Model Set up and Analysis tools for Squeak and Rattle in LS-DYNA

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Thessaloniki, Greece

LS-DYNA®
Dynamore Nordic Forum
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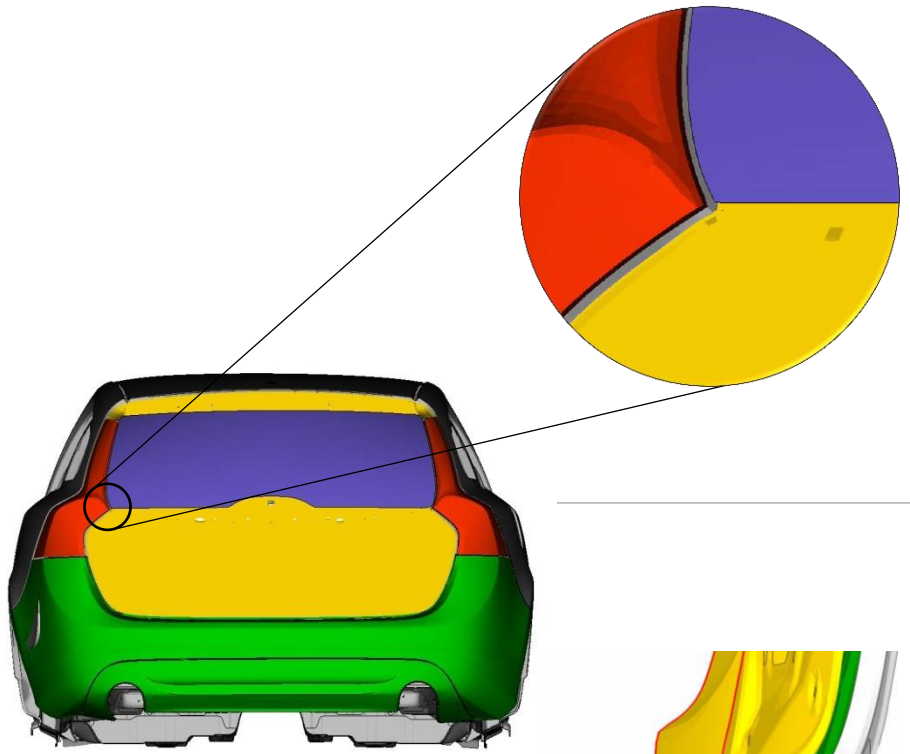
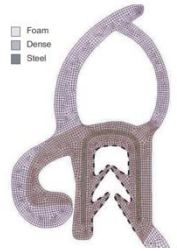
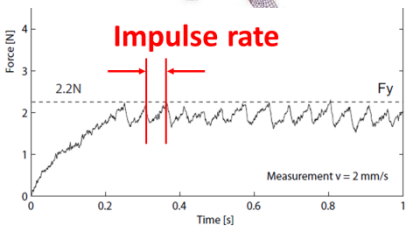
Background



F(t)

Rattle/
Chafing



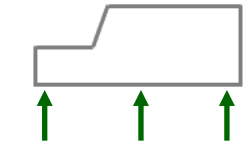


Squeak

Ref: Matti Rantatalo ISBN 978-91-7439-134-3

Simulation procedure

Load definition



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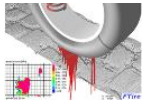
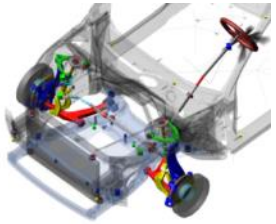
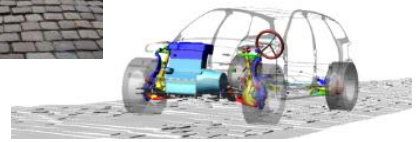
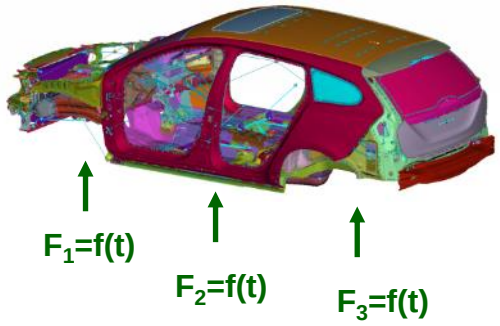




