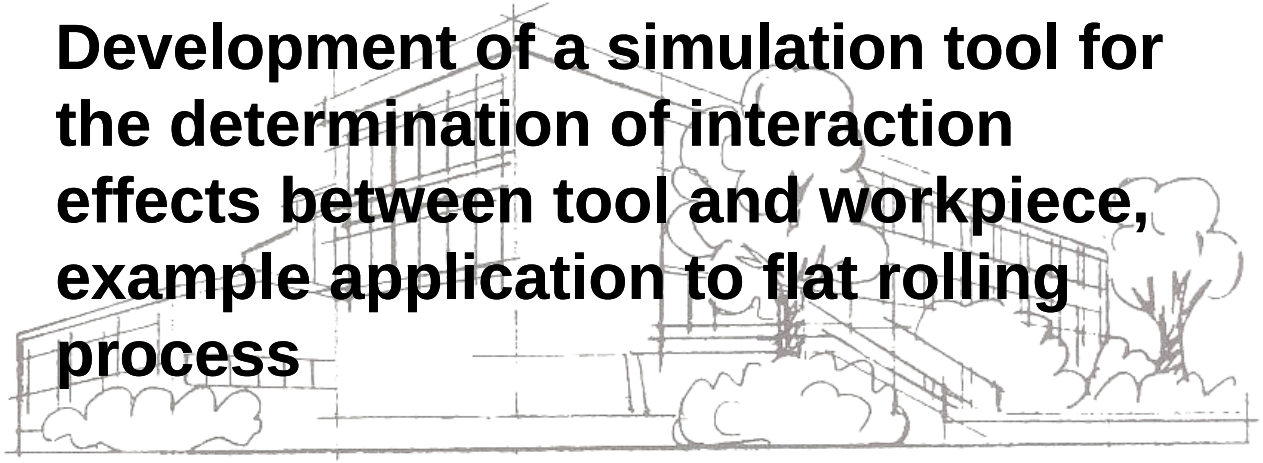
Development of a simulation tool for the determination of interaction effects between tool and workpiece, example application to flat rolling process



Influence of interaction effects of structures and processes (SPP1180)

Institute of Metal Forming

Presented by: M.Sc. Sreedhar Puchhala

Dresden, on 1. March 2007

RWTH RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

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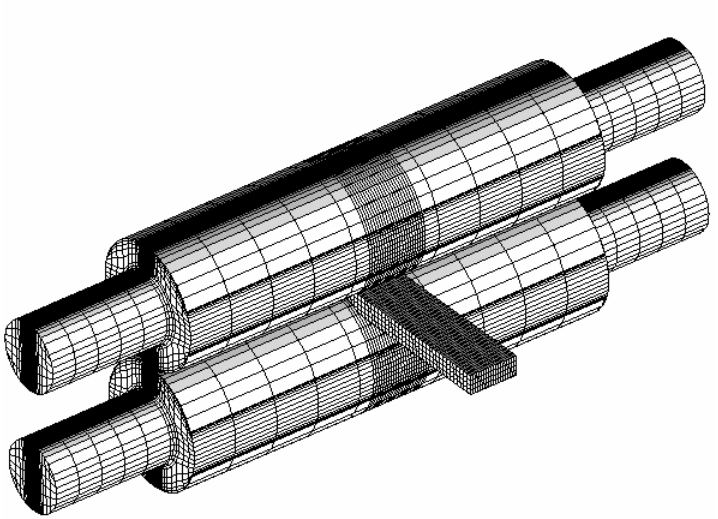
Outline

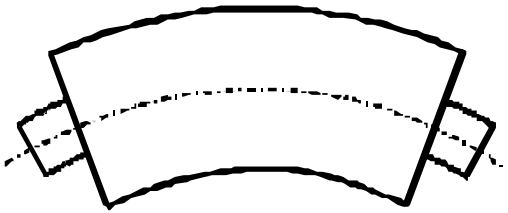
- Problem definition, during flat rolling
- Concept of simulation model
- Computation of bending effects of working rolls
- Quad configuration (multibody contact)
- Elastic strip tension
- Experimental measurement techniques

Problem definition during flat rolling

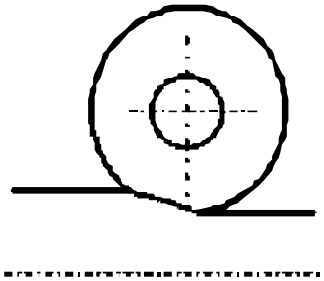


The load distribution between rollers and workpiece causes elastic deformation in the rollers.

