A new mixed-mode cohesive delamination model with internal friction

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Delamination is a failure phenomenon typical of composite materials. The numerical simulation of the decohesion between layers is often addressed by means of a cohesive approach, making use of interface elements. In the literature, there exists a huge number of works regarding the cohesive modelling of delamination, see for instance ([1], [2], [3], [4]).

This work is devoted to the formulation of a new cohesive law, able to deal with the general case of mixed mode behaviour, typically occurring in real life delamination problems. The proposed cohesive model has been developed within a thermodynamically consistent framework and it is based on an isotropic damage formulation. In order to properly reproduce the coupling between normal and shear modes, a three-surface activation domain characterized by an internal friction angle is introduced in the plane of the cohesive stresses (Figure 1): each of the three normals to the domain defines a distinct damage mode. A decomposition of the strain energy release rate in terms of the three damage modes is achieved in a natural way by projecting the cohesive tractions onto the three normals. The mixed-mode fracture energy is the result of modes interaction, without the need to define an empirical law.

Several numerical examples are simulated in order to validate the proposed interface law in both pure mode and mixed-mode delamination problems. In particular, the comparison between the numerical results and the experimental data of Mixed-Mode Bending (MMB) tests ([5], [6]) is shown.

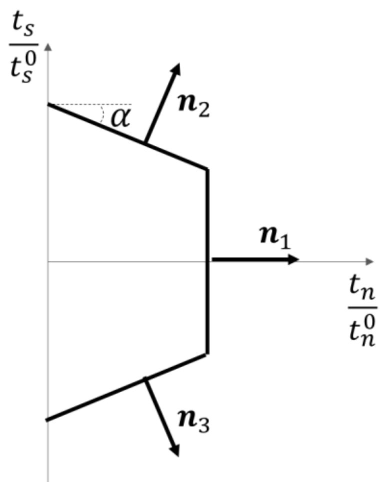

Figure 1: three-surface activation domain

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