eta/DYNAFORM 5.9

Neue Features

12. November 2012

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http://www.dynamore.de

Übersicht

- Die DYNAmore GmbH
- ETA – ein paar Zahlen
- Bestehende LS-DYNA und eta/DYNAFORM Kunden
- eta/DYNAFORM 5.9 – Neue Features
- Ausblick
- EADS: Anwendung aus der Industrie

DYNA*more* GmbH

Gesellschaft für FEM-Ingenieurdienstleistungen

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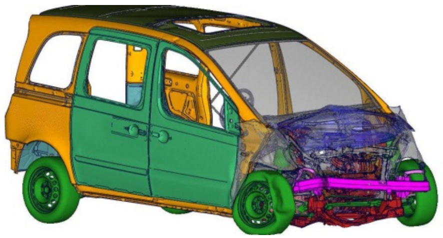
Tel.: 0711 / 45 96 00 0
http://www.dynamore.de
http://www.dynaexamples.com



Your DYNA distributor and *more*

Facts

- 70 employees in 2012
- headquarters located in Stuttgart/Vaihingen
- office in Langlingen, Dresden, Berlin, Ingolstadt
- on-site office in Sindelfingen (Mercedes passenger cars)
- on-site office in Untertürkheim (Mercedes trucks)
- on-site office in Weissach (Porsche)
- on-site office in Ingolstadt (Audi)
- Subsidiary companies in S and CH
- More than 200 customers in D, A, CH, E, I, ...

Engineering Technology Associates, Inc. (ETA)

- Established 1983
- Engineering Offices
  - Headquarters: Troy, Michigan USA
  - Locations: Canada, China, India
  - 300 Engineers
- Primary Business – CAE
  - Software Development and Distribution
    - eta/DYNAFORM
    - eta/PreSys
  - Engineering Services
    - Virtual Validation

www.eta.com

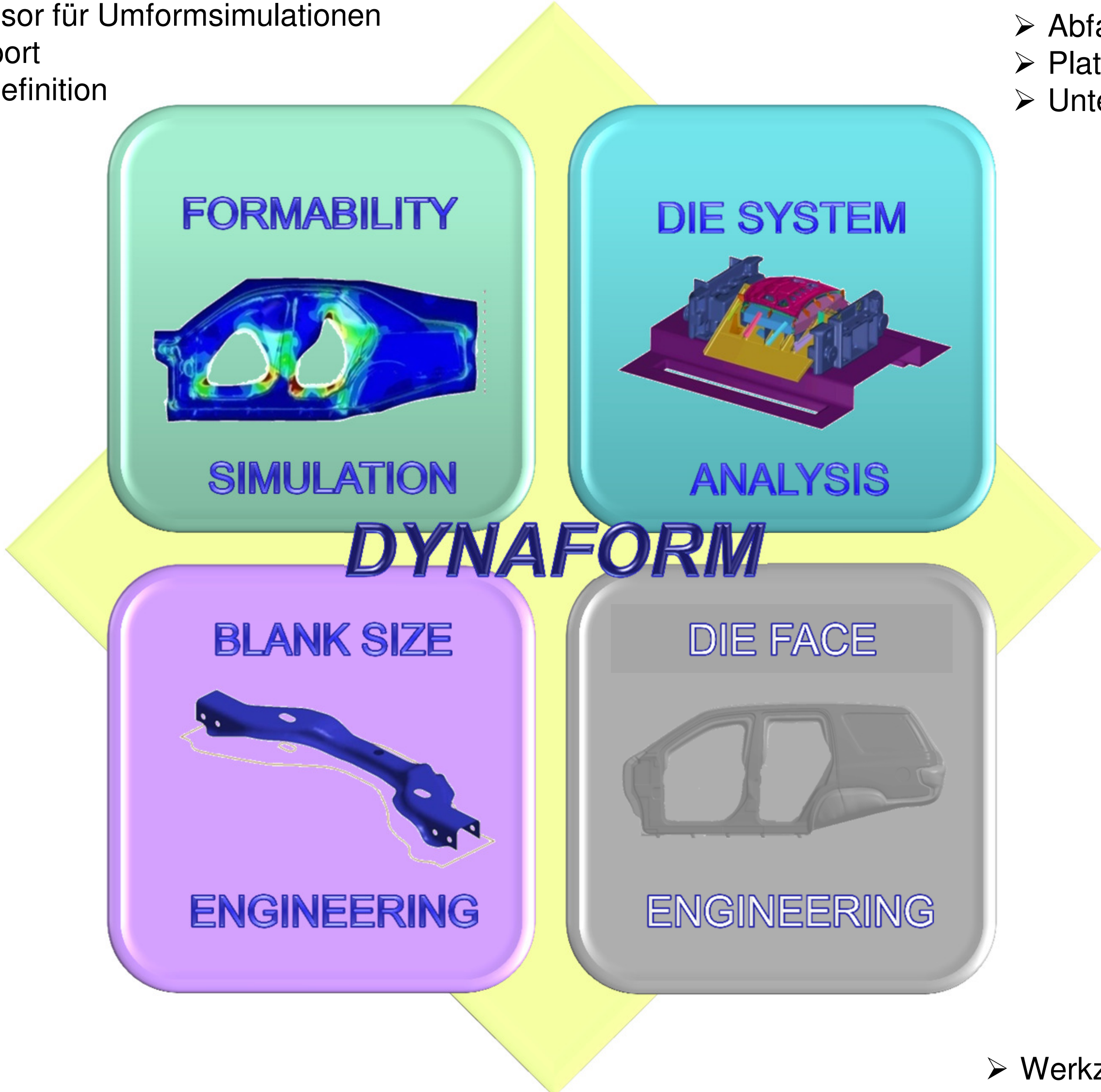
www.dynaform.com

www.etavpg.com

eta/DYNAFORM 5.9

- Pre- und Postprozessor für Umformsimulationen
- CAD-Import und Export
- AutoSetup Prozessdefinition
- Materialdatenbank
- Jobsubmitter
- Kompensation
- Rohrbiegen
- Superplastisch
- IHU
- Abkanten, Falzen …
- Optimierung

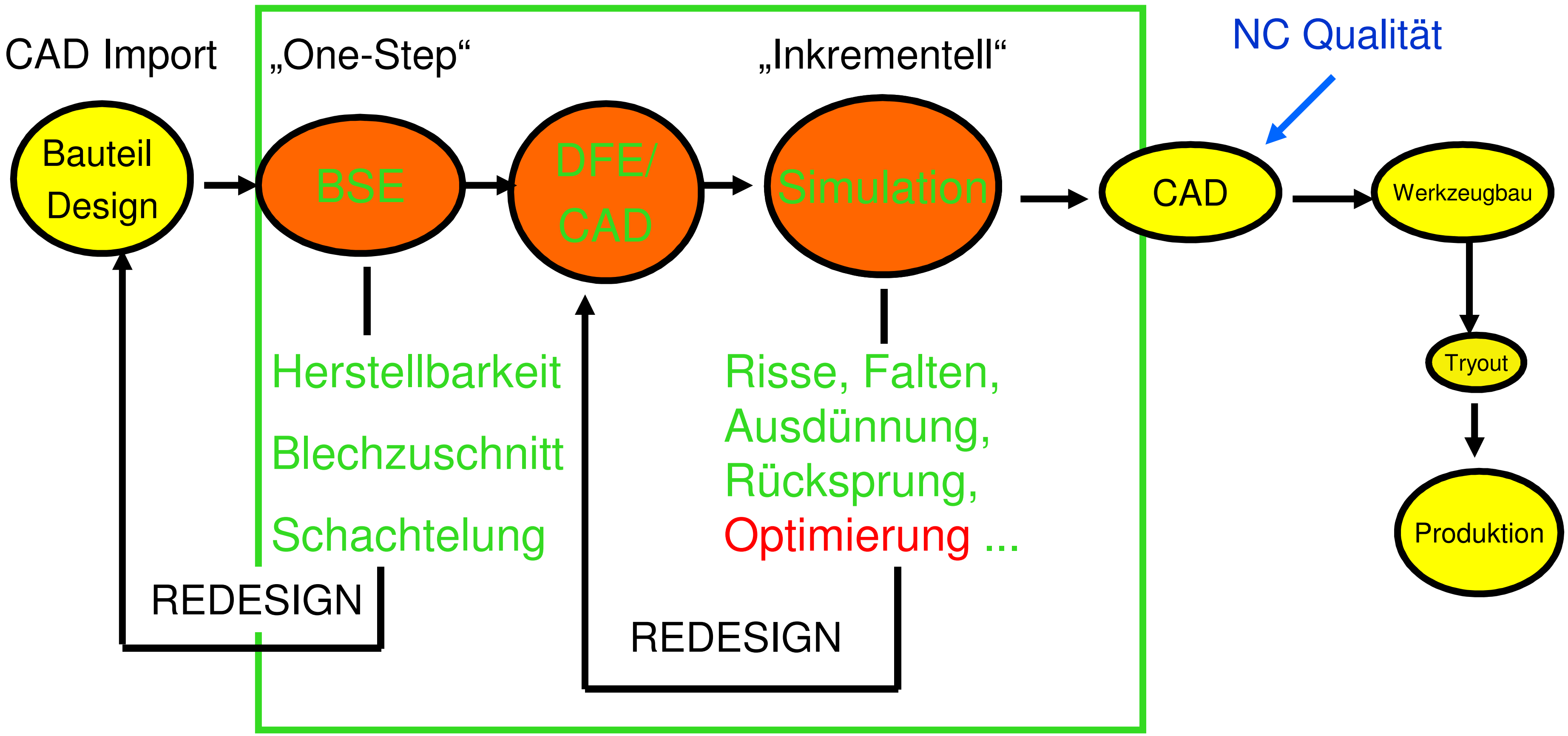
- Abfallbeseitigung
- Platinentransport
- Untersuchung der Werkzeuge

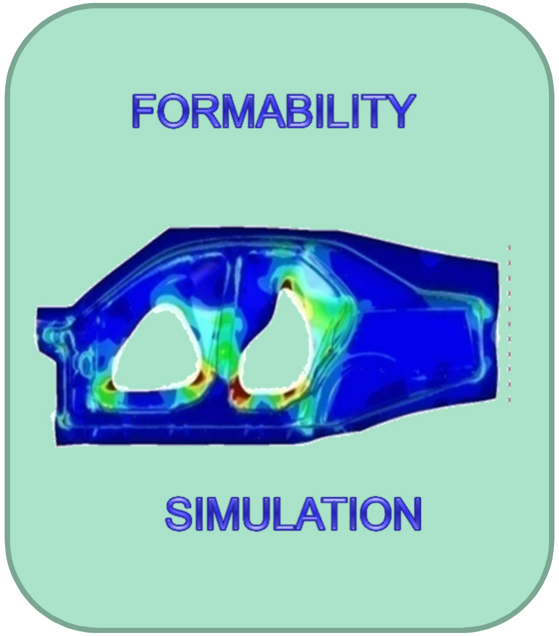


- Schachtelung
- Blechzuschnitt
- Modellaufbereitung
- Kostenkontrolle
- Machbarkeitsstudien im Einschrittverfahren

- Werkzeugkonstruktion

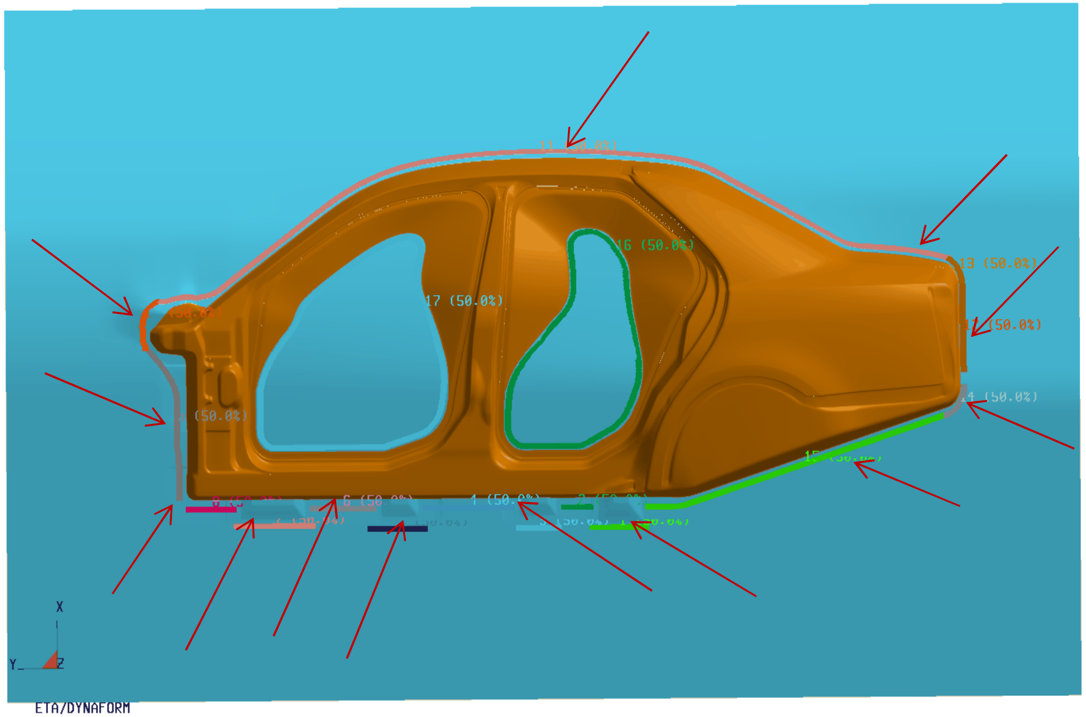
Integration in den Entwicklungsprozess





Optimization

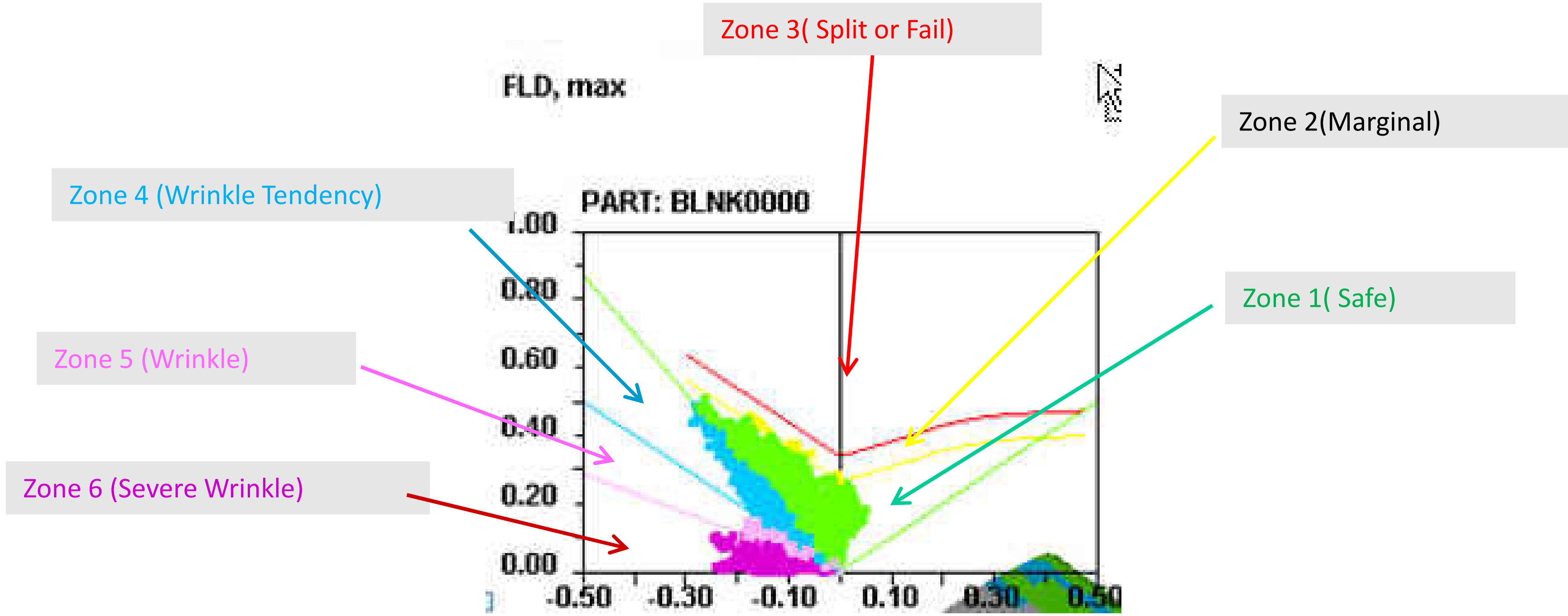
Forming Based Optimization Functions



- Drawbeads are designed to restrict the blank from wrinkling & splitting in a forming process
- Adjusting Drawbead Forces of a large/complicated Drawbead setup can be very challenging, very time consuming to achieve a formable panel/part, take weeks
- Efficiently utilize the optimization technology with modern computing power for Drawbead Forces optimization is practical to achieve a optimum configuration in a reasonable time frame, take days

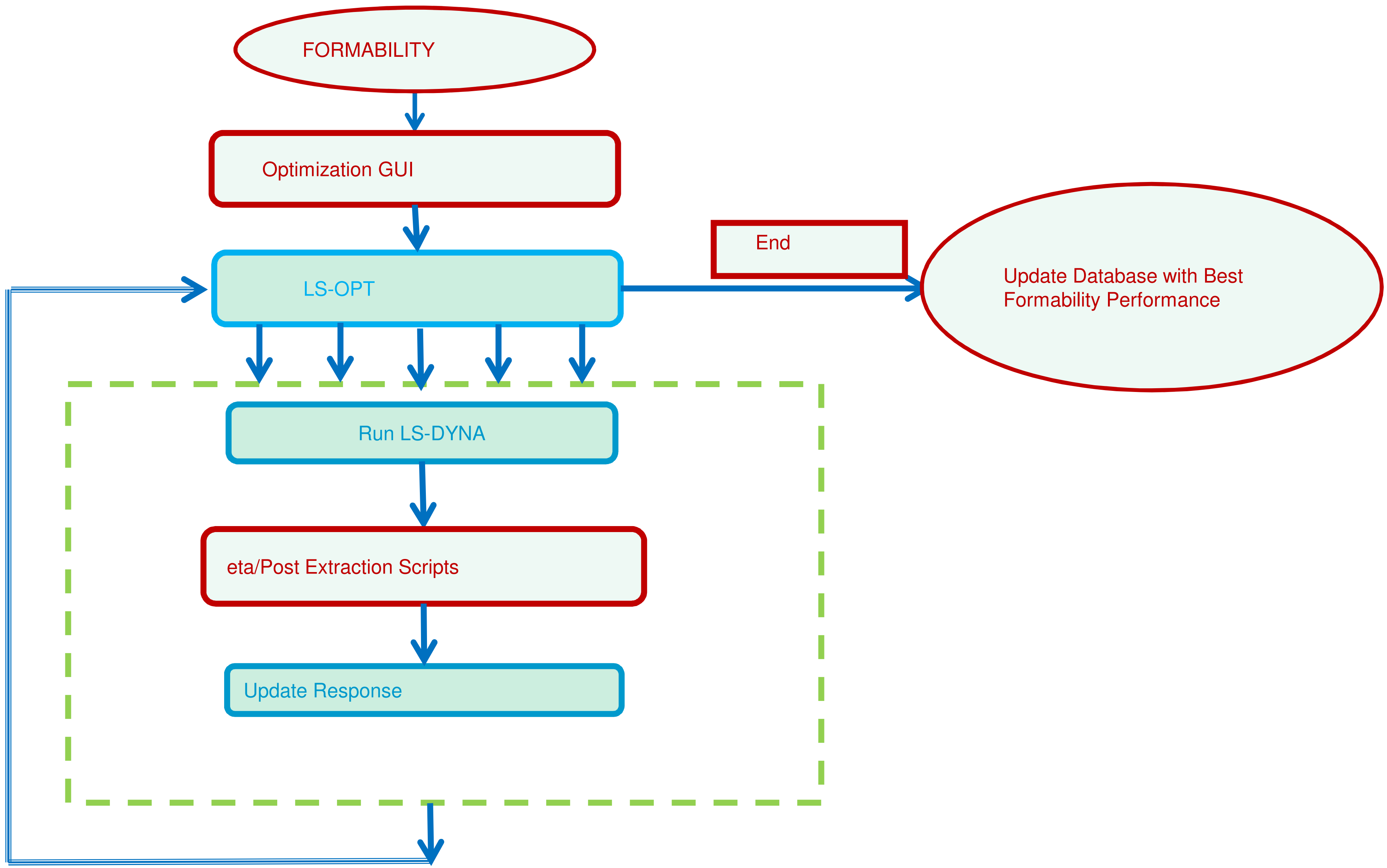
Optimization Based on (6) FLD Zones

Forming Limited Diagram (FLD)