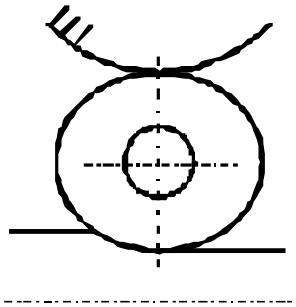
Bending



Flattening

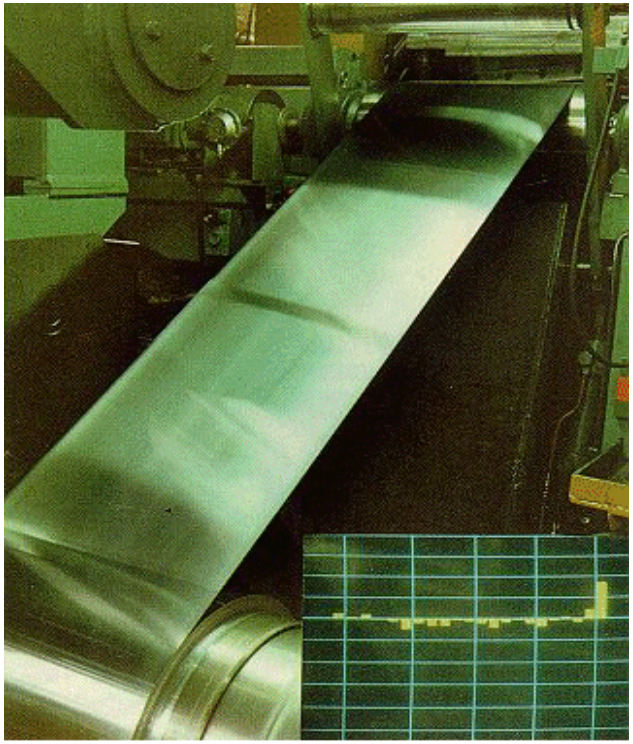


Change in profile

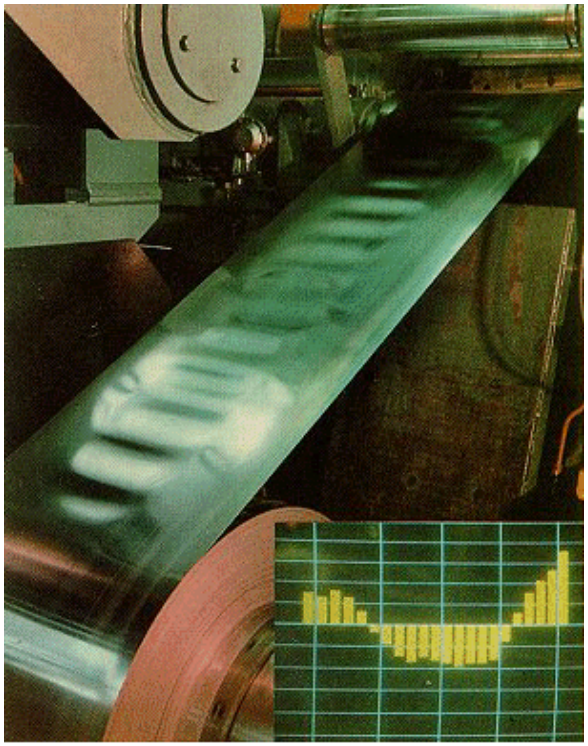


Problem definition, during flat rolling

