Numerical and perturbative approaches for strain localization and shear bands phenomena

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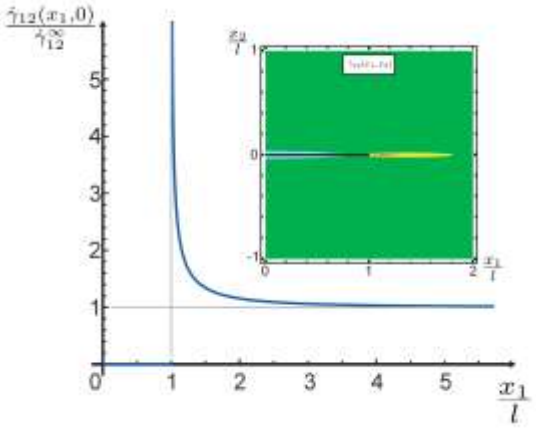
Strain localization and shear banding are tested with a numerial approach, in which the shear band is modeled as a zero-thickness nonlinear interface. This model is introduced into Abaqus through an external UMAT subroutine which takes into account the elasto-plastic behavior of the materials [1]. The simulation times are improved using an asymptotic technique. This technique permits to model the shear band as a region in which the yield stress is smaller than the yield stress in the matrix.

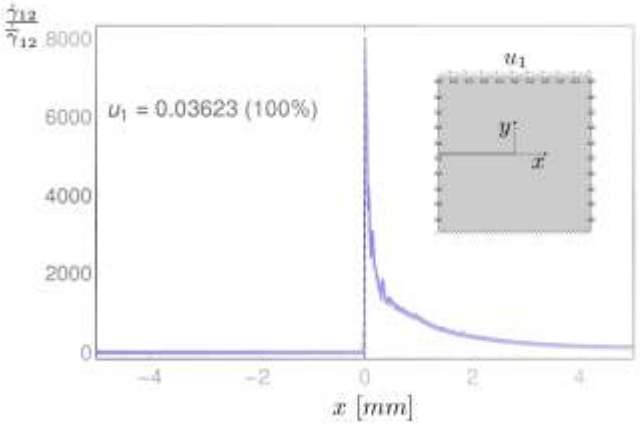
The numerical approach is contrasted with the perturbative one [2], in which the behavior of the ductile material is described according to the J2-deformation theory. In this approach, the shear band emerges as a perturbation of the homogeneous prestress state.

Both approaches indicate that the shear bands propagation follows a straight line tragectory under shear loading. This propagation phenomenon is linked to the existence of a strong stress concentration at the tip of the shear band. These concepts are fundamental for describing the failure mechanisms of ductile materials.

Perturbative approach:



Numerical approach:



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References:

[1] N. Bordignon, A. Piccolroaz, F. Dal Corso and D. Bigoni (2015) Strain localization and shear band propagation in ductile materials. Frontiers in Materials.

[2] D. Bigoni, F. Dal Corso (2008) The unrestrainable growth of a shear band in a prestressed material. Proceedings of the Royal Society A, 464, 2365-2390.