3D crack based on a nonlocal ductile damage approach
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Introduction
Metal deformation processes like other materials finally will lead to a phenomenon called damage which reduce metal strength and eventually fracture it. Numerical simulations help us to design this process in a controlled manner- see Figure 1.

Objective
Developing fully three dimensional numerical tools for damage and crack simulations is the goal of this project. Although the developed techniques are to be used for macroscopic modeling but they should take in to account the relevant microscopic phenomena (obtained in a parallel project) in an average way.

Method and results
Step I A special Tetrahedral element tailored to deal with incompressible plasticity has been developed and verified for large strain elasto-plastic damage behavior -see Figure 2.

Step II An adaptive procedure is designed in order to transfer state variables from one mesh to another-see Figure 3.

Step III Finally detecting the crack initiation propagation direction, inserting crack surface into the 3d volume and finally decoupling the nodes lying on the crack surface -see Figure 4.

Conclusion & Further extension
Crack initiation and propagation based on nonlocal damage media is implemented for 3D large deformation problems. It will be further extended to include more complex geometry and more cracks at the same time.