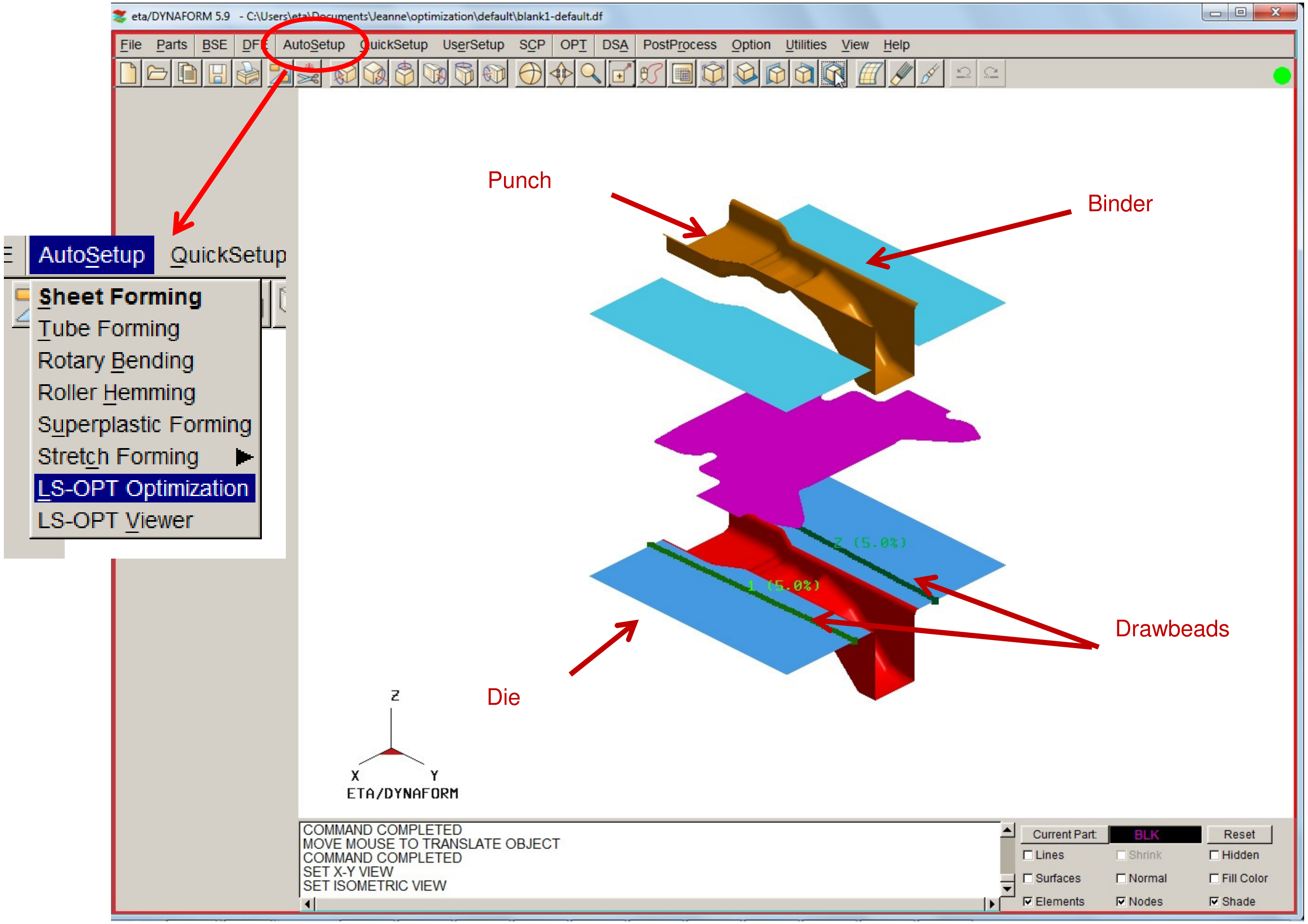


Define Constrain/Objective function as the ratio of elements in a particular Zone # / total elements

Optimization Flow Chart



Test Case 1: Tooling Setup

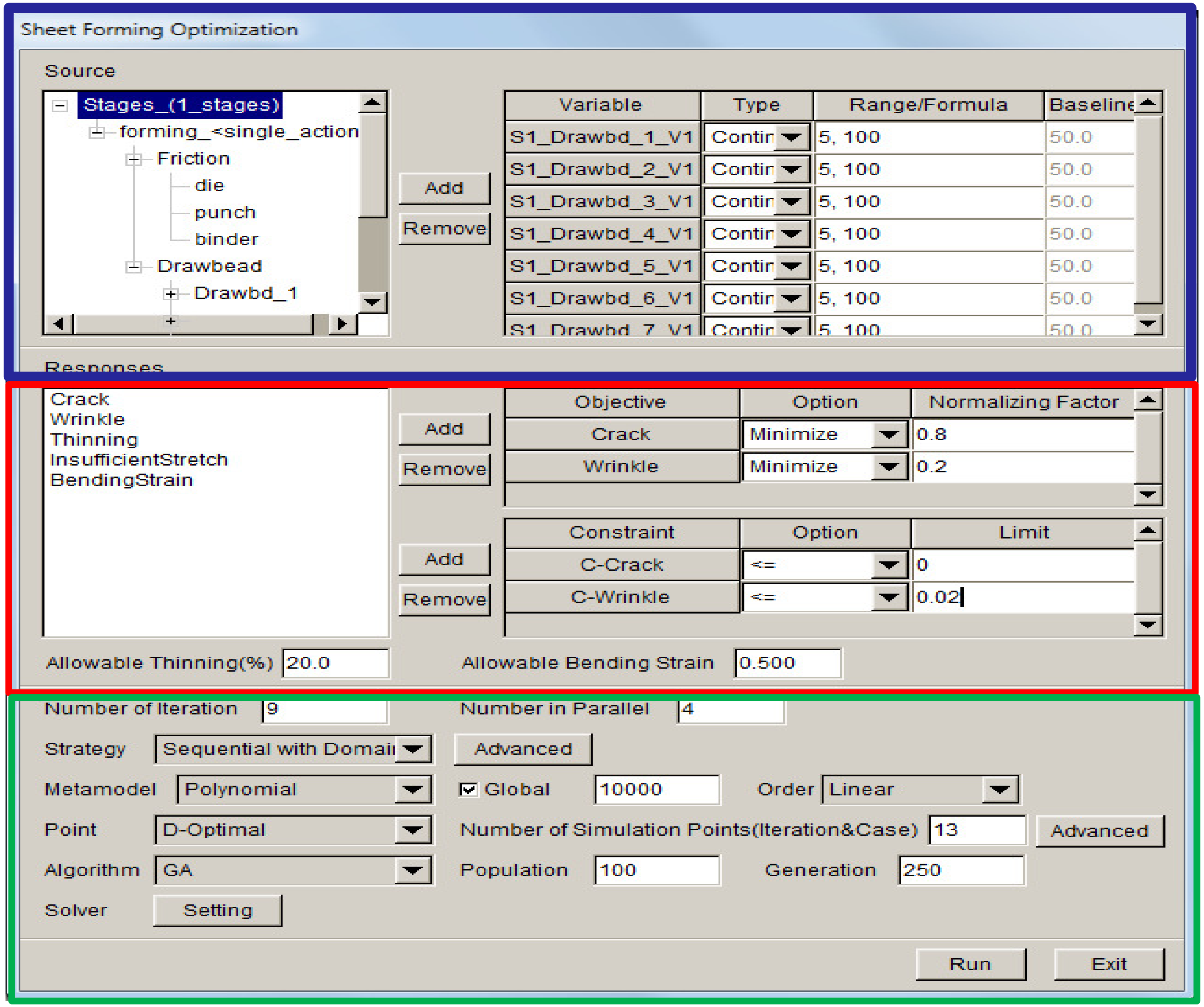


GUI of Optimization Overview

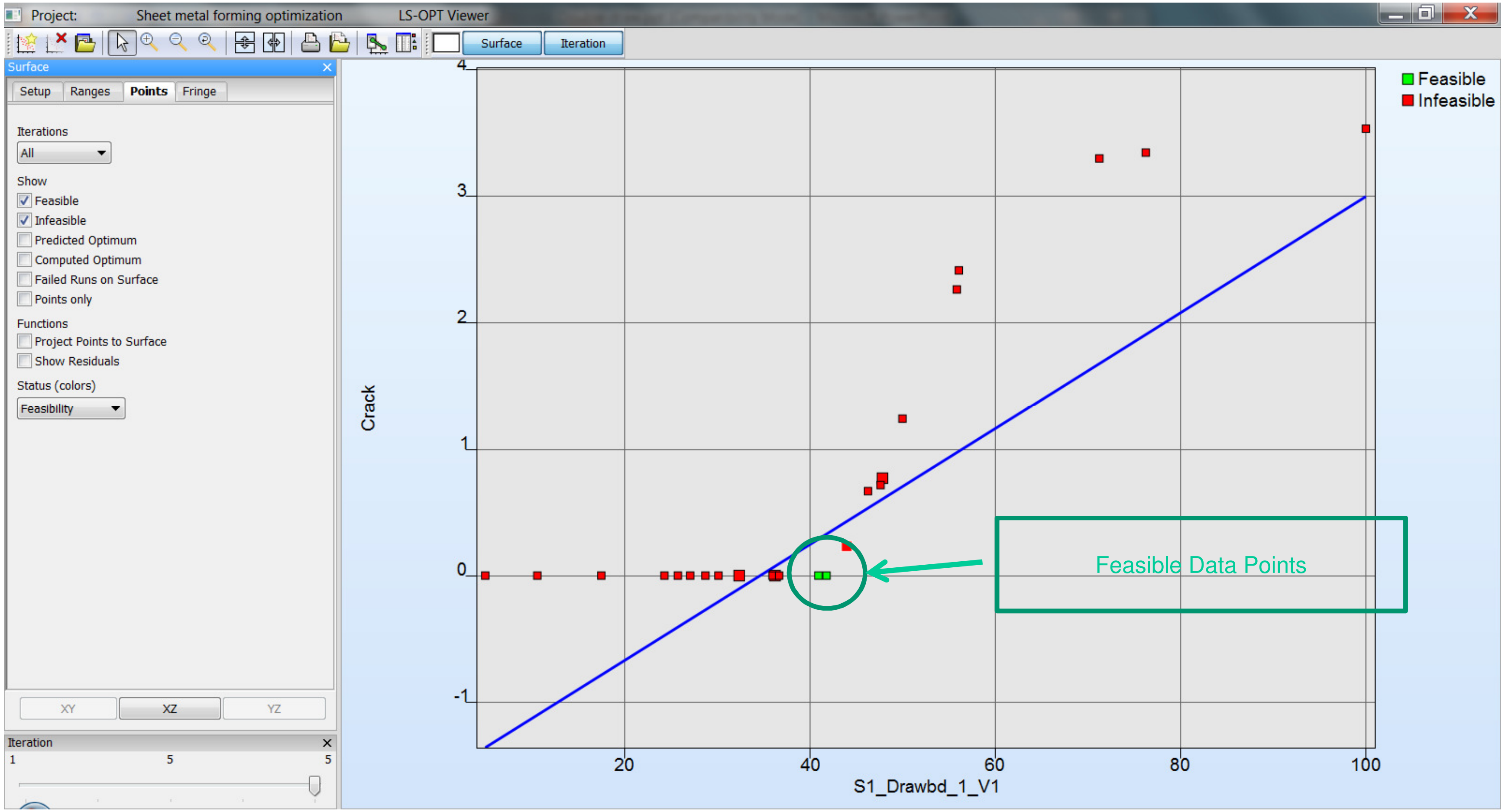
Design Variables
-> % Restraining Force
-> Friction Coefficient
-> Binder Force

Define Objectives and Constraints

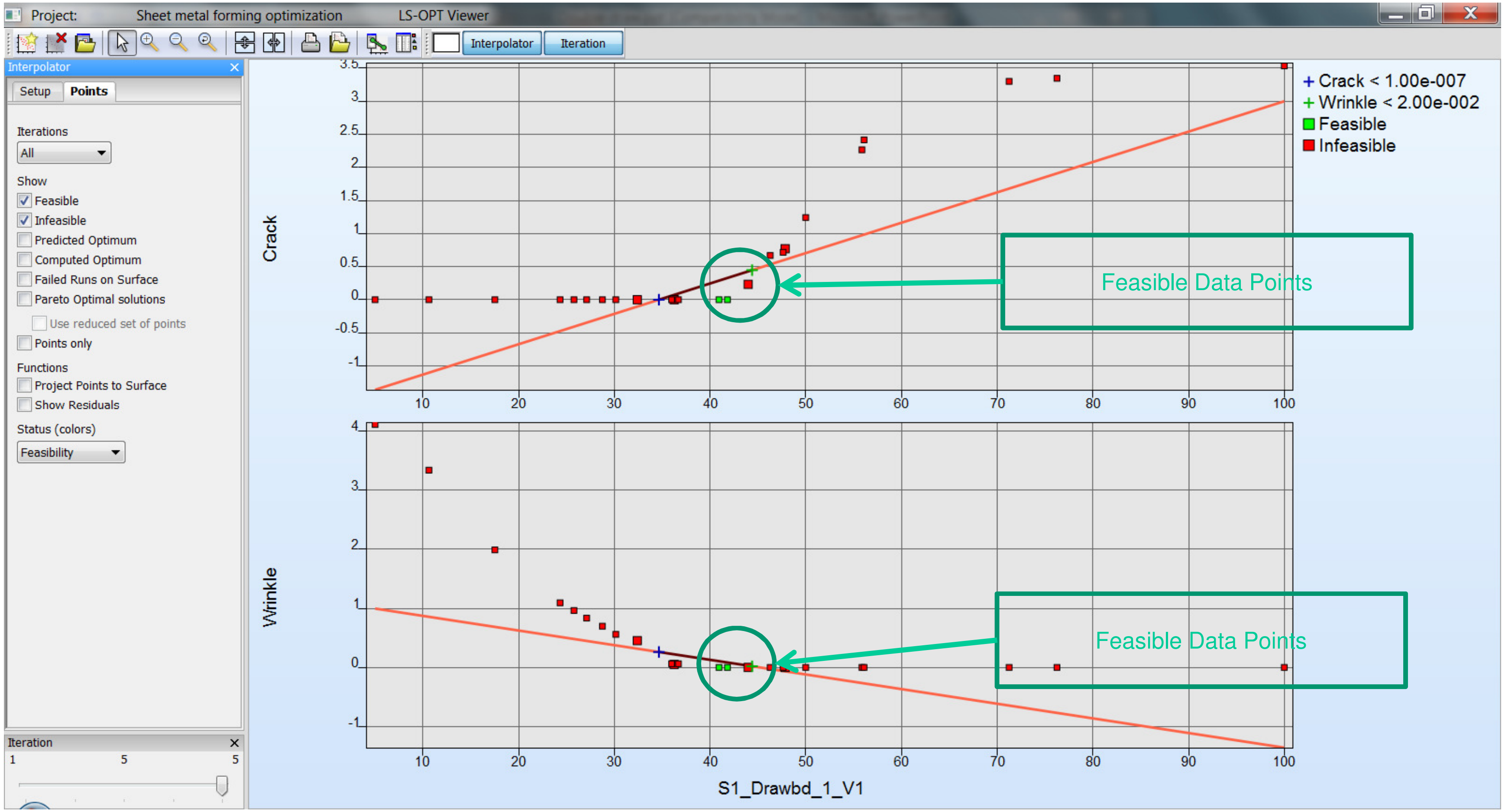
Optimization Methods options



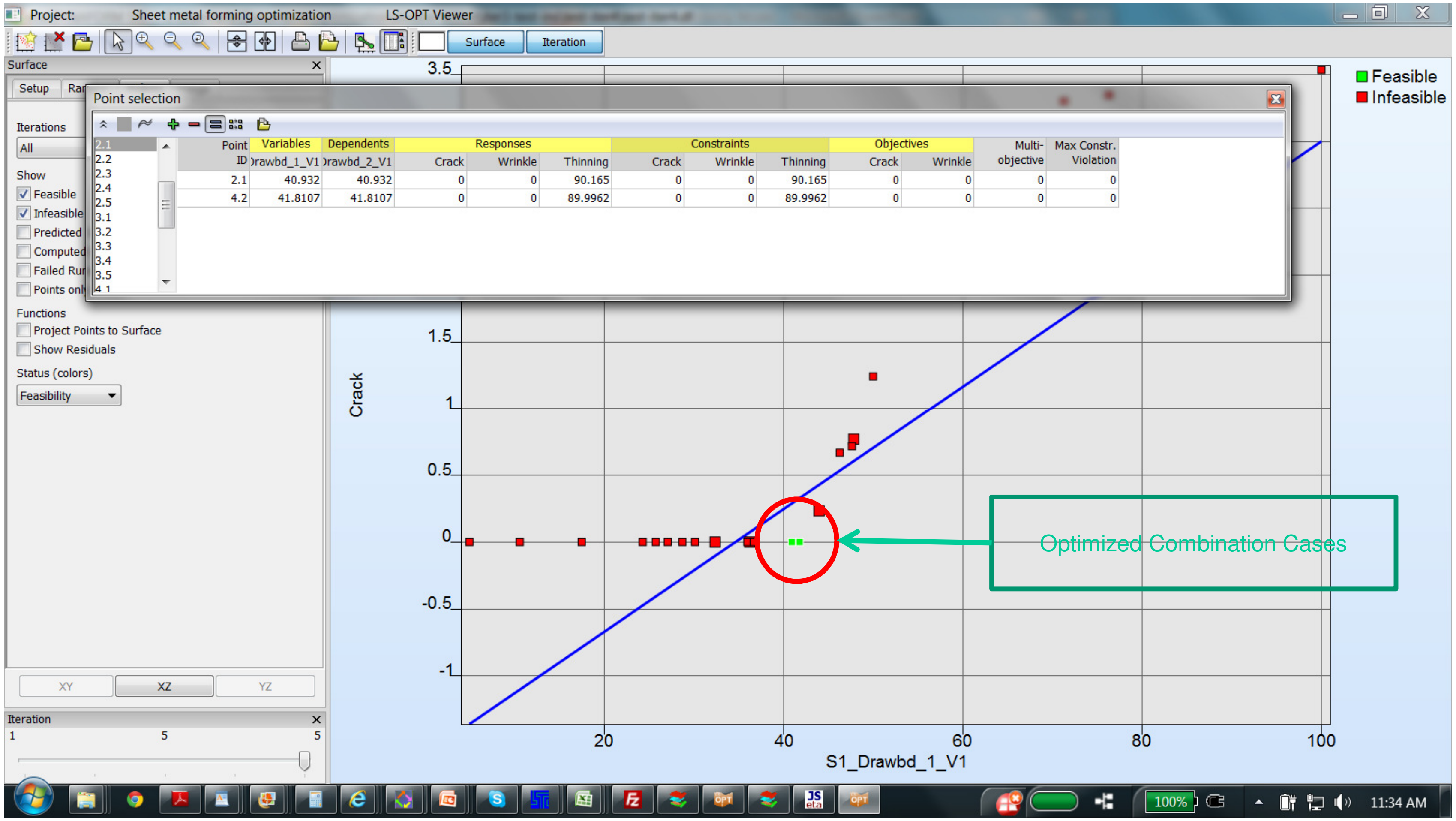
Test Case1: Splits Response



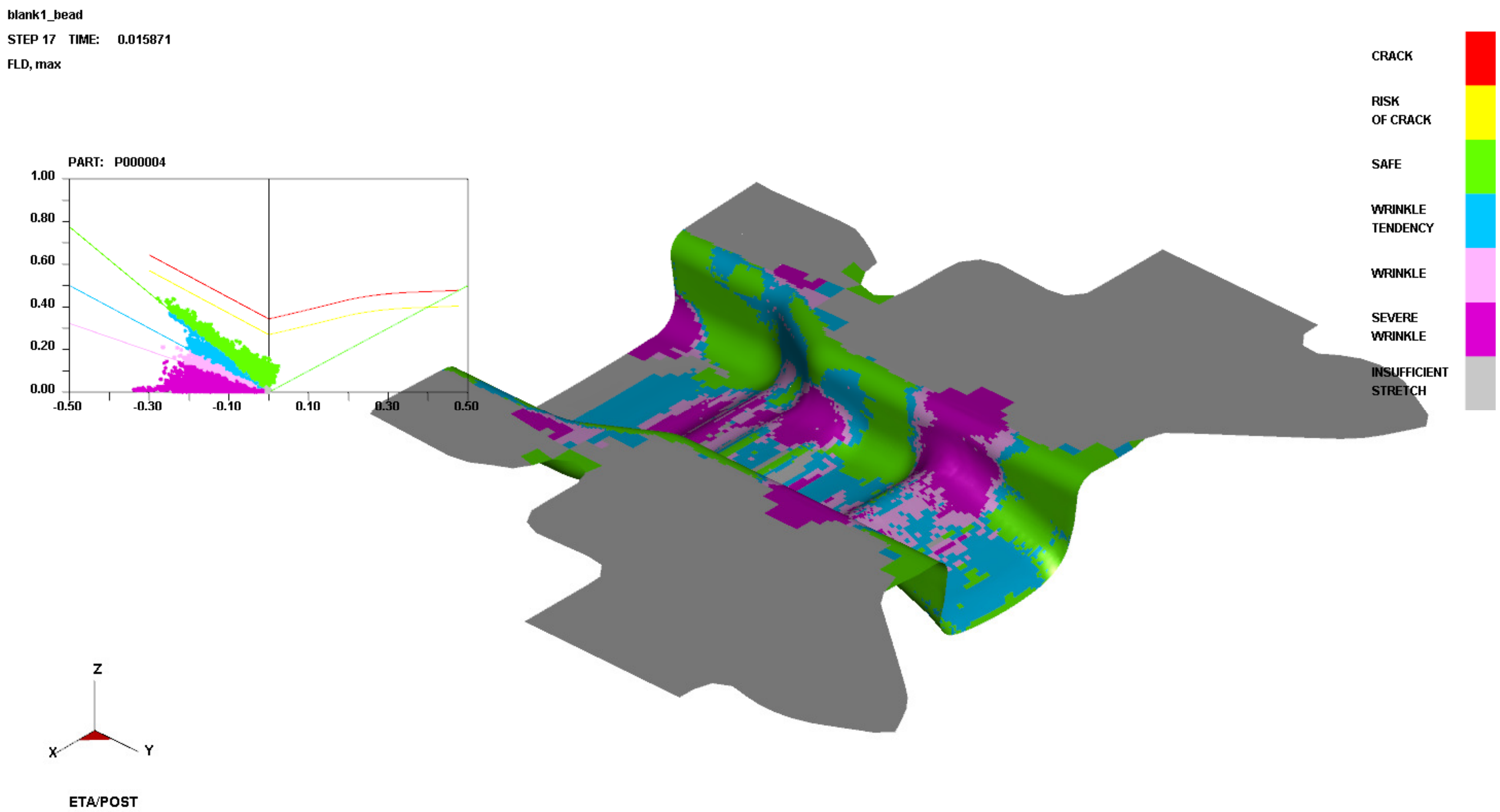
Test Case1: Splits and Wrinkle Responses



