

Prozess- und Zerreis-Simulationen von punktförmigen Verbindungen im Automobilbau unter Berücksichtigung unscharfer Prozess-Parameter

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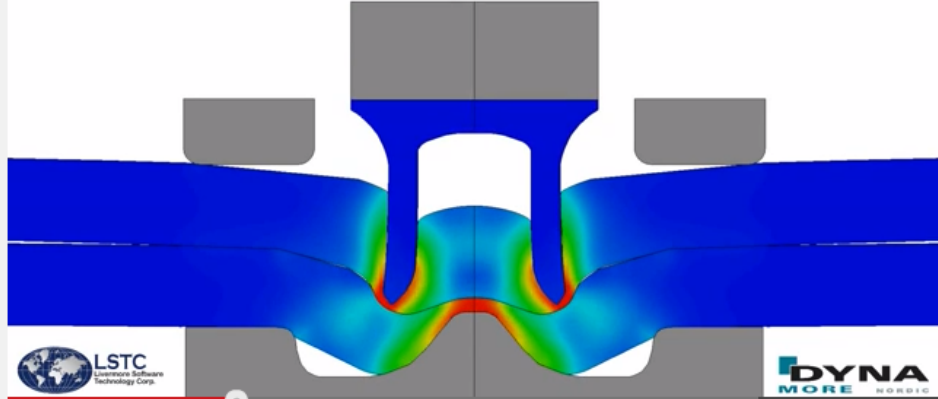
LS-DYNA TV: Beispiel Fügeprozess-Simulation

YouTube DE

Hochladen

lepenies@gmx.de

Visualize the equivalent plastic strain...



LSTC
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DYNA
MORE
NERGIC

0:21 / 1:28

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Info

Teilen

Hinzufügen

Veröffentlicht am 26.02.2013

This is a self-piercing riveting simulation carried out with LS-DYNA using axi-symmetric finite elements with a re-meshing strategy. The geometry as well as the material parameters were inspired by: Porcaro, R., Hanssen, A.G., Langseth, M., Aalberg, A.: "Through Process Modelling of Self-Piercing Riveting", 8th International

Mehr anzeigen

NOCH KEINE KOMMENTARE

Introduction to Riveting - Beaducation.com
von beaducation
2.058 Aufrufe
1:13:26

Disney Cartoon - Four Methods Of Flush Riveting - Aircraft Manufacturing
von egbdf111
115.219 Aufrufe
9:33

Reverse Rivet Flaring Set and Domed Piercing Base
von CraftedFindings
2.729 Aufrufe
3:06

Making Hot rivets for the Titanic project
von Ballard Forge
17.147 Aufrufe
1:55

Henrob Automotive Industry
von 18004HENROB
5.682 Aufrufe
4:04

BOWHUNTING: Double Deer Morning!!!
von TheFieldArcher
Empfehlungen für mich
2:30

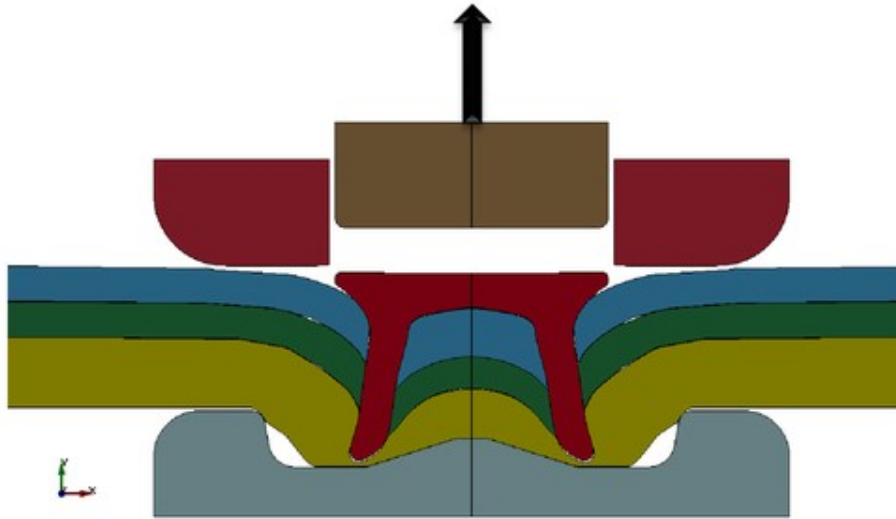
LS-DYNA Sample Models 1
von LancemoreJP
100 Videos

NM-11: Riveting machine for skates.wmv
von Stefan Gustavsson
6.641 Aufrufe
9:51

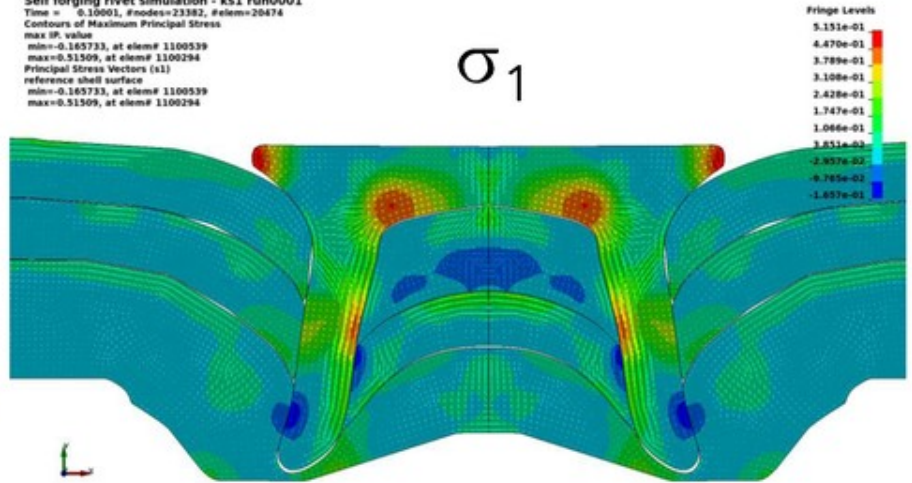
LS-DYNA Tutorial Part #1
von AI TAB
15.609 Aufrufe
11:02

Beispiel einer Fügesimulation mit LS-DYNA

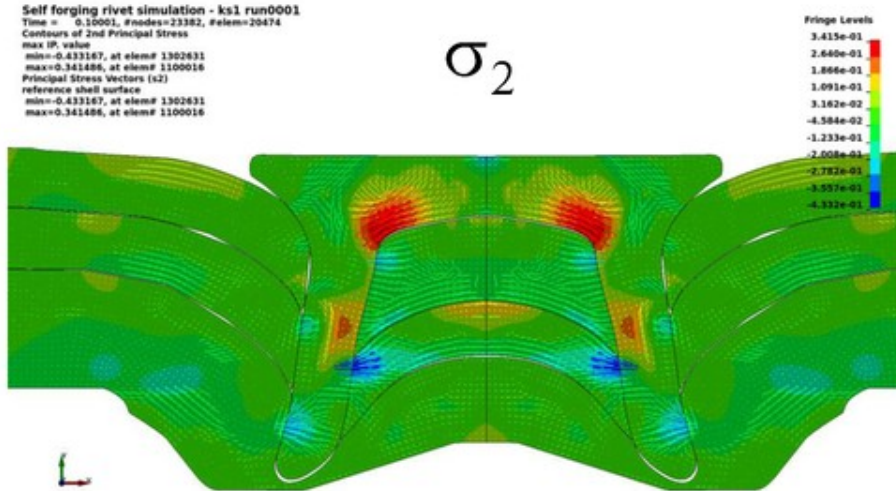
Self forging rivet simulation - ks1 run0001
Time = 0.10001, #nodes=23382, #elem=20474



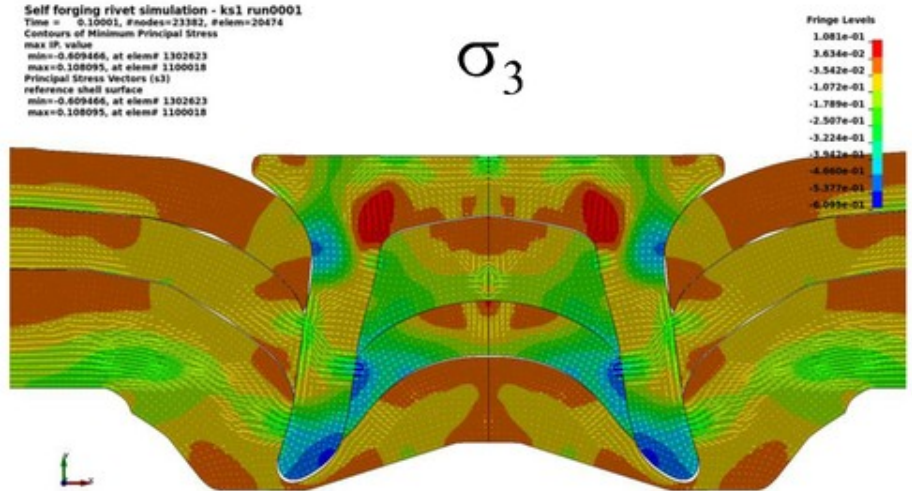
Self forging rivet simulation - ks1 run0001
Time = 0.10001, #nodes=23382, #elem=20474
Contours of Maximum Principal Stress
max IP value
min=-0.165733, at elem# 1100539
max=0.51509, at elem# 1100294
Principal Stress Vectors (s1)
reference shell surface
min=-0.165733, at elem# 1100539
max=0.51509, at elem# 1100294



