A new mixed mode integral for three-dimensional fracture mechanics applied to cracked bodies: analytical and numerical approach

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This work deals with a generalization of the Mtheta integral which allows the uncoupling of fracture modes in three-dimensional geometries. The integral is based on an energy approach including essentially an integral formalism and the virtual works principle in the mixed mode decoupling method. The technique is based on the use of three-dimensional singular displacement and stress fields defined in the crack vicinity and in a local referential. One of the main difficulties is the local field definition in a three-dimensional vision. Analytical developments are followed by a numerical implementation in the Castem finite element code. An appropriate definition of the integration domain makes it possible to achieve the distribution of each mode of fracture along the crack front line in terms of energy release rate. A numerical validation is proposed with a discussion on the integration domain independence and on the transition from a two-dimensional to a three-dimensional vision.

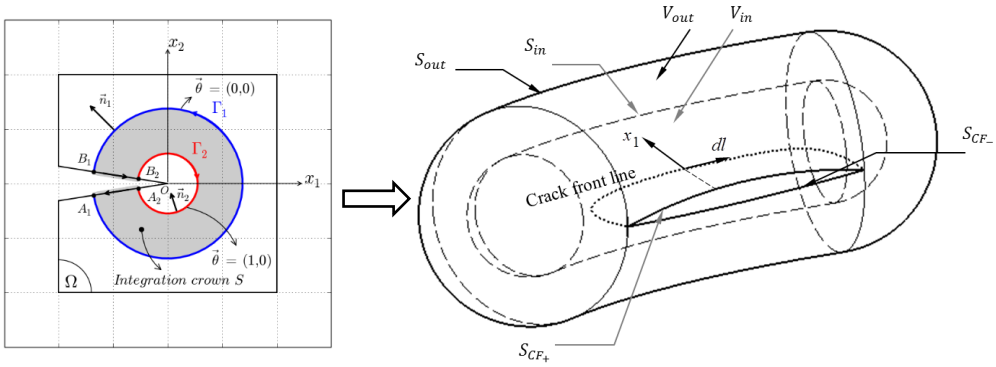

Fig. 1: 3D versus 2D comparison of a crack in fracture mechanics problem

Key words: Energy release rate, Crack front, Finite element, Fracture mechanics, Invariant integral, Numerical computation, Three-dimensional problem.