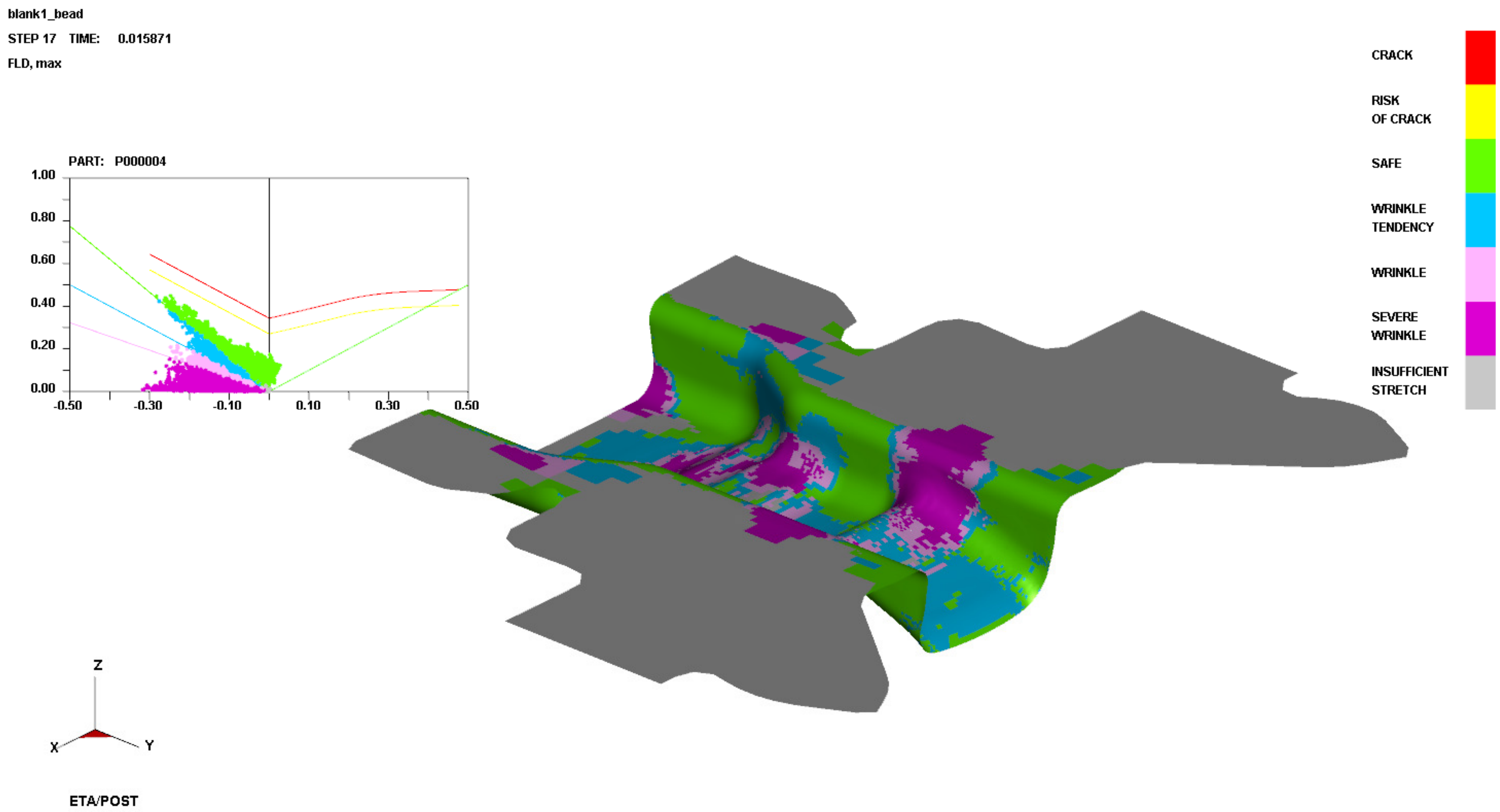
Test Case1: Feasible Designs



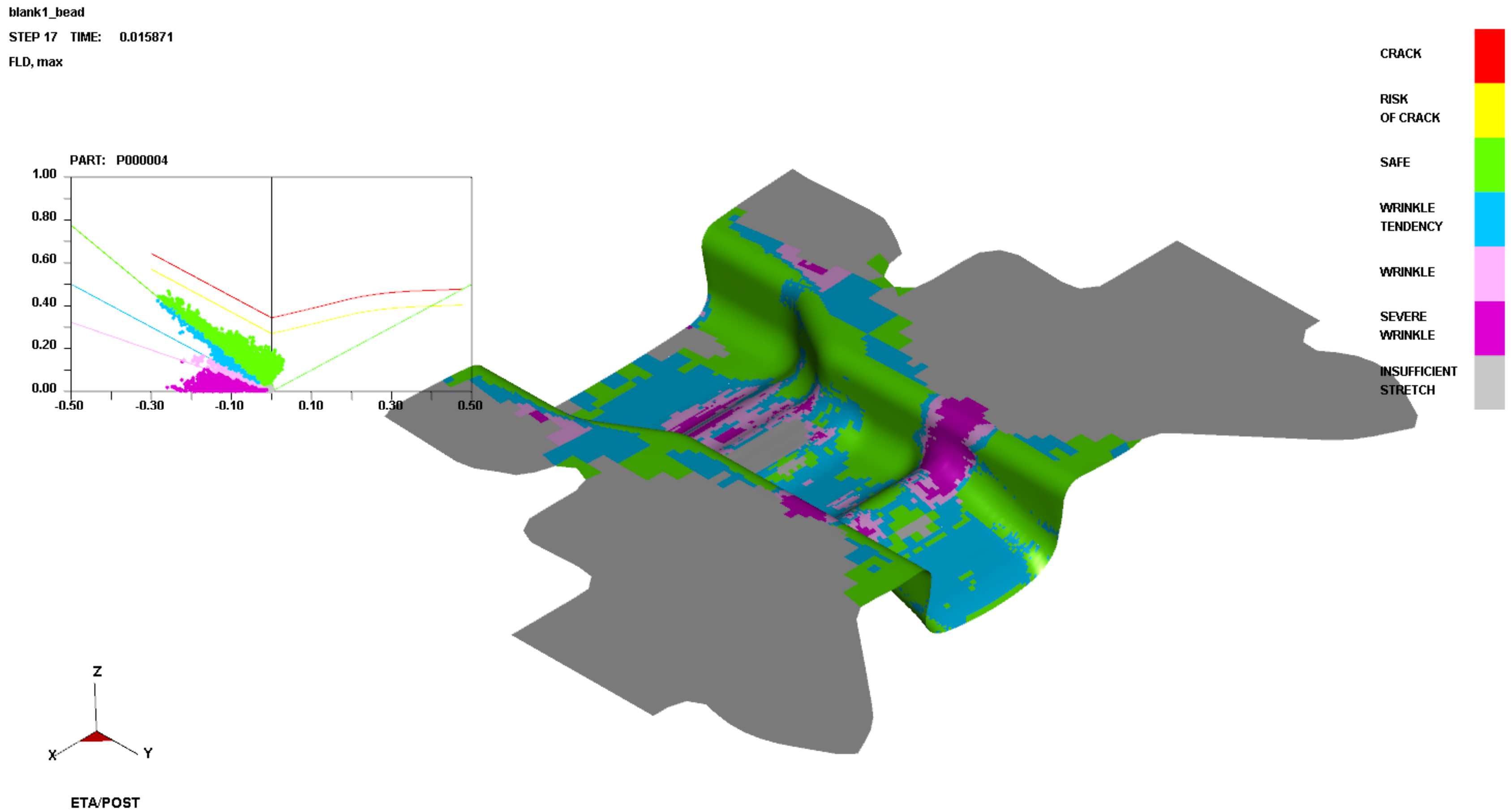
Test Case1 - Baseline



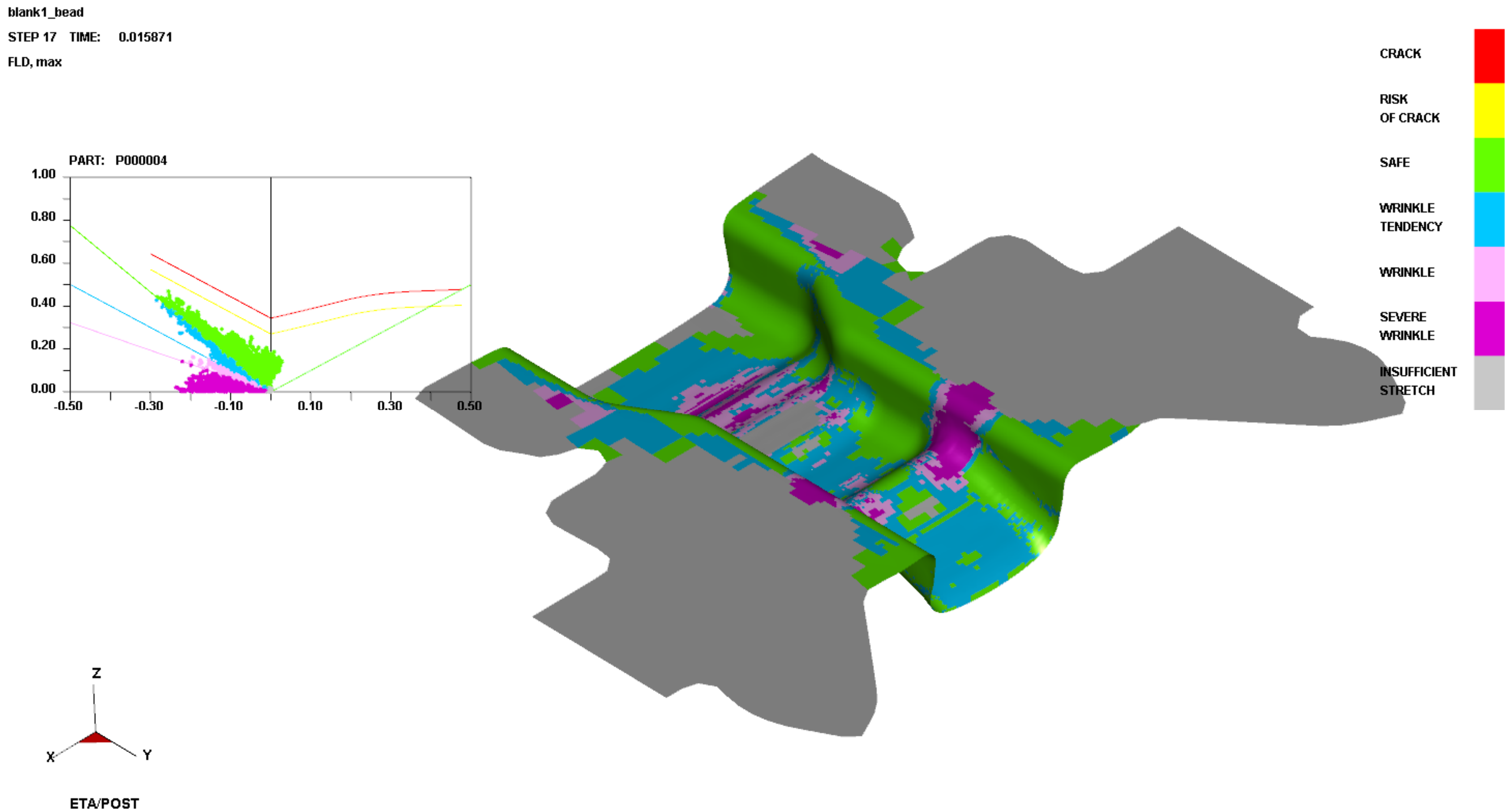
Test Case1- Feasible Iteration



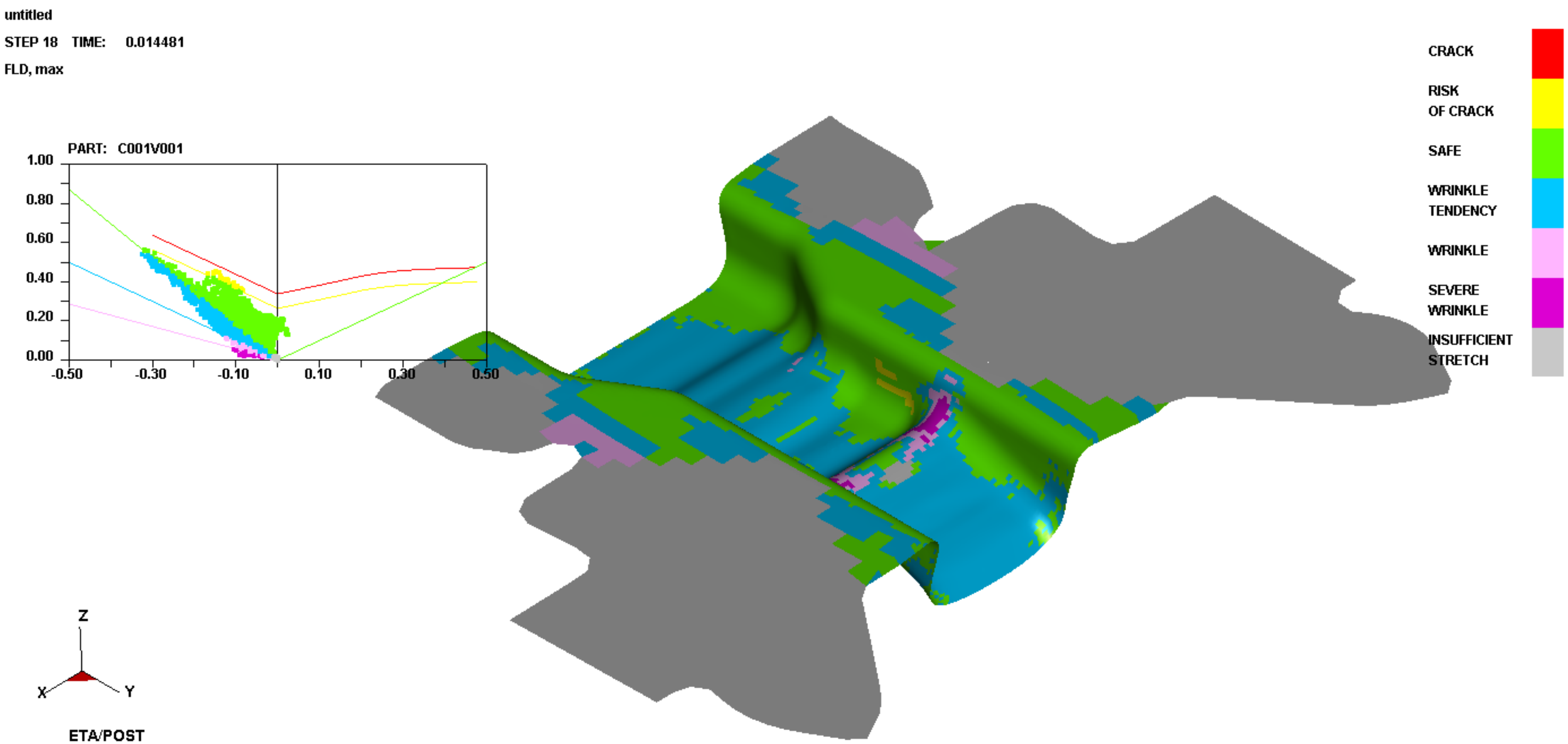
Test Case1- Feasible Iteration



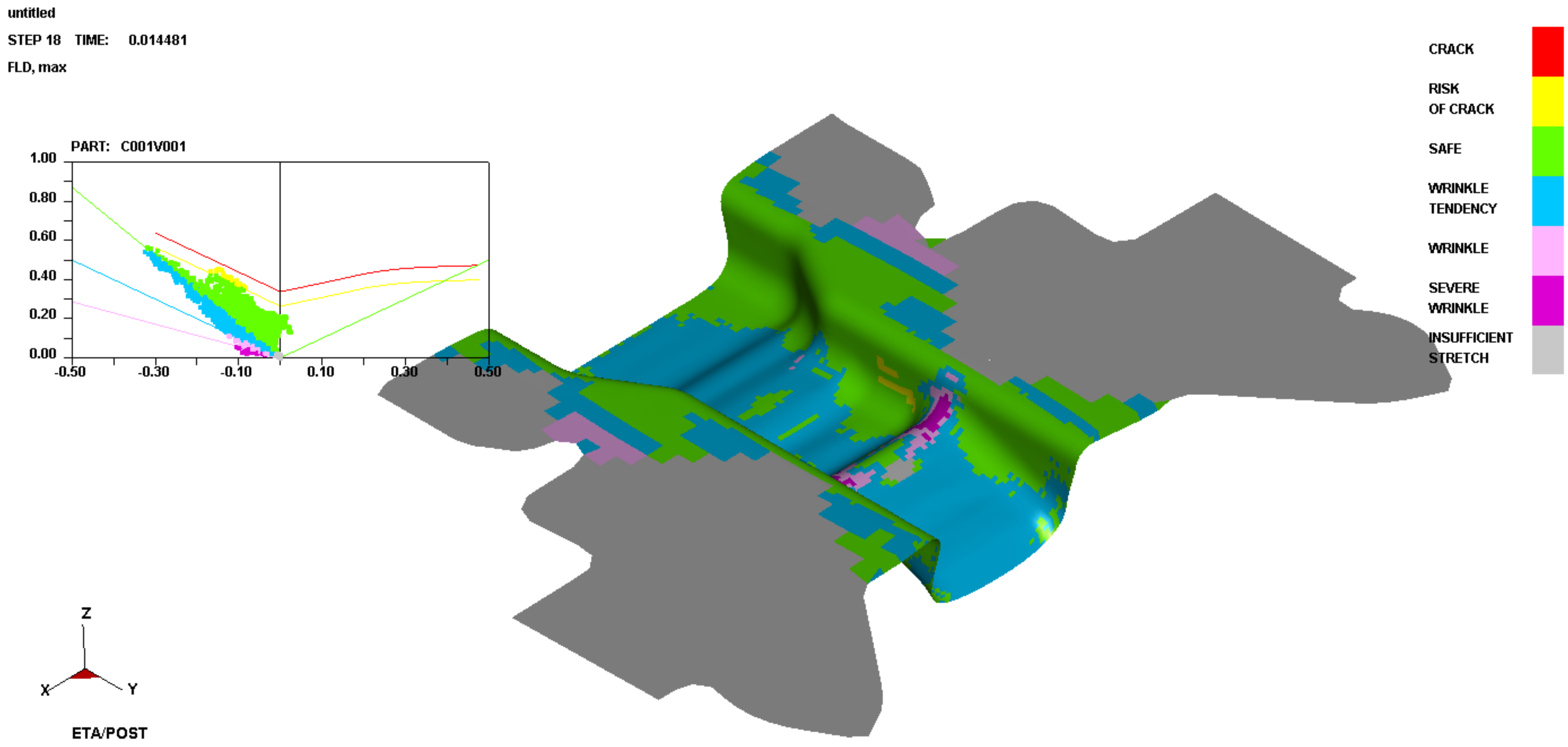
Test Case1- Feasible Iteration



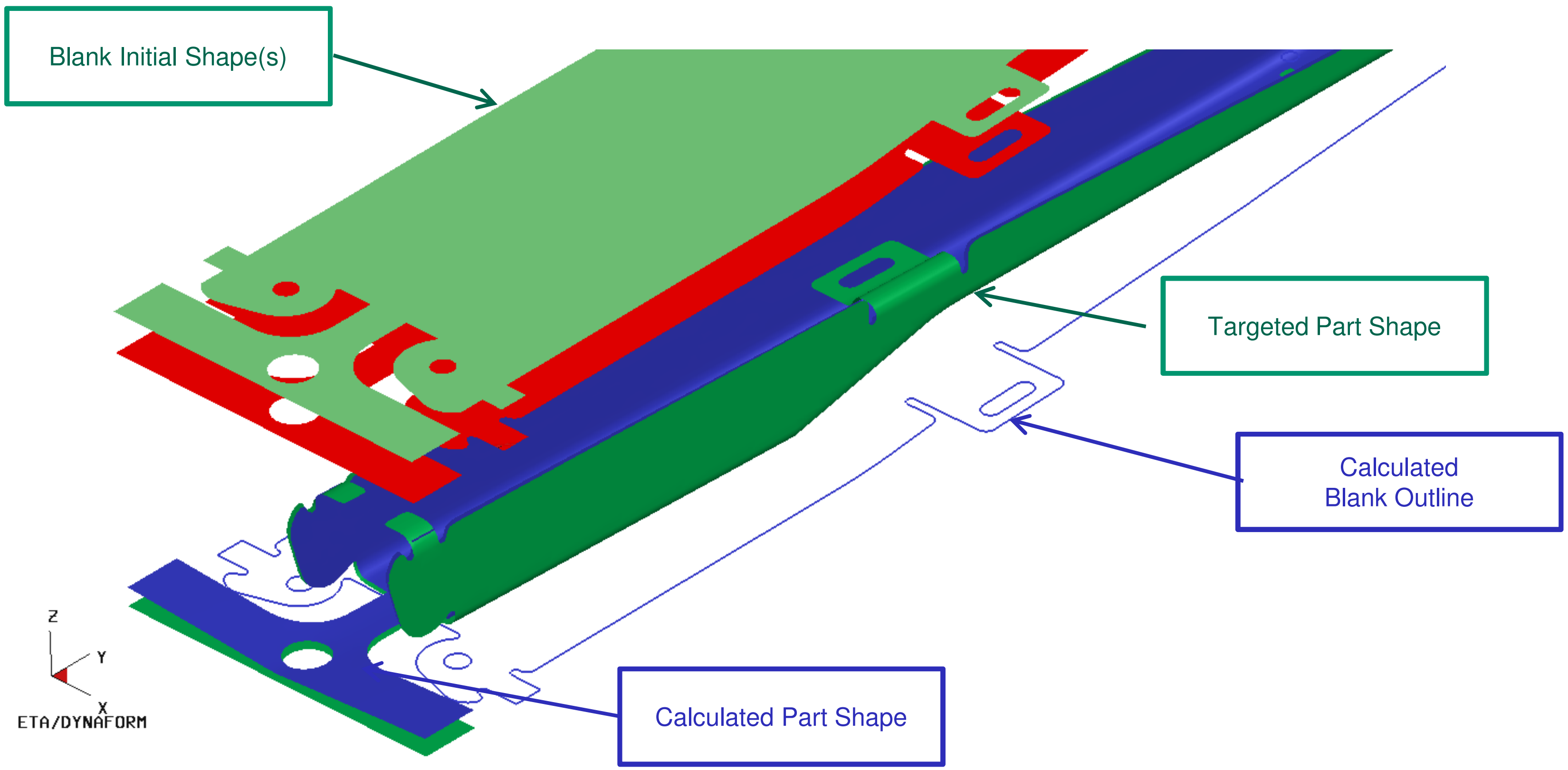
Test Case1- Feasible Iterations



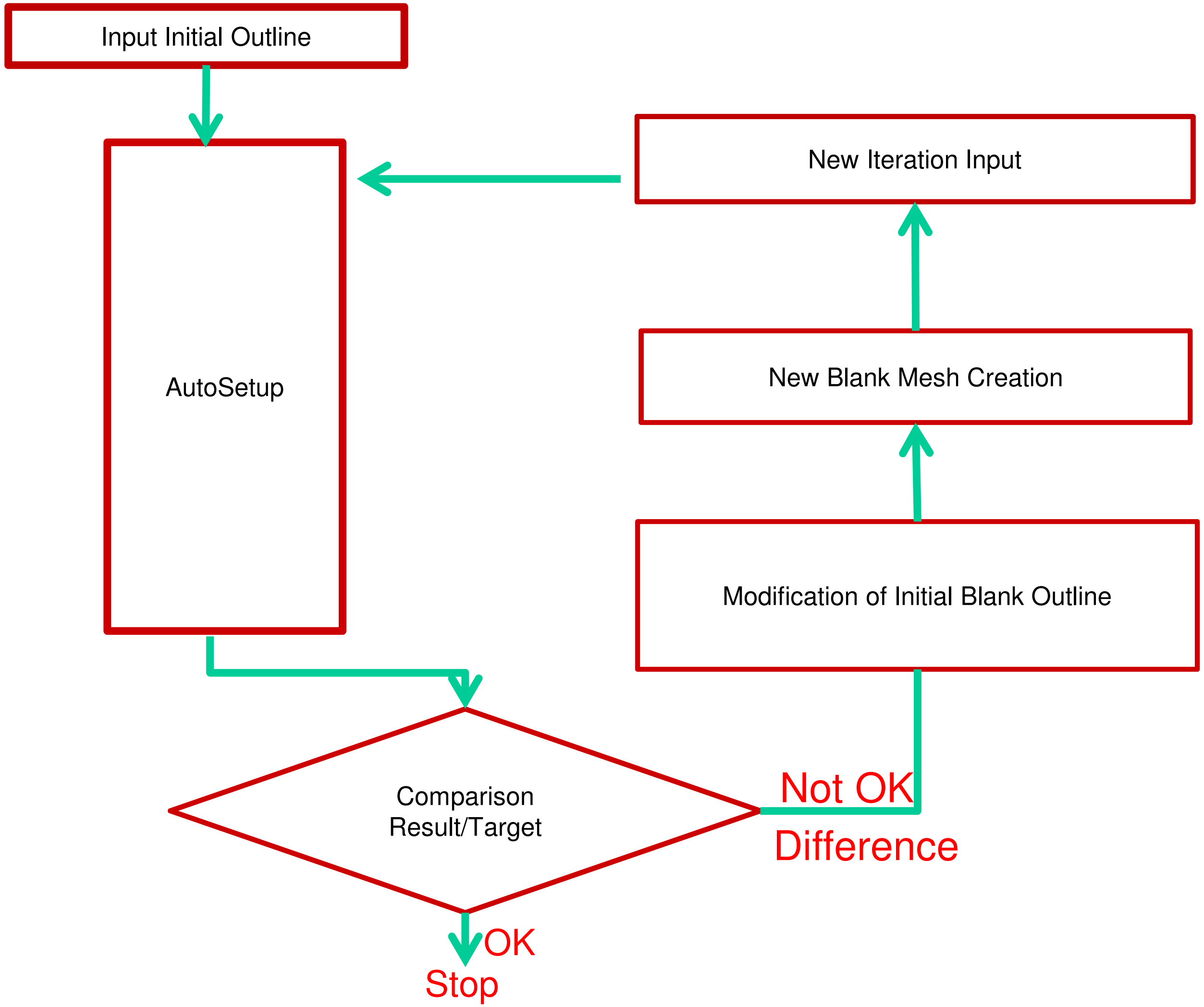
Test Case1- “Optimized” Drawbead Rates



Blank Outline Optimization

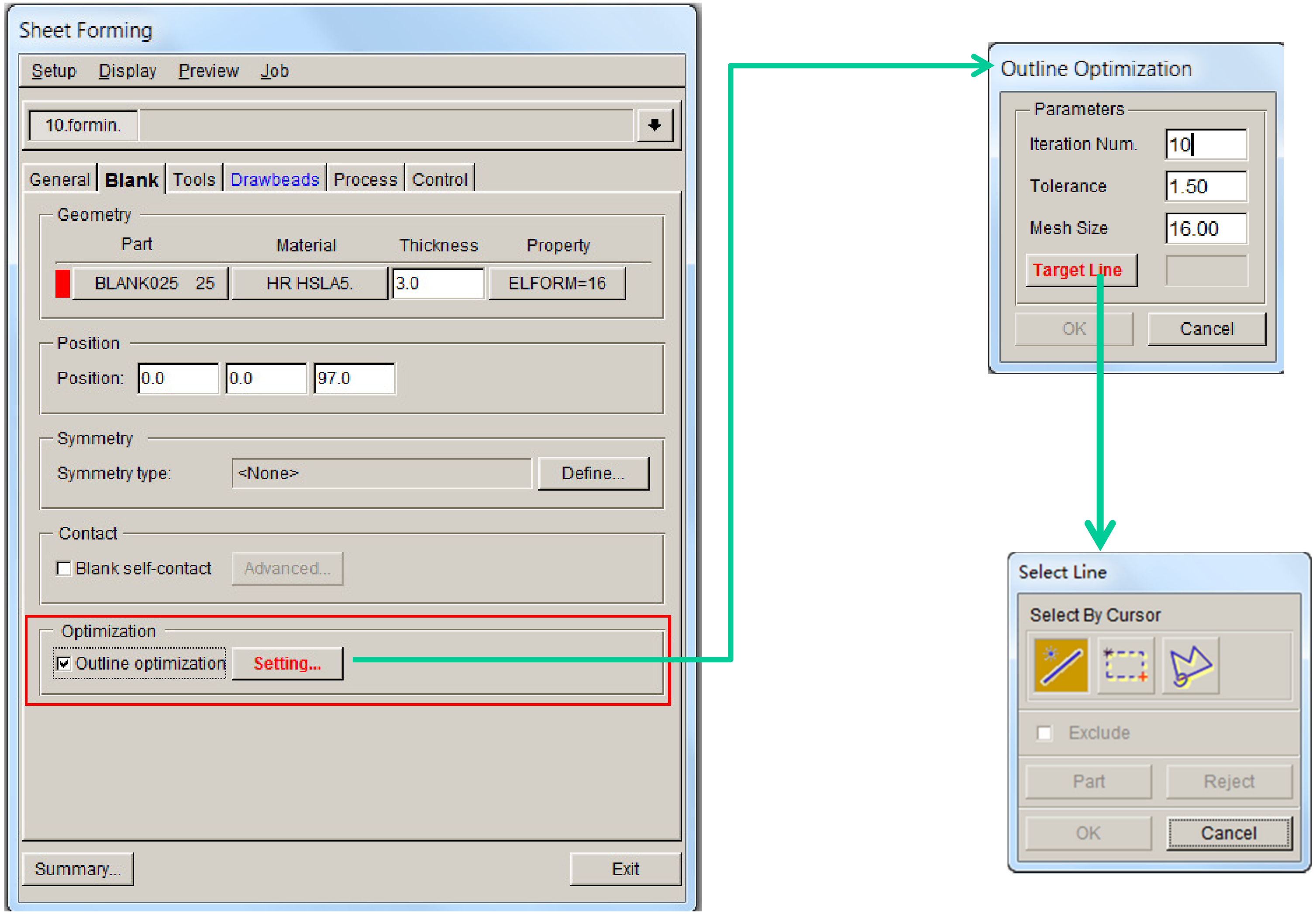


Workflow of Blank Outline Optimization



Blank Outline Optimization

