The influence of maximum stress and spectrum energy on variable amplitude fatigue crack growth rate

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The effective block approach (EBA) is a concept where the crack growth rates are quantified and modeled by treating a block of variable amplitude (VA) loading as being similar to a single cycle of constant amplitude (CA) loading, but with a greater amount of energy compared to a single CA cycle. The fatigue crack growth rate per block can be determined for a certain VA spectrum and typically shows a linear relationship with the crack length (exponential crack growth) and a cubed relationship with the reference stress (i.e. maximum stress) [1,2]. However, in general there has been little success in relating the crack growth rates from one VA spectrum to another or in determining the VA crack growth rate based on CA crack growth data. In the current paper first the potential drop and crack length fitting, as previously employed for obtaining very accurate CA crack growth rate data, will be used to accurately determine the VA crack growth rate per block as a function of crack length and reference stress. Secondly, an energy based approach is used relate the crack growth rate per VA block for different VA spectrums. The influence of the reference stress on the VA crack growth rate per block of cycles is used to determine the contribution of the stress range of individual cycles in the VA block on the total energy of the VA block.

References:

[1] L. Molent, M. McDonald, S. Barter, R. Jones. *Evaluation of spectrum fatigue crack growth using variable amplitude data*. International Journal of Fatigue 30 (2008) 119–137.

[2] L. Molent, R. Jones. *A stress versus crack growth rate investigation (aka stress – cubed rule)*. International Journal of Fatigue 87 (2016) 435–443.

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