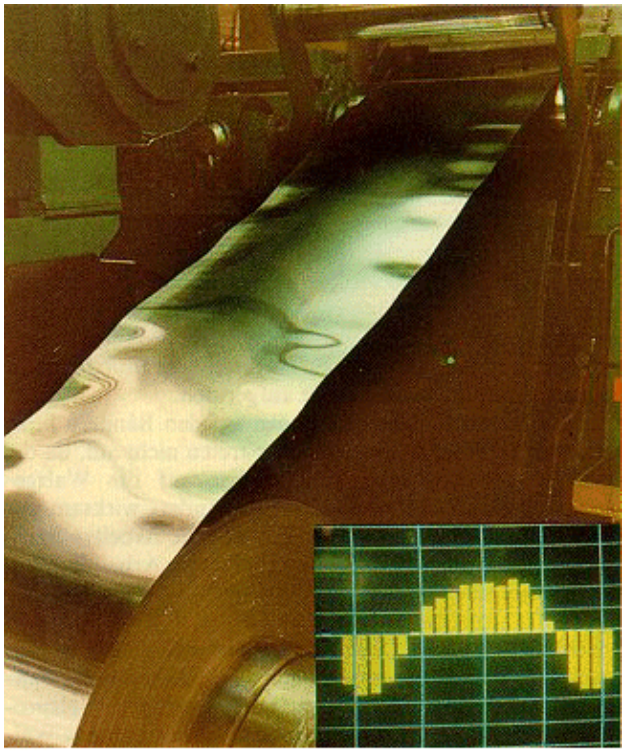
Flat strip



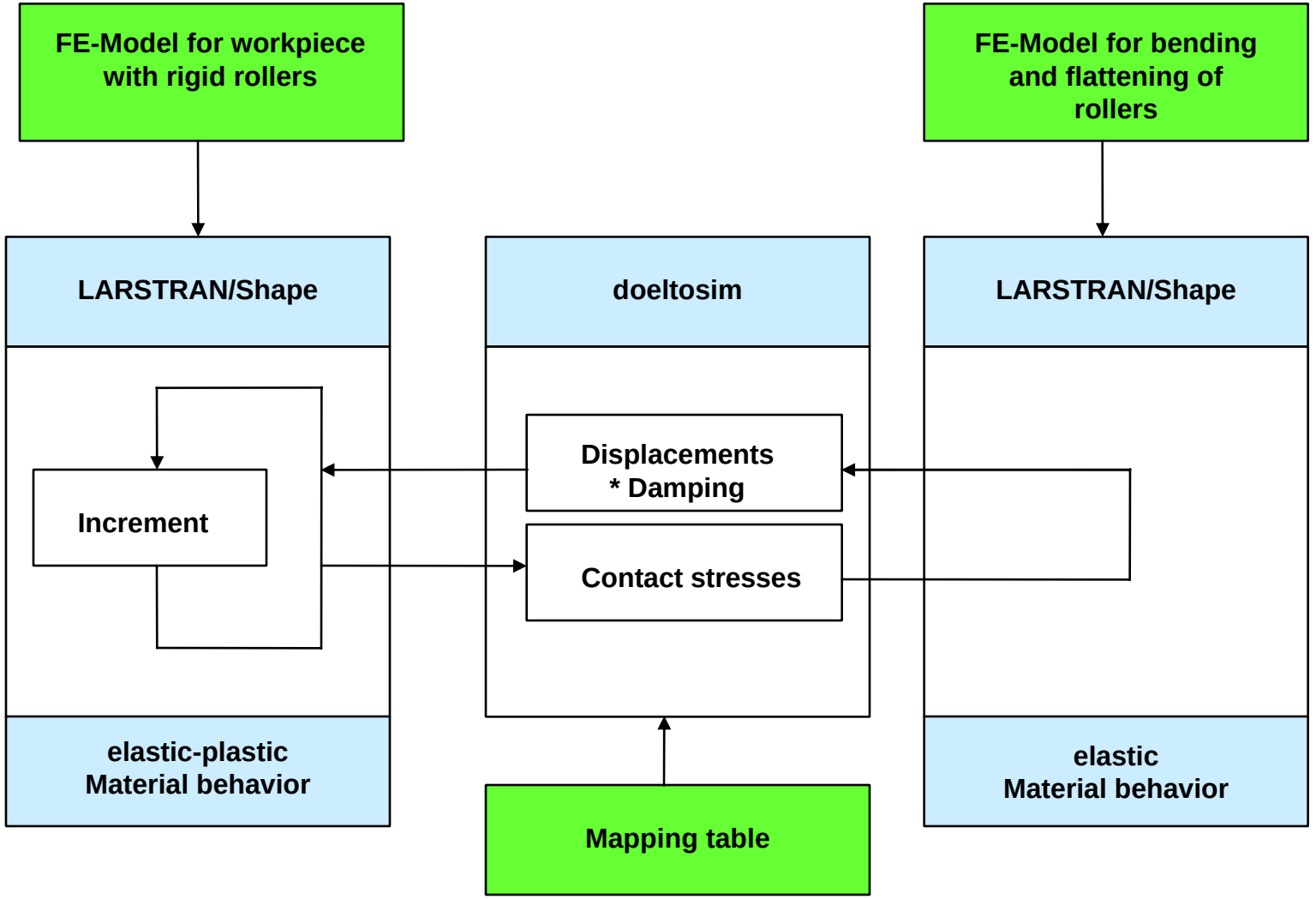
Middle crown



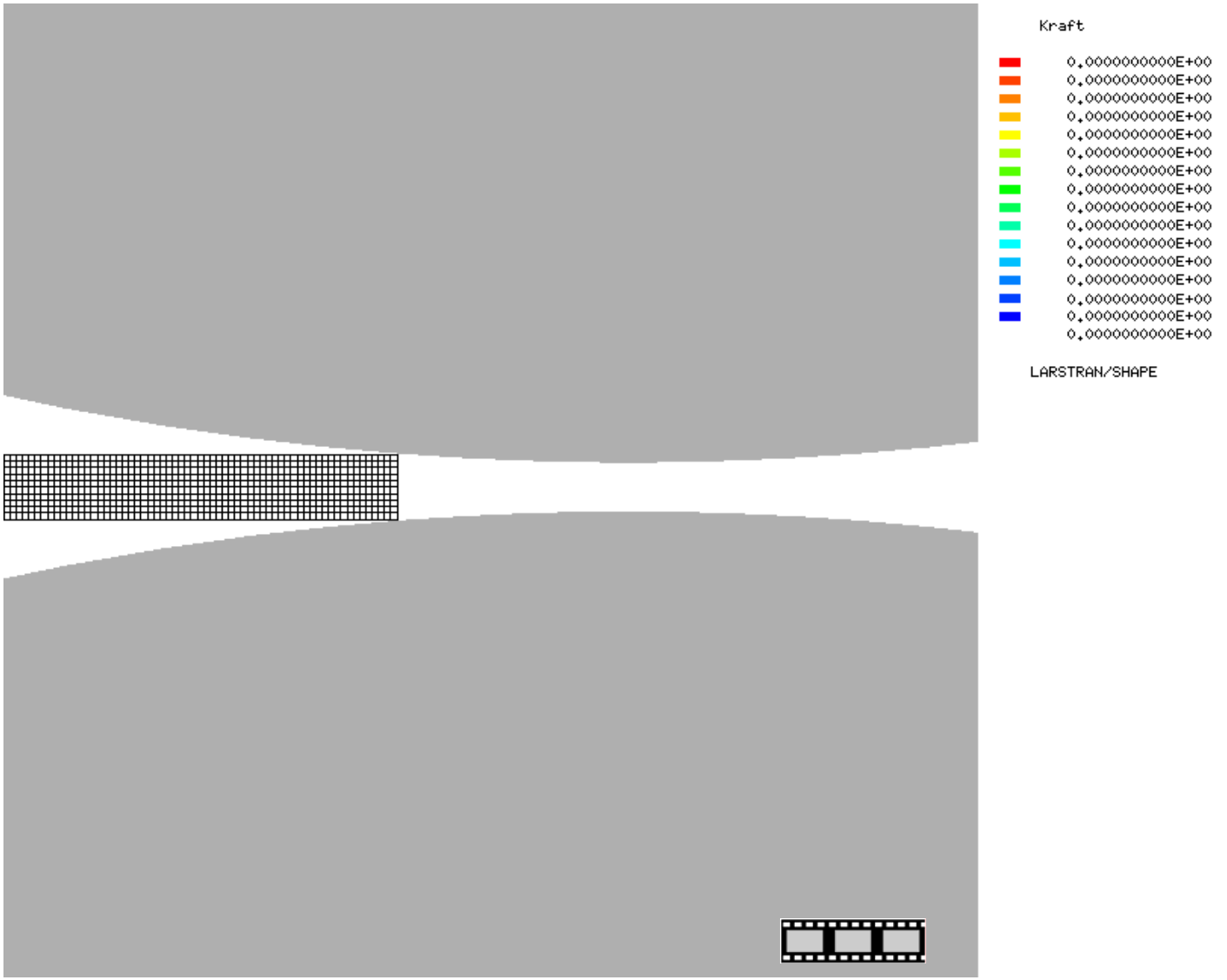
Edge crown