The Optimization function is integrated in Blank of AutoSetup.



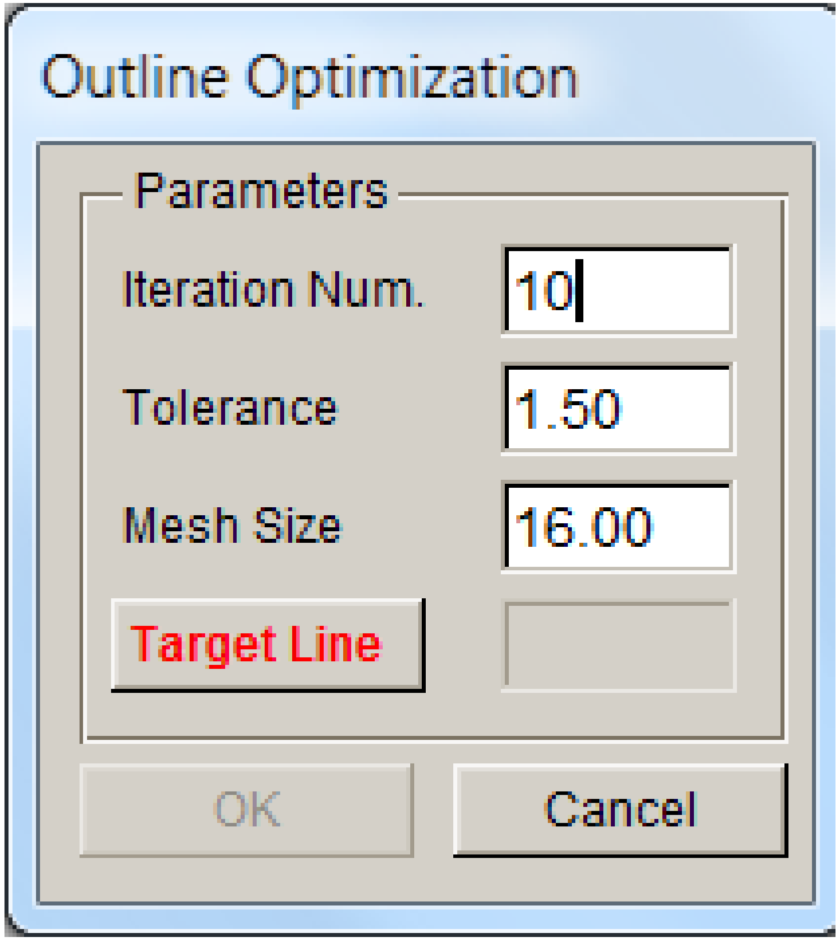
Blank Outline Optimization

Parameters:
①**Iteration Num:** Define the Iteration number.

②**Tolerance:** Define the allowable maximum gap between Target line and the simulation result boundary line of optimized Blank outline.

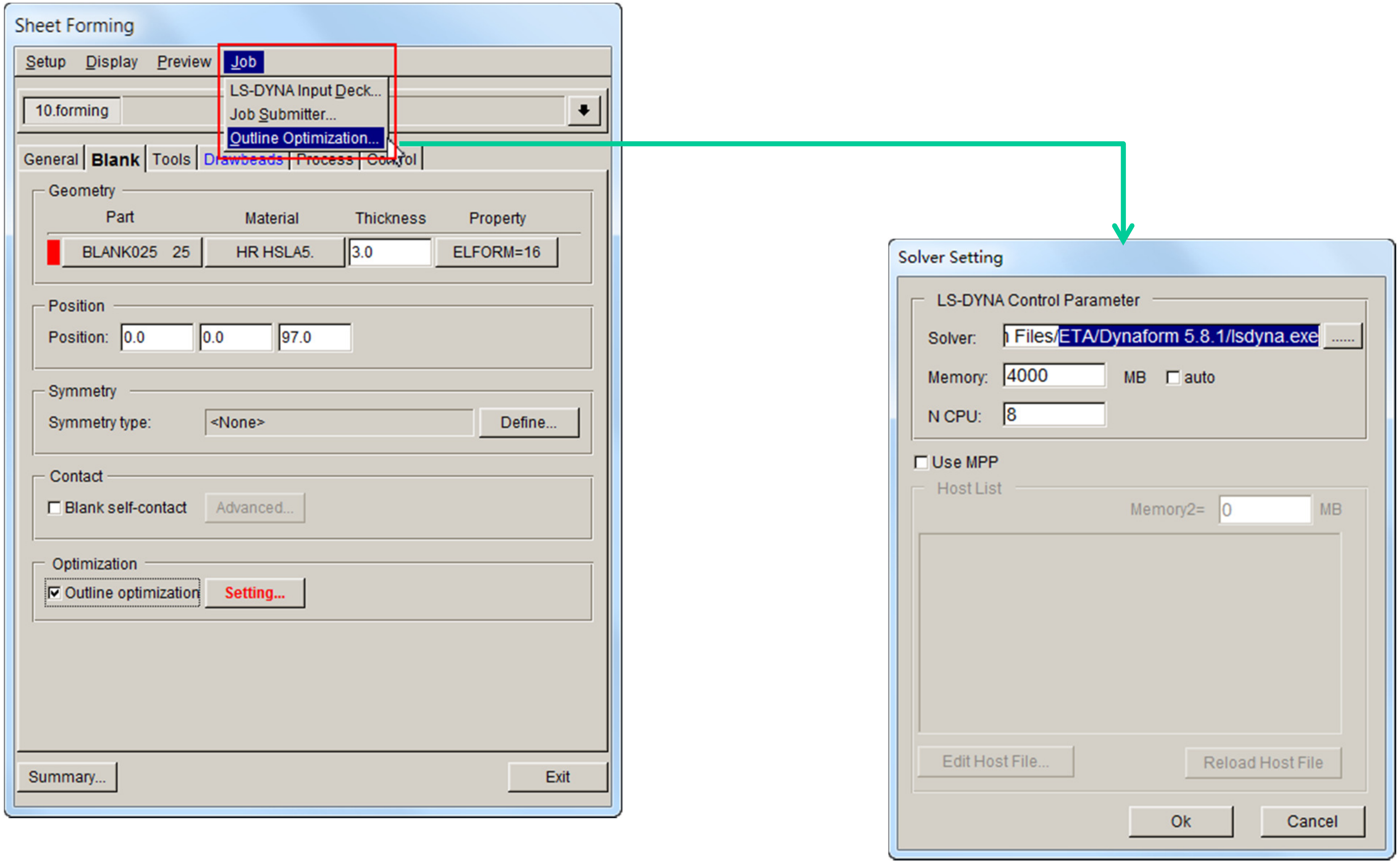
③**Mesh Size:** This parameter controls the element size. (Same as Blank Generator)

④**Target Line:** Select Trim Line, or part boundary line, or bead line as target line.



Blank Outline Optimization

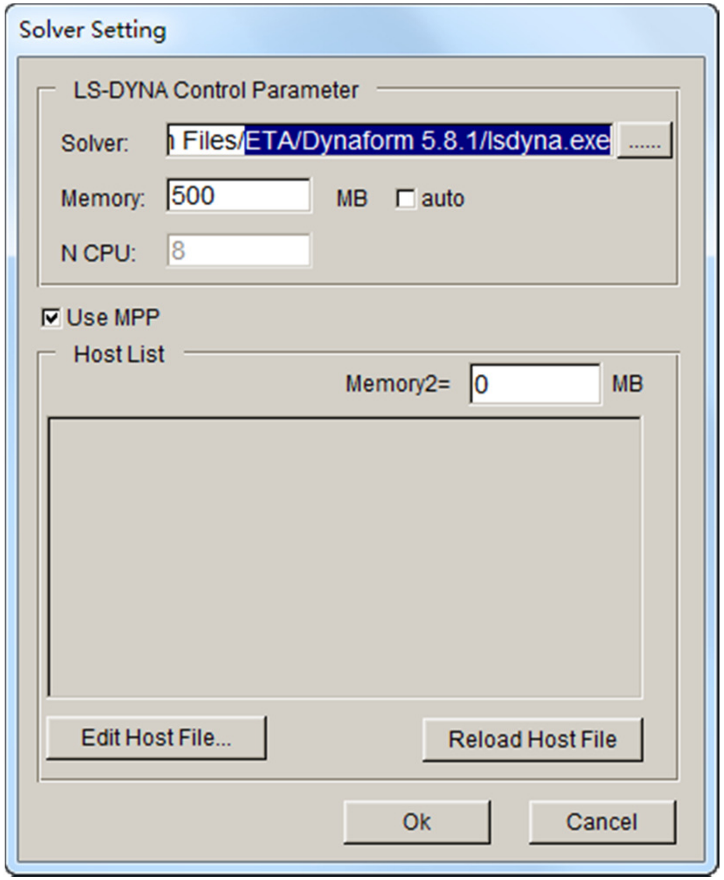
New option "*Outline Optimize*" is added in the Job menu, which is used to run blank optimization.



