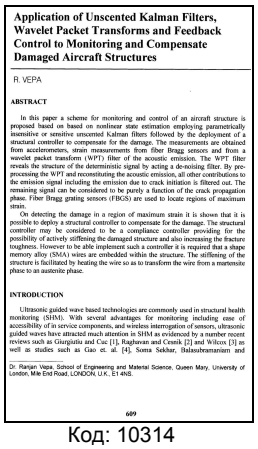

Application of Unscented Kalman Filters, Wavelet Packet Transforms and Feedback Control to Monitoring and Compensate Damaged Aircraft Structures

R. VEPA

ABSTRACT

In this paper a scheme for monitoring and control of an aircraft structure is proposed based on based on nonlinear state estimation employing parametrically insensitive or sensitive unscented Kalman filters followed by the deployment of a structural controller to compensate for the damage. The measurements are obtained from accelerometers, strain measurements from fiber Bragg sensors and from a wavelet packet transform (WPT) filter of the acoustic emission. The WPT filter reveals the structure of the deterministic signal by acting a de-noising filter. By pre-processing the WPT and reconstituting the acoustic emission, all other contributions to the emission signal including the emission due to crack initiation is filtered out. The remaining signal can be considered to be purely a function of the crack propagation phase. Fiber Bragg grating sensors (FBGS) are used to locate regions of maximum strain.

On detecting the damage in a region of maximum strain it is shown that it is possible to deploy a structural controller to compensate for the damage. The structural controller may be considered to be a compliance controller providing for the possibility of actively stiffening the damaged structure and also increasing the fracture toughness. However to be able implement such a controller it is required that a shape memory alloy (SMA) wires are embedded within the structure. The stiffening of the structure is facilitated by heating the wire so as to transform the wire from a martensite phase to an austenite phase.

INTRODUCTION

Ultrasonic guided wave based technologies are commonly used in structural health monitoring (SHM). With several advantages for monitoring including ease of accessibility of in service components, and wireless interrogation of sensors, ultrasonic guided waves have attracted much attention in SHM as evidenced by a number recent reviews such as Giurgiutiu and Cuc [1], Raghavan and Cesnik [2] and Wilcox [3] as well as studies such as Gao et. al. [4], Soma Sekhar, Balasubramaniam and

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Ключевые слова:

Содержание.