AEROSPACE ENGINEERING

NIMBUS - Development of a methodology for the "hardware in the loop" integration of data acquired in flight with "digital twins" and augmented reality tools

Funded By	NIMBUS S.R.L. [P.iva/CF:09434470010]
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Context of the research activity	The research consists in defining a method to rationally choose type, number, and placement of sensors inside an aircraft (model aircraft) with the electronic devices for data acquisition, processing, and transmission, in order to maximize the gained information useful for identifying the flight status. The interpretation of the data will be supported by the use of digital models of the aircraft and its subsystems, models that will be developed "ad hoc".
Objectives	The research scope is inspired by the modern flight test technology, supported by digital models (digital twin), with stronger integration of a modern ground station functions, equipped with augmented reality devices. The objectives are multiple: 1) define a method for choosing the most suitable sensor suite to capture a specific phenomenon involving the aircraft in operations: in this case an important role comes from industrial collaboration that can suggest more suitable operational requirements and use cases. 2) Define the necessary avionics configuration (conditioning and data acquisition from sensors, interrogation of embedded "digital twin" models, data processing and definition of inferences useful for recognizing the contingent state, data transmission to the ground), considering the type of low-cost model aircraft. 3) Define the architecture of the ground station that integrates augmented reality devices and the human machine interfaces to implement improved situational awareness logics. 4) Validate the system with a flight test campaign that allows to verify the quality of the design choices; also in this case the industrial collaboration will allow to offer a "certified" support to the flight tests. At the end of the doctoral activity, a procedure will be drawn up that summarizes the most suitable aircraft setup procedure and the ground station configuration with a lessons learned summary.
Skills and competencies	Experimental activity, in the laboratory and on field. Integration of sensors on structures and on-board systems. Elements of diagnostics and prognostics. Data acquisition and processing with microprocessors and embedded

for the development of the activity	computing (Arduino and Raspberry Pi). Fundamentals of WiFi data transmission and telemetry. Development of models in Matlab-Simulink. Python and C programming. 3D printing techniques. Use of augmented reality devices.