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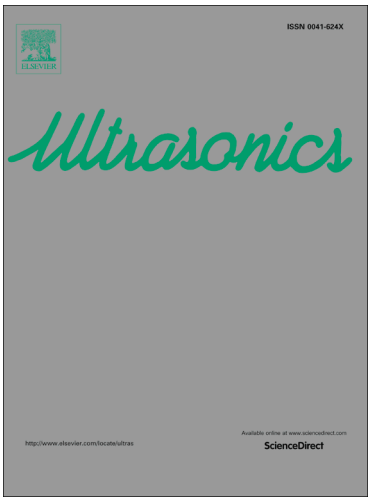

On-line prognosis of fatigue crack propagation based on Gaussian weight-mixture proposal particle filter

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On-line prognosis of fatigue crack propagation based on Gaussian weight-mixture proposal particle filter

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Abstract: Accurate on-line prognosis of fatigue crack propagation is of great meaning for prognostics and health management (PHM) technologies to ensure structural integrity, which is a challenging task because of uncertainties which arise from sources such as intrinsic material properties, loading, and environmental factors. The particle filter algorithm has been proved to be a powerful tool to deal with prognostic problems those are affected by uncertainties. However, most studies adopted the basic particle filter algorithm, which uses the transition probability density function as the importance density and may suffer from serious particle degeneracy problem. This paper proposes an on-line fatigue crack propagation prognosis method based on a novel Gaussian weight-mixture proposal particle filter and the active guided wave based on-line crack monitoring. Based on the on-line crack measurement, the mixture of the measurement probability density function and the transition probability density function is proposed to be the importance density. In addition, an on-line dynamic update procedure is proposed to adjust the parameter of the state equation. The proposed method is verified on the fatigue test of attachment lugs which are a kind of important joint components in aircraft structures.

Key Words: Fatigue crack propagation prognosis; On-line crack monitoring; Particle filter; Guided wave; Mixture proposal;

1. Introduction

Prognostics and health management (PHM) has been paid a lot of attention in recent years, which considers actual system conditions via sensors and the system remaining useful life through prognosis methods [1]. The PHM technology is capable of replacing scheduled maintenance with

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