EUROPEAN DEFENCE AGENCY

SAMAS – SHM APPLICATION TO REMOTELY PILOTED AIRCRAFT SYSTEMS

Participating Members

Consortia/Organization

POLITECNICO MILANO 1863

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LEONARDO

The use of Remotely Piloted Aircraft Systems (RPAS) is nowadays growing and recent market studies estimated that the spending on RPAS will almost double in the next decade. They offer the possibility to extend the duration of vehicles as well as the acceptance of high-risk mission profiles, due to the absence of a human pilot on-board. Their utilization would be not only be connected to military purposes but also to security-related, scientific and environmental missions. Nevertheless, the absence of any physical pilot poses some new challenges that have to be addressed through applied research, in particular concerning structural ageing as well as the occurrence of overloads and impacts, the latter being a primary concern for composite materials. With this in mind, the development of a reliable Structural Health Monitoring (SHM) system is a mandatory step to guarantee the RPAS efficiency and safety, in view of their progressive integration into the non-segregated airspace within any specified area of operations.

Objectives

The main innovative aspect of the methodology pursued in SAMAS is the coupling of model information and signals from sensors for the robust interpretation of sensor readings. Specifically, the methodology is applied to load monitoring and impact identification, the latter for both low and high velocity phenomena.

Two platforms have been identified for the verification and validation of the project outcomes:

» Platform 1 (Figure 7a): the Hornet is a surveillance RPAS made of composite material and built by Military Air Works 1, properly sensorised and tested in-flight as part of the project activities

» Platform 1 (Figure 7b): the stabiliser of a MALE RPAS, made of composite material and build by Leonardo company, it is used for ground tests of both the load and impact monitoring system

ASTM Standard tests allowed the definition of material mechanical properties for the calibration of the numerical models. Then, tests on a laboratory scale were used to set the monitoring system parameters for their operation. Finally, the systems were installed on the platforms (figure 8 – system installation), performing flight tests in real conditions (figure 9 – flight test) and a laboratory-based online demonstration (figure 10 – demonstration).

The load monitoring system was able to real-time reconstruct the external aerodynamic load, approximated as an optimised number of lumped forces, then estimating the full-field variables of interest, either displacement, strain or stress.

The impact monitoring system was able to assess in real time the impact event, in terms of occurrence, location and type; then evaluating the health state of the structure relying on ultrasonic-based tomography techniques for the definition of the existence and position of the damage (figure 11 – impact monitoring).

The verification of the SAMAS activities has been done considering:

- SHM System Safety Assessment (SSA)
- SHM System Software reliability prediction
- Risk Assessment Tool (RAT) methodology for SHM implementation
- SAMAS compliance with regulations and feedback guidelines

The result of these investigations is formulated in the form of guidelines, from which it is clear that the success in SHM implementation and integration strongly depends on its ability to be integrated in the field of Integrated Logistics Support (ILS) and among all the available specifications.

Finally, a preliminary definition of the system devoted to the collection, elaboration, distribution and analysis of the SHM data for a RPAS is provided, dividing it into on-board and off-board segments.

Way Ahead

SAMAS is the third project in a row coordinated by Politecnico di Milano within the European Defence Agency (EDA) and focusing on SHM. This allowed to:

- Strengthen the synergies between Italy and Poland.
- Improve the knowledge and the skills necessary for the implementation of operating SHM systems.
- Enhance the industrial base fundamental for the SHM systems production and commercialization.

The SAMAS project brought the highest TRL among the three projects, pushing the consortium ahead toward the next project foreseen for the next years: SAMAS 2.

Related TBBs

- OSRA TBB 4 – System Diagnostics, Fault Prognostics, and Self Repair.

