Introduction

Structural Health Monitoring and Damage Prognosis of Metallic and non-Metallic Structures – Special Issue

This issue is a refereed compilation of selected papers presented at a conference on Structural Health Monitoring and Damage Prognosis of Metallic and non-Metallic Structures organised by the Aerospace Industries Division of the Institution of Mechanical Engineers (IMechE) that was held at the University of Sheffield UK in October 2006.

In the 21st century fibre reinforced plastics (FRP) can and will contribute for a substantial majority of the structural mass of an aircraft. They will be used extensively in the new Airbus A380 super jumbo, the first fully double-decked passenger jet (certified in spring 2007 to carry 853 passengers) that will take commercial flight in autumn 2007 and the new Boeing 787 Dreamliner aircraft. Composite materials offer a variety of advantages, however, affordability (reduced acquisition and direct operating costs, while maintaining or enhancing safety) is the key to survival in aerospace manufacturing, whether civil or military (A400M, Eurofighter, F-35). Advances in non-destructive damage detection and damage prognosis technology will enable increased performance and lower costs to be achieved with composite structures.

Structural health monitoring systems (SHM) have existed for a long time in some specific applications like civil structures which for several decades have been the subject for research on performance monitoring, modal analysis, condition assessment and damage detection. However, there recently has been a considerable upsurge in interest in the technologies for monitoring a wide range of high value structures and aerospace has been at the forefront of these developments. Fully developed structural health monitoring offers the possibility of knowing the damage state of an aircraft component/structure as well as having monitoring data available on factors controlling the further degradation of the structure such as the load spectrum and chemical environment. Together with the damage state information, a synthesis of these items offers the possibility of full prognostic capability in structures; i.e. the predictions of likely future life or probability of failure at all times in service. In addition, the implementation of structural monitoring systems may also have implications for airworthiness.

The conference drew together the state of the art in composites and metallic structural health monitoring, covering new sensing and processing hardware, data interrogation techniques (validation, extraction, normalisation), modelling and simulation to estimate the remaining useful life of the system and airworthiness issues. A range of aerospace, railway and civil engineering applications were presented and many of the concepts and approaches could be relevant to other industries (sports, naval, medical applications) seeking to exploit the benefits of SHM in composite and metallic constructions. Over 70 delegates from industry, research establishments and academia attended the event that was also sponsored by the Royal Aeronautical Society.

We would like to take this opportunity to thank the authors who submitted these high quality papers and, of course, the referees who helped ensure that high standards were maintained.

Last but not least we would like to acknowledge the efforts of Ms Lisa Rist (IMechE), Mrs Sarah Power and Mrs Jane Bradbury of the University of Sheffield for the organisation and running of the conference and for their assistance throughout the event.

Professor Costas Soutis

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