## Impact of boundary conditions on viscoelastic fracture fields

Andrea Sendula

Fracture in soft solids and viscoelastic materials is a key phenomenon arising in numerous natural and industrial applications. In this work, we investigate how boundary confinement affects the structure of a viscoelastic field surrounding a fracture. We conduct a numerical and asymptotic study of the fields surrounding a steadily propagating crack in a Kelvin-Voigt material confined to a strip geometry. To understand the influence of the strip width, we introduce a fracture Deborah number, $D = V\eta/LE$, to characterize the interplay between crack velocity $V$, material viscosity $\eta$, the geometric scale $L$ and the elastic modulus $E$. The dimensionless number represents the ratio of the scale of viscoelastic transition $V\eta/E$ to the geometric scale $L$. For small $D$, the problem reduces to a two-deck structure: an outer elastic region controlled by the geometry; and an inner viscoelastic zone of universal form that connects to the outer elastic deck through the mode-I fracture solution. For high $D$, our analysis reveals a novel double-decked structure comprising an outer near-one-dimensional deck dominated by a transverse viscous-elastic balance; and an inner deck of size $L$ in which the dynamics simplify to a 'quasi-viscous' constitutive regime, where longitudinal components of the constitutive law become dominantly viscous, but elastic stresses remain leading order in the transverse stress balance. The regime necessitates a multiple-scales asymptotic theory to produce a consistent matching between the inner and outer decks. Our results provide new insight into how the viscoelastic fracture fields change with confinement and offer a framework to assess the transition between different rheological balances in bounded geometries. Future work will explore how these confinement effects manifest in other viscoelastic models, such as Maxwell materials, building on self-similar Stokes solutions identified for the same geometry.