to proactively invest and to achieve highest scientific standards.
- Ability to work reliably towards agreed deadlines and to integrate and communicate with the surrounding research team.
- Fluent in English, written and spoken (C1, if possible). Good knowledge of French (B1 or better) desirable.

Application. Students in their last year can apply before their official graduation. To apply, please, **upload your complete dossier** including

- a coverletter (max. 1 page),
- a succinct and up-to-date CV (max. 2 pages),
- grade sheets (relevé de notes) from the last two years of study, ideally including courses relevant for the topic,
- a specimen of your scientific work relevant for the post (e.g., your single-authored MSc thesis or a first-authored seminar paper), if available,
- up to three nominations of academic contacts (full name, role & institutional email), and
- letter(s) of recommendation, if available,

as a single PDF file to https://enstaparis.recruitee.com/o/doctorant. Submissions via email are not guaranteed to be considered. Applications from candidates who do not hold French nationality will be subject to further verification by the relevant authorities. Shortlisted candidates will be invited for an interview. This interview will include a 10-15 min presentation about the specimen as well as a scientific paper chosen by the hiring committee. Applications will be considered before July 31 or until this post is filled.

Related Publications (open access)

[AC+21] Julien Alexandre dit Sandretto, Alexandre Chapoutot, Christophe Garion, Xavier Thirioux, and Ghiles Ziat. Constraint-based verification of formation control. In CDC, pp. 7136–7141. IEEE, 2021. https://doi.org/10.1109/cdc45484.2021.9683622 [URL]

[GH25] Gleirscher, M., Hönnecke, P. (2025). A Parametric Model for Near-Optimal Online Synthesis with Robust Reach-Avoid Guarantees. In: Bridging the Gap Between AI and Reality. AISoLA 2024. LNCS, vol 16032. Springer. https://doi.org/10.1007/978-3-032-01377-4_14

[M24] Merlinge, N. (2024). Set inversion and box contraction on Lie groups using interval analysis. *Automatica*, *165*, 111688. https://doi.org/10.1016/j.automatica.2024.111688 [URL]