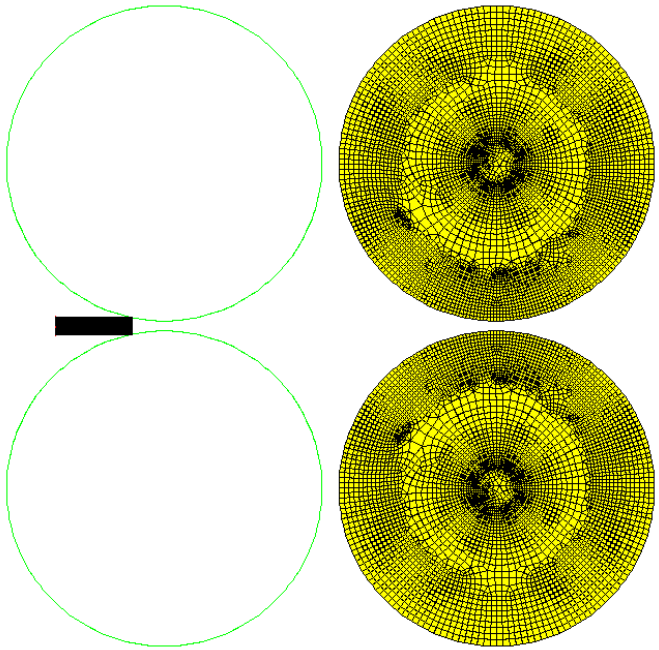
Concept of the simulation model (FEM – FEM coupling LARSTRAN)



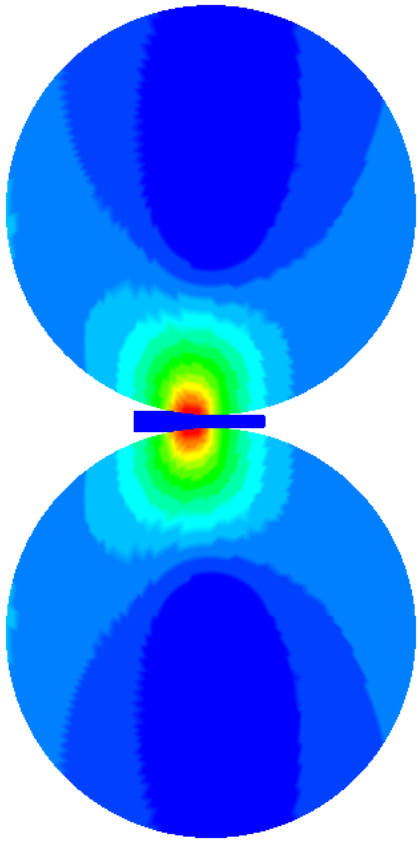
2D modelling - Contact stresses (rigid rollers)



