A Unified Near Tip Solution for Multi-material Anisotropic/Piezoelectric Wedges

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Due to the sharp change at the apex of the wedge and the discontinuity of material properties, the stress singularity usually occurs at the multi-material wedges. However, owing to the complexity of mathematical modeling, the near tip solutions are usually presented case by case. To have a unified near tip solution covering all the possible situations of multi-material wedges, the solution with matrix power function presented previously [1] for the interface corners are re-considered in this study. The generality of the proposed unified solution includes: (1) each wedge can be composed of any kind of anisotropic or piezoelectric materials; (2) no restriction is required on the wedge numbers; (3) no restriction on the angle of each wedge; (4) no restriction on the boundary of the wedge sides, which may be displacement-prescribed and/or traction-prescribed. In this unified solution, the singular orders are reflected through the matrix of singular orders, which covers all the possible singularities such as exponential, oscillatory and logarithmic singularity. The stress intensity factors are defined by the coefficient vector of this matrix power function. Since cracks, corners, interface cracks and interface corners are special cases of the multi-material wedges, the proposed unified solution may be useful for bridging the gap between them.

In addition to the singular solution expressed by the matrix power function, in this study the particular solutions of the wedge subjected to uniform tractions are also presented. It’s known that the uniformly distributed solution may become infinite everywhere in the wedge when the wedge angle is the critical wedge angle. A bounded non-uniform solution has been presented in the literature for the anisotropic elastic wedges [2]. In this study, a unified solution is also presented to include both anisotropic and piezoelectric wedges when the uniform tractions loaded on the two-sides of the wedge are unbalanced.