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Optical and analytical investigation of overloads in biaxial fatigue cracks

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ABSTRACT. Structural components are often subjected to complex multiaxial loading conditions. The study of fatigue cracks under such conditions is not easy from an experimental point of view and most works tend to focus more on the simpler but less realistic case of uni-axial loading. Consequently, there are many uncertainties related to the load sequence effect that is now well known and is not normally incorporated into the growth models. The current work presents a new methodology for evaluating overload effect in biaxial fatigue cracks. The methodology includes evaluation of mixed-mode (ΔK_I and ΔK_{II}) stress intensity factor and the Crack Opening Displacement for samples with and without overload cycle under biaxial loading. The methodology is tested under two different load levels and a range of crack lengths. All crack-tip information is obtained with a hybrid optical-analytical methodology. It combines experimental full-field digital image correlation data and Williams' elastic model describing the crack-tip field.

KEYWORDS: biaxial fatigue, overload, St-52-3N steel, digital image correlation

Nomenclature

a	crack length
a_n, b_n	coefficients in Williams' expansion
AOI	area of interest used for analysing data points inside a particular region within the field of view
COD	crack opening displacement
DIC	digital image correlation
K_I	stress intensity factor in mode I