Numerical Simulations of Forming Processes

Han Huétink

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Materials innovation institute

Chair “Mechanics of Forming Processes”

Mission:

- Develop advanced numerical methods for forming process simulations.
- Support the industry in using these methods.

Research themes: Material Modelling
Numerical Procedures
Optimisation

Staff

Han Huétink
Ton van den Boogaard
Bert Geijselaers
Timo Meinders

Wilko Emmens (Corus)
Harm Wisselink (M2i)

M2i Materials innovation institute

PhD researchers
(2 vacancies)

Bert Koopman (BOAL)
Semih Perdahcioglu (FOM)
Pawel Owczarek (STW)
Maarten van Riel (M2i)
Corijn Snippe (FOM/Nikhef)
Shihara Kurukuri (M2i)
Ashraf Hadoush (M2i)
Wissam Assaad (M2i)
Wouter Quak (M2i)
Muhammad S. Niazi (Nuffic)
2 Vacancies (M2i)

Research Area's

- Sheet metal forming (springback)
- Extrusion
- Material modeling

- ***Biomechanics***

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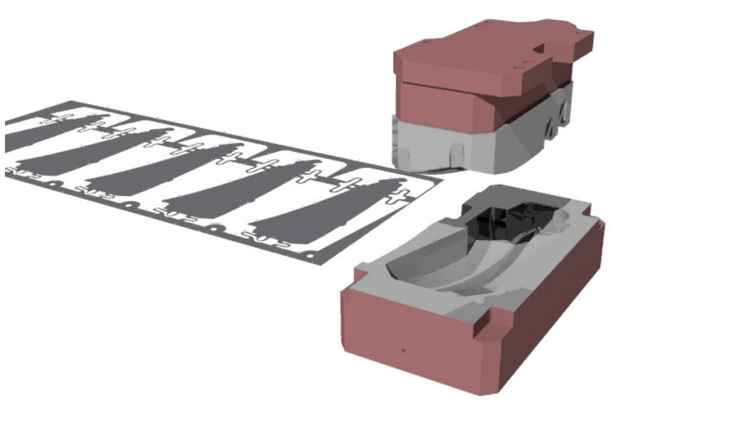
Sheet metal forming



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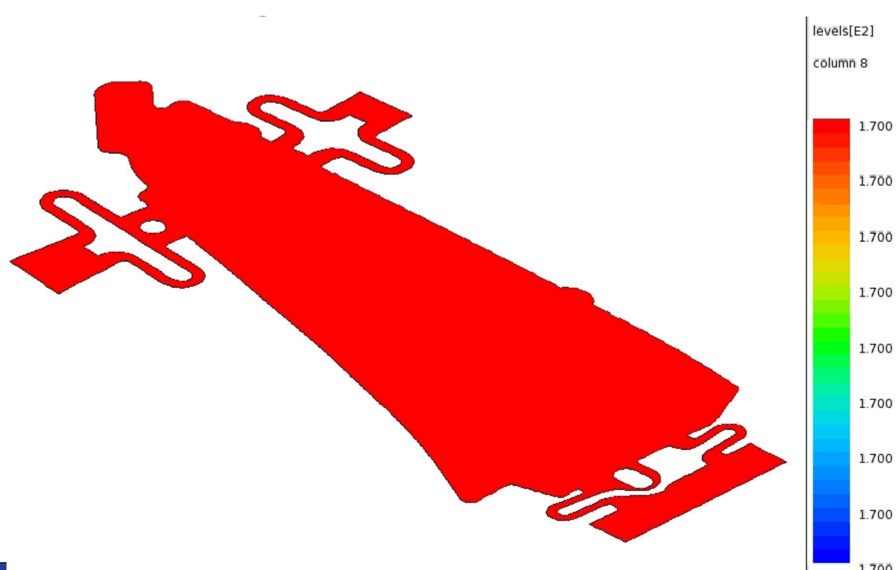

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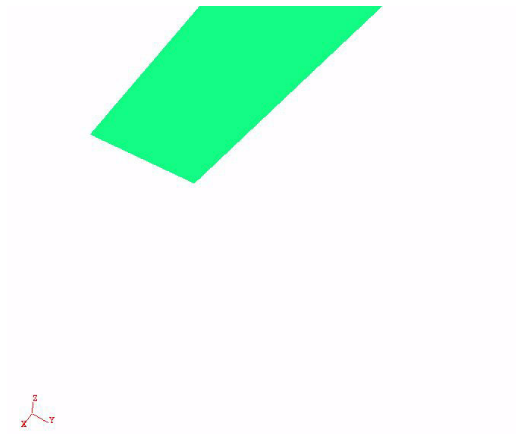
Failure prediction