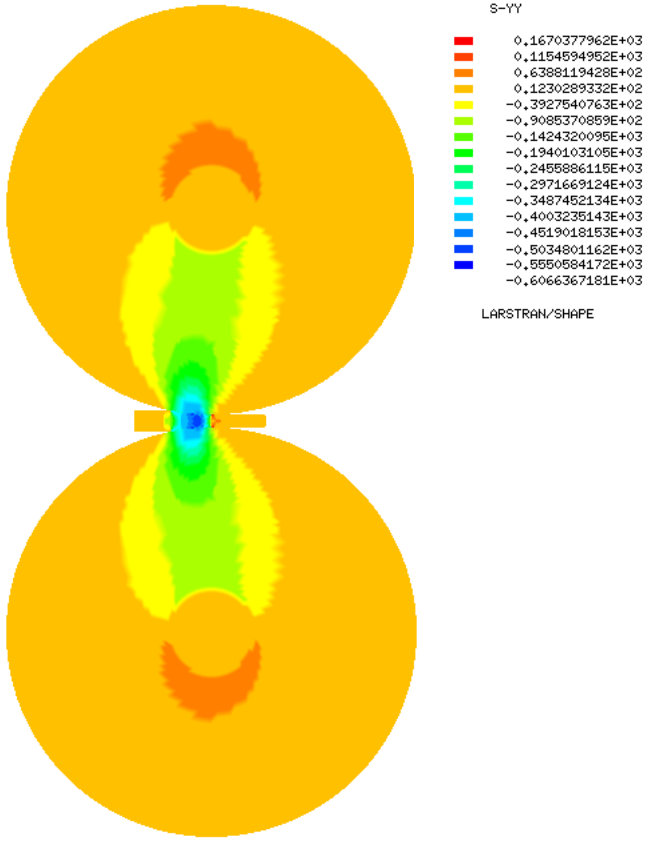
Numerical experiments



Plastic and elastic models

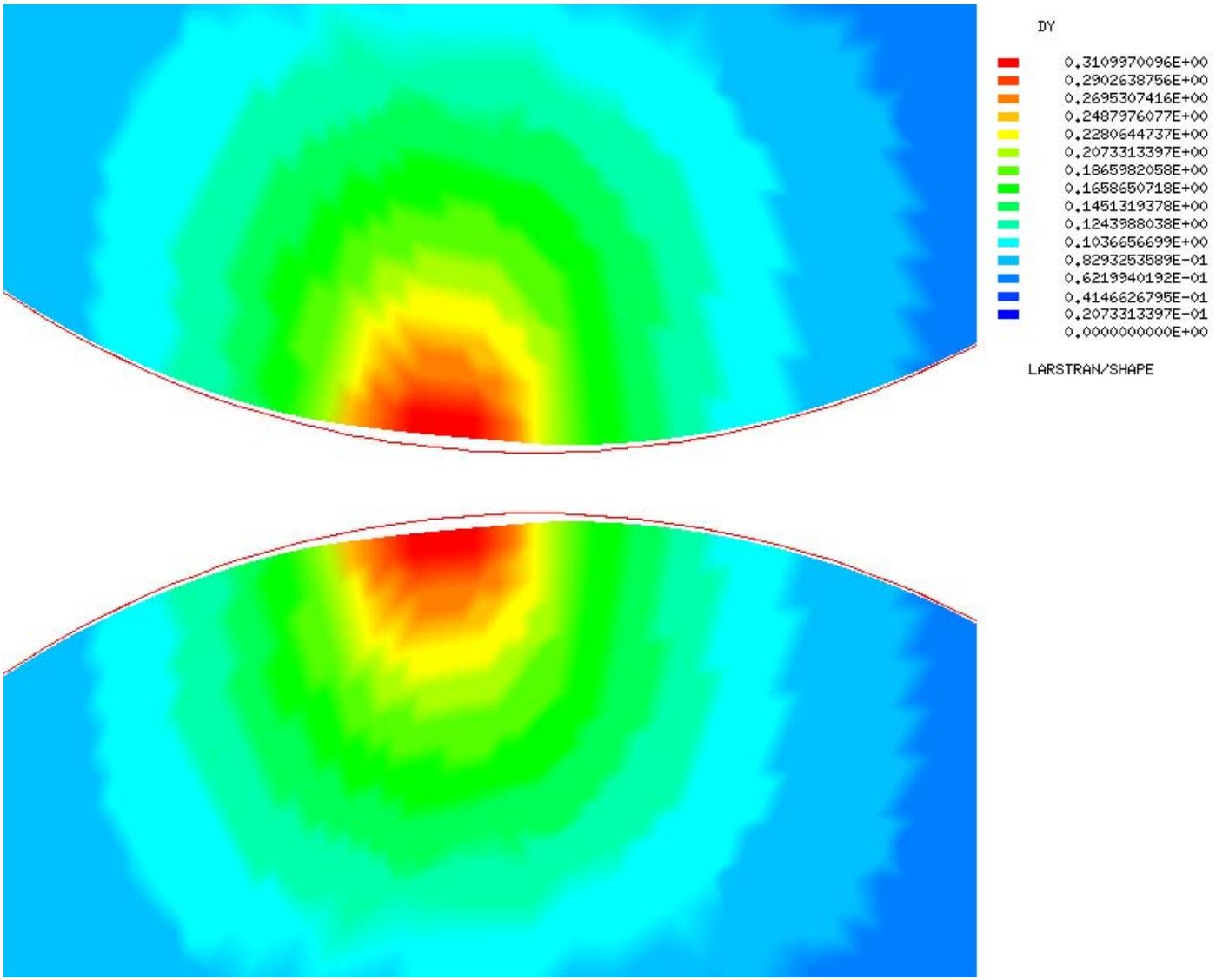


Deformation of rolls (Y)

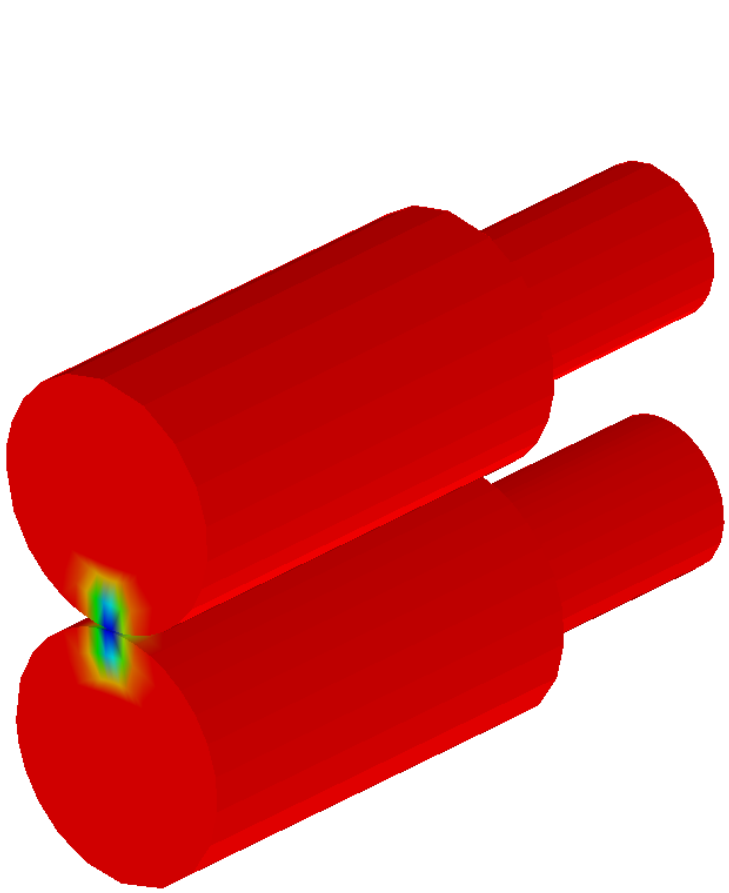


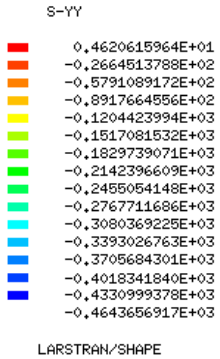
Stress distribution (S-YY)

