

Title The needs to predicting the fatigue life of the steel specimen using an empirical model of acoustic emission parameters

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Abstract

This work discusses on the capability of acoustic emission (AE) technique to be used as a prediction mechanism of the fatigue damage (or also fatigue life) for steel specimen. For this case, the specific material used is the carbon steel with the series of SAE 1045. Thus, a new empirical model based on the statistic and probabilistic theory was used for achieving this purpose, which it is said as the main contribution of this work. AE is a transient wave resulting from the sudden release of stored energy during a damage process. It is used to detect active microscopic events in a material, such as crack initiation and propagation. In most of the previous studies, the AE technique was used to detect the occurrence of irregularity on the material surface, such as crack that caused by both static and cyclic loadings. However, no work has been established for AE parameters to be used for predicting the fatigue life of materials. Looking to this opportunity, we are working to expand the work done by previous scholars, i.e. the development of fatigue life prediction relationship of the metallic materials using the combination approach of both fatigue and AE parameters. To accomplish the needs of the designated objective, the specific AE parameters (hit and count) and fatigue life parameters (number of cycles to failure and damage values) of the tested specimens captured using the designated data acquisition system while the specimen was exposed to the uniaxial cyclic test using the 100 kN servo-hydraulic machine at the testing frequency of 8-Hz. Both AE and strain signals were experimentally measured using the AE sensor and strain gauge respectively, with the sensors attached to the specimen during the cyclic test at several stress levels of constant amplitude loadings. The empirical relationship was suggested from the newly developed hit-life ($h-N$) curve, in correlation to the AE hits-number and cycles to failure. On the other hand, the validation results were then presented in the Weibull probability distribution technique, contributing a potential findings towards fatigue life prediction. From overall findings, it is indicated that the AE technique has the potential to assess strain-based fatigue life for any metallic material, and for this case is the SAE 1045 carbon steel, which is never been formulated before.

About the Speaker

Professor Ir. Dr. Shahrum Abdullah is the lecturer in Department of Mechanical and Materials Engineering, Universiti Kebangsaan Malaysia. He obtained the BEng (Mechanical Engineering) at Universiti Kebangsaan Malaysia (1995) and the MSc (Engineering Design) from Loughborough University, United Kingdom (1997). In 2005, he was awarded the Ph.D. degree in Mechanical Engineering at the University of Sheffield, United Kingdom. His PhD thesis is related to the scope of fatigue data analysis using the signal processing method, particularly the wavelet transform, which are the core research activities in his current days. He was assigned as a full professor in April 2011 and honoured by the university to lead Centre for Automotive Research (CAR) of the university. To date, he is the Head of Mechanical and Materials Engineering Department since May 2012. To highlight his international recognition towards his scholarly work, he was appointed as the Guest Professor at Universitat Duisburg-Essen (Germany) between October 2013 until March 2014, which the program is established by DAAD Germany. Prof. Abdullah authored many papers related to his specialization (engineering design and fatigue life assessment) in many international journals and proceedings. More than 250 papers have been published in the ISI and SCOPUS indexed journals with about more than 600 citations based on the SCOPUS database. Most of his published works are related to the structural integrity assessment of the metallic materials, particularly related to fatigue life assessment using signal analysis approach. Prof Abdullah is currently looking to the development of a fatigue life assessment relationship (based on statistics and mathematical approach) associated to the non-destructive test data, which is the subject of this seminar.

Host: Professor Zenji Horita

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