

Numerical modelling of the blanking process

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Numerical modelling of the blanking process

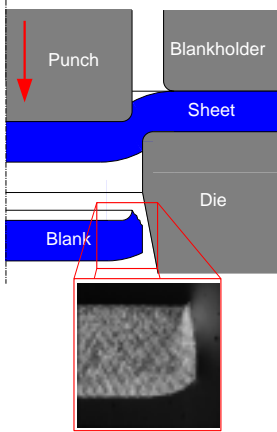
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1 Introduction



Knowledge : empirical
↓
Process development :
trial and error

1.1 Objective

Validated finite element model
to predict product shape

2 Problems

- Extreme deformation
- Ductile fracture
- Thermal and viscous effects

2.1 Large deformation

- Operator Splitted ALE :
 - 1 Updated Lagrange step
 - 2 Update nodal positions
 - 3 Convective step :

Discontinuous Galerkin :

$$\int_{\Omega} w (\varphi_g - \varphi_g^{old} - \vec{u}_g \cdot \vec{\nabla} \varphi_g) d\Omega - \underbrace{\sum_{elems} \int_{\Gamma_e} w \vec{u}_g \cdot \vec{n} (\varphi_g - \varphi_g^{ext}) d\Gamma}_{Upwinding term} = 0$$

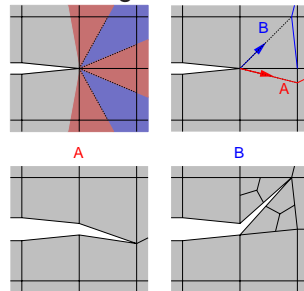
- ◇ φ_g^{ext} handled explicitly
→ φ_g can be solved on element level
- ◇ Renumbering in flow direction → fast convergence

- Frequent remeshing needed

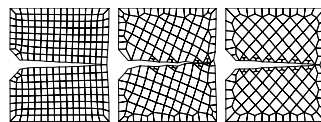
2.2 Ductile fracture

- Physics : growth and coalescence of voids
- Modelling : Discrete Crack approach
 - ◇ Local Mesh Modification

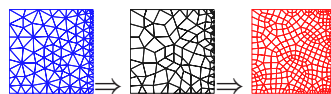
Algorithm :



Mesh objectivity :



- ◇ Global Mesh Modification :
Mesh generator :
Conversion $\Delta \rightarrow \square$:

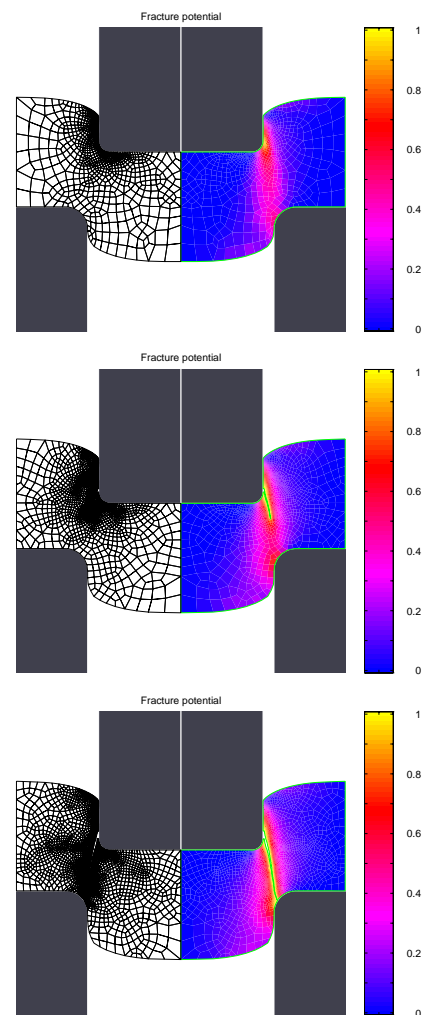


- Crack direction :
 - ◇ Derived from crack potential (Damage like parameter, no influence on constitutive behaviour)

- ◇ Potential from void growth (Rice & Tracey)

$$\int_0^{\bar{\epsilon}_p^f} 0.427 \exp \frac{3\sigma_m}{2\bar{\sigma}} d\bar{\epsilon}_p$$

3 Results



4 Future

- Validation with experiments
- Inclusion viscous, thermal effects