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

HIGHFTECH ENGINEERING S.R.L.

PROJECT

IN4 Università degli Studi di Ferrara

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA | CENTRO INTERDIPARTIMENTALE DI RICERCA INDUSTRIALE AEROSPAZIALE - AEROSPACE

DEMOCENTER

COMPANIES

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COESIONE ITALIA 21-27 EMILIA-ROMAGNA | Cofinanziato dall'Unione europea | RegioneEmilia-Romagna

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

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LAboratory of **L**ightweight **A**ircrafts **CO**ndition **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

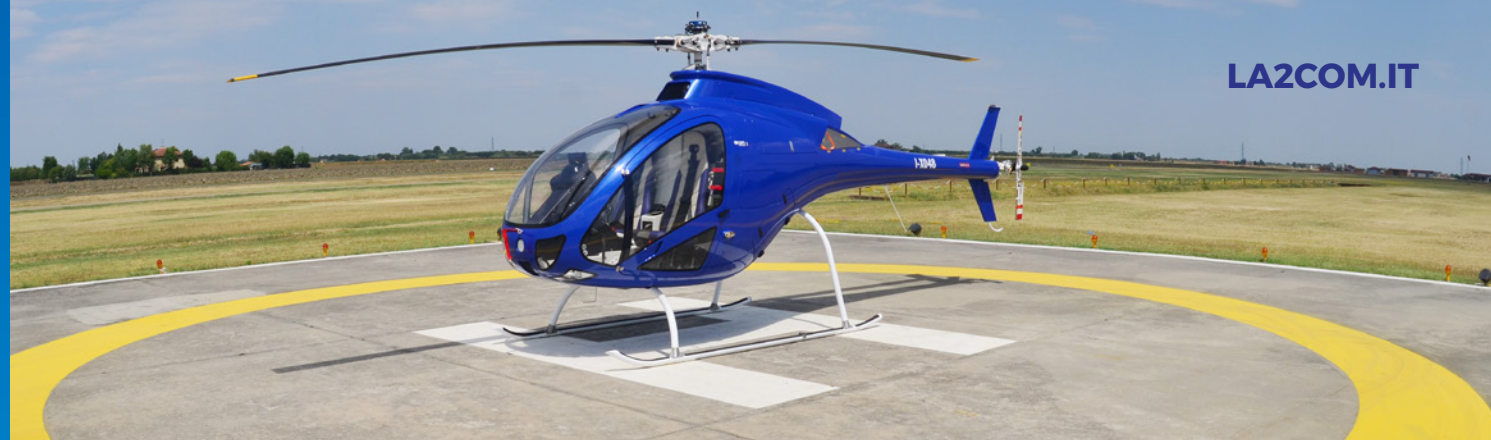
RESULTS

- Sensorize the aircraft
- Machine Learning algorithms for monitoring and diagnosis based on features constructed through Data Fusion
- Digital Twin of the aircraft
- 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.**



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