Self forging rivet simulation - ks1 run0001
Time = 0.10001, #nodes=23382, #elem=20474
Contours of 2nd Principal Stress
max IP value
min=-0.433167, at elem# 1302631
max=0.341486, at elem# 1100016
Principal Stress Vectors (s2)
reference shell surface
min=-0.433167, at elem# 1302631
max=0.341486, at elem# 1100016

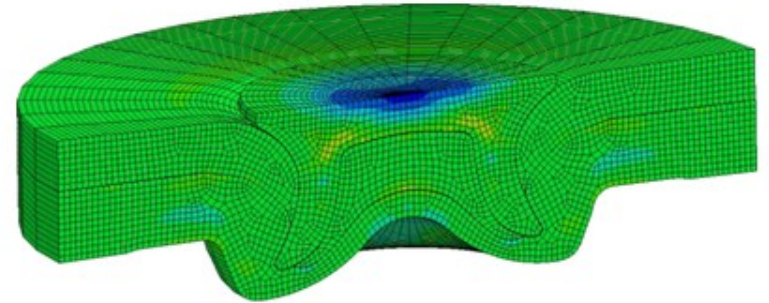
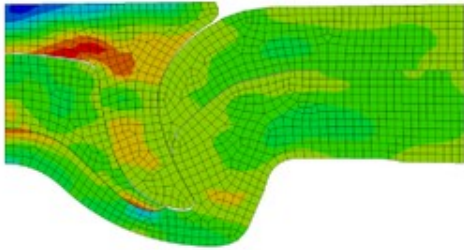


Self forging rivet simulation - ks1 run0001
Time = 0.10001, #nodes=23382, #elem=20474
Contours of Minimum Principal Stress
max IP value
min=-0.609466, at elem# 1302623
max=0.108095, at elem# 1100018
Principal Stress Vectors (s3)
reference shell surface
min=-0.609466, at elem# 1302623
max=0.108095, at elem# 1100018

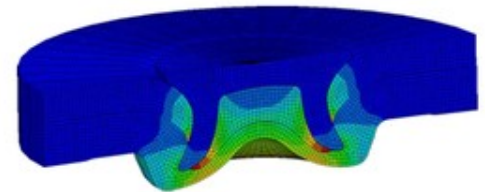
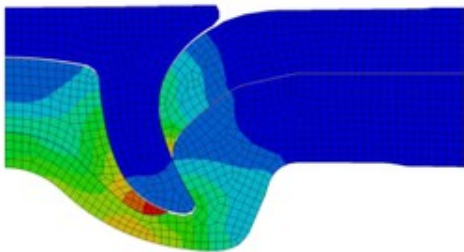


3d-Basismodellerstellung

- Mappen der Ergebnisfelder auf 3d-Netz
 - 3D-Netzerstellung + Mapping (*INITIAL_LAG_MAPPING)

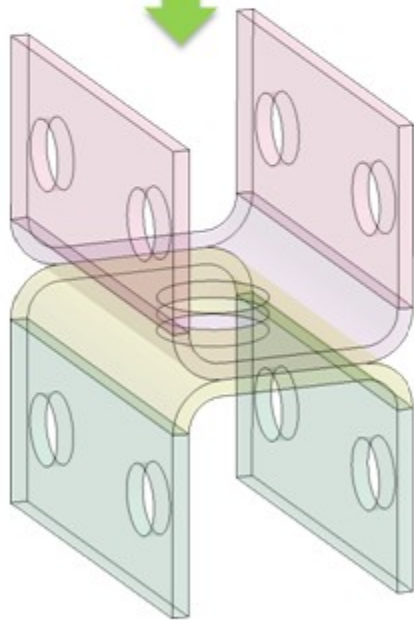
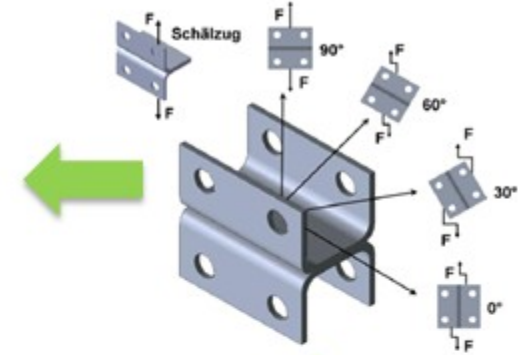
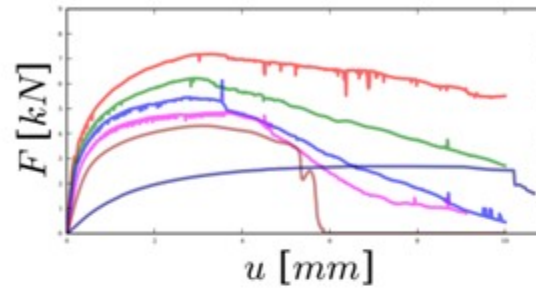
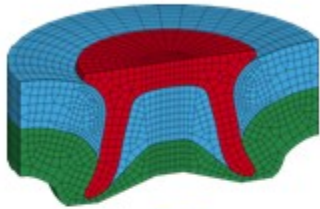


- Mapping in vorhandenes 3D-Netz (*INITIAL_LAG_MAPPING)

