

A generalised Comninou contact model for interface cracks in anisotropic bimetals

María A. Herrera-Garrido and Vladislav Mantič

*Grupo de Elasticidad y Resistencia de Materiales, Escuela Técnica Superior de Ingeniería,
Universidad de Sevilla, Camino de los Descubrimientos, s/n, Sevilla, 41092, Spain.*

In interface cracks between dissimilar materials, contact between the crack faces in a region close to the crack tip is very common, particularly under mixed-mode loading conditions. This has been observed in numerous analytical and numerical studies. This feature distinguishes interface cracks from cracks in homogeneous materials and emphasizes the importance of considering frictional effects in the local mechanical response. Consequently, a contact model is required to obtain physically consistent descriptions of the crack tip fields.

This work investigates the asymptotic elastic fields associated with a semi-infinite interface crack with frictional contact between the crack faces in linear elastic anisotropic bimetals under generalised plane strain conditions. The analysis is formulated within the framework of the Comninou contact model of interface cracks [1,2], combining contact conditions with the classical Coulomb friction law. Asymptotic power-law solutions are derived in [3] using the Stroh formalism of anisotropic elasticity [4,5].

The crack tip asymptotic solution is governed by two coupled parameters: the singularity exponent λ and the frictional shear stress direction ω , which coincides with the direction of relative sliding in the contact zone. These parameters are obtained from a system of two nonlinear eigenequations expressed in closed form in terms of bimaterial elastic properties. In contrast to many existing formulations, the sliding direction is not assumed a priori but emerges naturally from the solution of the eigenproblem.

Particular attention is given to solutions with $\lambda \geq 1$, which are relevant for the asymptotic description of frictional contact near the transition from stick to slip in anisotropic bimetals. According to established results [6], no singular (unbounded) stresses occur at this transition, so only solutions with $\lambda \geq 1$ are physically meaningful in this context. These asymptotic solutions can also be applied to partial slip contact problems, such as the interaction between an indenter or punch and a sample, layer, foundation, or half-plane.

The results provide a consistent asymptotic description of frictional contact effects at interface crack tips in anisotropic bimetals. The proposed framework is relevant for the modelling of contact-dominated interface fracture and can also be applied to the asymptotic analysis of partial slip contact problems.

References

- [1] M. Comninou, The interface crack, *J. Appl. Mech.*, 44:631–636, 1977.
- [2] M. Comninou, Interface crack with friction in the contact zone, *J. Appl. Mech.*, 44:780–781, 1977.
- [3] M.A. Herrera-Garrido and V. Mantič, Stress singularities in the generalised Comninou frictional contact model for interface cracks in anisotropic bimetals, *J. Mech. Phys. Solids*, 203:106214, 2025.
- [4] A.N. Stroh, Dislocations and cracks in anisotropic elasticity, *Phil. Mag.*, 3:625–646, 1958.
- [5] A.N. Stroh, Steady state problems in anisotropic elasticity, *J. Math. Phys.*, 41:77–103, 1962.
- [6] J. Dundurs and M. Comninou, Some consequences of the inequality conditions in contact and crack problems, *J. Elasticity*, 9:71–82, 1979.