Virtual road profile

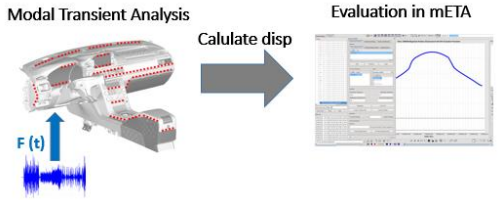


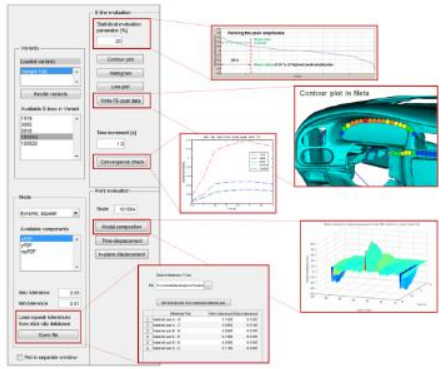
Modal transient analysis

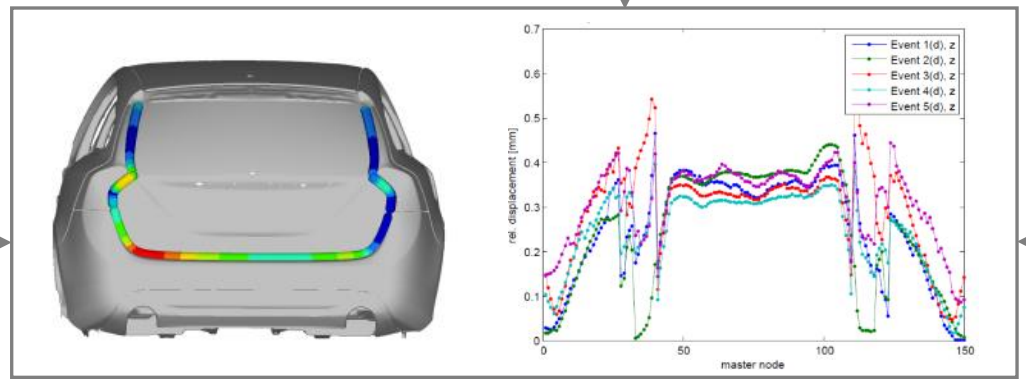


Event 1: Test track A
Event 2: Test track B
…

E-LINE Method







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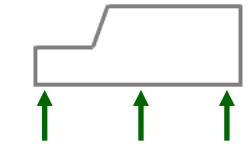

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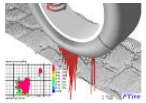
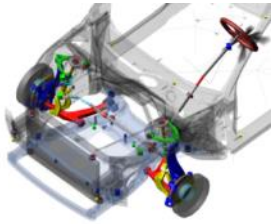
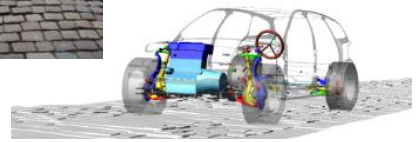
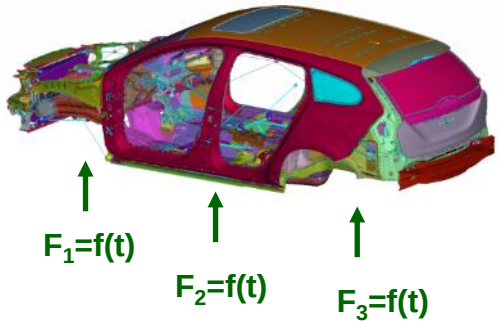