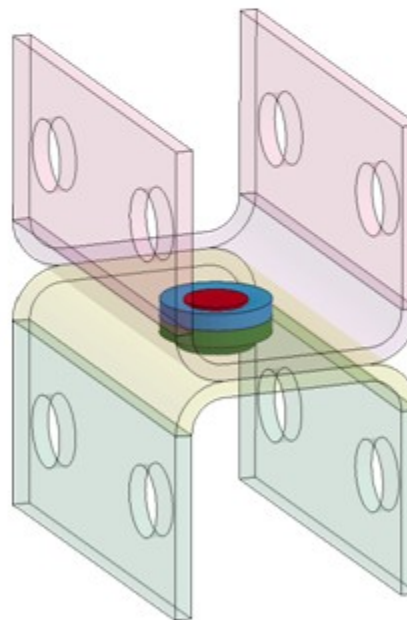


automatisierte Prognose von Verbindungsfestigkeiten ✓

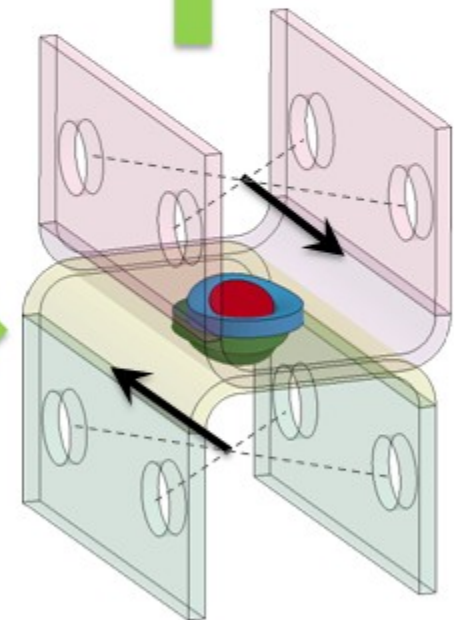
Verbindungstyp generieren



Basismodell erstellen/wählen

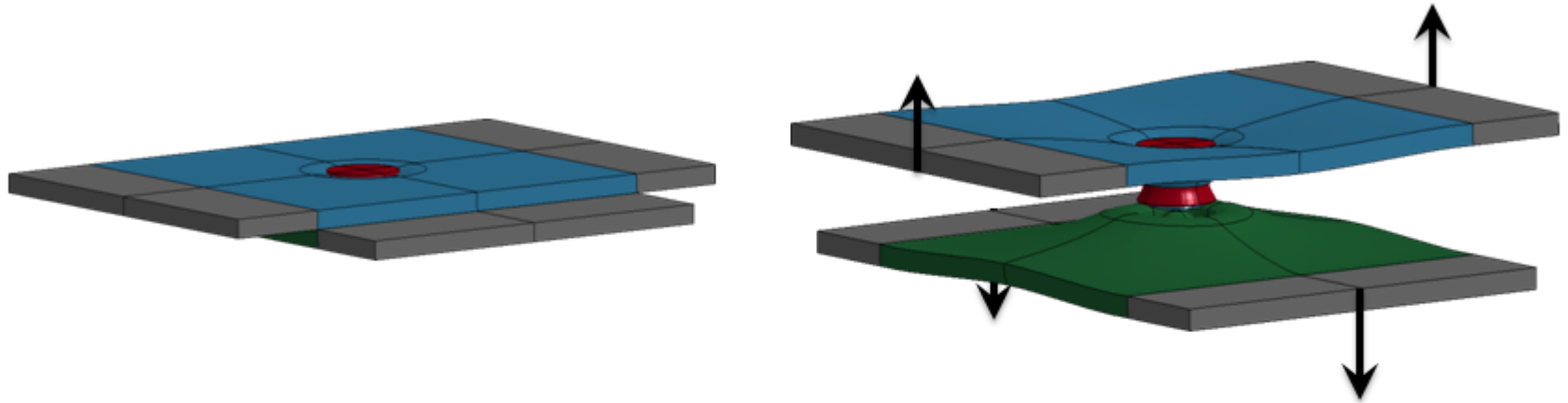


Basismodell zusammenfügen

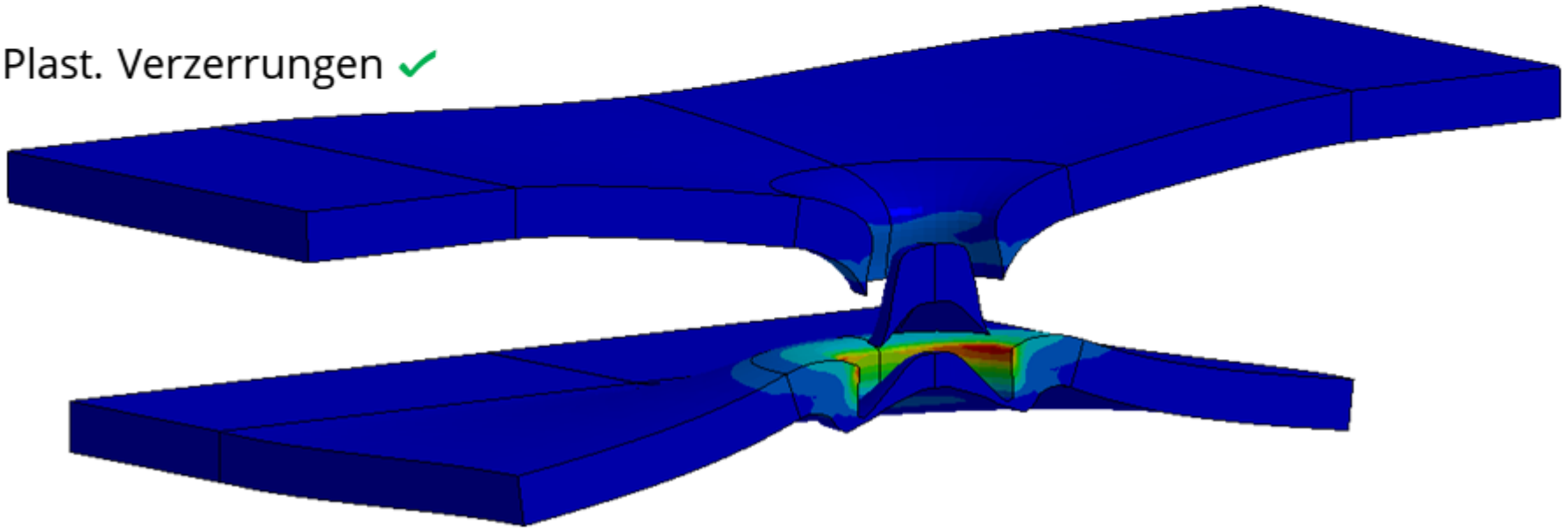


Basismodell belasten

Cross Tension Test

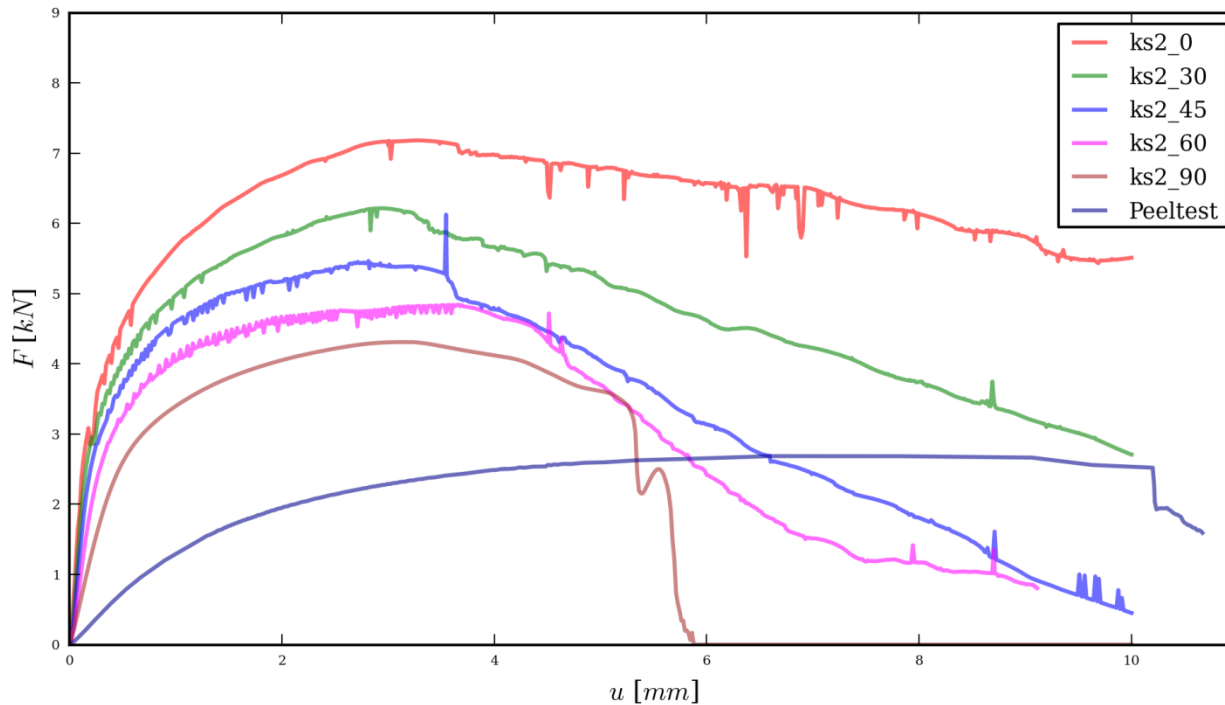
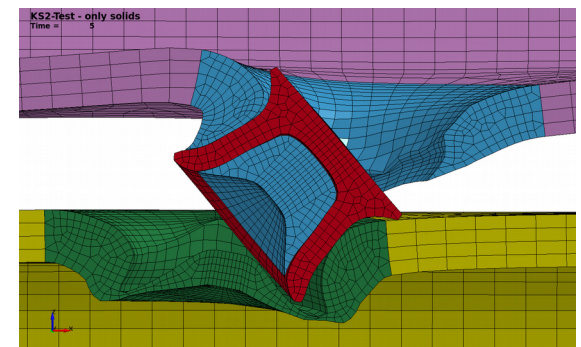
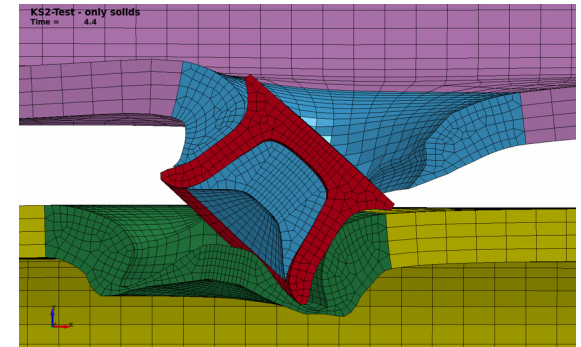
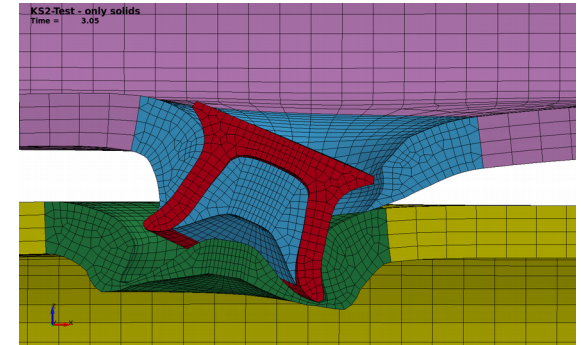
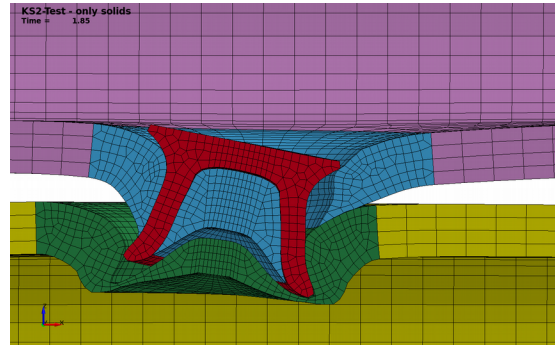
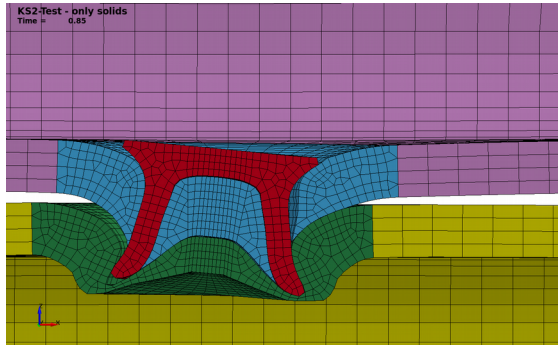