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Sheet metal forming

Springback: elastically driven change of product shape after load removal

Reality: large deviation between desired product and sprung-back product

Springback compensation is needed

Costs for American car industry for springback related issues: $50 million

Adaptive integration

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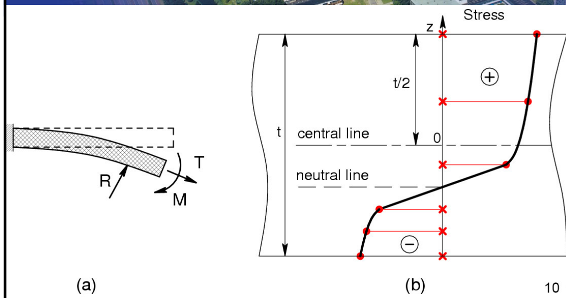
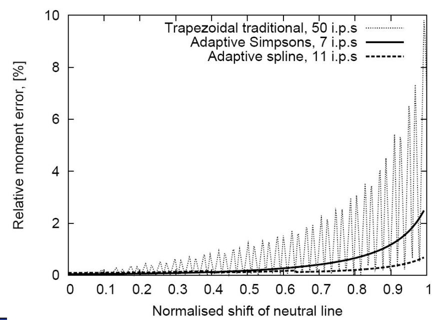


(Burchitz, Meinders)

Adaptive integration scheme:

- *uses integration points more efficiently;*
- *guarantees accurate springback prediction at minimal costs.*



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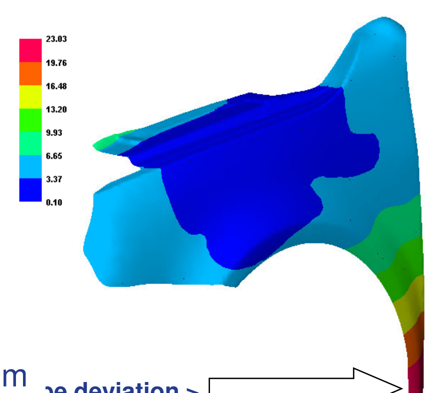
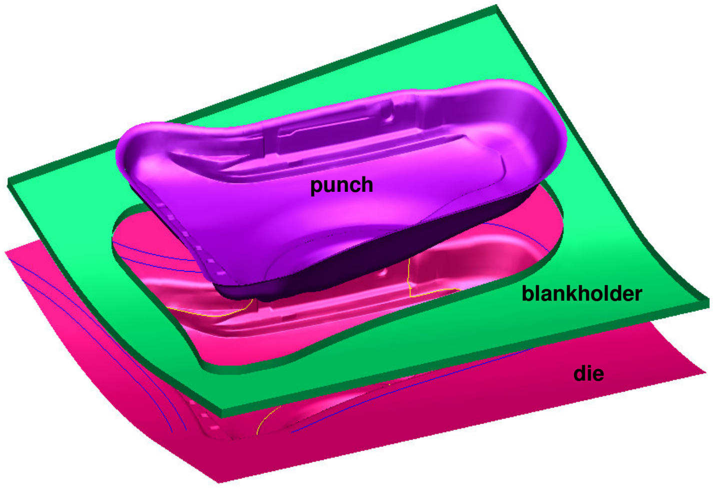
Springback Compensation



- **goal** develop an automatic springback compensation algorithm

...pe deviation > 21mm

Springback Compensation



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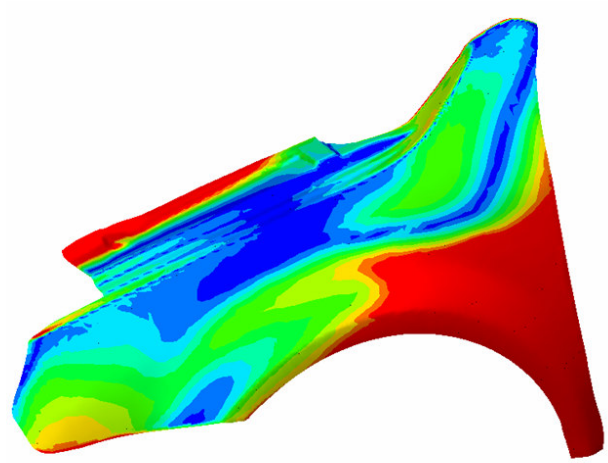
springback