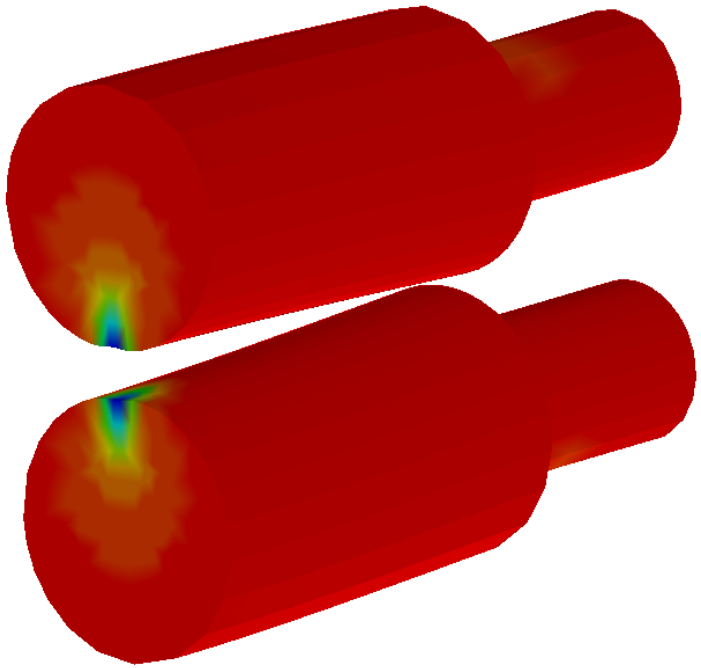
Ideal rolls Vs deformed elastic rolls

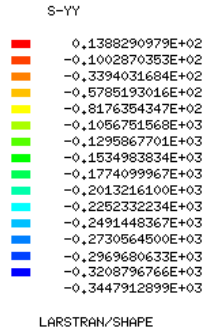


Stress distribution (S-YY) in 3D model





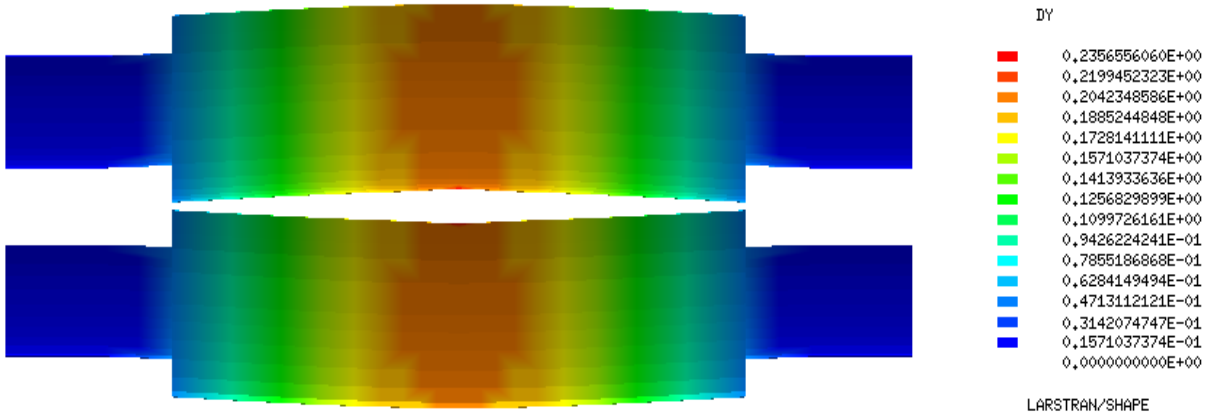




Fixed axis model

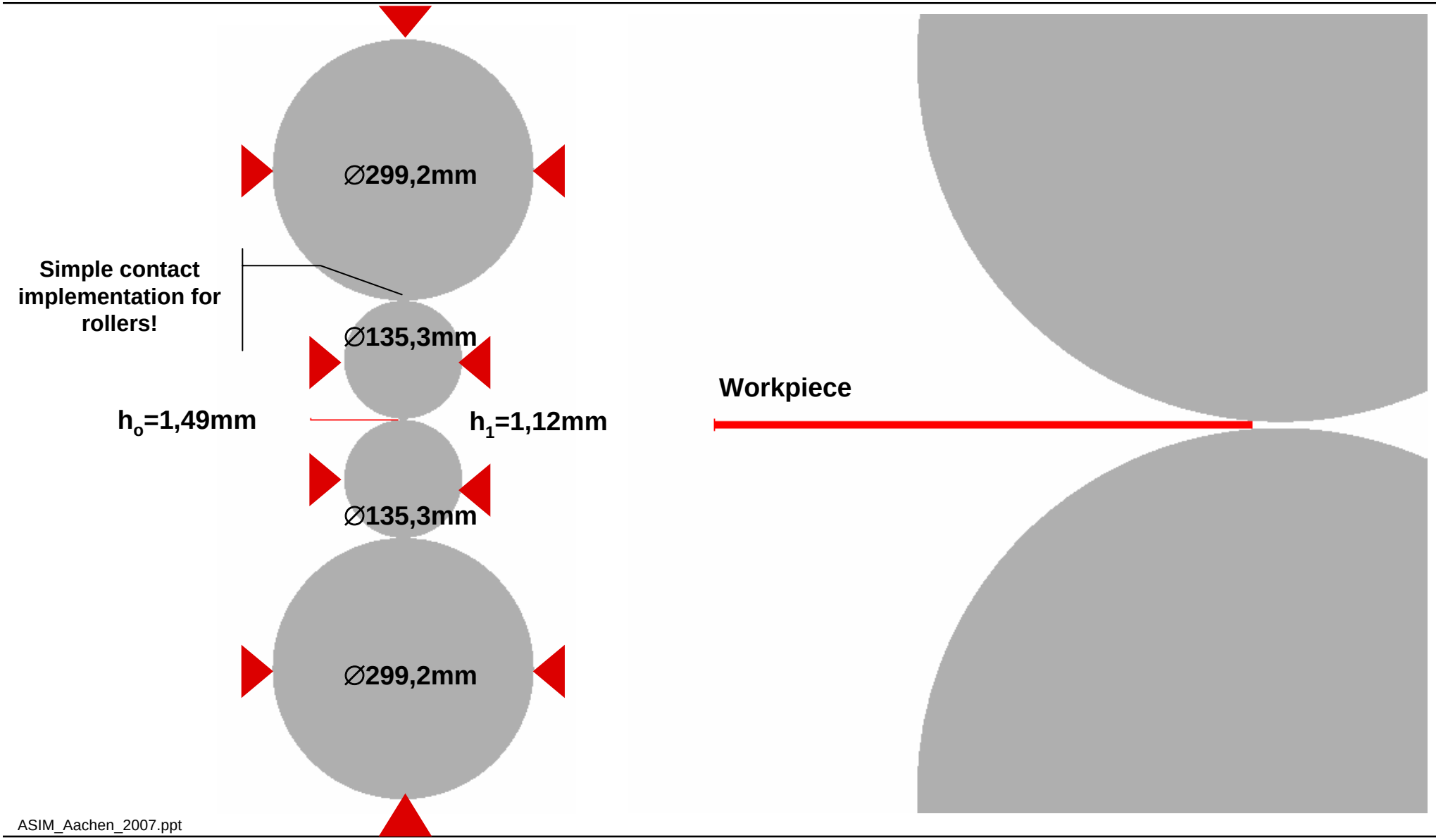
At ends fixed model

Bending effects in the working rolls (1:50 zoom)

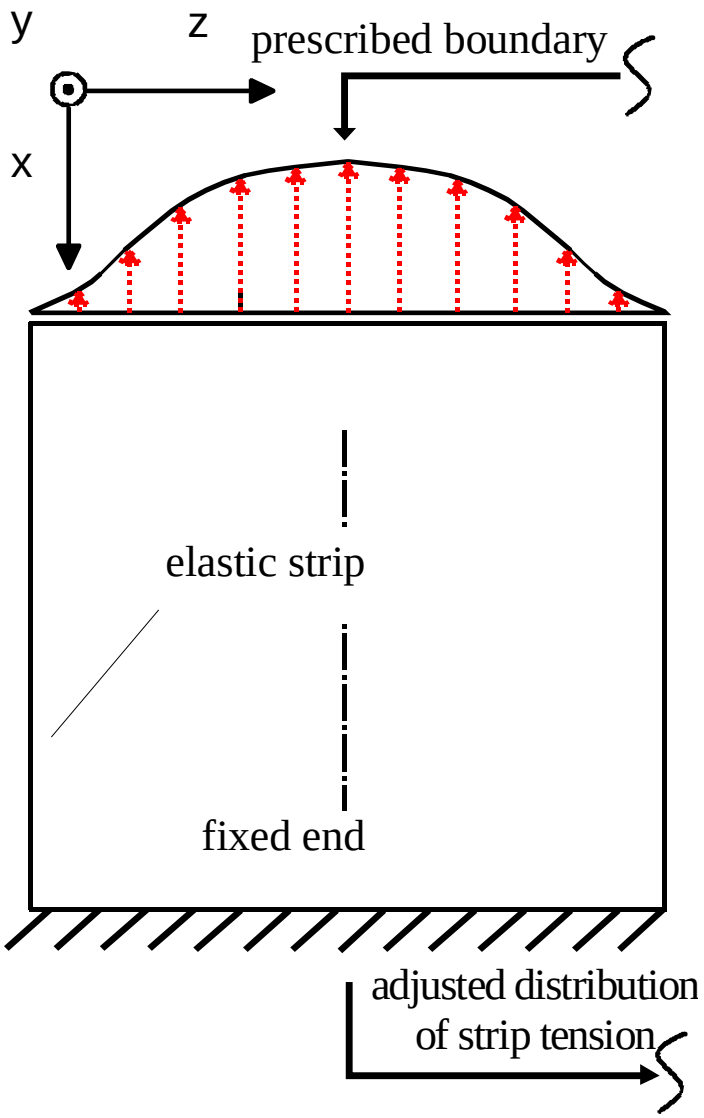


- Work roll flattening requires supporting rolls
- Contact between working and supporting rolls
- Linear thermo-mechanical (elastic) effects

