INTEGRATION OF STRUCTURAL HEALTH MONITORING FOR COMPOSITE STRUCTURES INTO THE AIRCRAFT HEALT MANAGEMENT AND MAINTENACE SYSTEMS

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SUMMARY

Acousto-ultrasonic Structural Health Monitoring was applied to damage detection on a realistic composite structure. A damage index was developed to allow the definition of damage state to be passed to the aircraft health management system. An approach was developed to incorporate this into the aircraft health management and maintenance systems.

Keywords: Composite aircraft structures, structural health monitoring, acousto ultrasonic, health management, maintenance management.

ABSTRACT

Advanced composite structures are becoming increasingly popular in aircraft applications. Their high specific strength and stiffness together with high fatigue and corrosion resistance make advanced composite materials an ideal selection for such demanding structural applications. They are also cost effective because of the ability to manufacture large complex shapes with low part counts. However, such structures are susceptible to in-service impact damage, which may lead to serious degradation of their structural integrity. As a result, such structures are over-designed to cater for such damage and they are subject to costly inspection and maintenance regimes. Structural Health Monitoring (SHM) may detect impact events and/or characterise any damage including its location and extent. The use of such technology has the potential to reduce conservatism in design and hence lead to more cost effective and fuel efficient structures. A more immediate benefit of SHM systems is the potential to reduce maintenance costs and increase platform availability through improved inspection techniques, particularly for inaccessible areas and flexible maintenance scheduling based on frequent monitoring.

Research was undertaken within the EU 6th Framework program TATEM to assess a number of SHM systems as to their technology-readiness for application to the SHM of a complex composite aircraft structure.

A number of commercially available SHM systems were assesses with respect to their ability to identify and monitor impact events and damage on aerospace composite structures. This evaluation was conducted via a test program on an F/A-18 horizontal stabilator in both a loaded and unloaded configurations [1].

A goal of the TATEM program has been to develop an approach to the handling and analysis of data obtained from SHM systems that can be integrated within an overall Integrated Vehicle Health Management (IVHM) system. As part of this approach the generation of a Damage Index (DI) data-file is required as an output of the SHM system. This DI data-file will contain the essential information of the structural state that is required by the Data Management Platform (DMP) for the diagnosis of current structural health and further prognosis. The DMP handles the data flow and analysis procedures as part of the IVHM (see Figure 1).

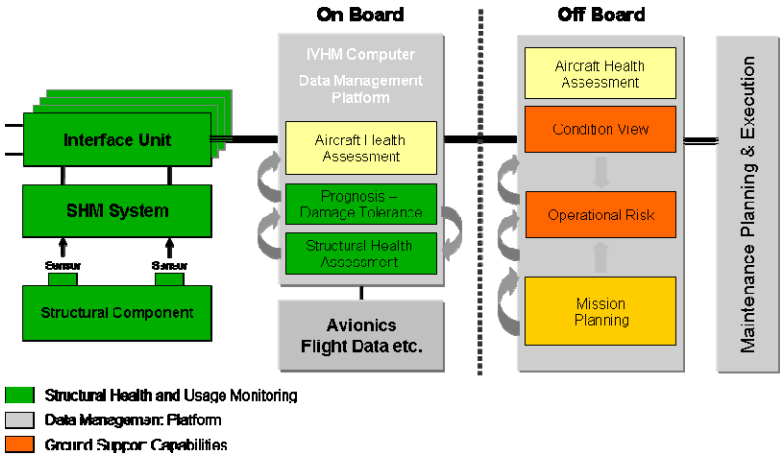

Figure 1. Conceptual approach for an aircraft health management system

This paper summarises the development of an appropriate damage index from SHM evaluations using a commercially available acousto-ultrasonic SHM system.

Methodologies are summarised, for the integration of the data generated from the SHM system into the aircraft health management and maintenance systems. This includes the definition of a Functional View for the health management process of aircraft composite structures. This functional view defines the step-wise process of data generation and handling and identifies the functional and system requirements for the process to be successfully undertaken.

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References

1. I. Herszberg, M. Bannister, M. Buderath, H.C.H. Li, E. Saenz, B. Whittingham, Z. Zhou, Application of SHM systems to a composite aircraft structure – a TATEM usecase. *Proceedings, 4th European Workshop on Structural Health Monitoring EWSHM 2008*, Cracow 2-4 July 2008.