

Modeling of ductile fracture in the blanking process

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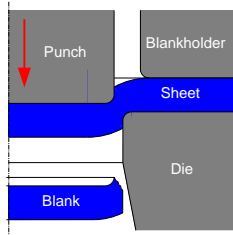
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Introduction

The metal blanking process is an industrially important process. One great problem in modeling this process is the prediction of initiation and growth of cracks, in which the deformation history is a very important aspect. As can be seen in the figure, the crack path determines the eventual product quality.

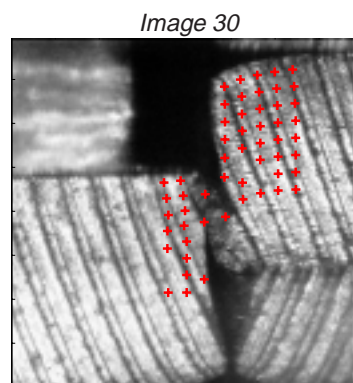
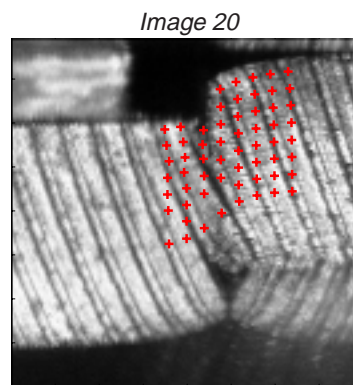
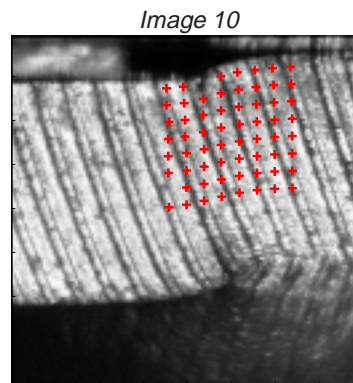
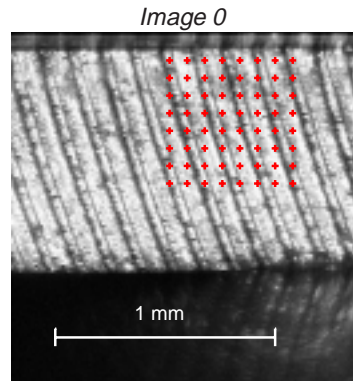
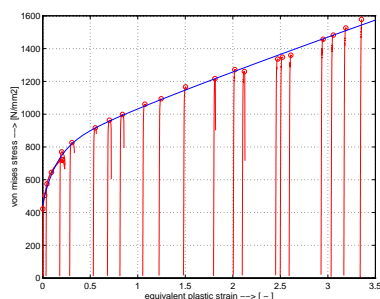


Objectives

- ▷ Modeling ductile fracture
- ▷ Verification of crack initiation and growth in various experimental setups

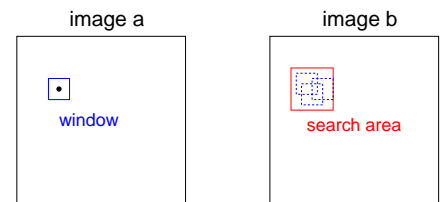
Material model

A stress - strain relationship has to be available up to the high strains (3-4) reached in blanking. This is obtained with twenty uniaxial tensile tests with a different predeformation imposed by rolling. Their **true stress - true strain curves** are plotted and a **master-curve** of the used **13% Cr steel** is fitted through their maxima \circ .



Experimental

In-situ observations of the blanking process were made and the displacements were measured, using **digital image correlation** on 31 subsequent images. 4 stages are shown in the middle.



▷ Method

- ▷ Take two images
- ▷ Choose point to follow
- ▷ Define **window** around point
- ▷ Define **search area** (max. displ.)
- ▷ Calculate **window** position in **search area** with optimal correlation, based on existing contrast differences in one image

▷ Results

- ▷ Optimization iterations do not always converge (1% drop out)
- ▷ Accuracy: $2 \cdot 10^{-4}$ x image size

Conclusion

Preliminary results suggest that digital image correlation can be used in the experimental verification of a FEM blanking process model.

Besides the experimental verification, work has to be done on modeling ductile fracture in a separate experiment.

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