Virtual road profile



Modal transient analysis



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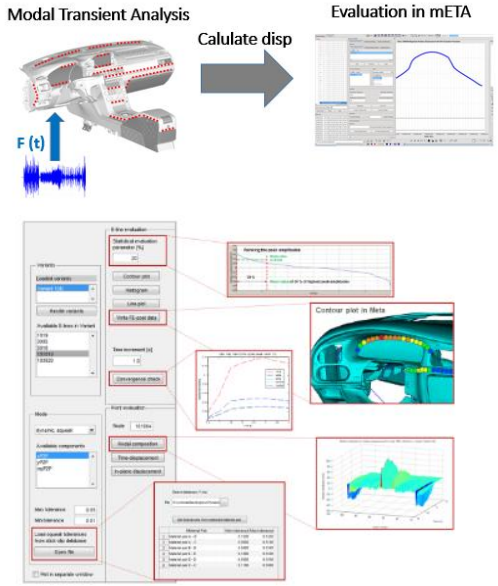
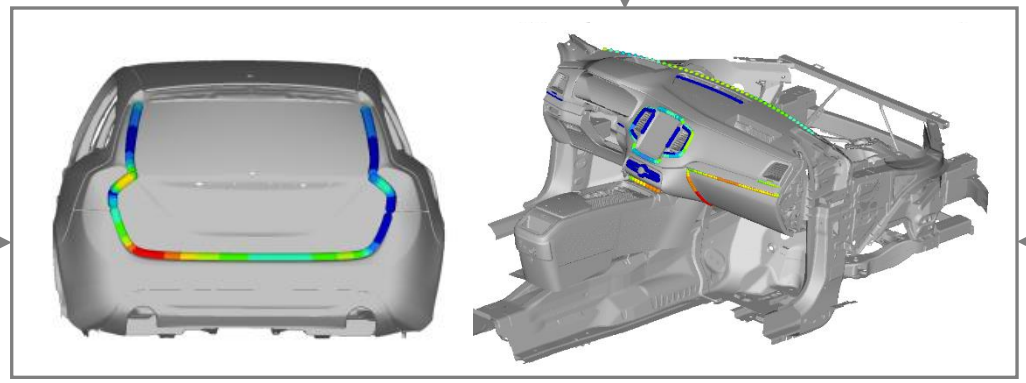




Virtuell development

CAE simulation

Static and dynamic stiffness

Evaluation-LINE Method (E-LINE):
- Relative displacement (absolute value)
- Time domain (statisticical approach)
- Rattle correlation with tolerance anaylsis (RD&T)
- Squeak correlation with Stick-slip test data

Stress
Time domain

Disp, vel, acc
Time domain

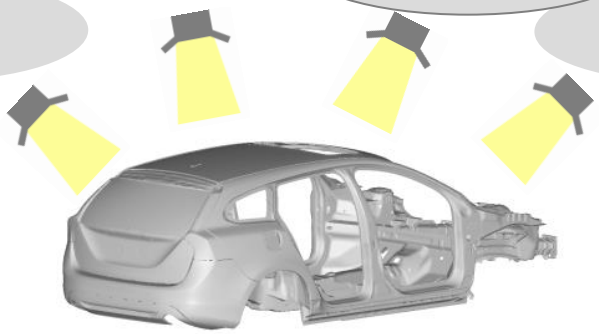
Disp, vel, acc
Frequency domain

Durability

Solidity

Crash

NVH



The E-LINE Method

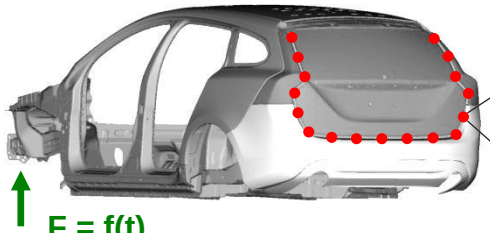
Evaluating

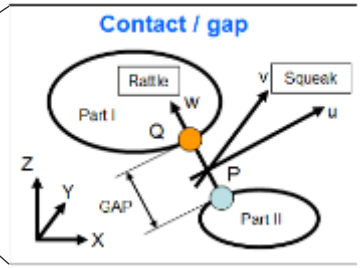
relative displacement

along a **LINE**

Ref: SAE 2012-01-1553

Modal Transient





The E-LINE Method

Evaluating

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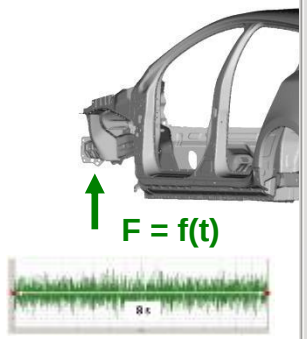

