Matched asymptotic solution for crease nucleation in soft solids
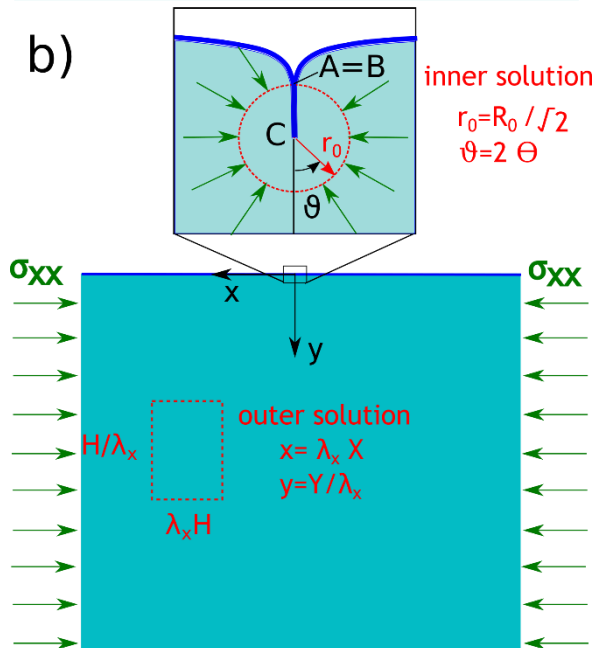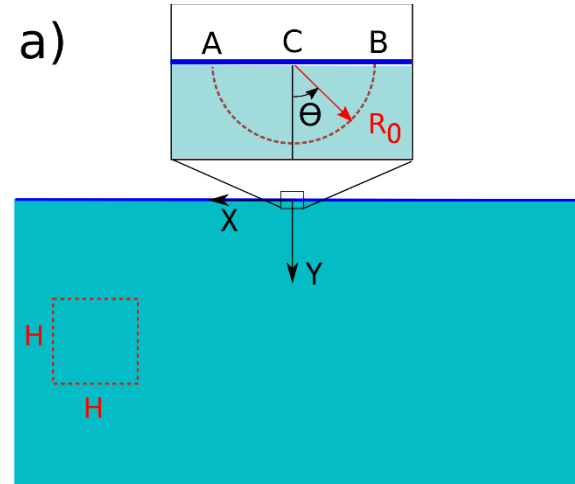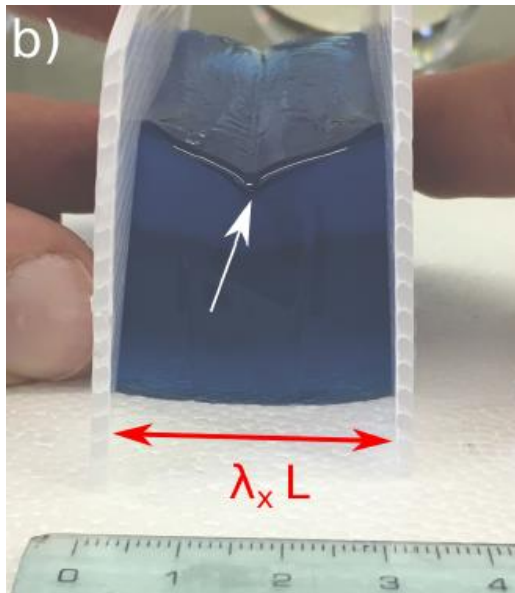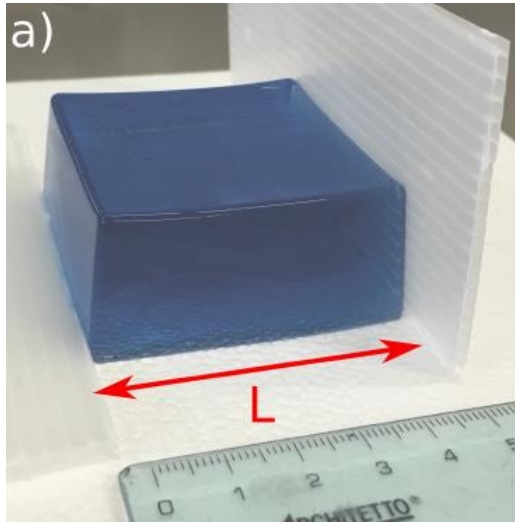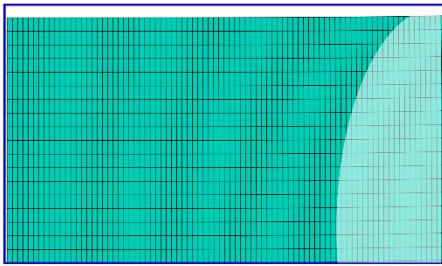
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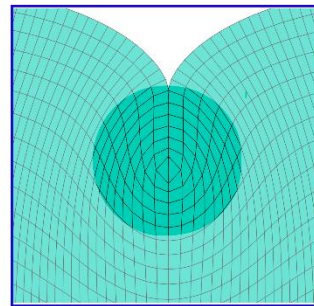
Analytic predictions of the nucleation threshold and crease morphology

