A parametric approach to acoustic entropy estimation for assessment of fatigue damage

Ali Kahirdeh, Christine Sauerbrunn, Huisung Yun, Mohammad Modarres

PII: S0142-1123(17)30115-9
DOI: http://dx.doi.org/10.1016/j.ijfatigue.2017.03.019
Reference: JIJF 4282

To appear in: *International Journal of Fatigue*

Received Date: 30 June 2016
Revised Date: 17 March 2017
Accepted Date: 21 March 2017

Please cite this article as: Kahirdeh, A., Sauerbrunn, C., Yun, H., Modarres, M., A parametric approach to acoustic entropy estimation for assessment of fatigue damage, *International Journal of Fatigue* (2017), doi: http://dx.doi.org/10.1016/j.ijfatigue.2017.03.019

A parametric approach to acoustic entropy estimation for assessment of fatigue damage

Ali Kahirdeh[1], Christine Sauerbrunn[2], Huisung Yun, Mohammad Modarres
Center for Risk and Reliability, Department of Mechanical Engineering, University of Maryland, College Park, MD, USA
Email: Kahirdeh@umd.edu, csauerbrunn@gmail.com, hsyun@umd.edu, Modarres@umd.edu

Keywords:
Acoustic Entropy, Parametric Estimation, Information Entropy, Acoustic emission, Aluminum alloys

Abstract
A parametric approach to estimating the acoustic entropy detected over the course of fatigue damage is presented. Information entropy and relative entropy is estimated through a parametric approach where trial probability density functions (PDFs) are fitted to each individual received acoustic signal as the material degrades over the cycles of loading. The PDF that produces the maximum cumulative entropy is selected to model the signals. This selection criterion is due to the fact that the PDF with higher cumulative entropy results in less bias during the selection process. The evolution trends of both information entropy and relative entropy show the stages of fatigue damage observed in the fatigue indicators such as change in hardness. The acoustic entropy has an advantage over the conventional indices of damage as it can be employed directly in the online sensor based structural health monitoring schemes as a diagnosis feature.

1. Introduction
Information regarding the health of the constitutive elements of the critical structures is of paramount importance to ensure catastrophic failure is avoided. Such information is obtained by probing into the underlying physics of the problem and inspecting the structures for material degradation. Almost all solid materials are prone to fatigue damage due to any cyclic loading they experience over their life. The

1 Corresponding author , Phone: +1 (301) 405 5297, Fax:+1 (301) 314 9601
[2] Currently with Boeing Company, St. Louise, MO. USA