Plast. Verzerrungen ✓



Prognose der Kraft-Verformungs-Abhängigkeiten 3d

Feinmodell-Simulationen für KS2-Probe und Schälzugversuch



*MAT_SPOTWELD (*MAT_100)

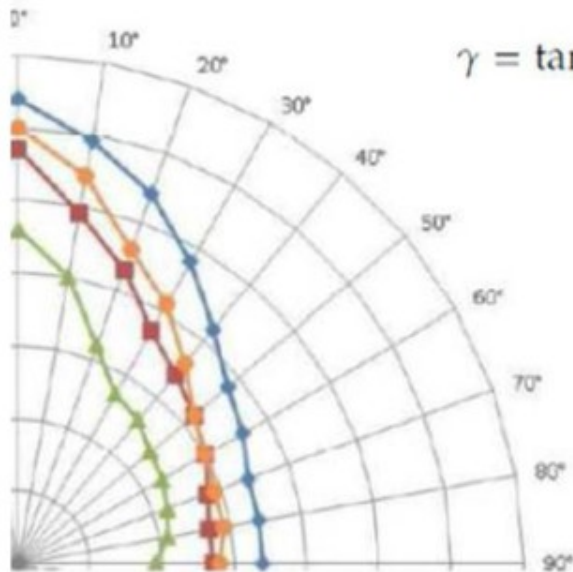
- New failure model OPT=11 for beam elements, where failure depends on loading direction via curves

OPT = 11 invokes a resultant force based failure criterion for beams. With corresponding load curves or tables LCT and LCC, resultant force at failure F_{fail} can be defined as function of loading direction γ (curve) or loading direction γ and effective strain rate $\dot{\epsilon}$ (table):

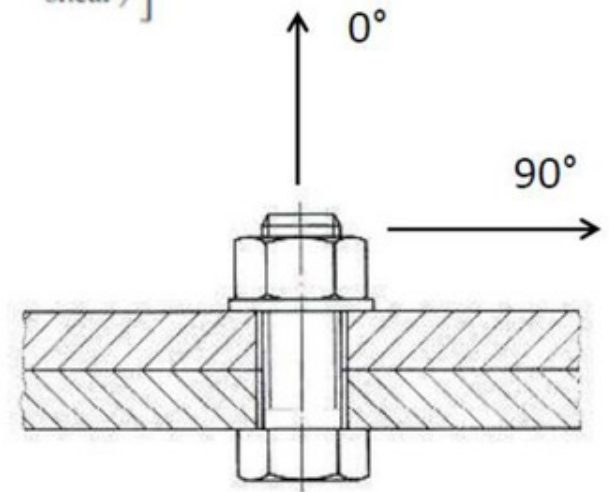
$$F_{fail} = f(\gamma) \quad \text{or} \quad F_{fail} = f(\gamma, \dot{\epsilon})$$

with the following definitions for loading direction (in degree) and effective strain rate:

$$\gamma = \tan^{-1} \left(\left| \frac{F_{shear}}{F_{axial}} \right| \right), \quad \dot{\epsilon} = \left[\frac{2}{3} (\dot{\epsilon}_{axial}^2 + \dot{\epsilon}_{shear}^2) \right]^{1/2}$$



ISO thread
round thread
trapezoidal thread
buttress thread



Berücksichtigung der Parameter-Unschärfe

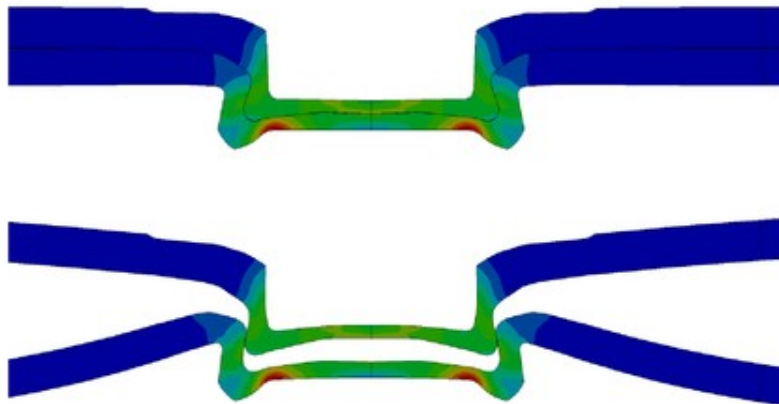
■ Ziel:

- Bestimmung der relevanten Prozessparameter (Reibbeiwerte, Nietfußgeometrie) auf die Eigenschaften einer HSN- bzw. CLN-Verbindung
- automatisierte Kalibrierung der Prozesssimulation – Bestimmung realitätsnaher Prozessparameter
- numerische Bestimmung von Zusammenhängen
 - z.B. Hinterschnitt – KS2_90-Tragfähigkeit

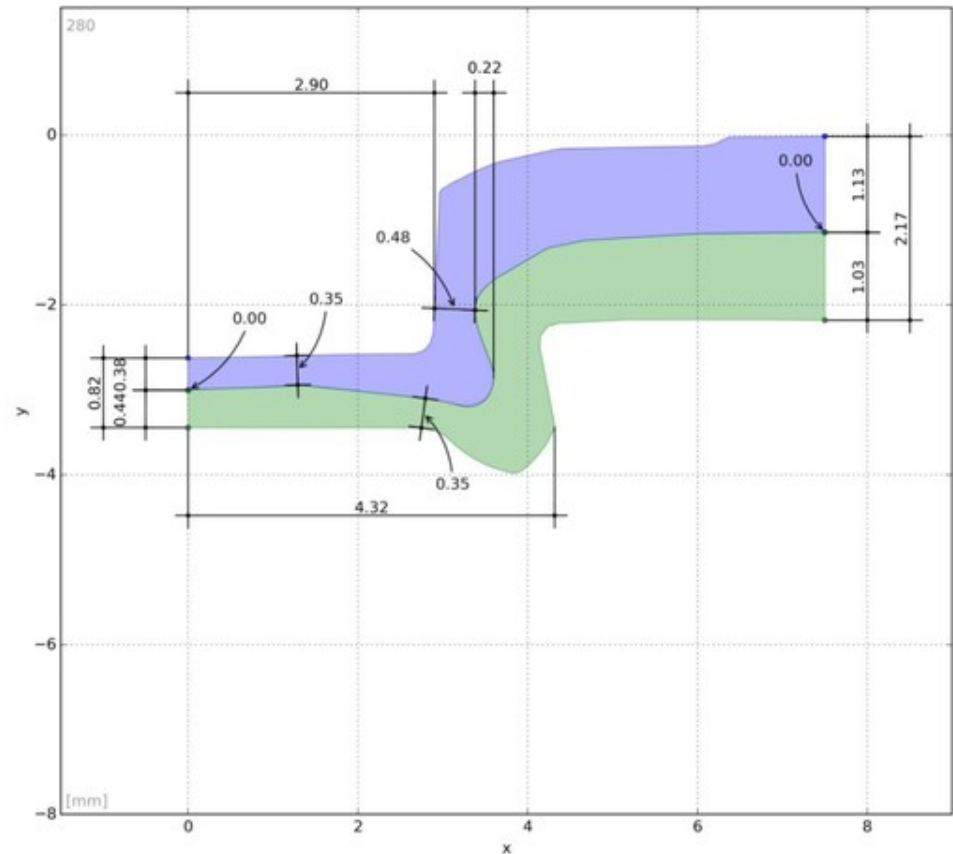
■ Exemplarische Sensitivitätsanalyse

Prozess-Simulation Clinchen (CLN)