Springback Compensation



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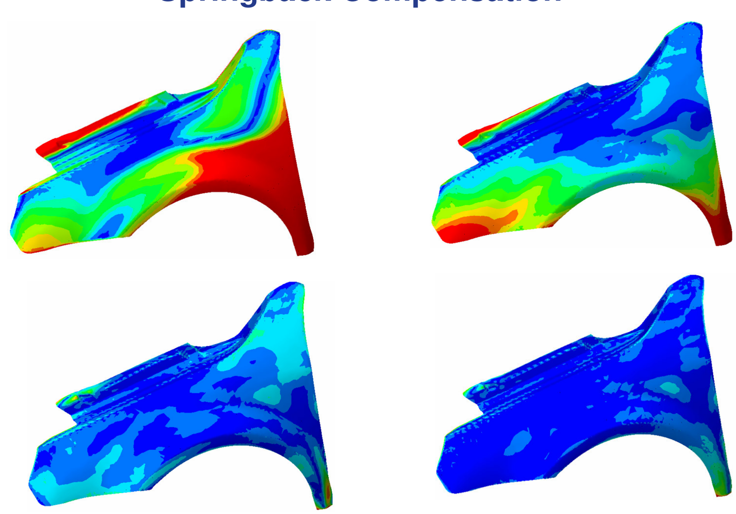
Springback Compensation



Incremental sheet forming

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Incremental sheet forming

- Advantages
  - Relatively simple and cheap setup
  - Large deformation
  - Enhance the formability

Ideal for prototyping and small series production

- Disadvantage
  - The process is **SLOW**

First time right!!
Need for simulations

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- Extrusion
- Material modeling

- *Biomechanics*

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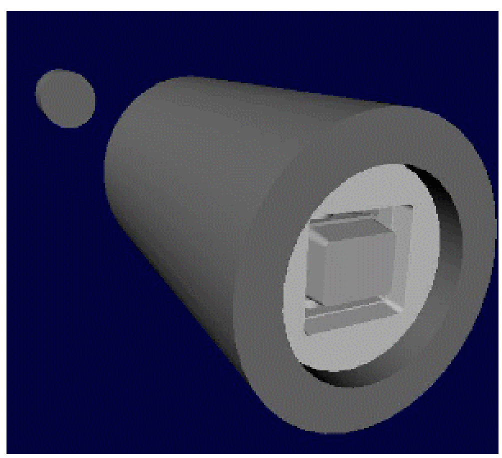

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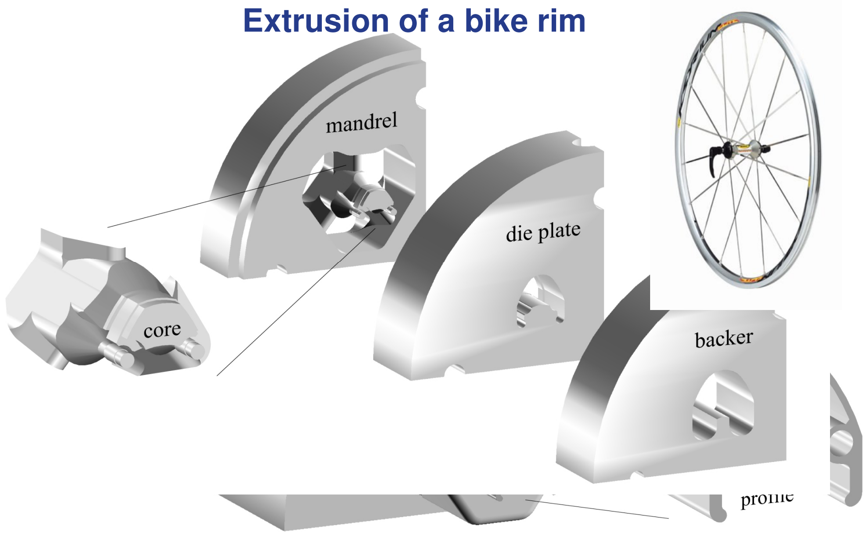
Extrusion of a bike rim



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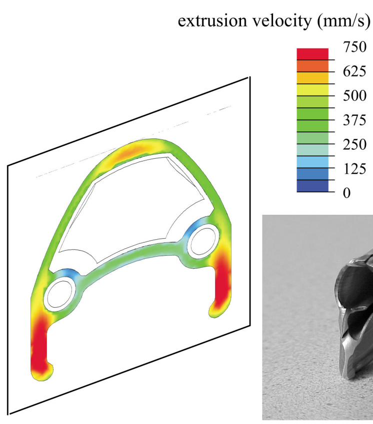
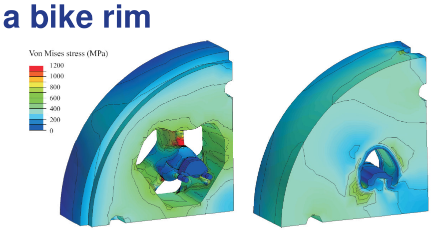
Extrusion of a bike rim