FE geometry quarto configur0ation (2D model)



Outlook – extended simulation model considering strip tension



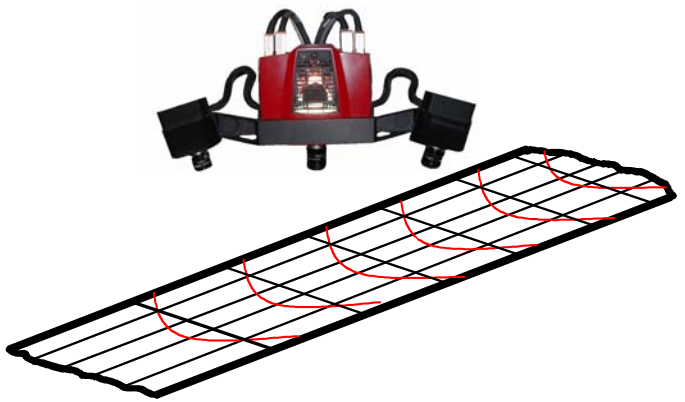
- **Geometry of the strip from plastic simulation is extracted**
- **Invert the deformation distribution into the strip flow direction**
- **The elastic strip is fixed on one end and the inverted displacements are applied as nodal forces**
- **The stress distribution is computed**
- **The stress distribution is scaled and implemented into the plastic model**