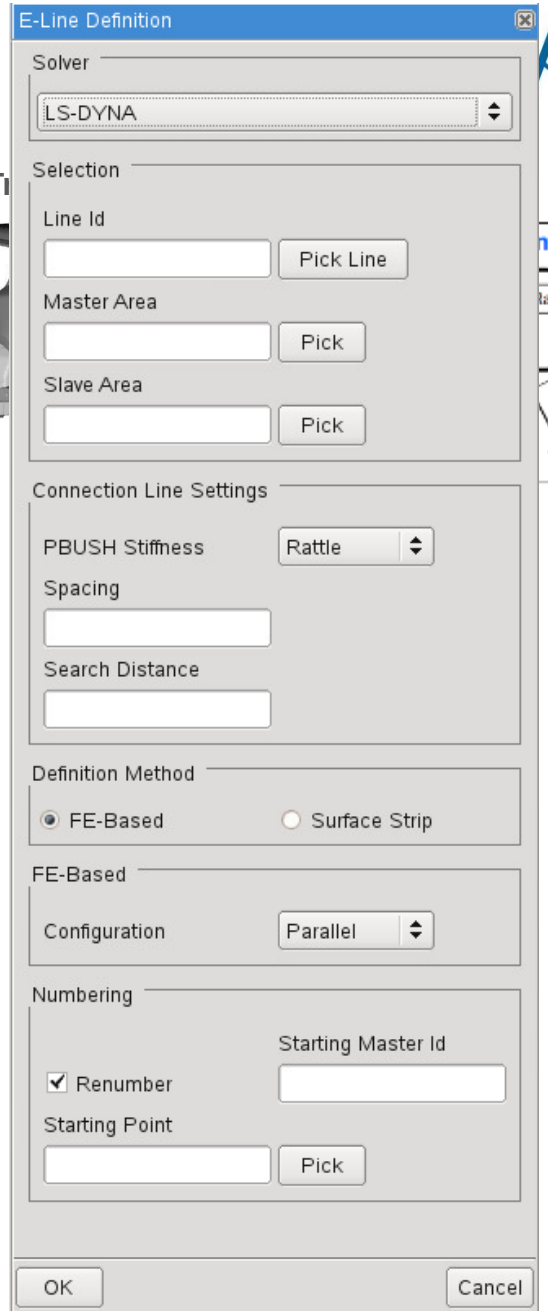

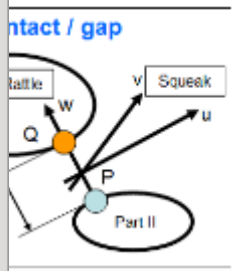

The E-LINE Method

Evaluating

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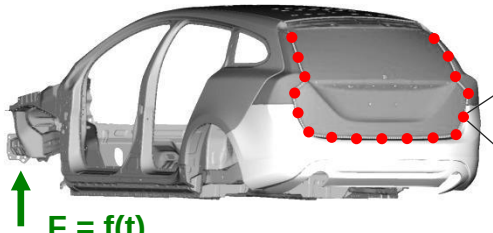
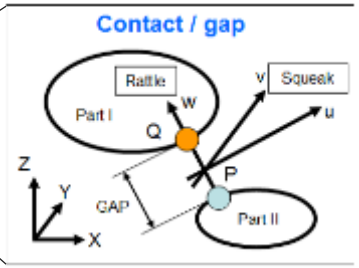
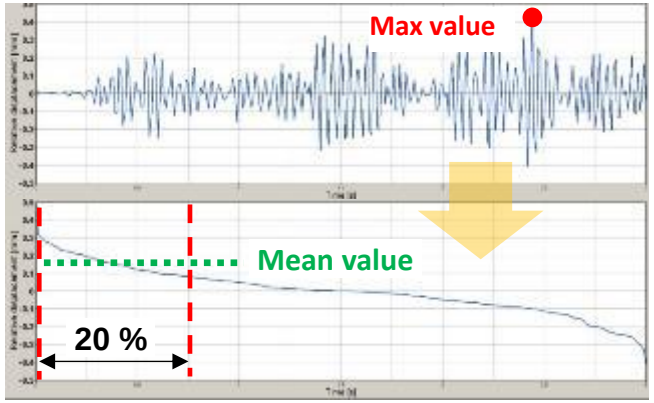
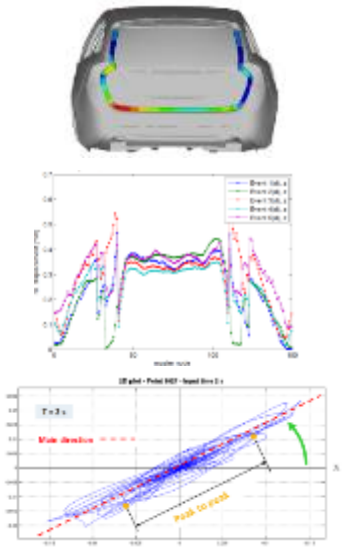




