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Title:

A combined strip-yield critical damage model for predicting FCG under VAL

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract
Methods: Describe your selection of observations or experimental subjects clearly
Results: Present your results in a logical sequence in text, tables and illustrations
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

The critical damage model developed in [1-3] does not need a fitting parameter since its hypotheses are physically-based: crack tips recognized as sharp notches with a radius proportional to their CTOD; variable crack tip radii as a function of the CTOD induced by each load cycle under VAL; corresponding crack growth steps with variable increments; damage not assumed to happen only at the element adjacent to the crack tip; fracture of the material element adjacent to the crack tip due to the fatigue damage it accumulated during its entire life; and notch-tip strain concentration effects described by Neuber, Molski-Glinka, or the Linear rule, depending on the dominant stress state around the crack tip. A more general numerical load order model is proposed here, using strip-yield-based routines to calculate cycle-by-cycle the stress and strain profiles both *before* and *ahead* of the crack tip, accumulating damage *ahead* of the crack tip based on them, considering both residual stresses and eventual crack closure effects. Contrary to traditional strip-yield models [2], crack extension does not require an empirical **da/dN** equation based on Elber's $\mathbf{\Delta K_{eff}}$ hypothesis. Instead, crack extension results from material elements that reached a critical damage according to Miner's or to any other damage accumulation rule, properly applied to $\boldsymbol{\varepsilon}$**N** procedures considering memory effects. The cycle-by-cycle interaction between strip-yield and critical damage routines would can then consider both closure and residual stress effects in the same numerical model: closure reduces the strain range $\boldsymbol{\Delta\varepsilon}$ calculated at each material element at each load cycle, while residual stresses mainly affects the associated $\boldsymbol{\sigma_{max}}$. Since the strip-yield routines are able to calculate stresses and strains, both before and ahead of the crack tip, both closure and residual stress effects (and their mutual interaction) can be accounted for with this sensible methodology.

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[4] Newman Jr,JC. A crack-closure model for predicting fatigue crack growth under aircraft spectrum loading. ASTM STP 748:53-84, 1981
[5] Newman Jr,JC. FASTRAN-II – a fatigue crack growth structural analysis program. NASA Technical Memorandum 104159, February 1992
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