

Automatic 3D Crack Growth Simulation Based on Boundary Elements

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An automatic 3D crack growth algorithm for fatigue crack propagation of arbitrary three dimensional problems with linear-elastic material behavior is presented. The stress analysis is based on a special BEM formulation – the 3D Dual Discontinuity Method (DDM) – which is advantageous for modelling propagating cracks. An optimized evaluation of very accurate SIF's and T-stresses along the whole crack front and the knowledge of 3D corner singularities are the basis of the proposed 3D crack growth criterion. The criterion is a predictor-corrector procedure taking into account the T-stresses and the often missing K_{III} in addition to K_I and K_{II} for the calculation of the kink angle. Moreover, a 3D singularity analysis is performed ensuring a valid square-root singularity along the crack front, especially in the vicinity of the intersection with the free surface. This guarantees a bounded energy release rate. Finally, the high level of automatization is accomplished by a sophisticated re-meshing algorithm for the update of the numerical model.

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