11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

A NEW METHOD TO EXTRACT STRAIN ENERGY RELEASE RATES USING XFEM AND IRWIN'S INTEGRAL

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Key words: *XFEM, fracture mechanics, stress intensity factors*

An analytical formulation based on Irwin's integral and combined with the extended finite element method is proposed to extract mixed-mode components of strain energy release rates in linear elastic fracture mechanics. Crack tip enrichment functions in XFEM allow for evaluation of integral quantities in closed form, resulting in a simple, accurate and efficient method. Several benchmark examples on pure and mixed mode problems are studied, investigating the effects of the order of the enrichment, mesh refinement, and the length of crack extension. The results indicate that high-order enrichment functions have significant effect on the convergence, in particular when the integral limits are finite. When the integral limits tend to zero, simpler strain energy release rate expressions are obtained, and high-order terms vanish. Nonetheless, these terms contribute indirectly via coefficients of first-order terms. The numerical results show that high accuracy can be achieved with high order enrichment terms and mesh refinement. However, the effect of the integral limits remains an open question; with finite integration limits tend to give more accurate results.

REFERENCES

[1] M. Lan, H. Waisman and I. Harari. A direct analytical method to extract Strain Energy Release Rates from Irwin's integral using XFEM., *International Journal for Numerical Methods in Engineering*, Vol. **95(12)**, 1033–1052, 2013.

[2] M. Lan, H. Waisman and I. Harari. A direct analytical method to extract Strain Energy Release Rates from Irwin's integral using XFEM., *International Journal for Numerical Methods in Engineering*, Vol **96(12)**, 787–812, 2013.