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A. Gravouil, Y. Renard and A. Combescure

XFEM FATIGUE CRACK GROWTH ANALYSIS UNDER COMBINED LCF AND HCF LOADINGS

Benoît Dompierre
Cenaero ASBL, B-6041 Gosselies, Belgium, benoit.dompierre@cenaero.be

Martin Forbes
Cenaero ASBL, B-6041 Gosselies, Belgium, martin.forbes@cenaero.be

Eric Wyart
Cenaero ASBL, B-6041 Gosselies, Belgium, eric.wyart@cenaero.be

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ABSTRACT

Industries such as the Aeronautics industry, often deal with problems with complex geometries and HCF/LCF loadings and would be advantaged by more accurate and (often) conservative fracture fatigue predictions. Popular commercial software such as NASGRO can evaluate crack propagation for complex loadings, but are limited to a finite number of catalog geometries. Crack propagation for complex geometries can be evaluated thanks to 3D XFEM but is generally limited to pure LCF or pure HCF loading.

This paper proposes a method for carrying out complex 3D XFEM crack propagation simulations for problem cases with combined LCF/HCF loadings. At first, the aforementioned methodology is applied to simple geometries in order to compare the results to results given by NASGRO. After this validation step, a second step is to evaluate the fatigue crack propagation on a fan blade FE model of a real-world problem subject to complex loadings. In parallel to this second step, modal analyses on the cracked structure are carried out regularly in order to check if the crack induced frequency shift does not compromise the validity of the results. The whole methodology was developed in order to minimize the global computational over-cost.

Comparing our results to those obtained with classic crack propagation approaches demonstrates that there are cases where taking into account only continuous cycle loadings can lead to significantly different predictions.