

The project aims to create a physical and virtual laboratory for the monitoring and diagnosis of light aircraft. Heterogeneous measurements are processed through Data Fusion techniques and integrated with simulations of a Digital Twin.

Data classification algorithms provide indicators of the aircraft's health status to promptly identify any faults. The case study is an ultralight helicopter, for which a simplified test bench is created to validate the procedure.



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LEAD PARTNER



PROJECT PARTNER



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COMPANIES



Cofinanziato
dall'Unione europea



IL PROGETTO LA2COM È REALIZZATO GRAZIE AI
FONDI EUROPEI DELLA REGIONE EMILIA-ROMAGNA.



LA²COM
Laboratory of Lightweight
Aircrafts **C**ondition **M**onitoring

Laboratory of
Lightweight Aircrafts
Condition Monitoring:
integration of
multimodal experimental
data fusion and digital
twin simulations

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GOALS

- Select appropriate sensors for the type of component being monitored
- Build Data Fusion algorithms that integrate heterogeneous signals from aircraft
- Develop Machine Learning techniques for monitoring, diagnosis, and prognosis of aircraft by integrating Data Fusion techniques
- Develop the Digital Twin of the aircraft, integrating a finite element model, a lumped parameter model of the transmission system, and a motion control model under various flight conditions

RESULTS

- Sensorize the aircraft
- Develop Machine Learning techniques for monitoring, diagnosis, and prognosis of aircraft by integrating Data Fusion techniques
- Develop the Digital Twin of the aircraft, integrating a finite element model, a lumped parameter model of the transmission system, and a motion control model under various flight conditions
- Prototype test bench and validated Digital Twin of the test bench
- Simulated dataset of signals in the presence of damaged components
- Real-time diagnosis and prognosis system based on the Digital Twin
- Design methodology for optimizing aircraft design to achieve weight reduction and lower fuel consumption

ACTIVITY PLAN

The project is divided into several phases:

- **Selection and installation of additional sensors:** Analysis of the system to identify the sensors to be integrated with those already on-board to acquire all the necessary data for comprehensive aircraft monitoring.
- **Integration of experimental data through Data Fusion techniques:** The monitored signals are heterogeneous, as they are acquired through different types of sensors, and must therefore be processed to obtain a homogeneous dataset on which classification algorithms can be effectively applied.
- **Development of Machine Learning techniques:** Definition of classification algorithms and ad-hoc indicators capable of monitoring and diagnosing the health status of the aircraft, based on representative features.
- **Creation of the aircraft's Digital Twin:** Advanced mathematical models, used to simulate the aircraft in various domains, are integrated to create a Digital Twin of the aircraft. This will allow real-time simulations to diagnose and prognosticate structural issues, simulate damages, and optimize design.
- **Setup of the test bench:** The effectiveness and reliability of the developed techniques and systems are validated through tests conducted on a test bench specifically created as a simplified mockup of the helicopter chosen as the case study.

