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AN AUTOMATED METHOD FOR THE MEASUREMENT OF FATIGUE CRACKS PROGRESSION

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ABSTRACT

This paper describes the work conducted at LOME - the Optics and Experimental Mechanics Laboratory - on the implementation of an automated vision system for fatigue crack growth detection and measurement. The system relies on optimized feature extraction by morphological image processing and continuous calculation of the *dA/dN* parameter for adaptation of the optimal time interval for image registration, and has already shown very promising results.

Keywords: fatigue crack, crack-tip progression, crack growth rate, optical metrology, image processing.

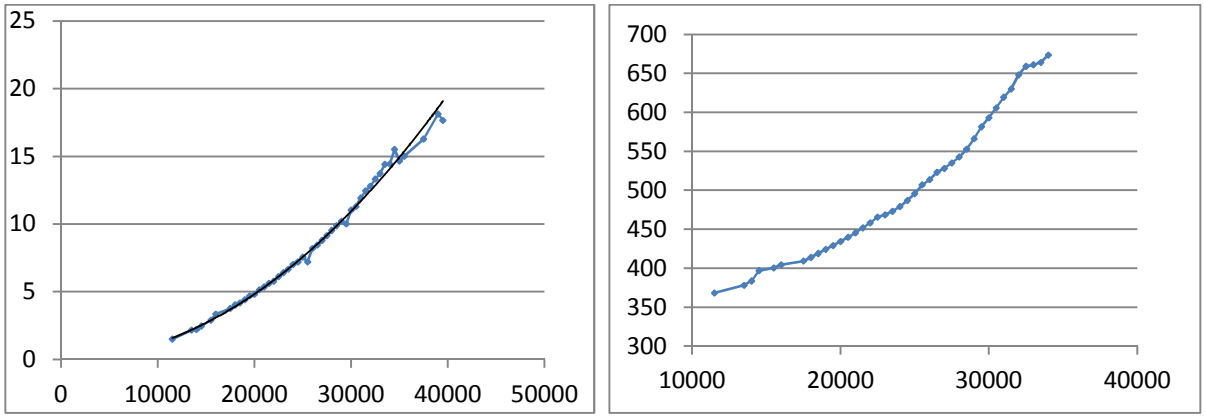
INTRODUCTION

Measurement of fatigue crack progression has been a fastidious but necessary activity for the Mechanical Engineering experimentalist. The traditional method for crack propagation measurement involves continuous observation and measurement of the crack-tip progression with a travelling microscope and a reticule, whereby measurements are taken at regular time or tester cycle intervals, and propagation speed is calculated (Mathieu et al, 2012). The experimentalist's experience and sensitivity on fatigue tests is therefore essential for estimation of the reading time intervals, in particular towards the end of the experiment when the propagation rate increases and failure to perform the necessary readings may irrevocably jeopardize the entire trial. Furthermore, when assessing crack growth rates an important source of variability is reportedly the evaluation of the crack length (Clark et al, 1975).

Up until recently, an automated method for the registration and measurement of crack-tip progression was not simply worth the effort. The necessary cameras were either too expensive or didn't have the necessary resolution and dedicated image processing algorithms weren't available or were mostly directed at Digital Image Correlation (DIC) as an alternate option for the crack-tip detection and measurement. The progression of automatic vision algorithms and morphological image processing as well as the constant improvement on CCD technology and camera price plunge, no longer justify holding back the development of automated systems that are competent in replacing both the travelling microscope and the experimentalist time to perform optical measurements.

LOME developed such an automated system, together with a dedicated illumination system described elsewhere in this conference, and recently started making the first automatic measurements and assessing the results in Al alloy 6082-T6, which are very encouraging up to the moment and in good agreement with data measured with a traditional apparatus (Moreira et al, 2008).

RESULTS AND CONCLUSIONS



(a) (b)

Fig. 1 -Crack size (a) and ΔK (b) plotted against N for a typical test.

The result from a typical test is shown in Fig. 1 for both crack size, a, and ΔK against number of cycles, N, and show an expected behaviour for this material.

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