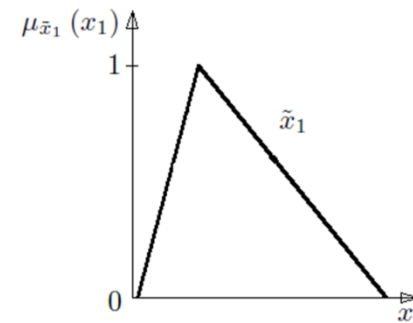
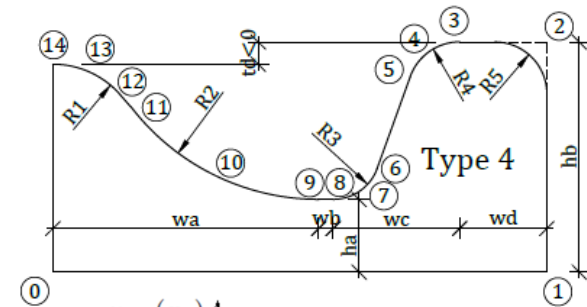
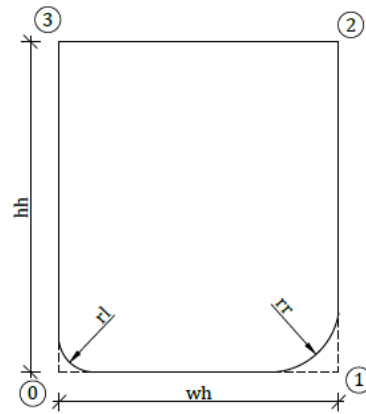
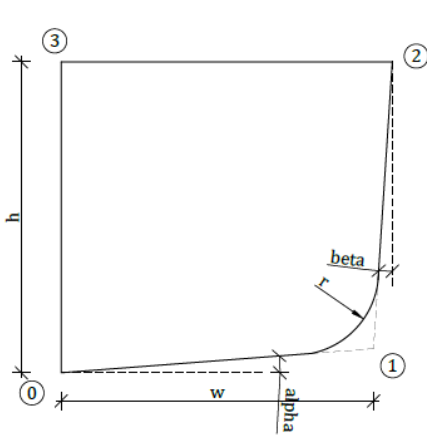
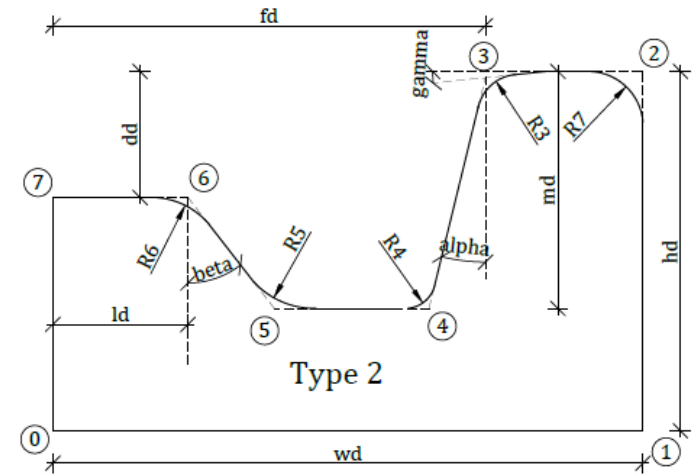
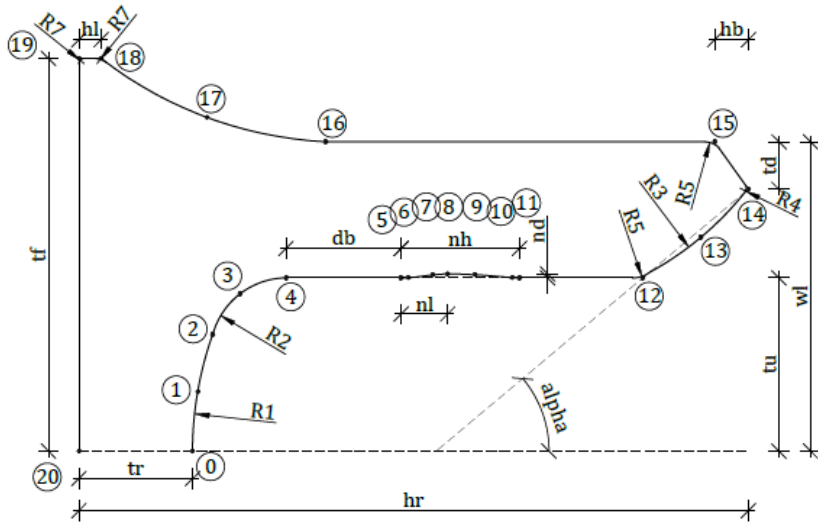
- automatisiertes Aufsetzen von axialsymmetrischen Fugesimulationen
- automatisierte Vermessung der Fügegeometrie nach Entlastung
- automatisierte Zerrei-Simulationen



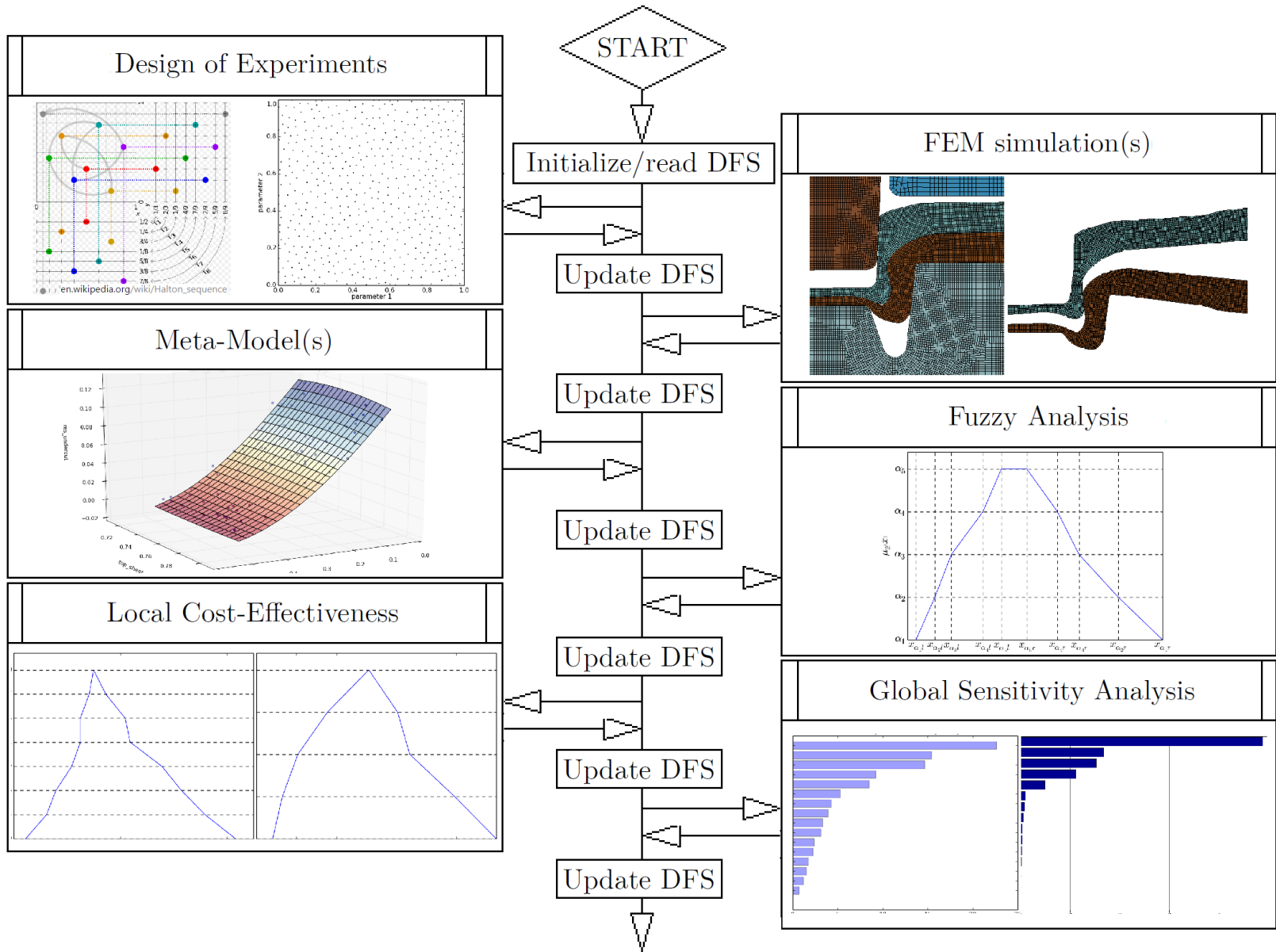
epspl



parametrische Nietsystemgeometrien (HSN-Prozess)