Blank Outline Optimization

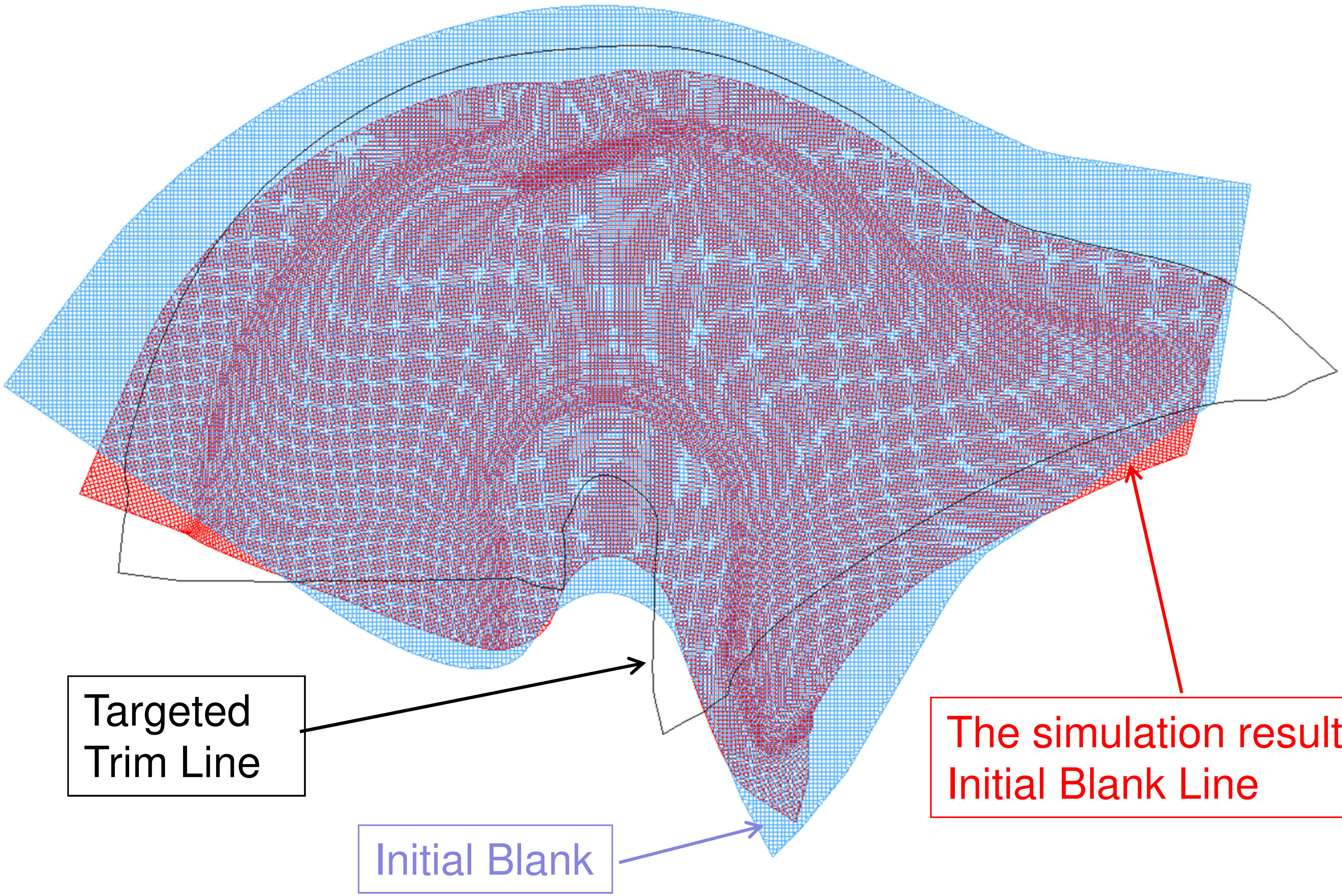
This optimization tool is independent of the solver; it works with LSDYNA_s.exe as well as LSDYNA_d.exe.

LS-DYNA Control Parameter:
•**Solver:** Set the type of Solver.
•**Memory:** Set memory size for different stages.
•**N CPU:** Set CPU number.

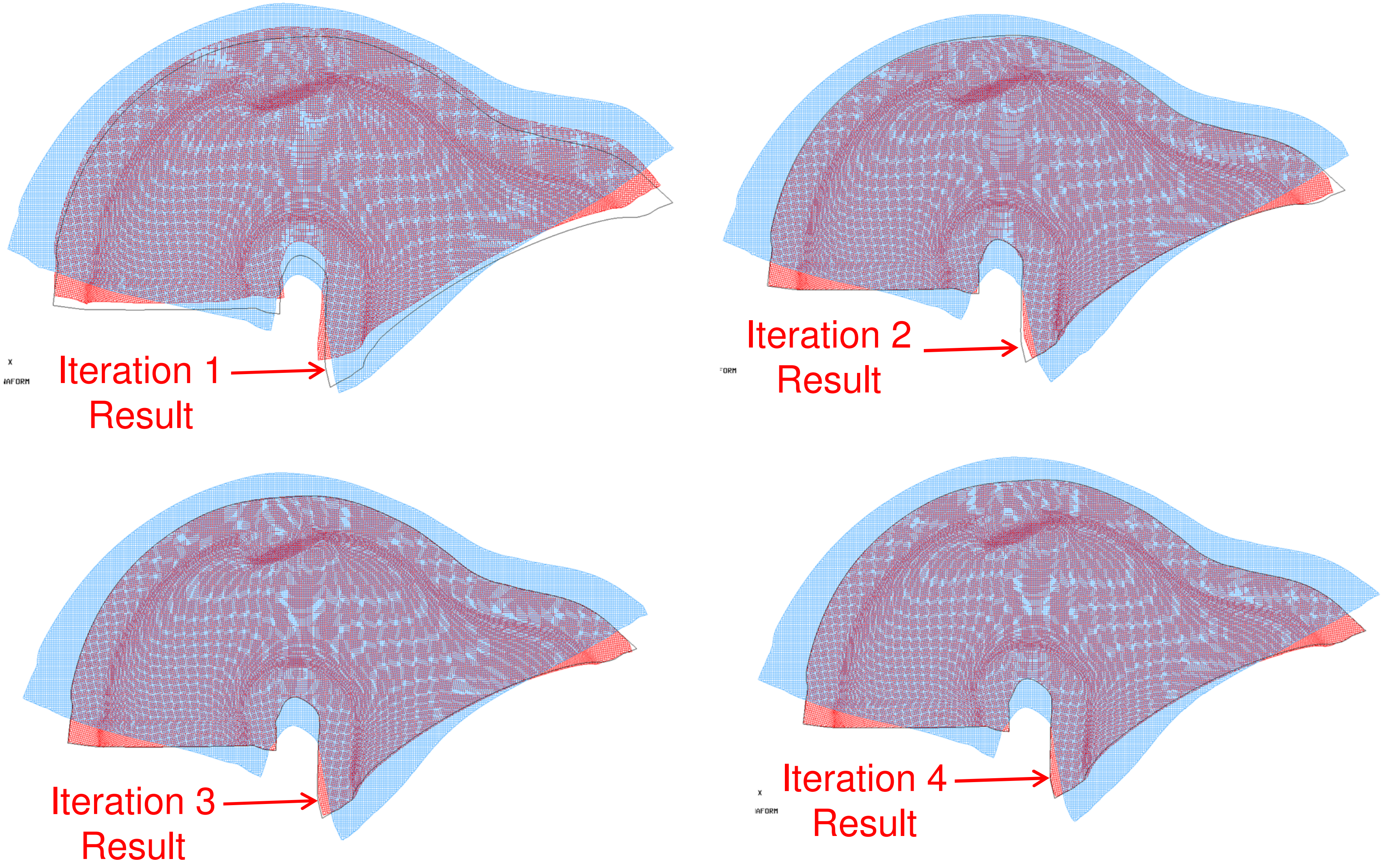


Use MPP:

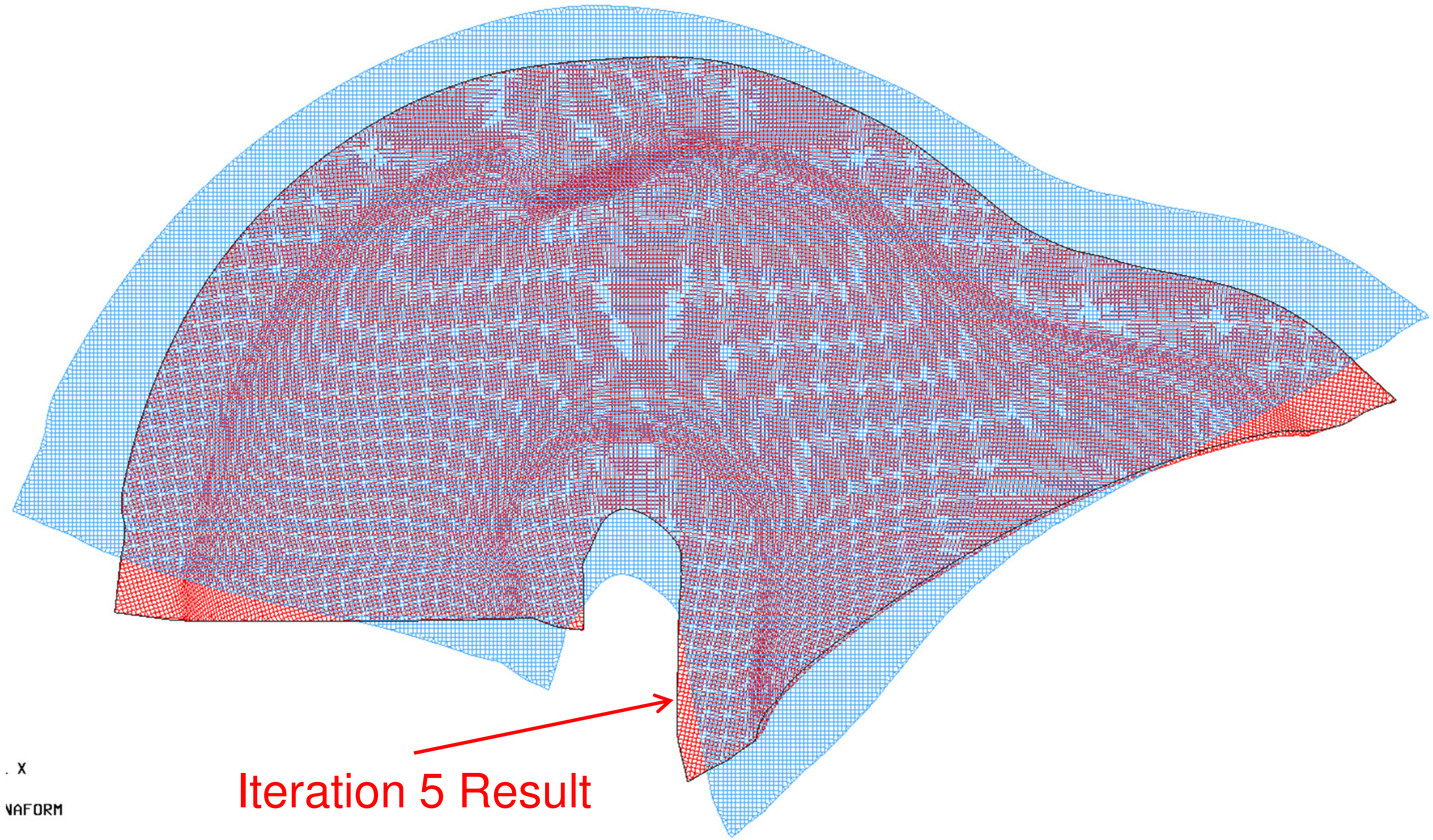
- **Memory2:** Set memory size for MPP.
- **Edit Host File:** Edit CPU config file.
- **Reload Host File:** Reload CPU config file.


Targeted Trim Line
Initial Blank
The simulation result of Initial Blank Line

Blank Outline Optimization



Result of Fifth /Final Optimization



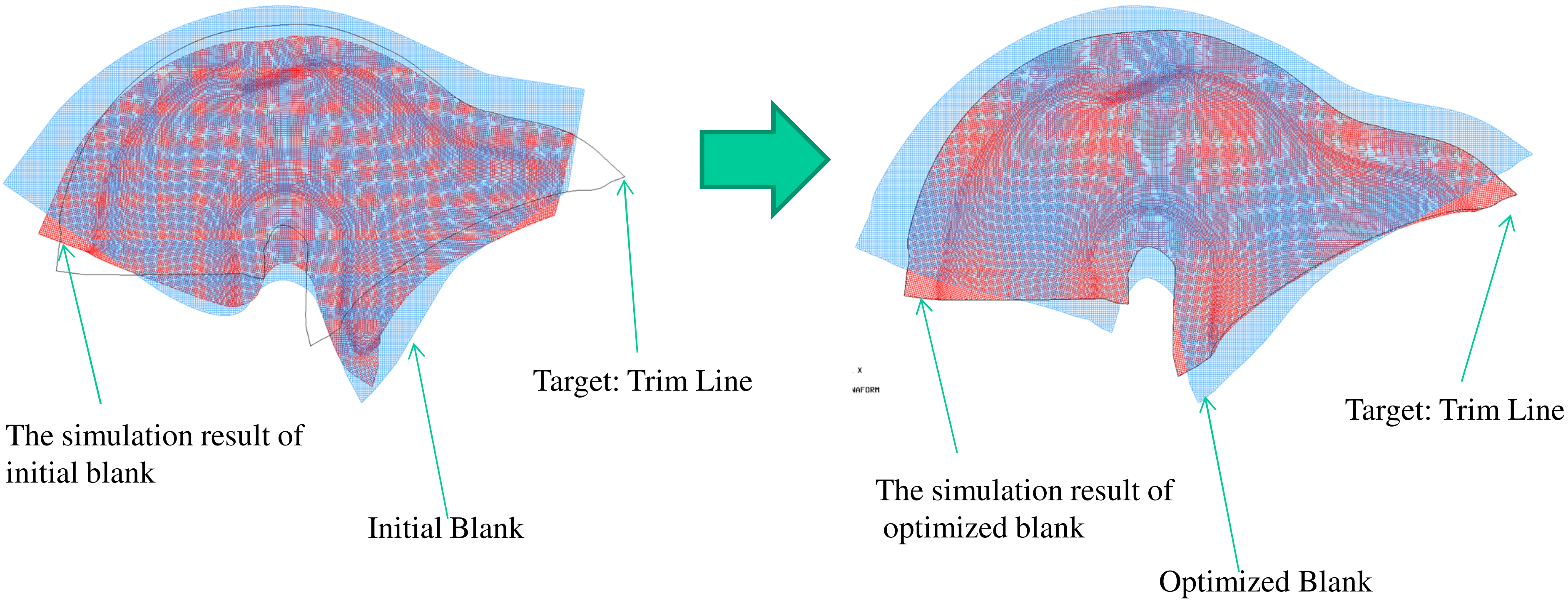
Iteration 5 Result

Simulation & Targeted

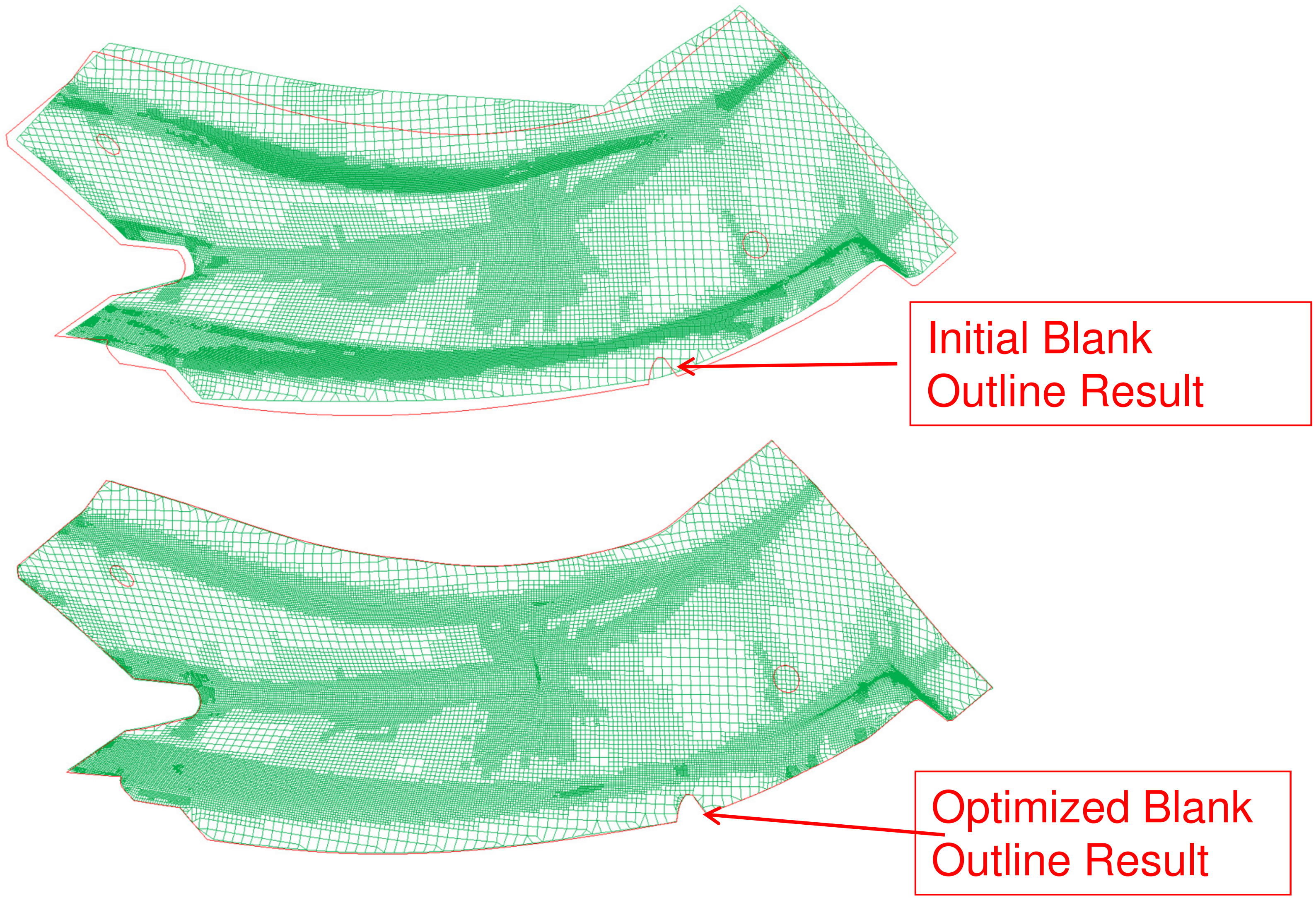
Blank Outlines Converged

Blank Outline Optimization

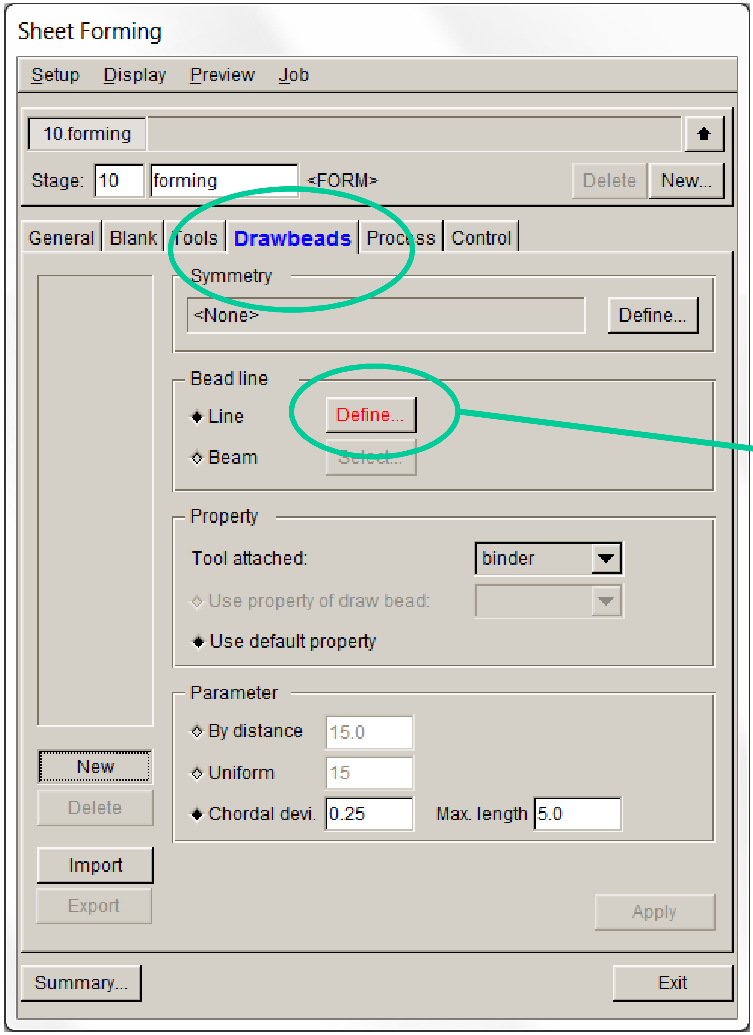
Blank optimization provides an automatic method of modifying the blank outline in order that final blank matches the target.