Experimental measurement techniques

Optical strain measuring system (ARGUS)

Measuring the strain distribution in the strip

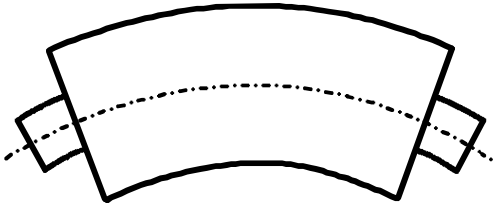
Precision:= 0.01% Strain



Optical Digitalising system (ATOS)

Mesuring the Roll bending

Precision:= 1/10000 of Mesuring field size

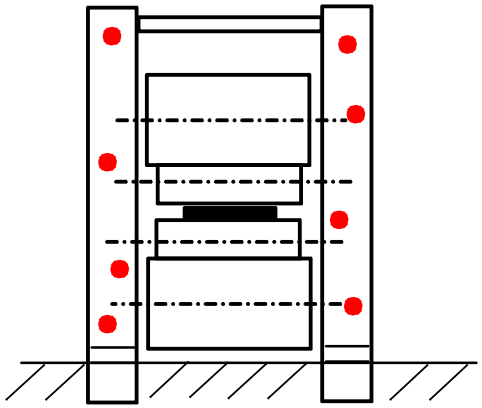


:= Coordinates of mesuring points

Optical Coordinate mesuring (TRITOP)

Mesuring the whole machine deflection

Precision:= 0.01mm per Meter Object size

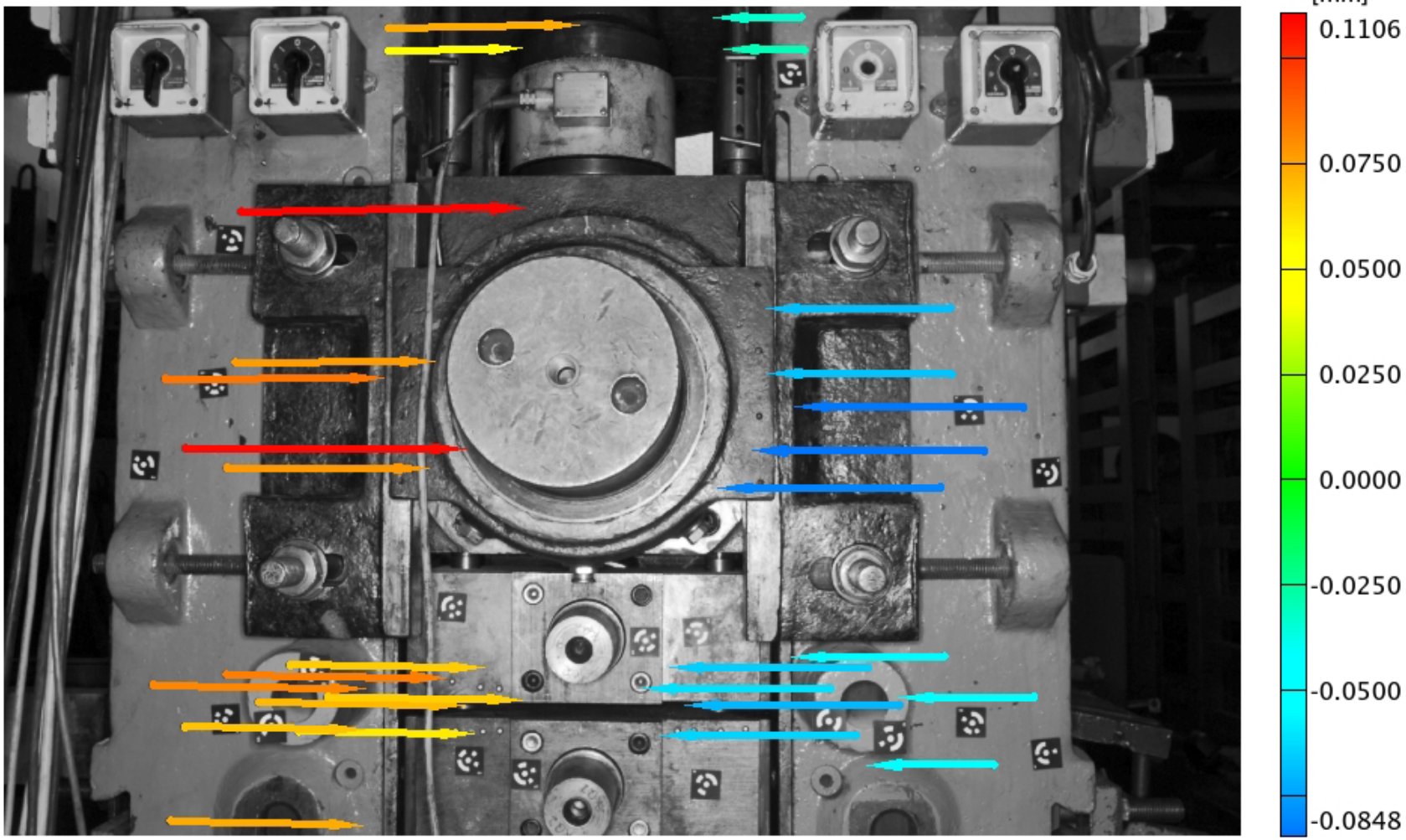


Deformation analysis

Static Load Fw = 729 kN

Roll moment Mw = 200 Nm

Deformation in X-axis direction



Deformation analysis

Static Load Fw = 729 kN

Roll moment Mw = 200 Nm

Deformation in Z-axis direction