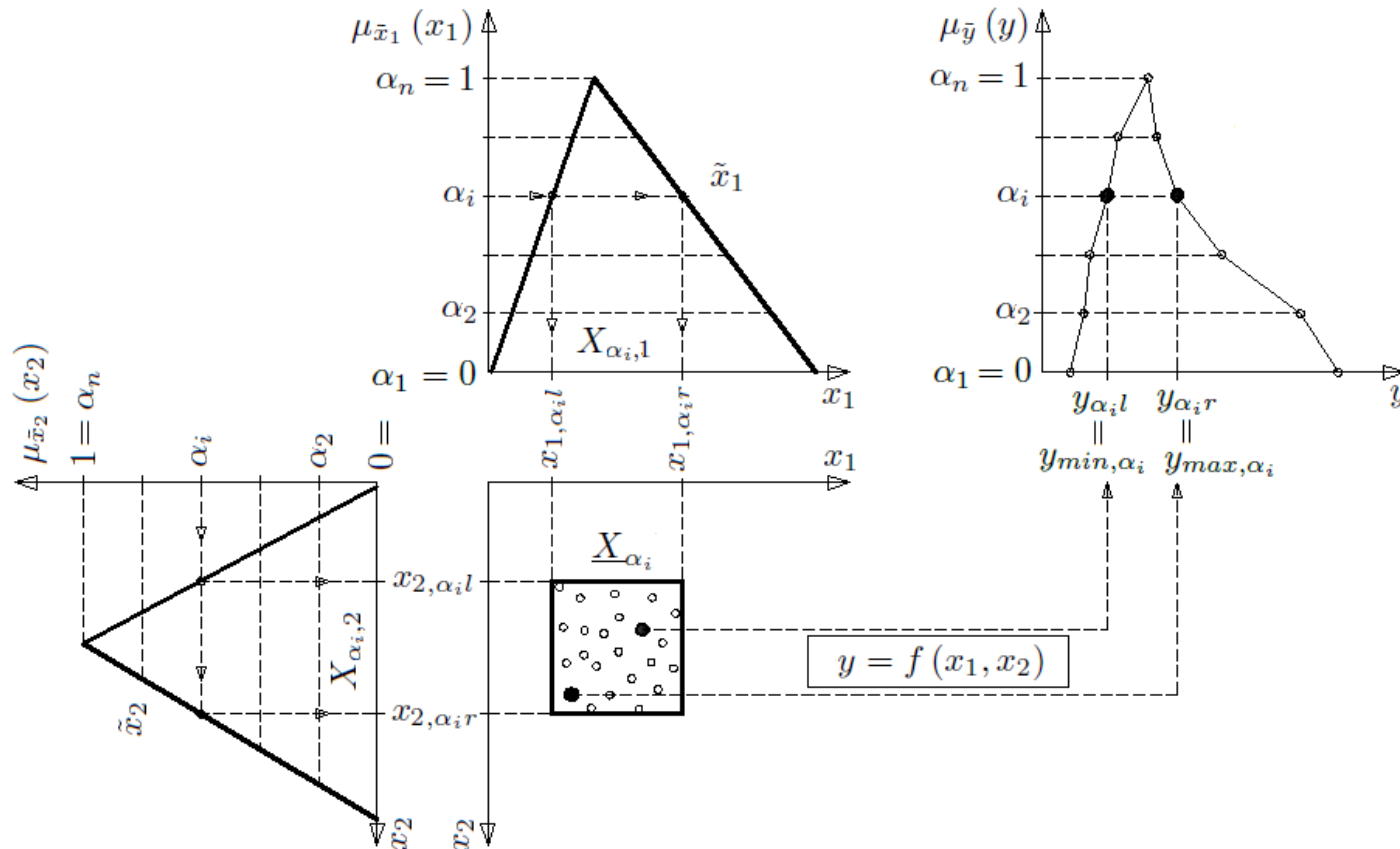


Ablauf einer VBT-Sensitivitätsanalyse



Fuzzy analysis

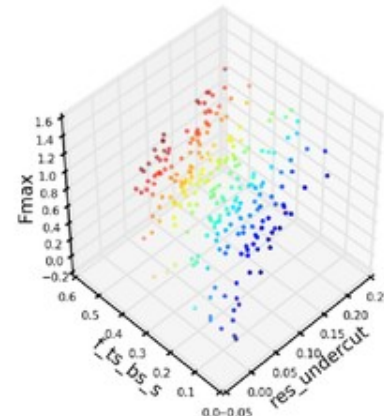
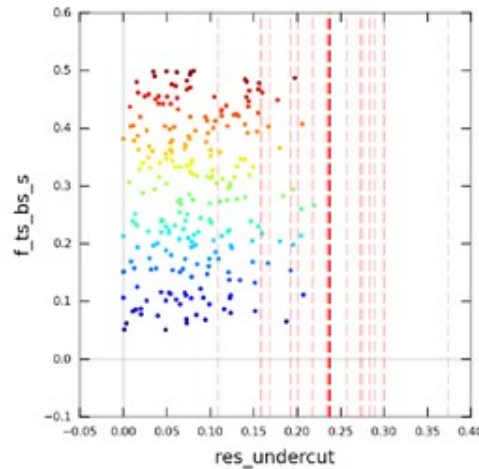
- A fuzzy analysis is performed in order to capture the impreciseness in an output caused by the impreciseness's in the input parameters.
- build the membership function for the chosen output



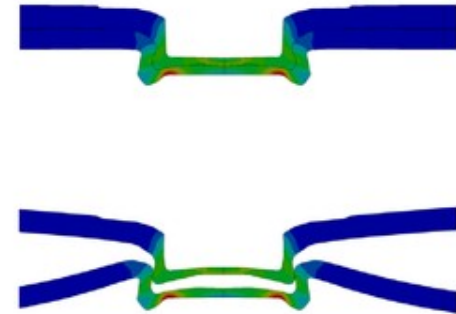
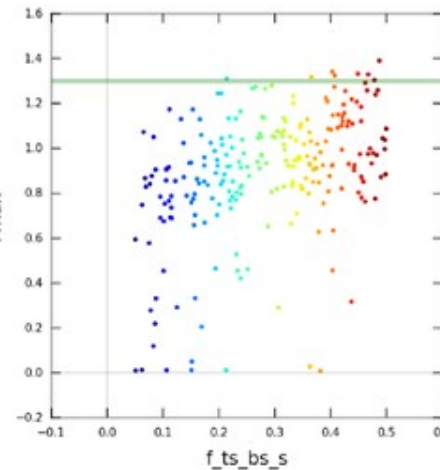
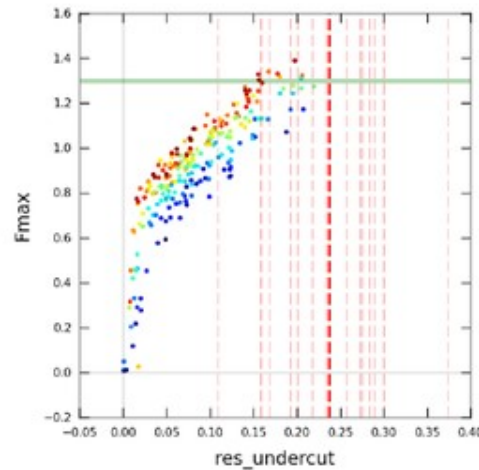
Design of Experiments (DoE): Prozesssimulation Clinchen

- $F_{\max,90}$ – Hinterschnitt – Reibbeiwert zwischen Blechen

Reibbeiwert
Oberblech-
Unterblech



F_{\max}



Hinterschnitt

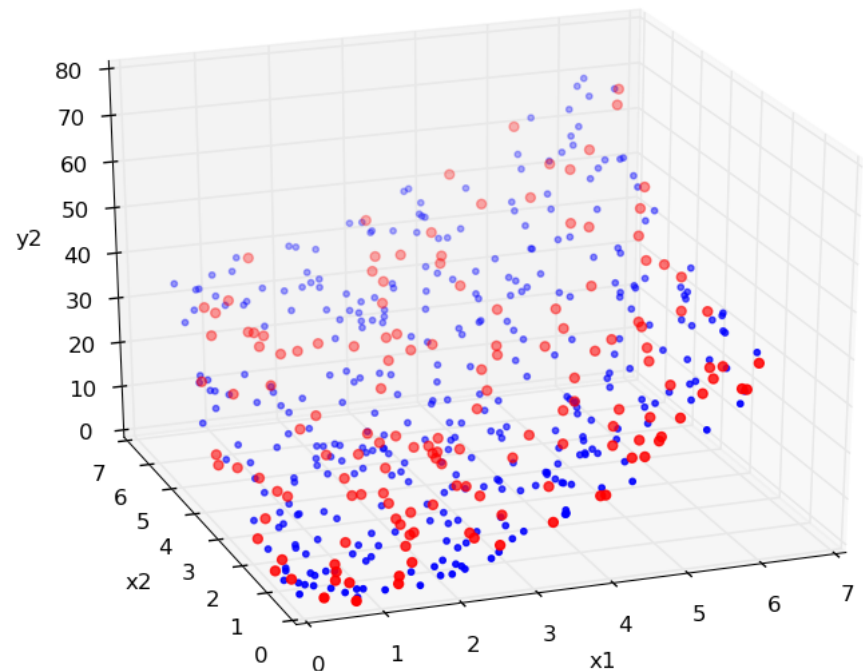
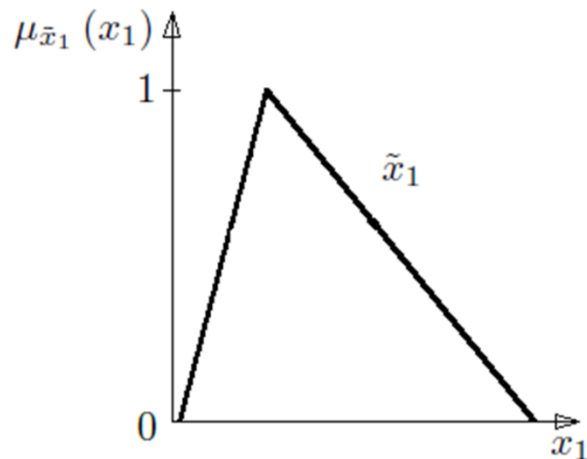
Reibbeiwert zwischen Blechen

Meta-models

■ Since FEM simulations are computationally expensive, meta-models are trained with the aid of LS-OPT for further usage (Fuzzy analysis, Cost-effectiveness fuzzy analysis).

