Exploration of Control Architectures for a Collaborative Aircraft System

Record number : OPR-1275

Overview

RESEARCH DIRECTION

David Rancourt, Professeur - Department of Mechanical Engineering

INFORMATION

david.rancourt2@usherbrooke.ca

ADMINISTRATIVE UNIT(S)

Faculté de génie
Département de génie mécanique
Institut interdisciplinaire d'innovation technologique (3IT)

LEVEL(S)

3e cycle

LOCATION(S)

3IT - Institut interdisciplinaire d'innovation technologique

Project Description

Context:

An alternative concept to helicopters for lifting and moving vertical loads consists of using autonomous tethered airplanes flying collaboratively. This approach reduces energy consumption and better addresses needs such as wildfire suppression and surveillance of Northern Canada. The COALL project aims to improve the understanding of tethered aerial systems and to strengthen the control of collaborative aircraft systems with a significant mass ratio by developing full-scale models as well as scaled-down models and prototypes. Although a first demonstration took place in 2022, substantial work remains before a prototype can complete a full mission.

The concept represents a pioneering approach that revolutionizes aerial work by leveraging fixed-wing collaborative tethered aircraft to lift payloads. While helicopters remain essential for many missions, this system opens new perspectives: 1- Extended endurance and high-altitude operations, enabling, for example, the rapid deployment of an aerial observation tower for Canadian Arctic surveillance. 2- A new mode of heavy-load transportation for wildfire suppression, with improved energy efficiency.

Project Objectives:

In the studied configuration, the aircraft operate in atypical flight conditions: significant lateral accelerations, rapid speed variations, and strong dynamic coupling between the load and the aircraft.

The PhD will focus on the design and evaluation of robust control architectures enabling optimal trajectory tracking despite these constraints. Several directions will be explored:
- Development and comparison of collaborative control formulations for tethered aircraft, with emphasis on the use of magnetorheological (MR) actuators to modulate cable tension and reduce dynamic coupling.
- Dynamic modeling of the MR actuator and integration into the global system model.Design, simulation, and experimental validation of force control laws.

Candidate Profile:
- Mechanical Engineering (aero/control) or Robotics Engineering (dynamics/control).
- Solid foundation in control and interest in collaborative systems.
- Programming skills (Matlab, C++).
- Strong interest in dynamic modeling and control optimization.
- Team spirit, autonomy, and scientific curiosity.

Discipline(s) by sector

Sciences naturelles et génie

Génie mécanique

Funding offered

Yes

$ 30 000

The last update was on 24 October 2025. The University reserves the right to modify its projects without notice.