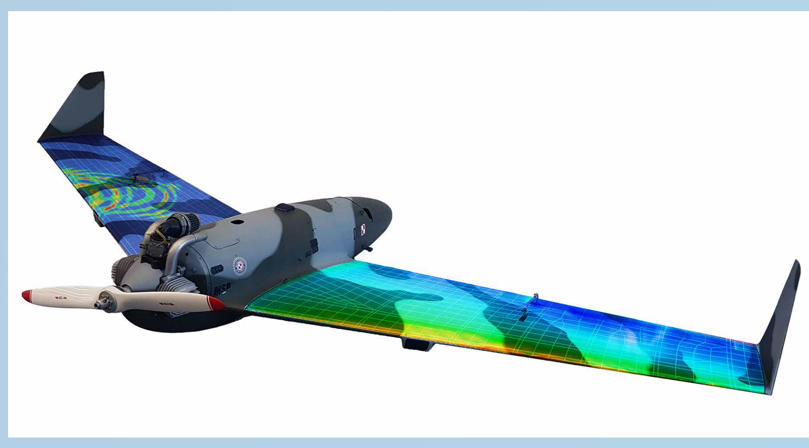

Figure 7a

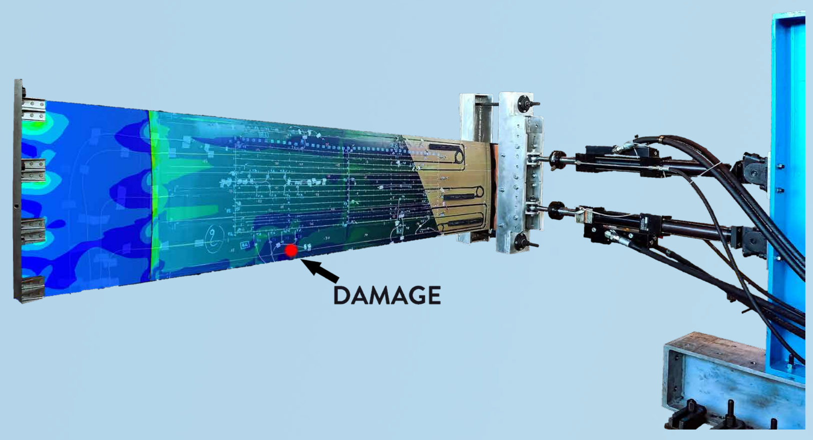

Figure 7b

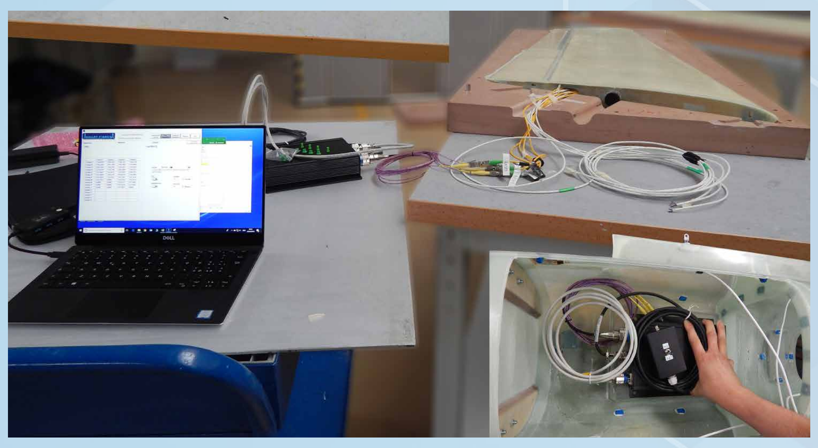

Figure 8 - System Installation

Figure 9 - Flight Test

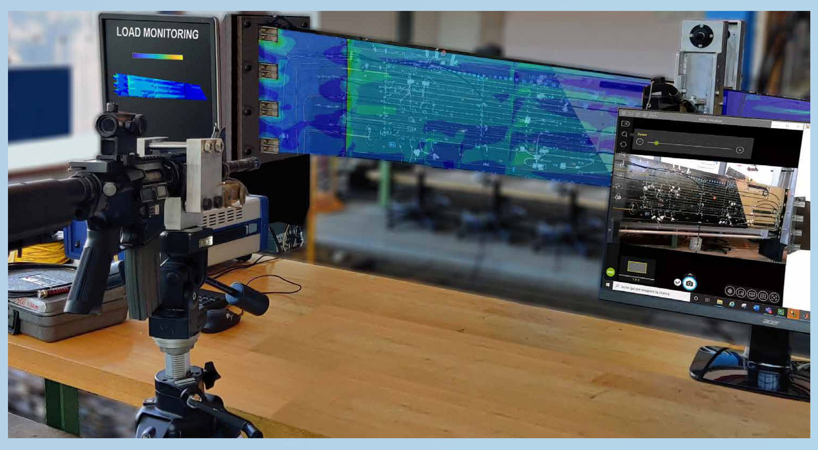

Figure 10 - Demonstration

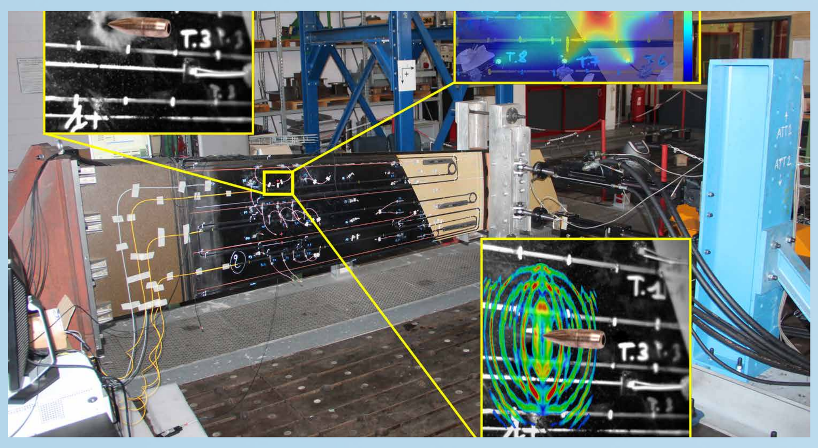

Figure 11 - Impact Monitoring

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EDA Activities
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