Master project, 2021-2022

MODELLING AND CONTROL OF A PROPULSION UNIT (PROPELLER / ELECTRIC MOTOR) FOR EVTOL APPLICATION

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Context

This internship is proposed in a context of strong development of electric, multi-copter, flying vehicles, also known as "eVTOL"[i] (drones and other urban taxis, see an example below) for the future generation of transportation. These new aerodynamic architectures associated to an unusual urban environment raise many scientific questions on the optimization of these aircrafts, but also on safety and regulatory aspects.

In order to support a larger-scale project involving the two LMFL & L2EP laboratories as well as ONERA, this internship proposes to establish the system modelling of a simplified "electric motor / propeller" assembly. This modelling will be compared to existing experimental databases on an isolated propeller issuing from a wind tunnel test campaign. The obtained model of 1 electric/propeller unit will be integrated in a studied quadcopter vehicle where there is a necessity to have a full model (of the vehicle) to control the flight by using EMR[ii] developed by Control team of L2EP. LMFL has knowledges on the aerodynamic aspect of the vehicle.

CityAirbus, an eVTOL example

Objective

By using EMR, the first objective of this project is to model and control of a "propeller/electrical machine" unit. Then, a quadcopter or hexacopter drone will be considered for control. Because the use of four or six units of the studied vehicle, different strategies could be proposed to ensure an optimal flight in term of energy consumption.

Work steps

- Bibliographic analysis on the subject.
- Establishment of a static model of a "propeller/electric machine" unit.
- Comparison with existing databases.
- Modelling and control of a quadcopter using EMR.
- Analysis and optimization of different configurations (4, 6 rotors).
- Possibility of adding dynamic effects (transition from hovering to forward flight).

Key words

System Modelling, EMR, Electrical Drives Model and Control, Quadcopter and Hexacopter Drones, Fluid Mechanic

References

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[i] https://evtol.com/
[ii] http://emr.univ-lille1.fr/