Response in Time Domain: P - Q

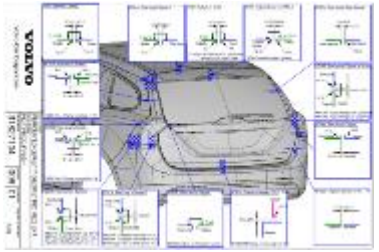


Post processing



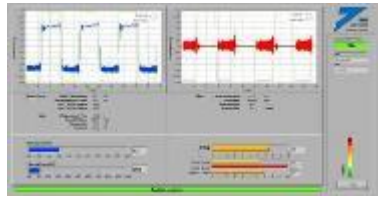
Tolerance analysis

Rattle/chafing



Stick-slip test

Squeak



The E-LINE Method

Evaluating

relative displacement

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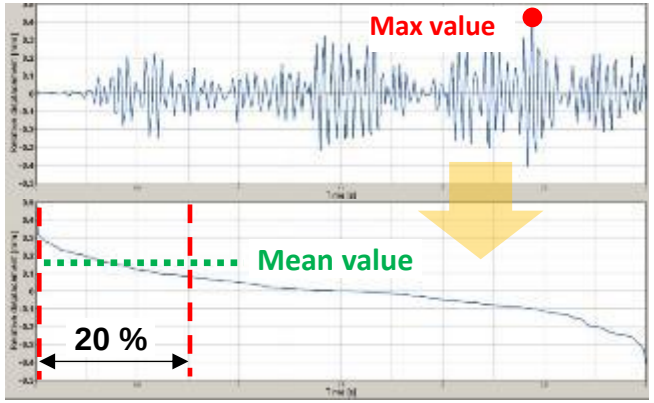
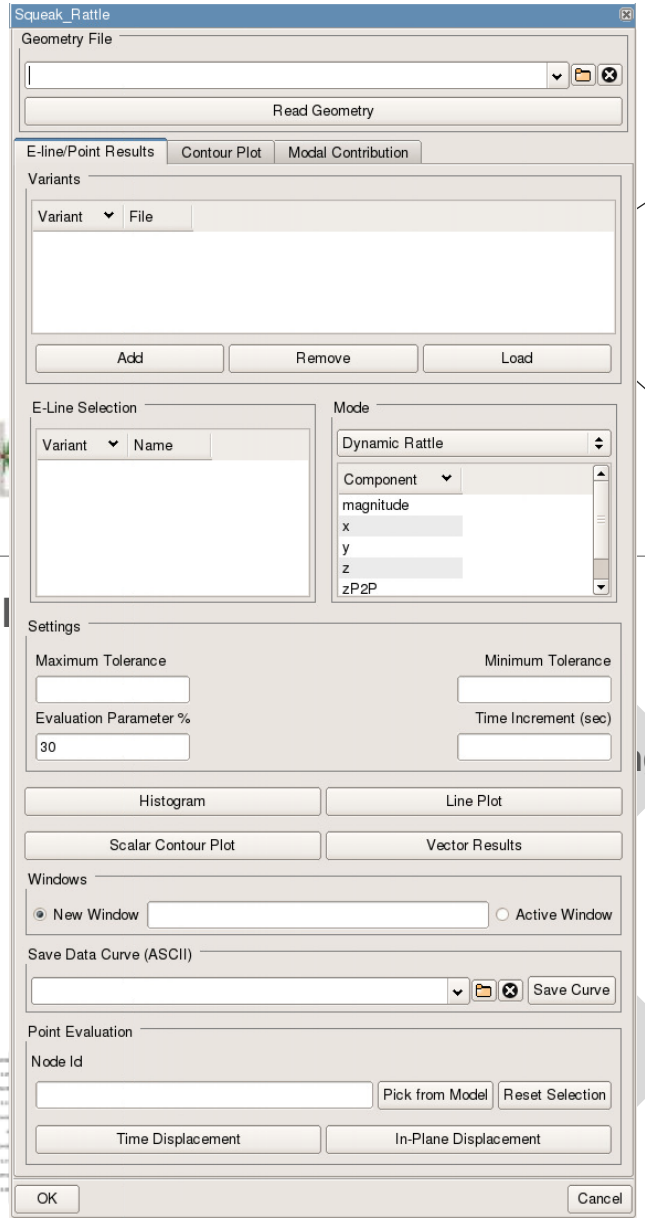
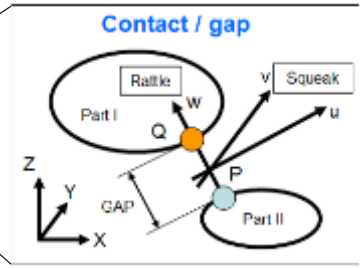
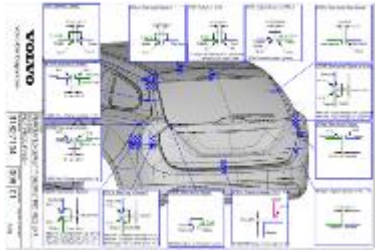
Response in Time Domain: P - Q



