Design of products and metal forming operations requires reliable predictions of the manufacturability and product properties after forming. Ductile fracture is characterized by microscale damage and macroscale strain localization, finally resulting in fracture.

Modeling ductile damage in metals

Micromechanism of ductile fracture of most metals involves void nucleation, growth and coalescence. Representative Volume Elements (RVEs) that capture the relevant microscale damage mechanics are used to represent this evolution.

A two-scale Computational Homogenization CH scheme, relates the micromechanics to macrostructural behavior. Classical schemes require separation of length scales, which should hold for both the geometry and the deformation gradients. To overcome this limitation, for moderate localization, a second-order CH procedure leading to a higher-order continuum on the macrolevel has been proposed by Kouznetsova, et al. [1]. The scheme still relies on locally representative RVEs and can’t capture extreme localization between voids.

The Continuous-Discontinuous CH approach overcomes this limitation. It is based on the idea that the microscopic deformation can be splitted into a bulk and a localization type of deformation. The macroscopic continuum is enriched with a cohesive discrete crack, which lumps the strain localization and residual load carrying capacity of the underlying microstructure.

References