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Material Modeling

Trend in metal forming industry towards complex materials:

- High Strength Steels (HSS, HSLA)
- Dual Phase Steels
- Trip Steels
- Aluminum
- Superplastic Materials

Simulation: Need for accurate material models and material parameters

Meta stable steel forming

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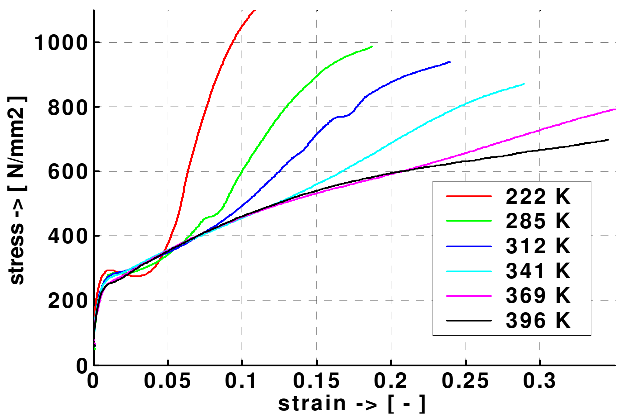

Properties of Sandvik Nanoflex

PHILIPS

S. Perdahcioglu

J. Post

H. Geijselaers

Transformations

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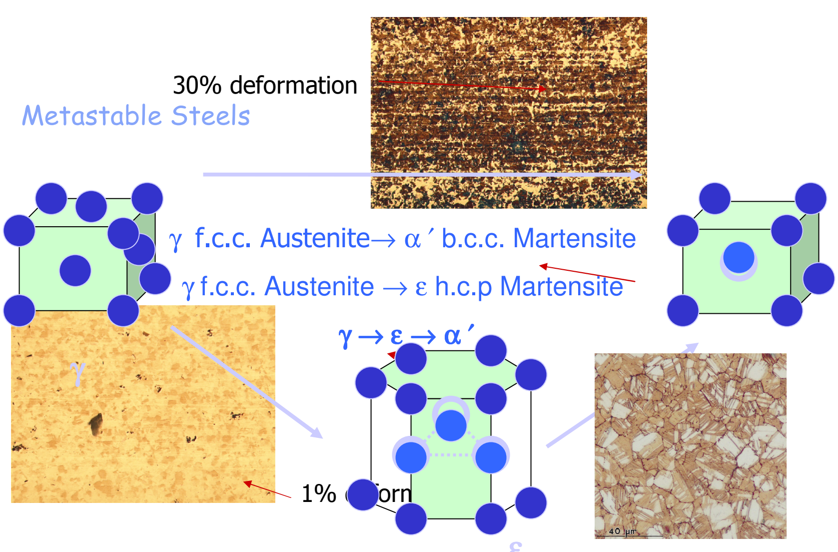

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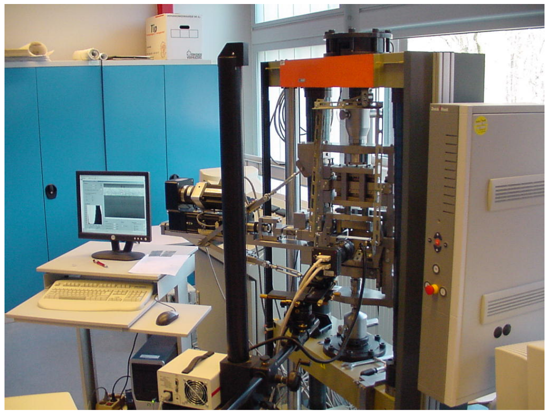
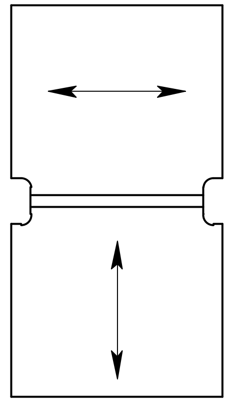
Bi-axial test equipment