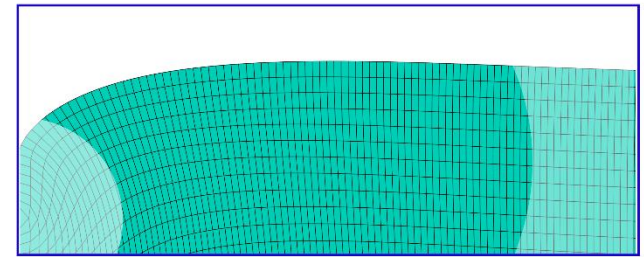Creasing is a material instability: it is localized in space and undetectable by linearization.

$$\lambda_x^{cr} = \tfrac{1}{4}\left(1 - 3\sqrt{5} + 2\sqrt{\tfrac{1}{2}\left(9 - \sqrt{5}\right)} - 2\sqrt{26\sqrt{5} - \sqrt{62\sqrt{5} + 1038} + 28} + \right.$$

$$\left. \sqrt{\left(-3\sqrt{5} + \sqrt{18 - 2\sqrt{5}} - 2\sqrt{26\sqrt{5} - \sqrt{62\sqrt{5} + 1038} + 28} + 1\right)^2 + 256}\right)^{1/2} \sim 0.637554.$$
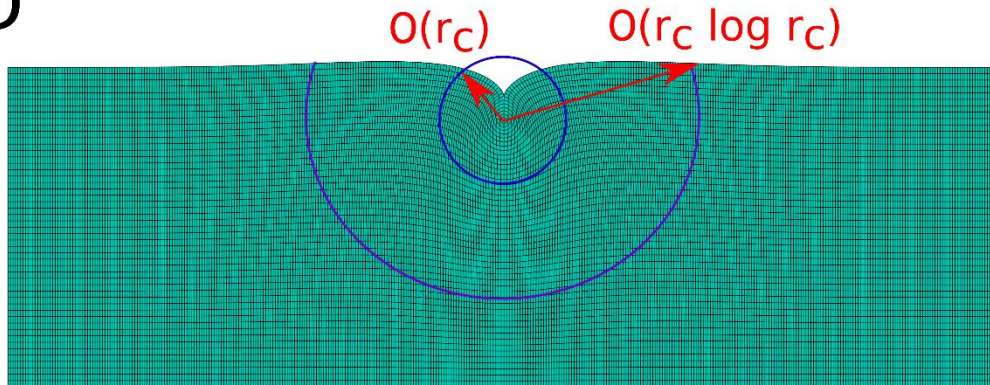
A

Outer solution : $r \gg r_c \log r_c$

B

Inner solution : $r < r_c$

C

Intermediate solution :
$r_c \ll r \ll r_c \log r_c$

D

$O(r_C)$ $O(r_C \log r_C)$

E

FE simulation

Theoretical prediction

[REF] P. Ciarletta, (2018), **Nature Communications** 9: 496.