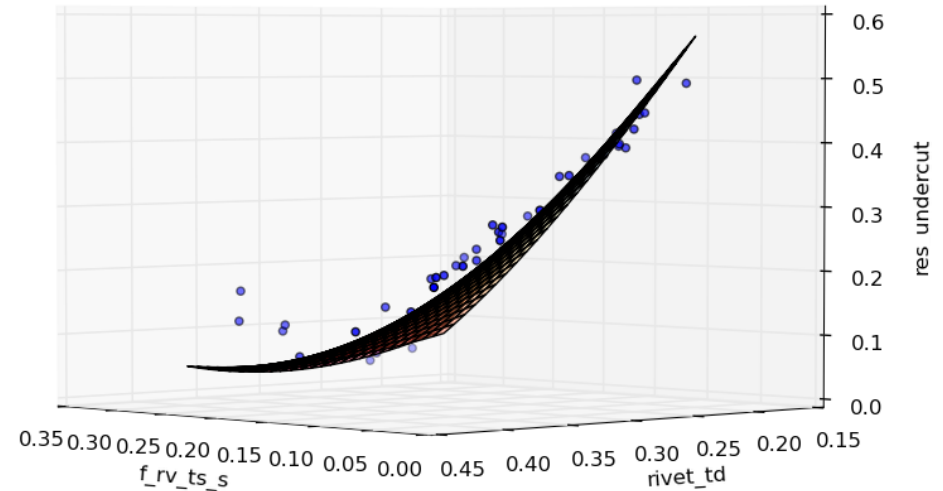
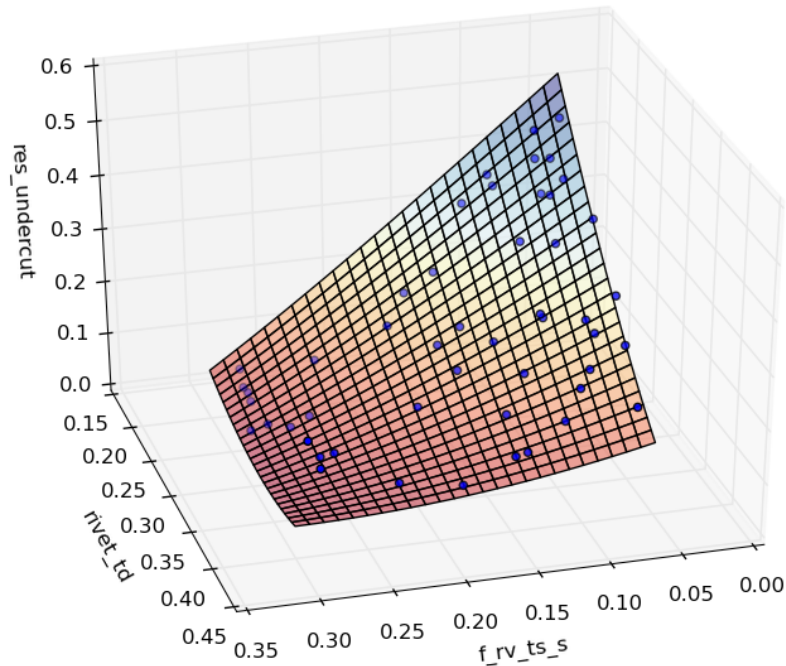
■ Workflow:

- extract points with results
- divide them into training and testing sets



Meta-Model

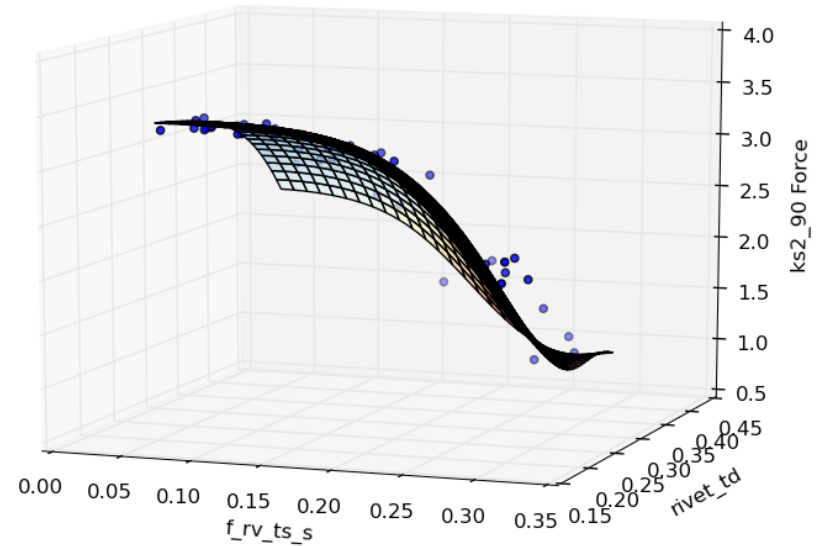
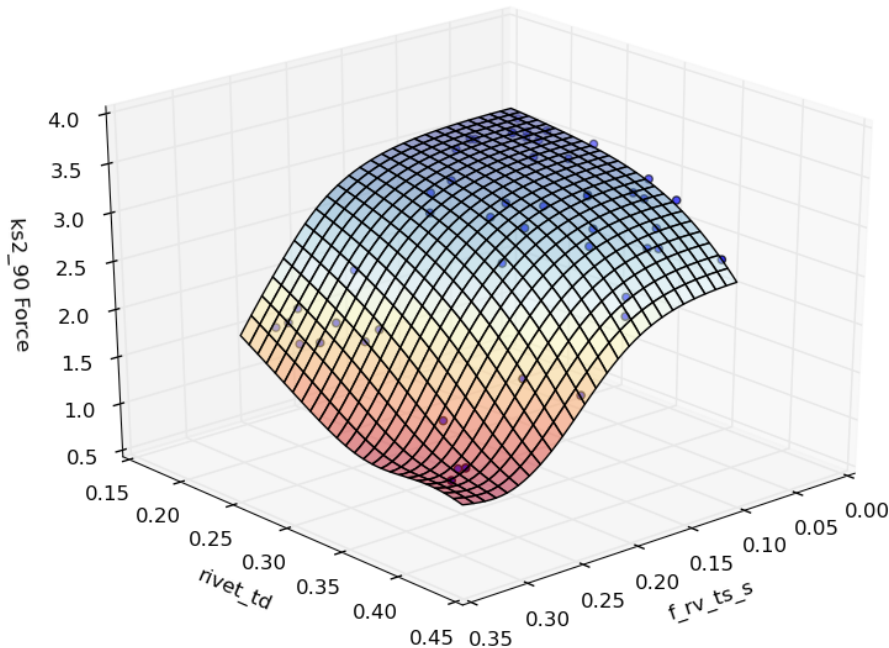
■ "rbf" meta-model 2D "cut" for the "res_undercut" output



Training (700 points) mean error: 8.90%
Testing (300 points) mean error: 18.8%

Meta-Model

■ "ffnn" meta-model 2D "cut" for the "ks2_90 Force" output



Training (700 points) mean error: 4.80%
Testing (300 points) mean error: 12.1%

Sensitivity analysis

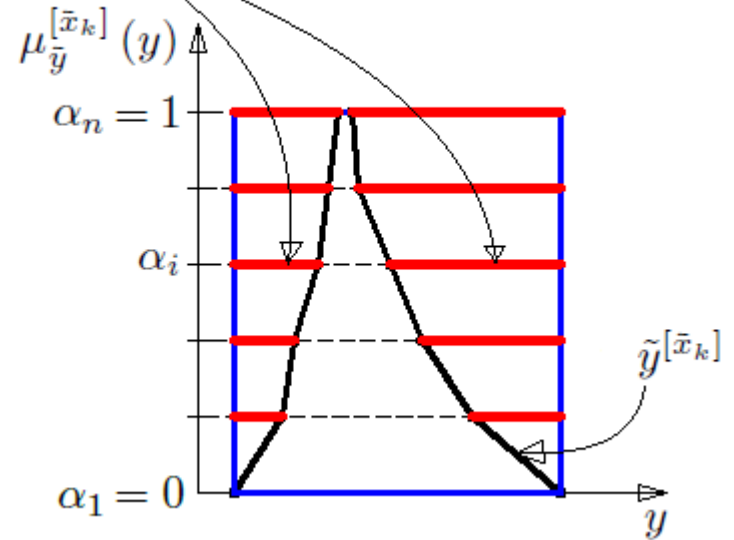
■ Use Local cost-effectiveness fuzzy analysis results to get sensitivity measures/coefficients.

