3D Direct Estimation of stress intensity factors (K_i) Finite Element Method DEK-FEM.

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ABSTRACT

The problem addressed here is the simulation of a cracked continuous body, supposed linear elastic and the computation of the SIFs. To recover the SIFs, many post-processing method have been developped such as the interaction integral. The proposed method directly provides the Williams' [1] asymptotic coefficients as degrees of freedom, among which the SIFs or the T-stress. A domain decomposition strategy is used to introduce an area where this series expansion is used as mechanical basis.

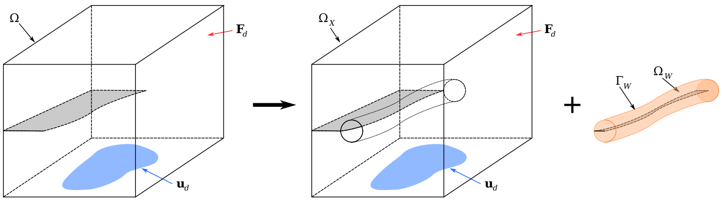

Figure 1: Domain decomposition between an analytical patch Ω_W and an X-FEM domain Ω_X.

The DEK-FEM presented in [2] is extended to three-dimension linear elastic simulations. The three fracture modes are considered, and 2D asymptotic series are spread along the front thanks to FEM

$$\boldsymbol{u}_W(\boldsymbol{X}) = \boldsymbol{u}_W(r,\theta,s) = \sum_s \sum_{n=0}^{n_{max}=\infty} \sum_{i=I,II,III} (a_i^n)^s \, \boldsymbol{\varphi}_i^n(r,\theta)\varphi^s(s). \quad (1)$$

$\boldsymbol{\varphi}_i^n(r,\theta)$ is the order n Williams series field. This displacement field and its associated stress field describes well the crack features.

The SIF evolution along the crack front is automatically provided, but also the T-stress evolution and the other asymptotic parameters. Local refinement is needed in order to improve the accuracy of the identification while limiting the computation cost, thus this strategy is embedded in a localized multigrid strategy as proposed by [3].

REFERENCES

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