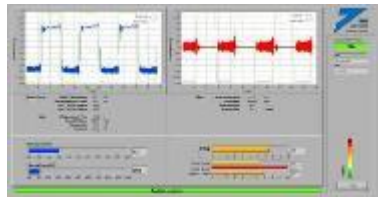




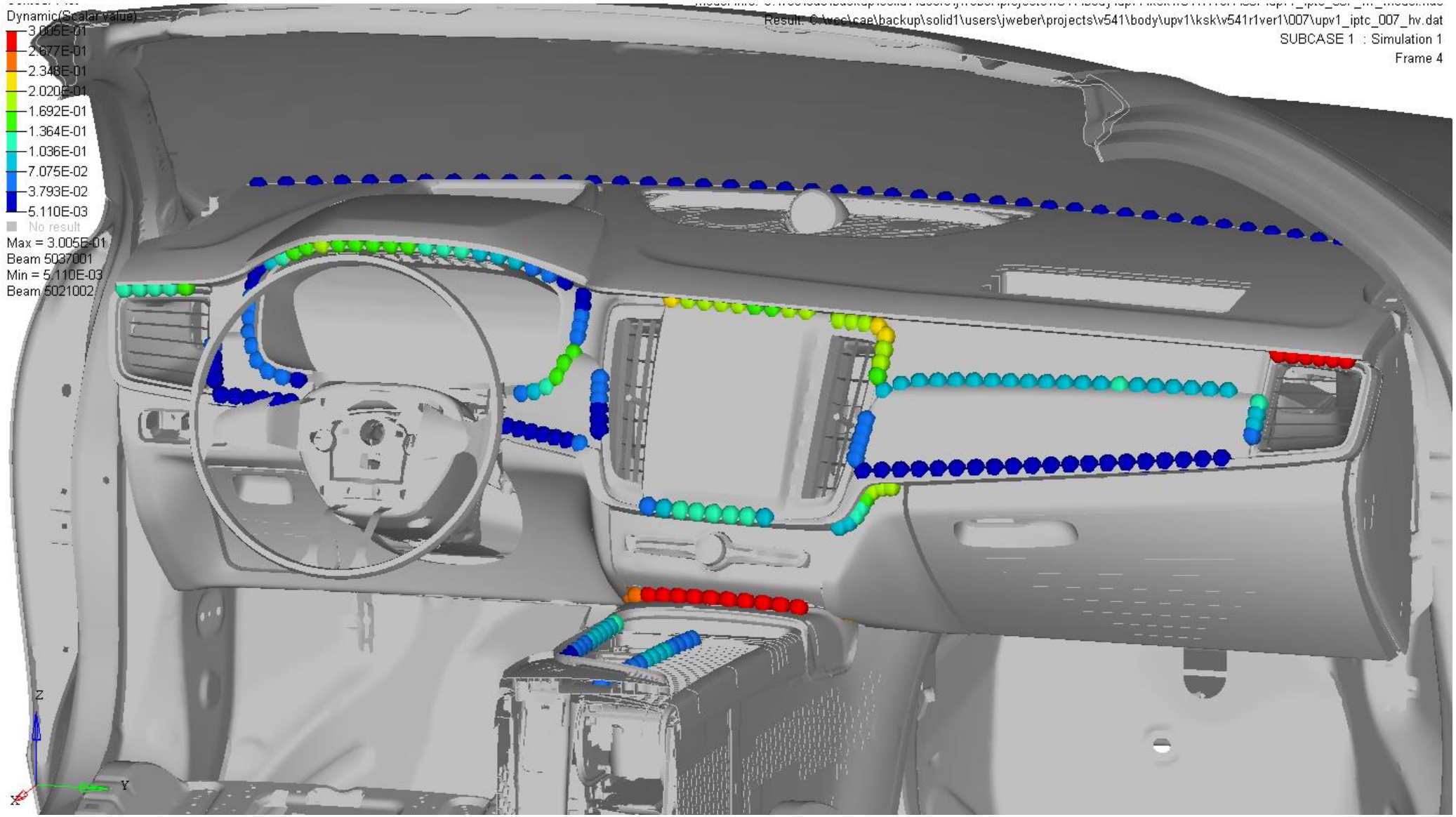
Tolerance analysis



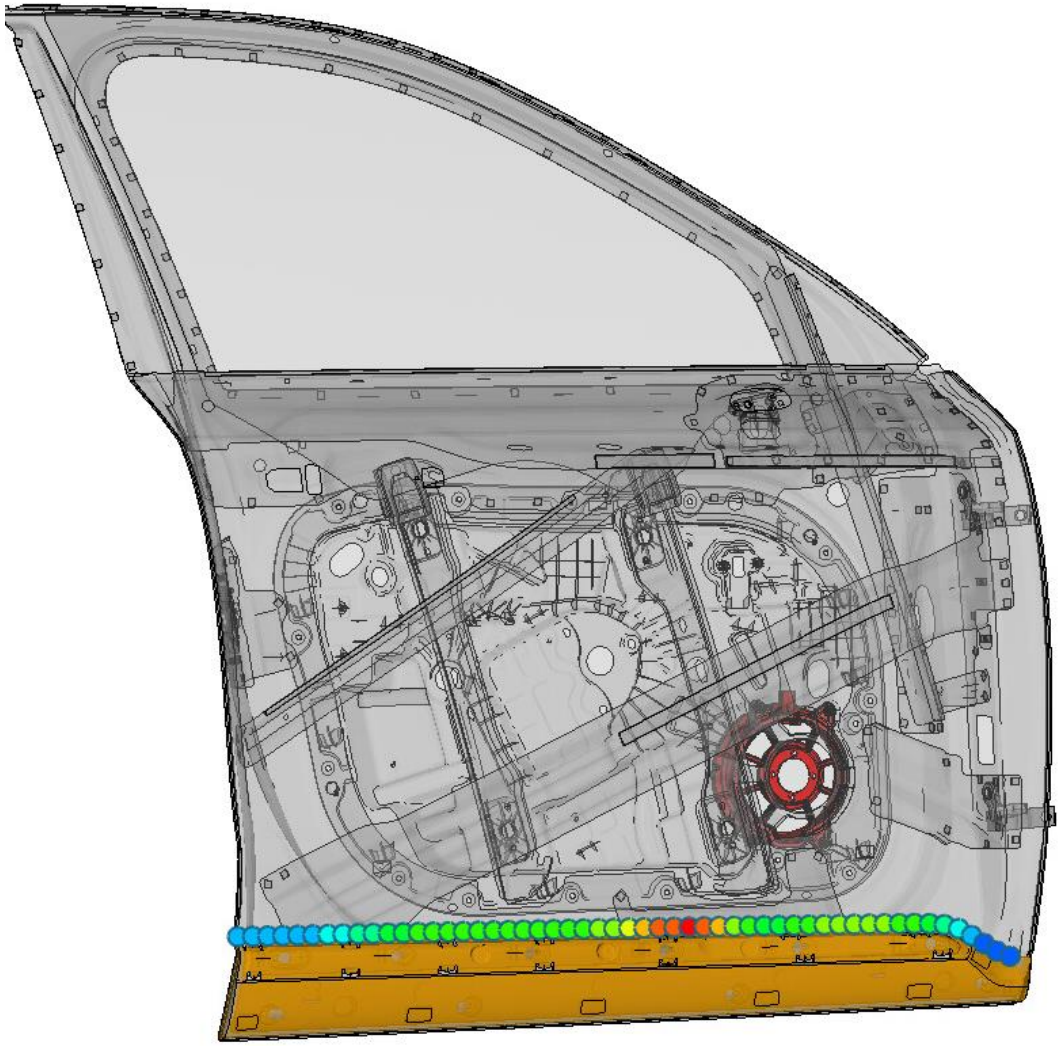
Stick-slip test



