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Colibri: Design, Optimization, and Data Driven Control of small VTOLs

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Context

UAVs are used for several purposes:

- Search and rescue missions
- Delivery
- Inspection, mapping, and research
- Agriculture
- Leisure

Hybrid vehicles ensures **mission flexibility** mixing vertical take-off and landing with higher forward flight **efficiency**.

Hybrid drone for delivery of goods by DHL

Research work

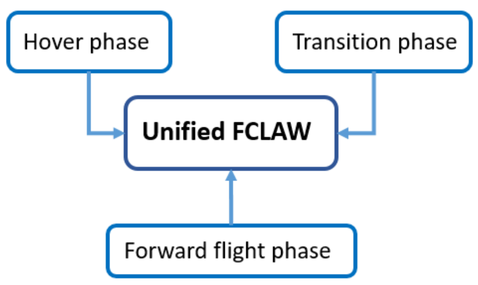
Design of tilt-wing vehicles

- Automated **design process** relying both on computational and experimental results [5]
- Focus on **wing-propulsion interaction** modeling [2].

Wing and propeller experiments at ENAC

Controls system design

- **Trajectory** optimization and tracking [7]
- Benchmark of **unified flight control laws** suitable for the broad flight envelope of VTOLs [6] [1] [4]



Control law for hover, transition, and forward flight

MDO problem formulation

- **MDO architectures** for design and control law optimization with **data driven** model enrichment
- **Multifidelity** optimization

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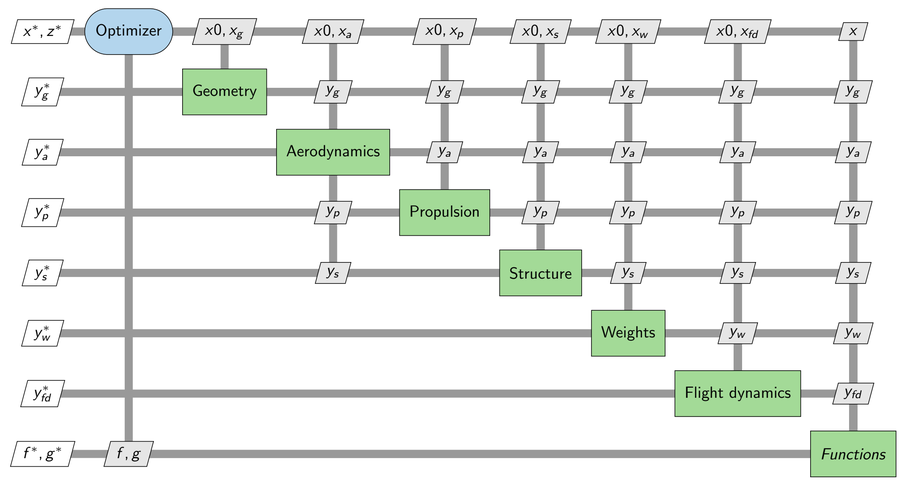
[2] ENAC, Toulouse, France

Objective

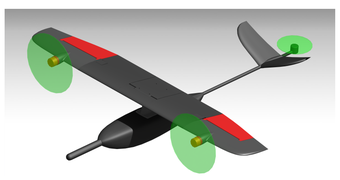
Development of a **lightweight MDO** methodology for small VTOLs.



XDSM of VTOL problem

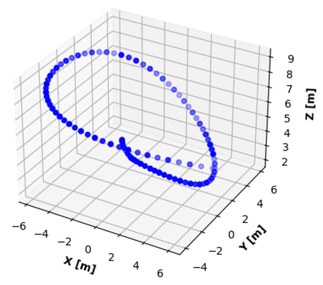
Perspectives

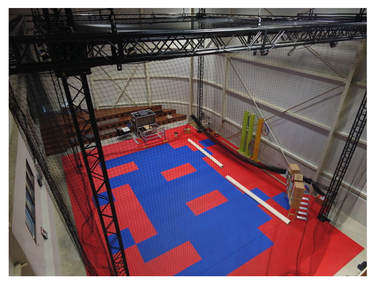
Application of the methodology to the design of a UAV for **atmospheric research** mission. **Geoscientific** applications [3] are also envisioned.



Colibri baseline design for atmospheric research

A starting point: quadcopter design and optimization.
For a given vehicle and set of waypoints, find the optimized **trajectory** and **propeller geometry**. Evaluate the results at ENAC's *volière*.





Optimized trajectory for ENAC's flight arena

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[5] J. Holsten, T. Ostermann, and D. Moormann. Design and wind tunnel tests of a tiltwing UAV. *CEAS Aeronautical Journal*, 2(1):69–79, December 2011.

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