Crack propagation in elastic media with anisotropic surface energy: Experiments, Phase-field simulations, Linear Elastic Fracture Mechanics

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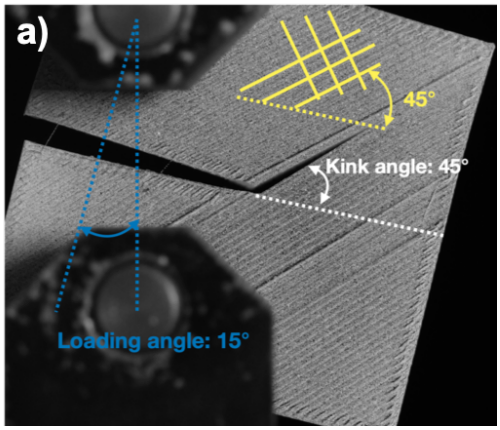
Additive manufacturing is receiving increasing attention due to its advantages in terms of modelling flexibility and allowing to easily design complex micro-structures [1]. A Recent study reports [2] achieving strongly anisotropic fracture toughness in material printed by Fused Deposition, while retaining isotropy in elasticity. The aim of this study is to explore brittle crack propagation in specimens fabricated by Fused Deposition in fracture experiments under mixed mode loading and provide numerical predictions based on a variational approach to fracture. Comparing numerical results using a strongly anisotropic phase-field model [3] with experimental data, we show the ability to predict crack trajectories and the relevant critical load for crack propagation. Such predictions can also be recovered by the generalized maximum energy release rate in a linear elastic fracture mechanics framework.



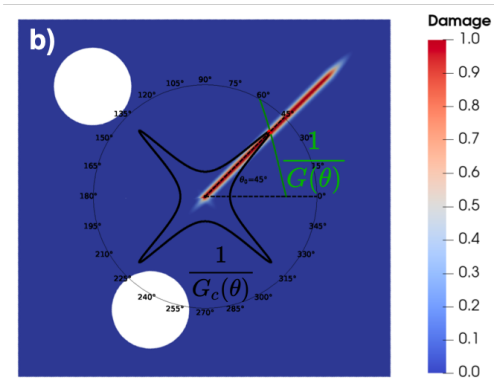


Figure 1: A kinking crack following material fibres in an anisotropic Compact Tension Shear specimen under mixed mode loading a) experimental setup and b) a snapshot of the predicted numerical crack path with 45° raster angle and 15° loading angle

References

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