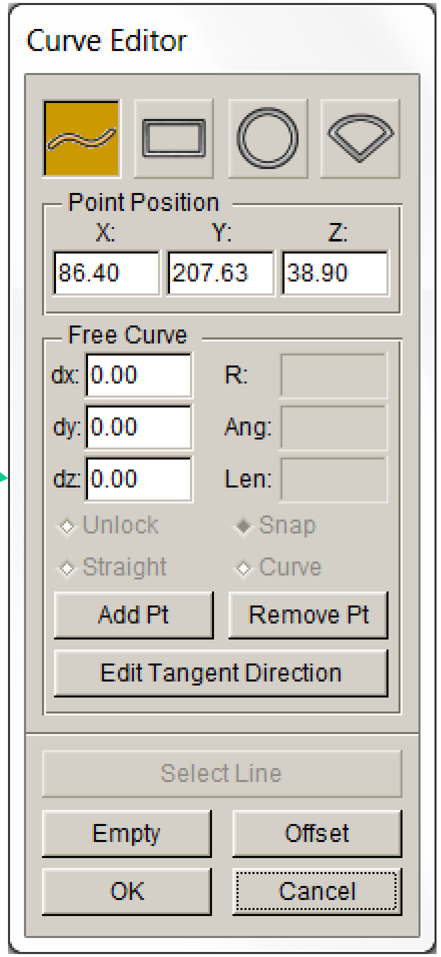


Blank Outline Optimization

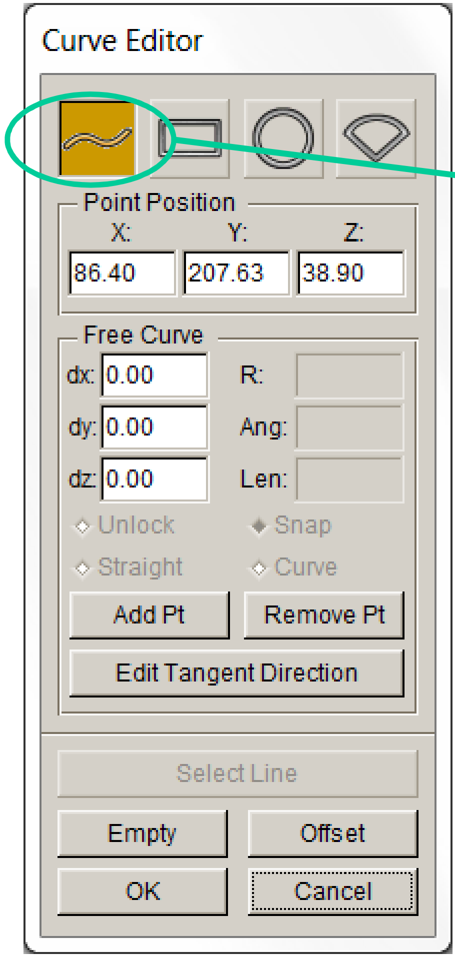


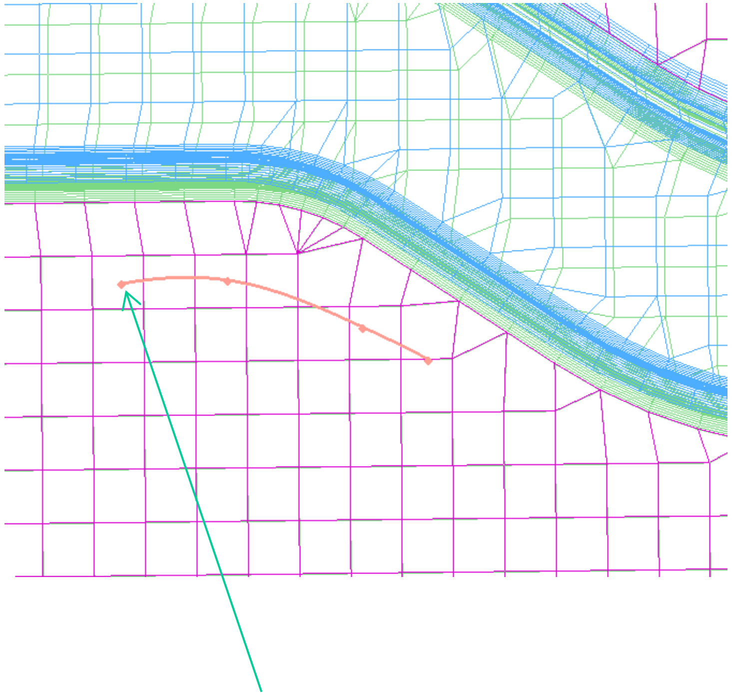
AutoSetup – Drawbeads


Sheet Forming
Setup Display Preview Job
10.forming
Stage: 10 forming <FORM>
Delete New...
General Blank Tools Drawbeads Process Control
Symmetry
<None>
Define...
Bead line
Line
Define...
Beam
Select...
Property
Tool attached:
binder
Use property of draw bead:
Use default property
Parameter
By distance 15.0
Uniform 15
Chordal devi. 0.25
Max. length 5.0
New
Delete
Import
Export
Apply
Summary...
Exit


Curve Editor
Point Position
X: Y: Z:
86.40 207.63 38.90
Free Curve
dx: 0.00
dy: 0.00
dz: 0.00
R:
Ang:
Len:
Unlock
Snap
Straight
Curve
Add Pt
Remove Pt
Edit Tangent Direction
Select Line
Empty
Offset
OK
Cancel

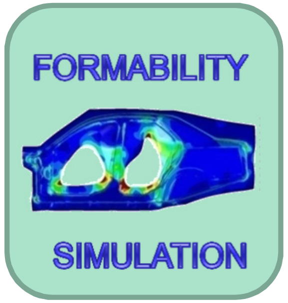
FORMABILITY SIMULATION

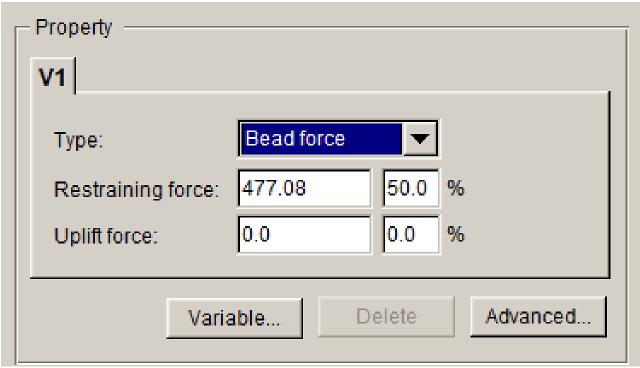


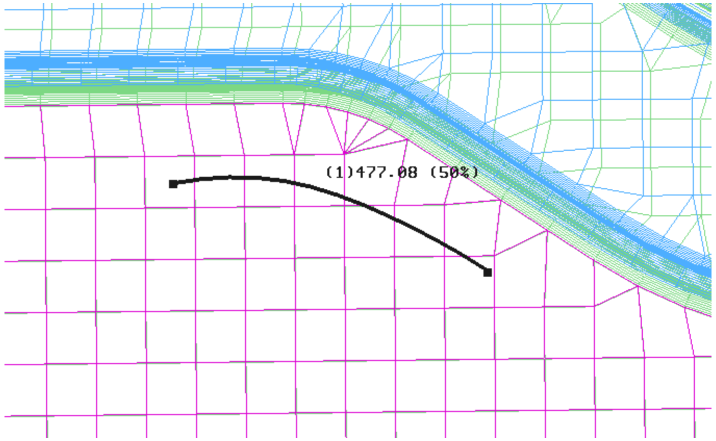


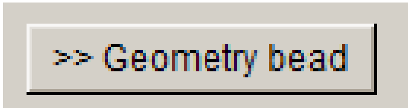
Free Selection

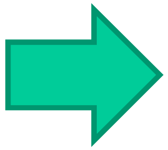
eta/DYNAFORM 5.9 – Drawbeads



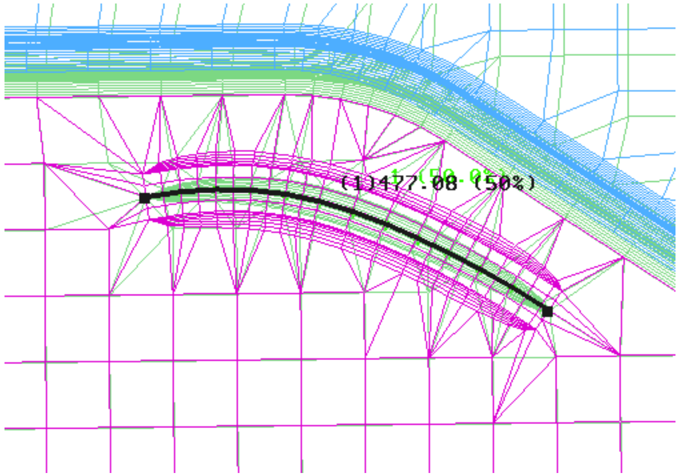




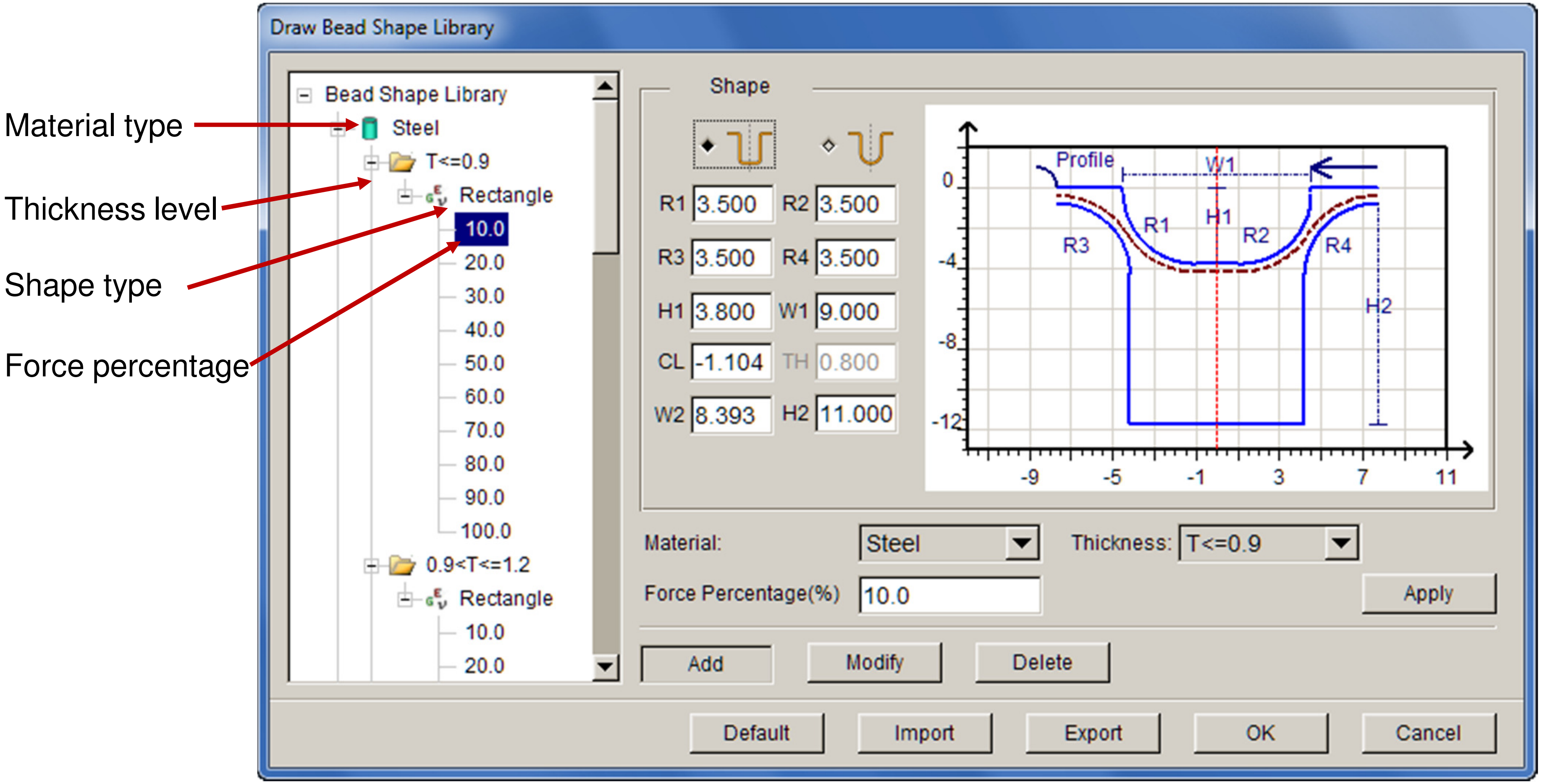




Drawbead Shape Library



GUI of Draw Bead Shape Library

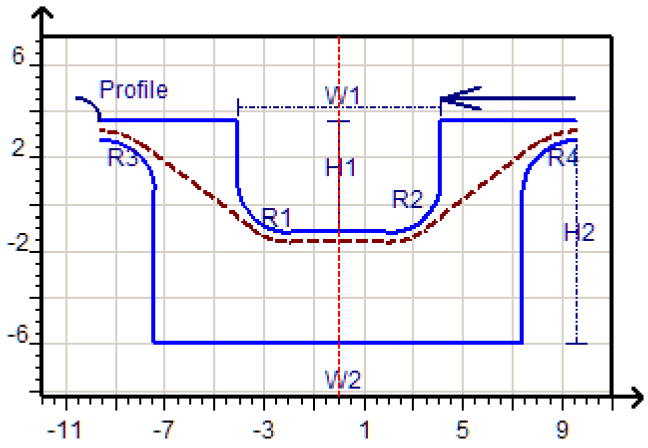


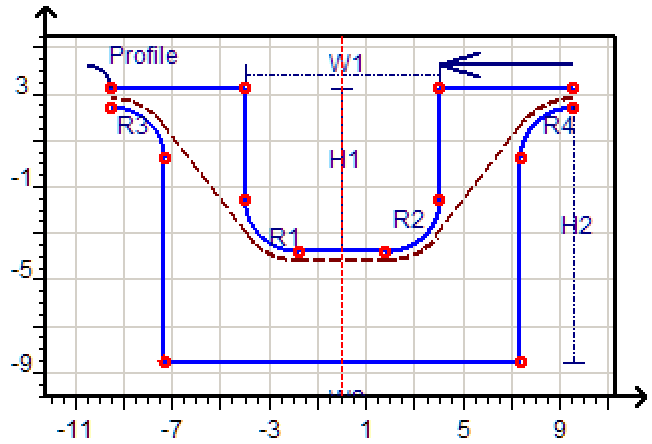
GUI of Draw Bead Shape Library

Diagram operation:

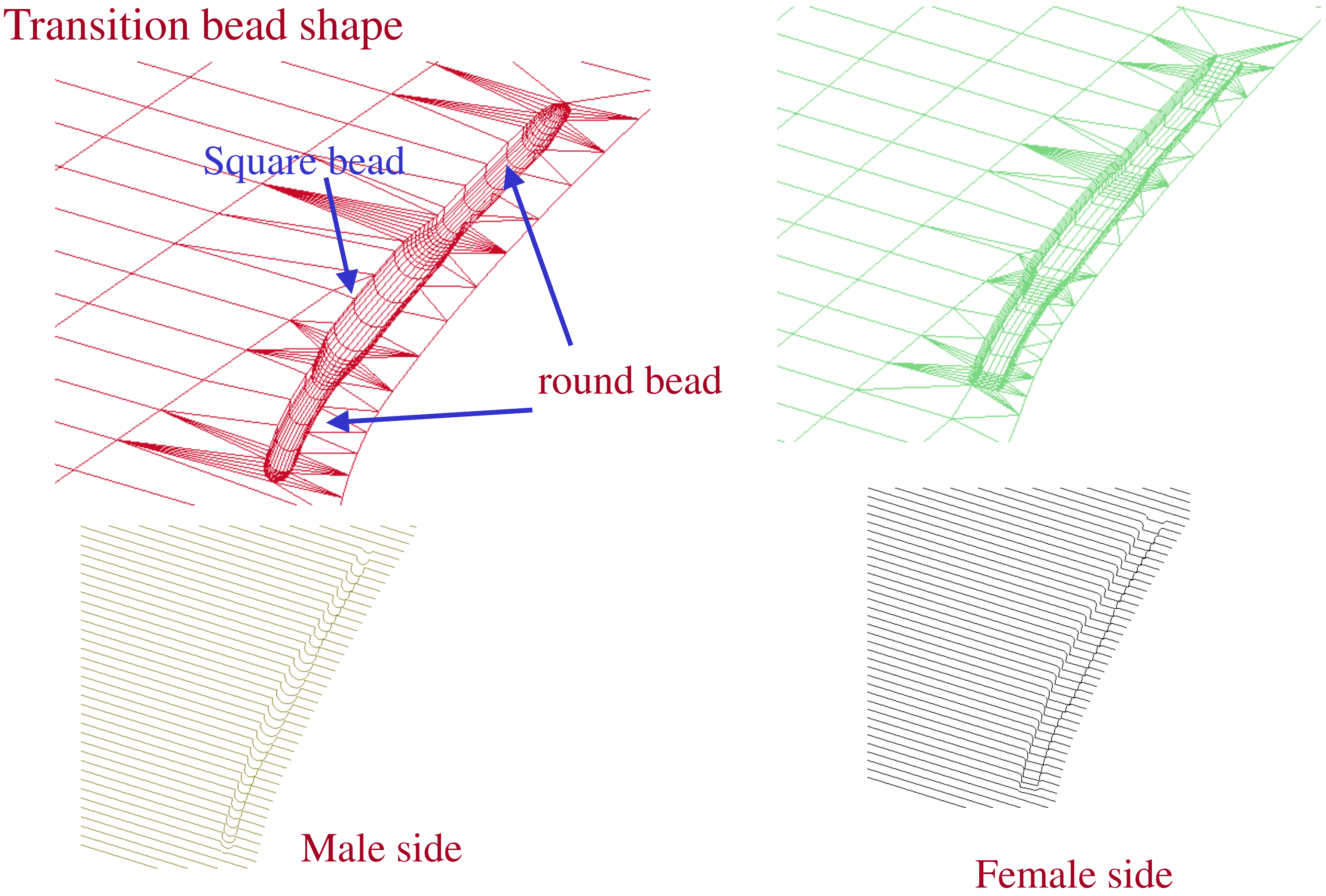
- ZOOM - Press the right mouse button and move up/down
- MOVE - Press the middle mouse button and move
- Fit screen - double click the diagram area with left mouse button
- Modify the parameters dynamically

  Double click the diagram area with middle mouse button, the drag the control point or the shape edge