Test equipment



sample

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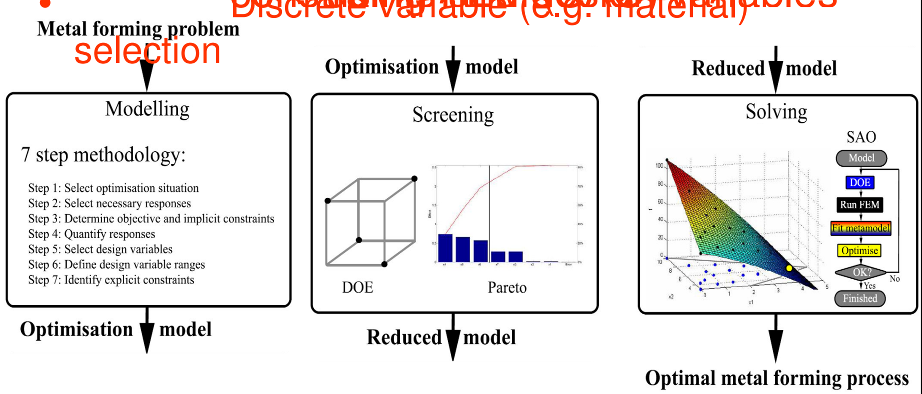
Optimisation

- Discrete variable (e.g. material) selection



Optimisation: Forging

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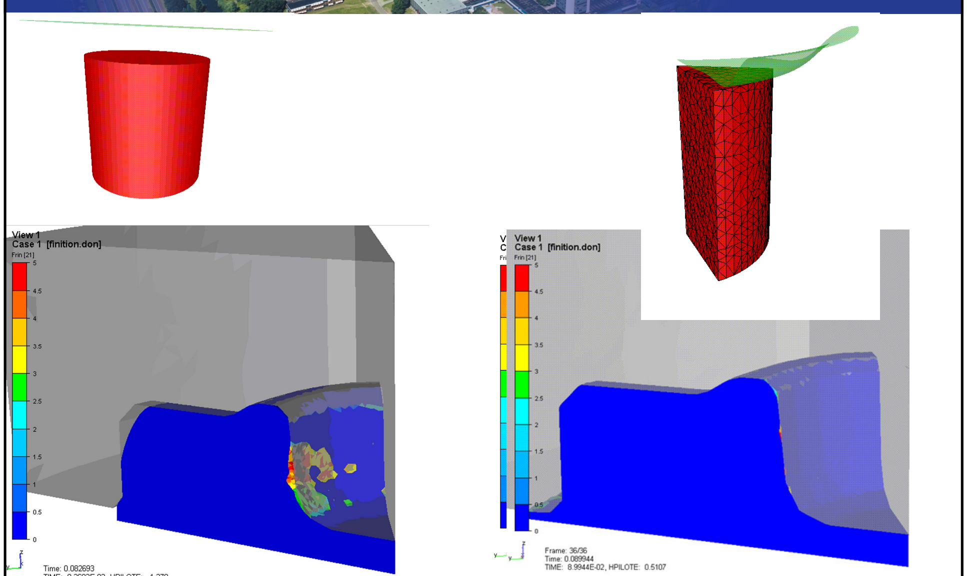

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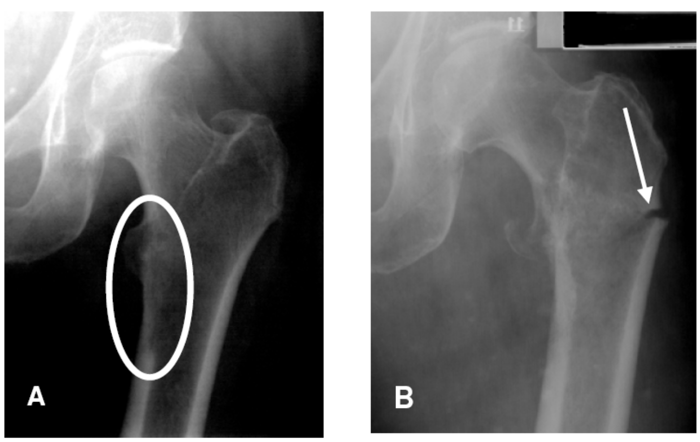
Bone Fracture



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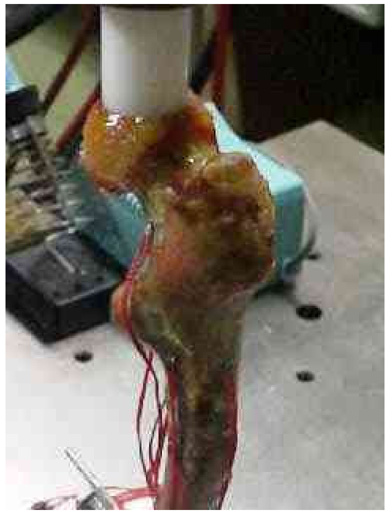

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Bone Fracture