■ Procedure:

■ compute the impreciseness reduction effectiveness for each α -level and each output membership function

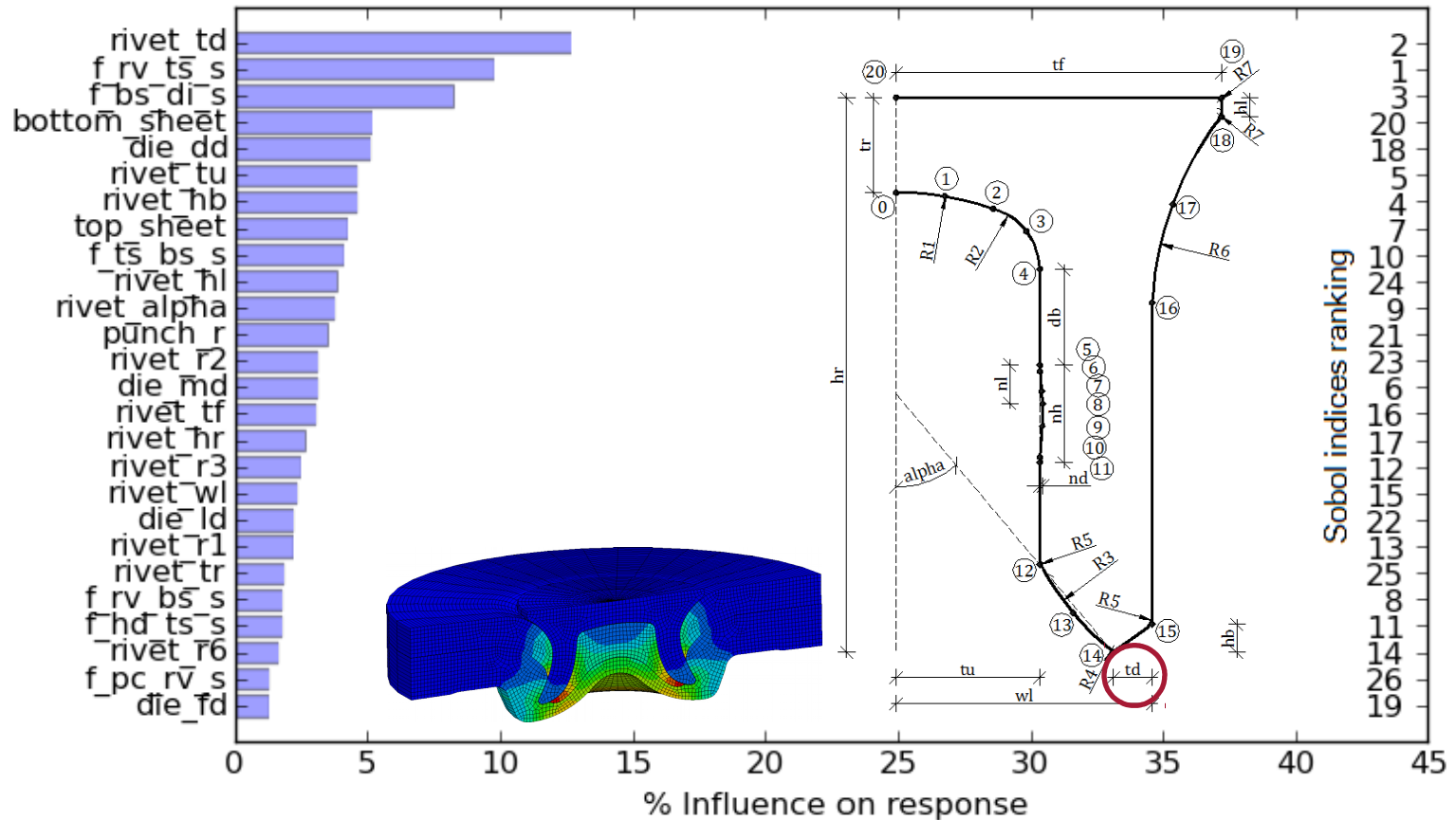
$$s^{[k]} = \sum_{i=1}^{n_\alpha} E^{[k]}(\alpha_i)$$

$$E^{[k]}(\alpha_i) = 1 - \frac{y_{\alpha_i r} - y_{\alpha_i l}}{y_{\alpha_1 r} - y_{\alpha_1 l}}, \quad i = 2, \dots, n_\alpha$$



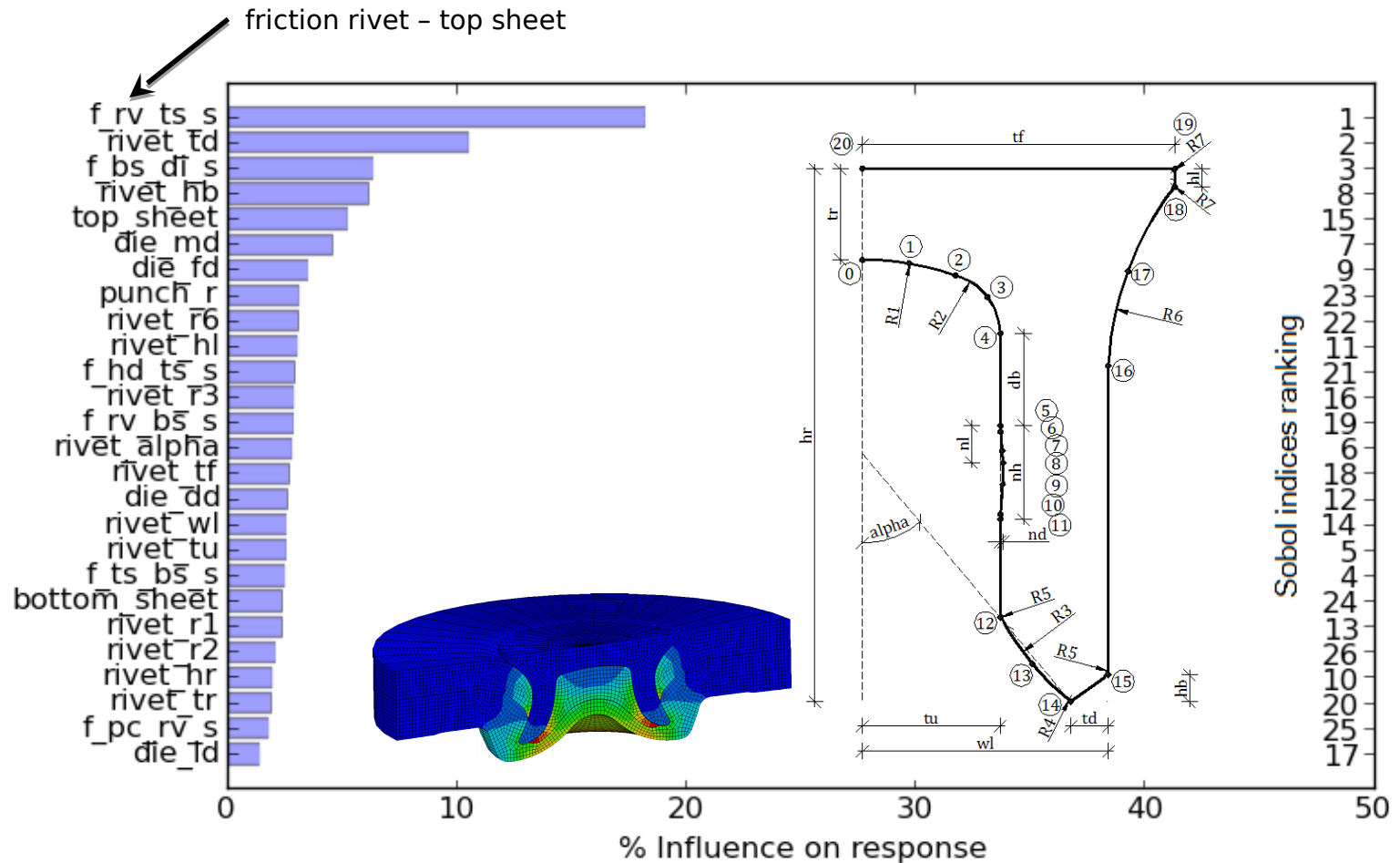
Sensitivity analysis

- obtained sensitivity coefficients for the “**res_undercut**” output from the local cost-effectiveness and with a simple sum:



Sensitivity analysis

- obtained sensitivity coefficients for the “**ks2_90 Force**” output from the local cost-effectiveness and with a simple sum:



Vielen Dank!

SCALE 

 Dr. Ingolf Lepenies – ingolf.lepenies@scale.eu