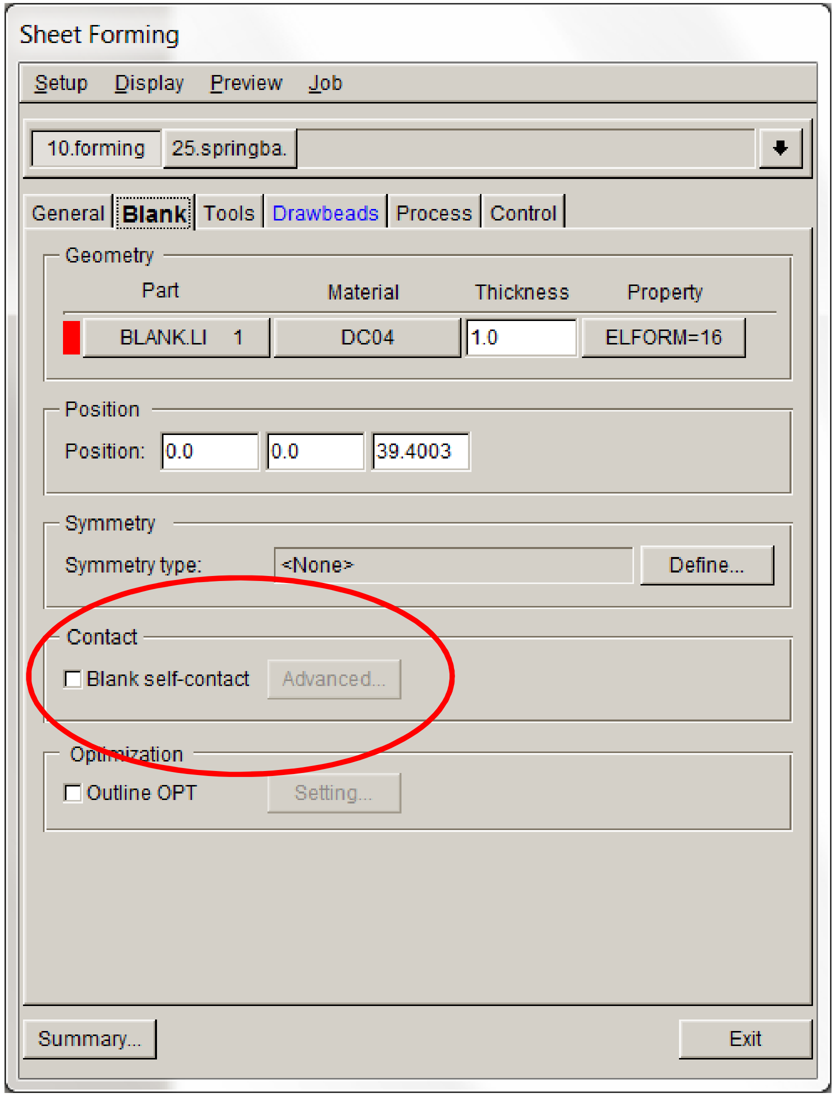




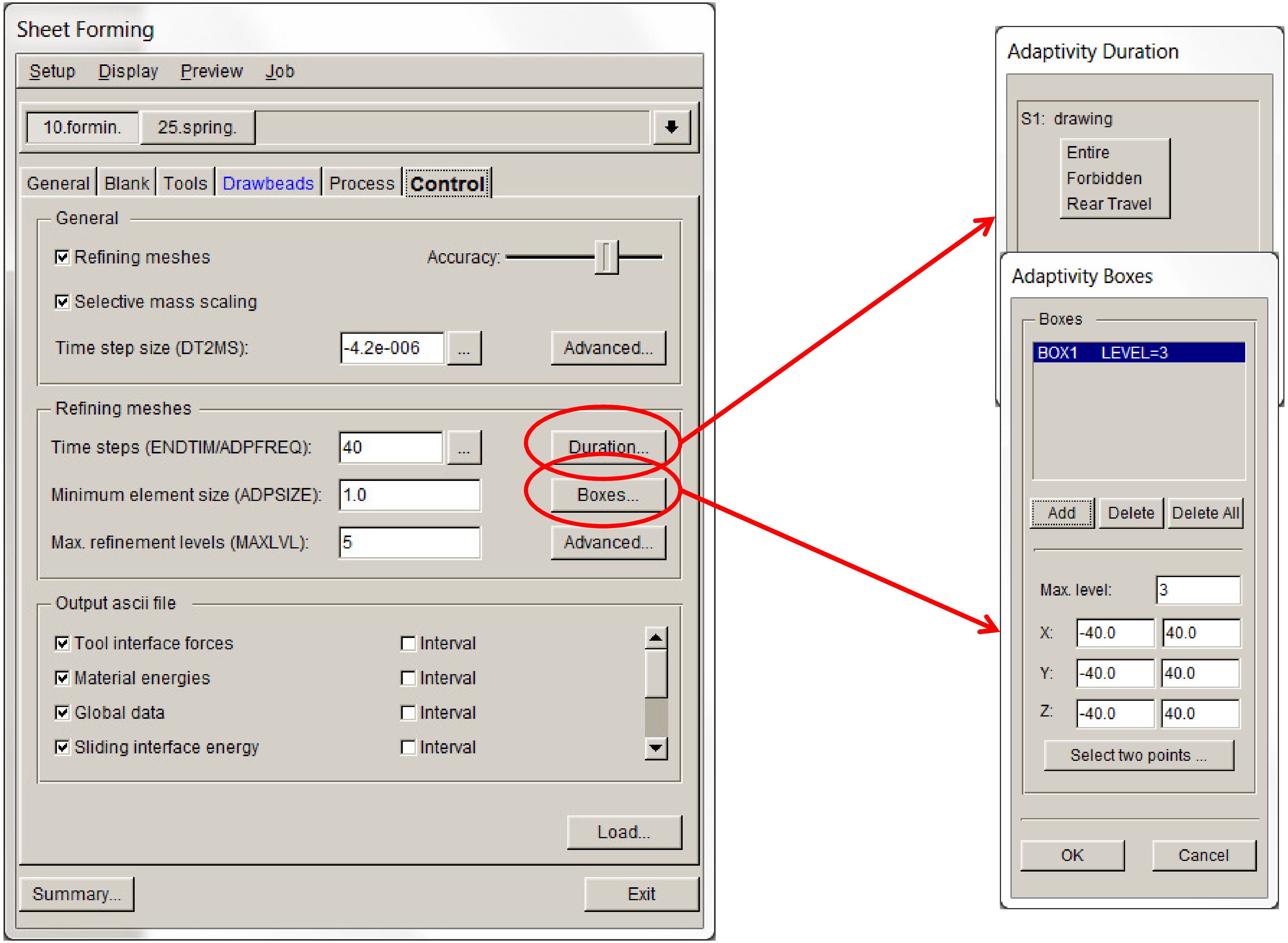
Bead profile



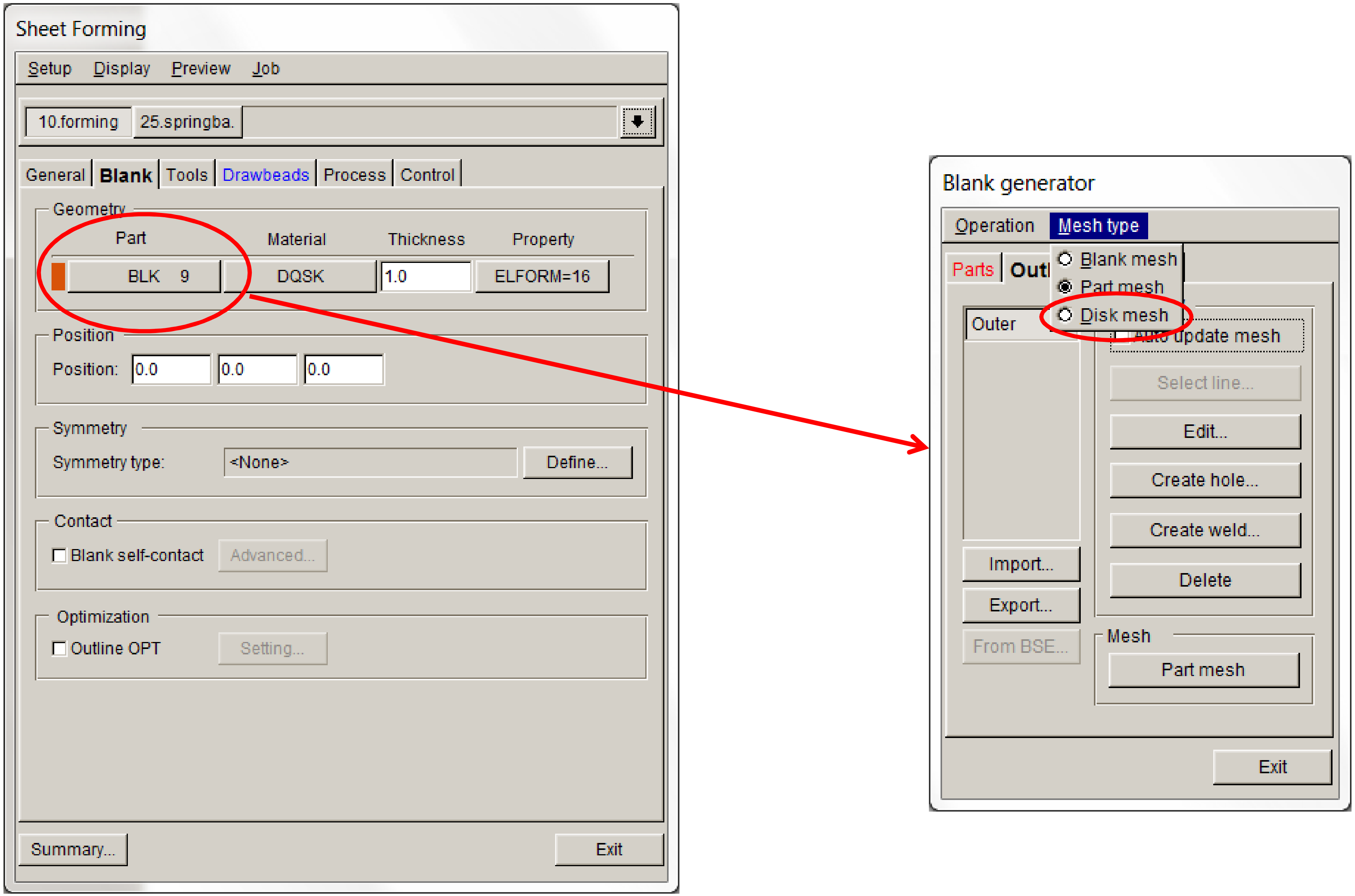
Blank Self Contact



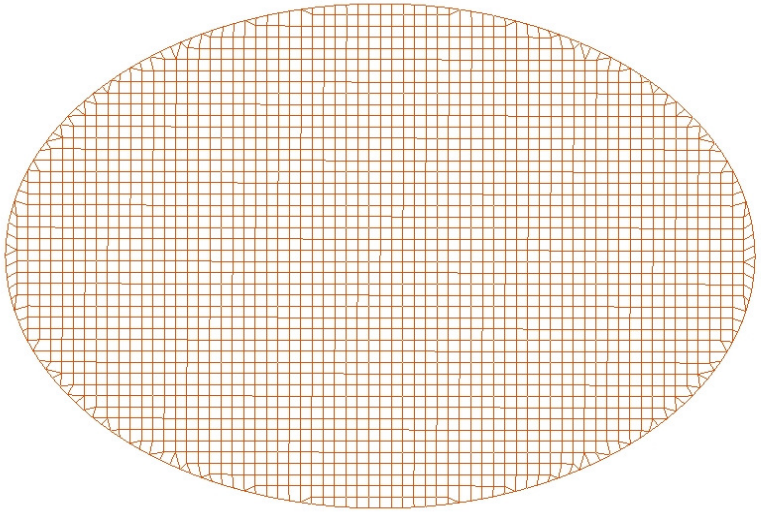
New Control Page



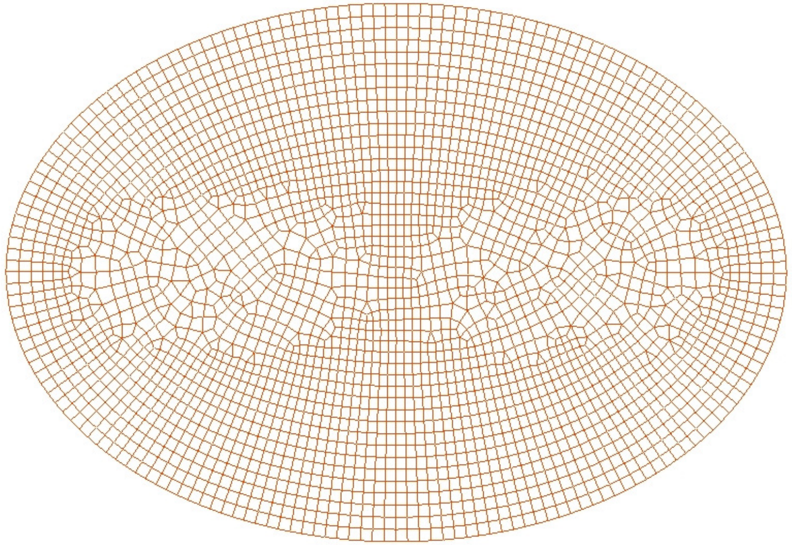
Blank Generator – New Mesher



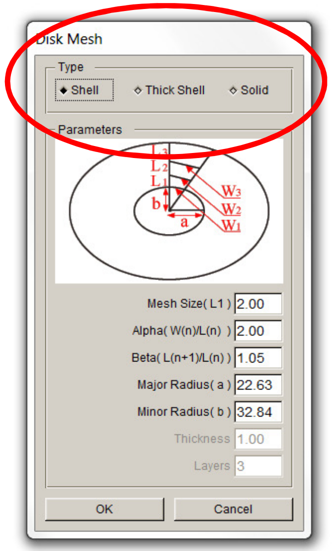
Blank Generator – New Mesher

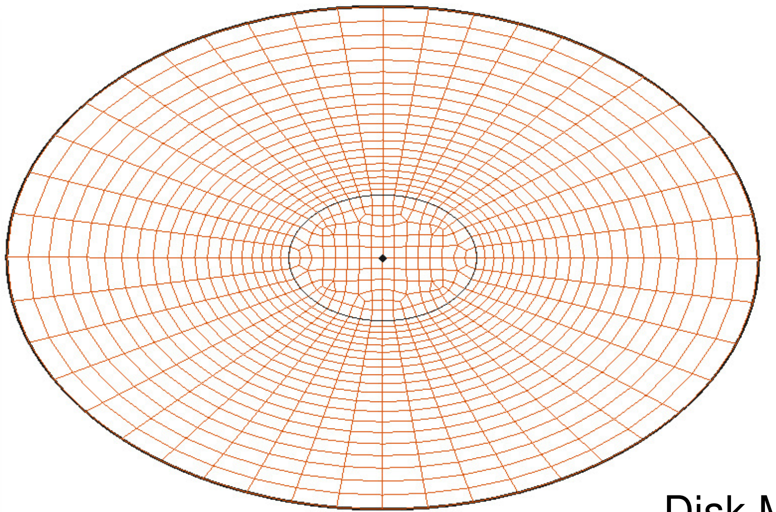


Blank Mesher



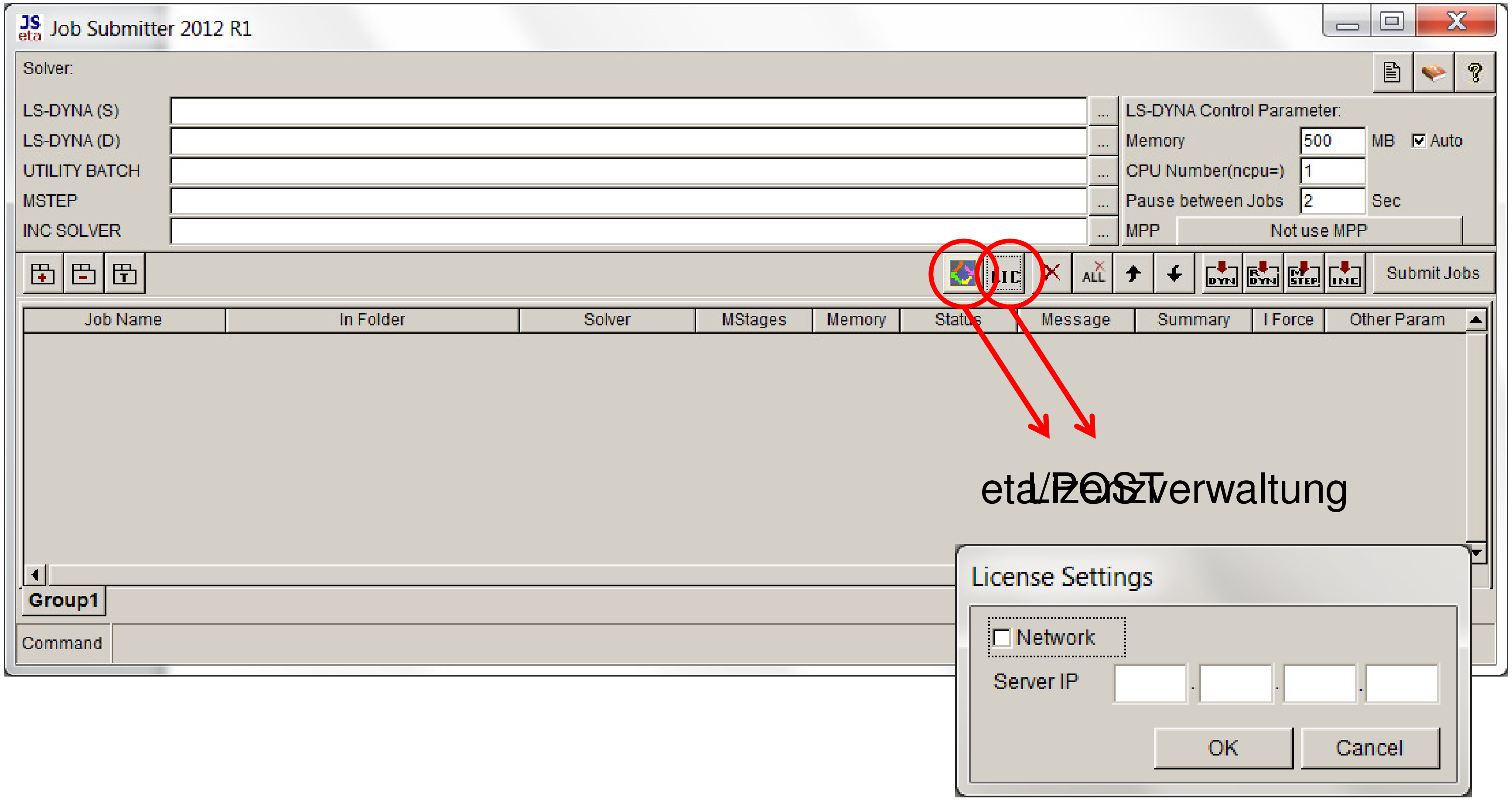
Part Mesher





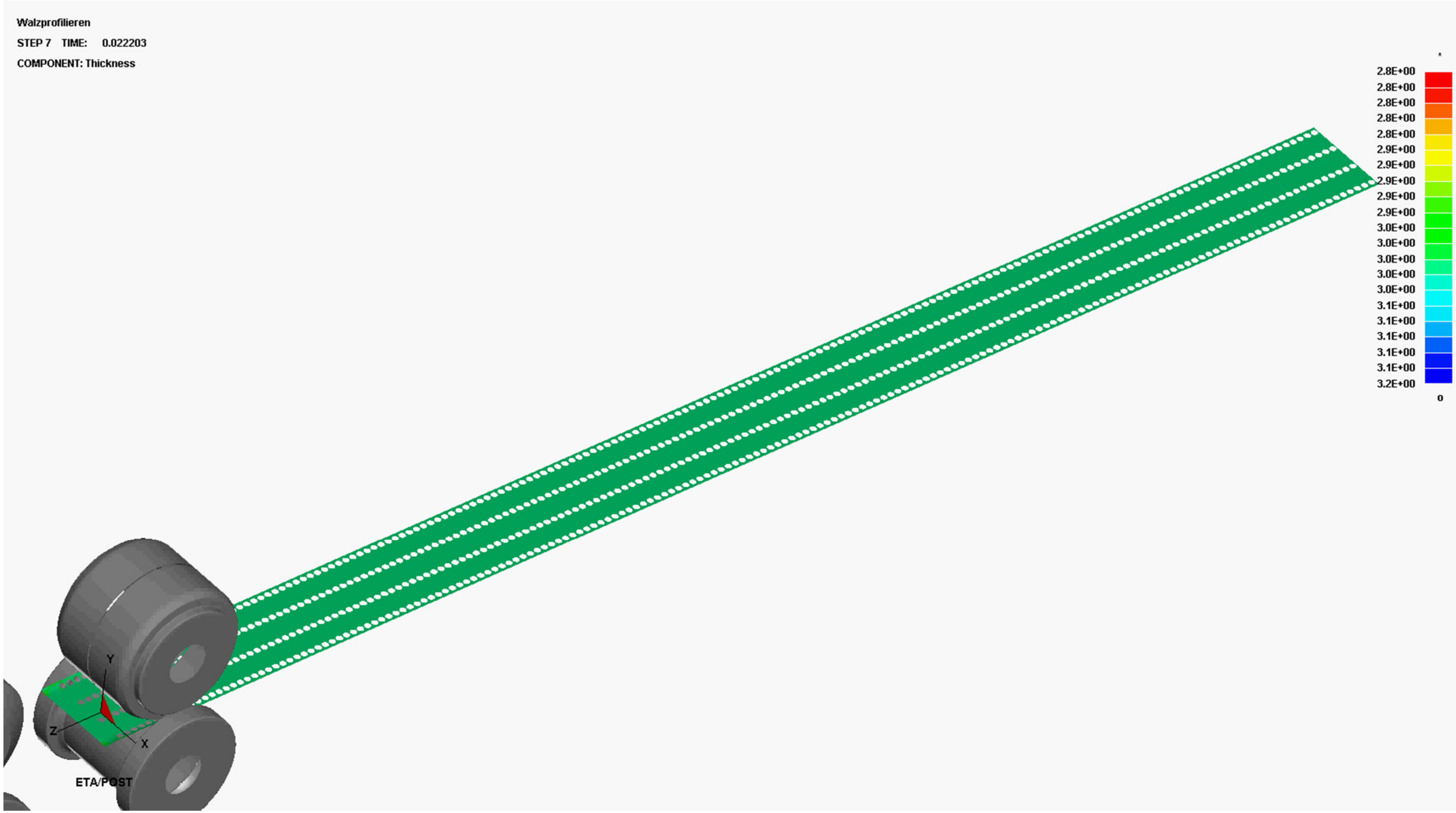
Disk Mesher

Job Submitter 2012 R1

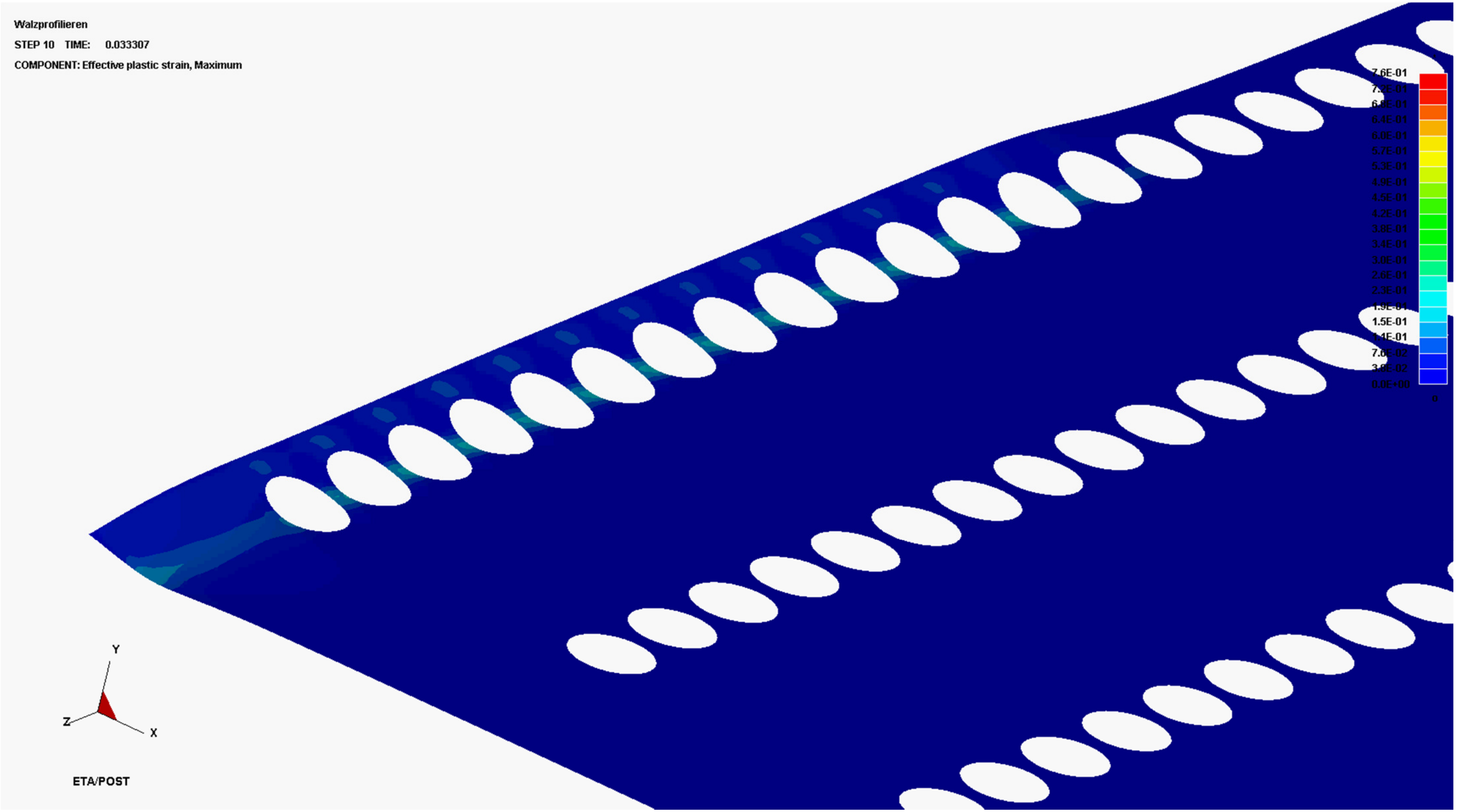


Ausblick

Walzprofilieren – Dickenverteilung gelocht



Walzprofilieren – Plastische Dehnungen gelocht (Detail)



