Phase-field models

1. The length-scale parameter

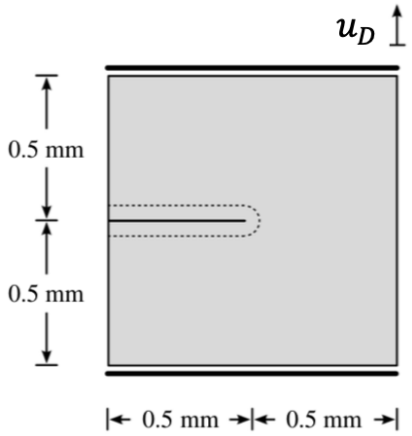
The length-scale parameter in phase-field models is related to the width of the diffuse crack. In fact, denoting by *r* distance perpendicular to the crack, it can be shown that the profile of damage across the crack is

$$d(r) = \exp\left(\frac{-|r|}{l}\right)$$

Plot this damage profile for $-5 \leq r \leq 5$ considering different values of the length-scale parameter (for instance, $l = 1$, $l = 0.01$ and $l = 0.01$). Discuss your results.

2. Isotropic phase-field model

Consider the direct tension test shown in the figure. The square specimen has a crack at mid-height. Displacements are restrained at the bottom edge and prescribed to u_D at the top edge. The material parameters are *E* = 210 GPa, ν = 0.3, G_c=2.7·10^{-3} kN/mm. The length-scale parameter is l = 0.015 mm. The load-stepping takes increments Δu_D = 10^{-4} mm and the tolerance (i.e. stopping criterion) for the staggered iterations is 10$^{-2.}$



The isotropic phase-field model provided (main file: TensionTest.m) allows to solve this problem.

a) Plot the damage field for imposed displacements u_D = 0.003 mm, 0.0055 mm and 0.0065 mm.

b) Solve the problem for a different length scale, l = 0.08 mm. Compare the solution with the two values of l. Discuss your results. What is the influence of l in the response?

c) Reverse the sign of prescribed displacements (i.e. apply compression instead of tension). Discuss your results.