Design Framework Validation for a Hot Spot on Complex Aircraft Structures

J.-B. IHN, M. S. LEONARD, S. E. OLSON and M. P. DESIMIO

ABSTRACT

Aircraft structural components may have known "hot spots" where any initial damage is anticipated to occur or has consistently been observed in the field. Automated inspection of these areas, or hot spot monitoring, may offer significant time and cost savings for aircraft maintainers, particularly when the hot spots exist in areas that are difficult to access or where traditional NDE inspection methods will not work. This paper discusses the development of hot spot monitoring techniques for a metallic lug component using piezo-generated elastic waves. The development process utilizes the recently created SHM system design framework and uses a multi-step approach progressing from simple coupon tests to the full scale component for system validation. Initial testing has been performed on titanium dogbone coupons. This testing has demonstrated the potential to detect relatively small cracks. However, actual crack detection has been complicated by issues of sensor system robustness and the reliability of "truth" data. Subsequent testing has been performed using titanium cantilever beam specimens. Sensor robustness and the reliability of "truth" data have been improved, but additional testing is required to further refine the techniques as only limited data is available from the beam testing. Recent experiments include fatigue testing of lug subcomponents with geometry and material properties very similar to the full scale component. Preliminary work demonstrates that damage indices can be mapped to crack length, although further studies are needed to combine the readings of all the piezoelectric sensors into a single crack length estimate. Building on the results from all of the earlier testing, SHM system development is underway for a full scale lug component to be fatigue tested under spectrum loading. Modeling, experimentation, and signal analysis performed at various steps of the development are discussed.

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Ключевые слова:

Содержание.