EADS INNOVATION WORKS

Superplastic forming @ EADS Innovation Works

Joachim Zettler, IW-MS

30.10.2012

EADS

Superplastic forming - Introduction

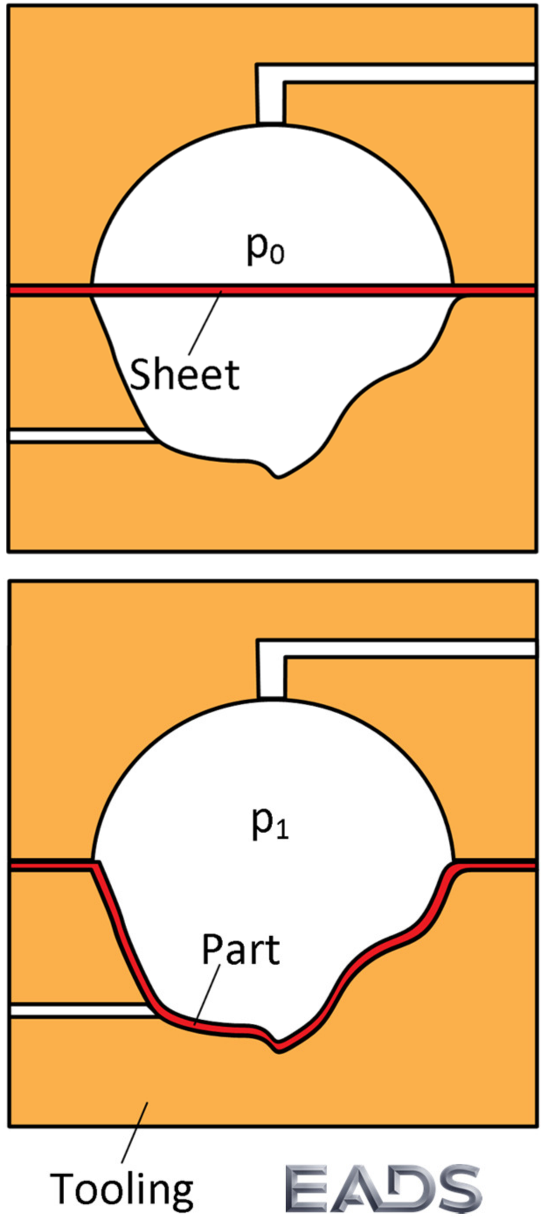
- Mainly used to form Ti6Al4V parts
- Yield stress is reduced at elevated temperatures (~ 900°C)
- Very high part accuracy is possible due to low residual stresses induced during forming
- High strain values for SPF (theoretically up to 1000% but practically around 300 – 400%)
- SPF state only at very low strain rates 1.E-5 < $\dot{\varepsilon}$ < 1.E-3
  → Very long process time

Superplastic forming - Principle

- Position sheet in tooling and fix it
- Heat up to desired SPF temperature
- Apply optimized gas pressure to reach strain rates in the desired range

…..wait a long time…..

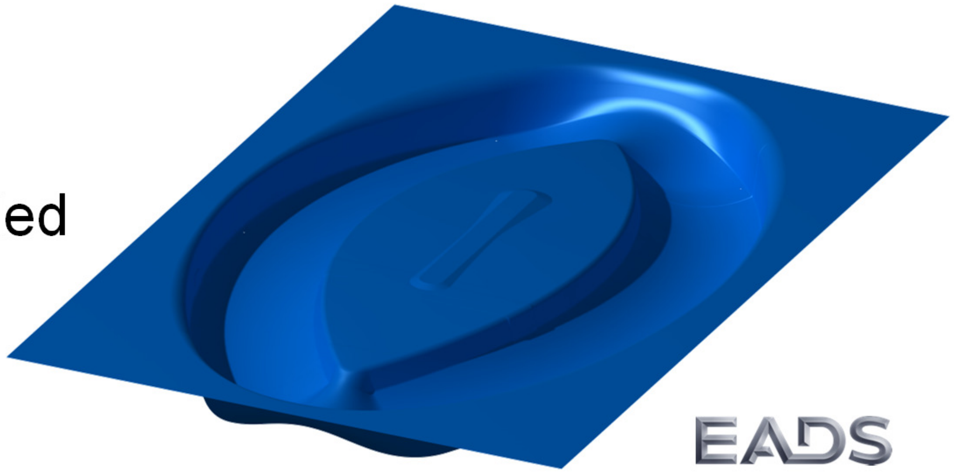
- Apply calibration pressure if necessary



EADS

Superplastic forming – Example part

- Part named “Nacelle”
- Material Ti6Al4V
- Thickness 3mm
- Due to symmetry, 2 parts per forming step
- Part size 2000mm*400mm
- 4 parts per A380 engine needed



Superplastic forming – Simulation setup with LSDYNA

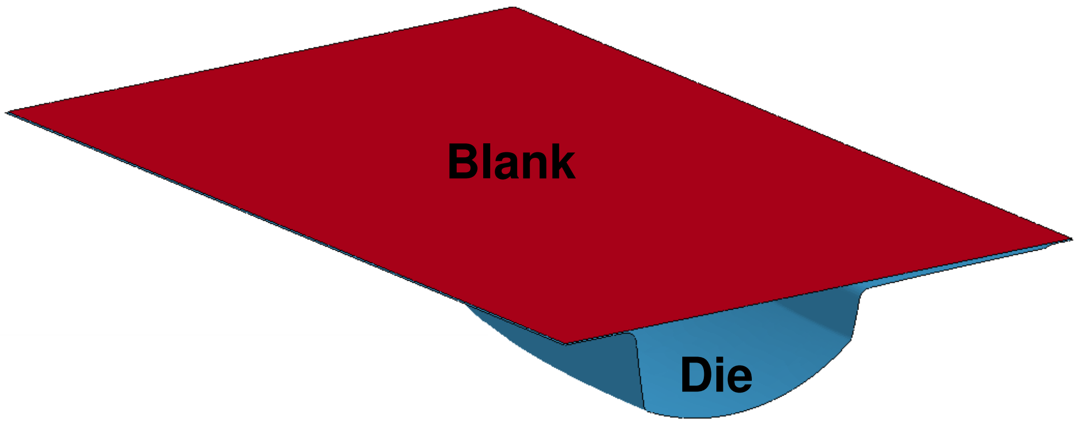
- Rigid die
- Blank modeled with shell elements type 2
- Contact between blank and die can efficiently only be modeled with constraint contact formulations. Proposed choice is surface to surface option

  *CONTACT_CONSTRAINT_SURFACE_TO_SURFACE
- Constitutive law used is

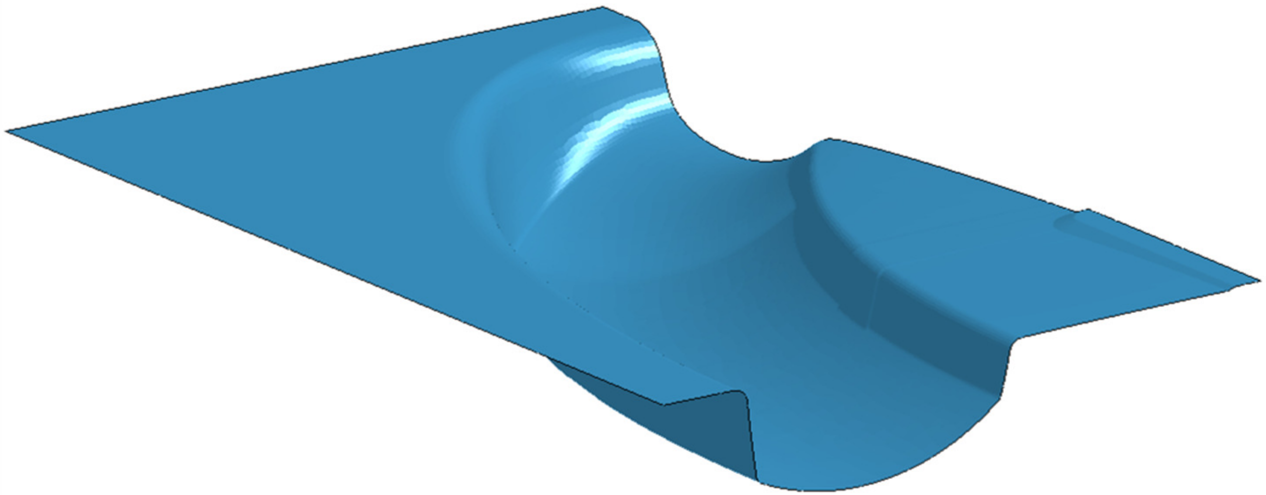
  *MAT_RATE_SENSITIVE_POWERLAW_PLASTICITY
- Loading pressure control to account for a desired forming strain rate can be used with the keyword

  *LOAD_SUPERPLASTIC_FORMING

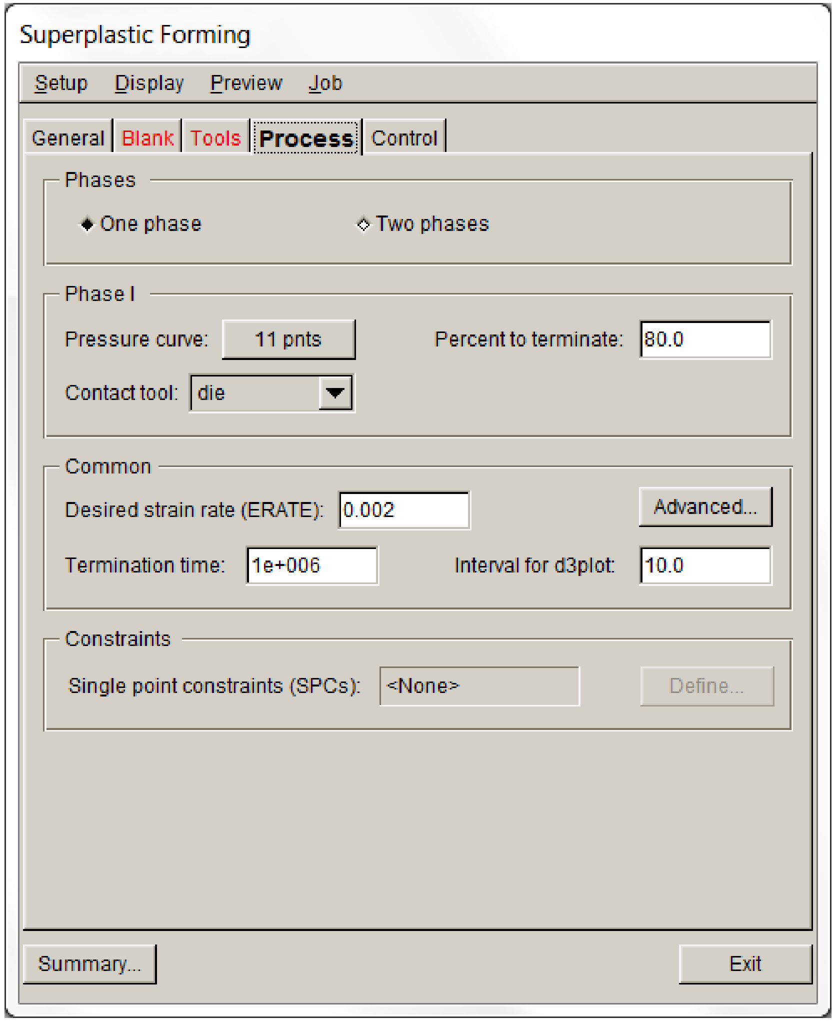
Superplastic forming – Simulation setup with Dynaform



Due to symmetry only a quarter is modeled

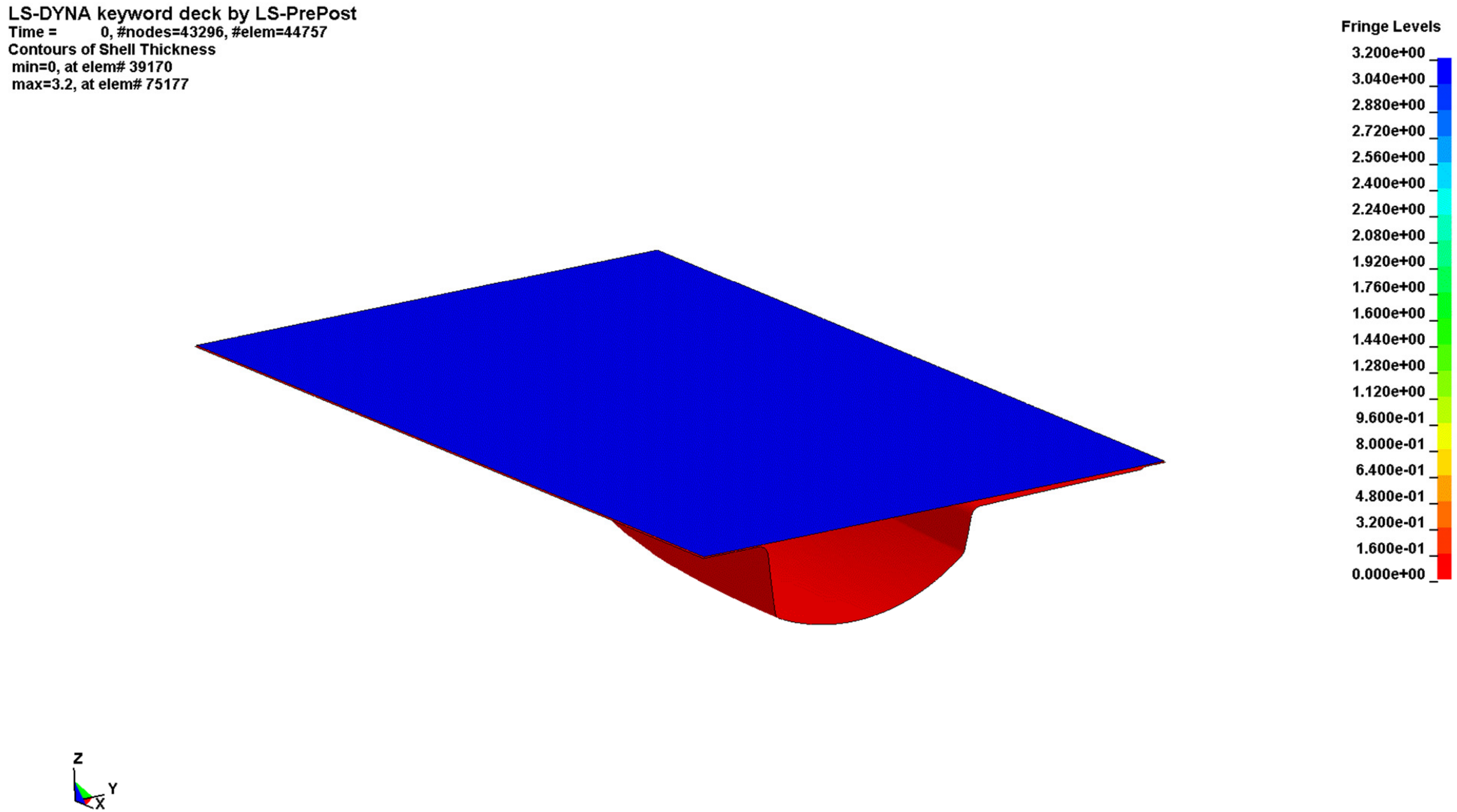


Superplastic forming – Simulation setup with Dynaform



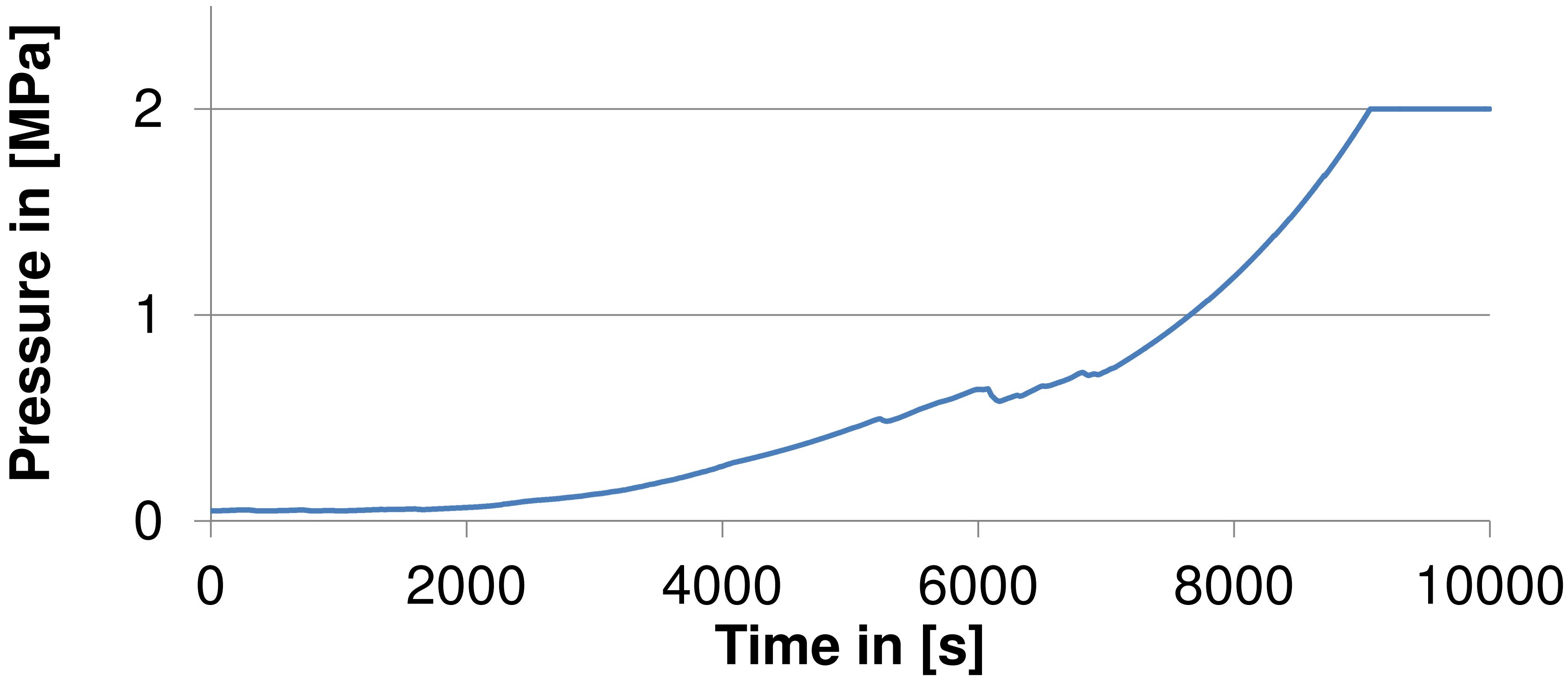
EADS

Superplastic forming – Nacelle simulation result



Superplastic forming – Nacelle simulation result for target strain rate of 2.5E-4

- The simulation is mainly used to derive a strain-rate controlled pressure amplitude and a realistic thinning prediction



EADS


TRIMMING8 / UNTITLED
STAGE 9 LOCAL STEP 1
STEP 9 TIME: 0.008001
Thank You !
ETA/POST