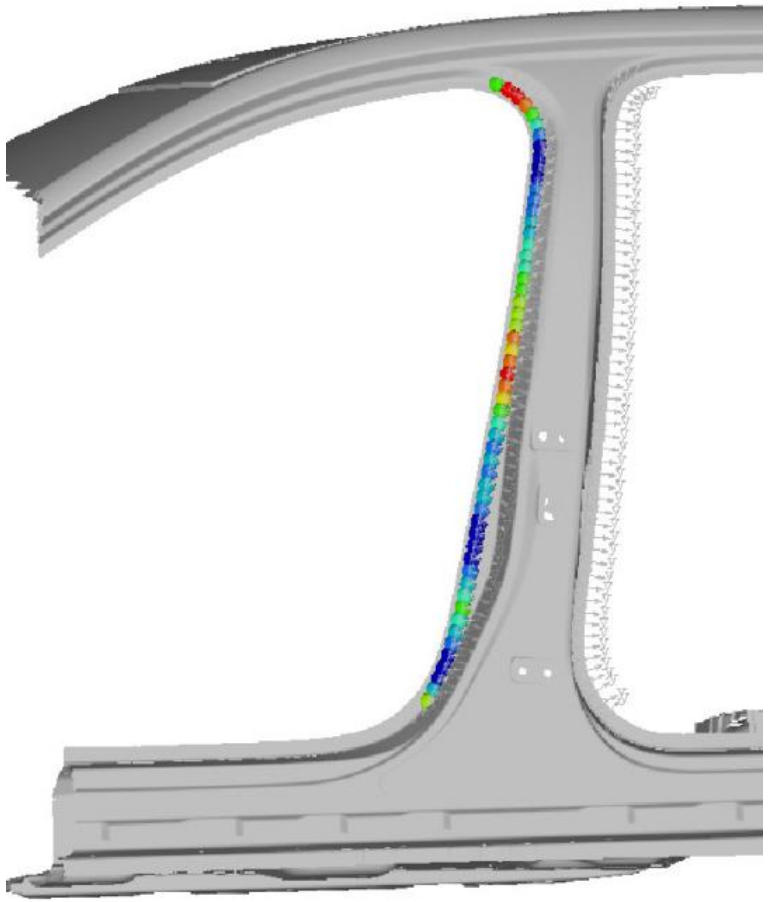
Areas of S&R risk (interior)



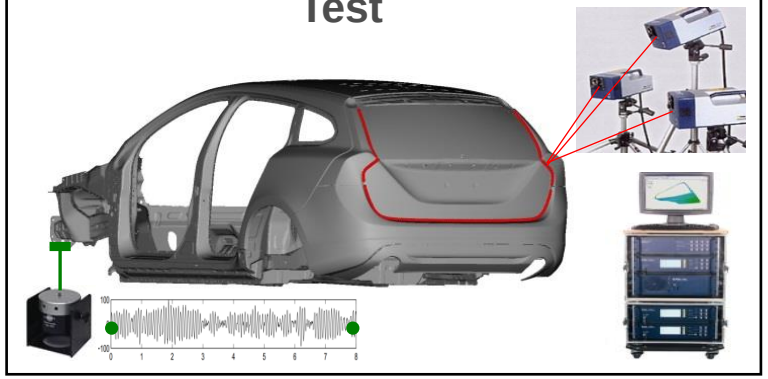
Areas of S&R risk (exterior)



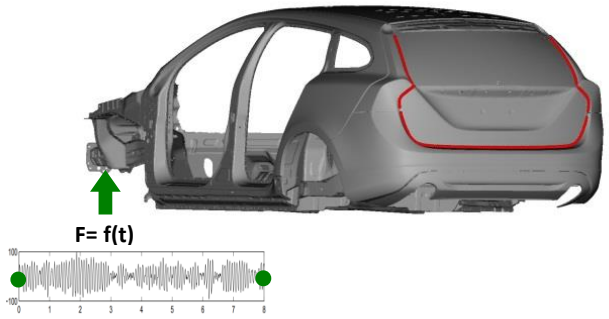
Areas of S&R risk (body)



Test



Simulation



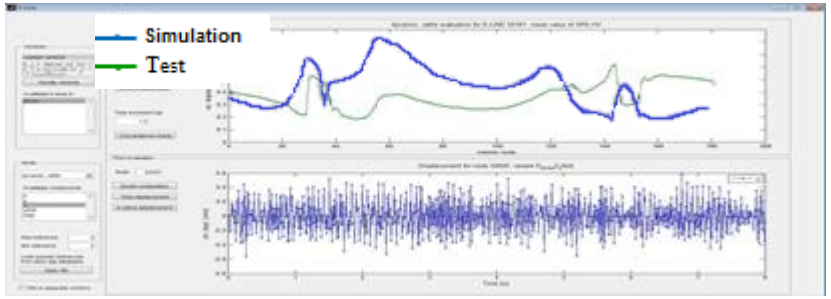
Displacement in global CS along E-LINE

Displacement in LCS along E-LINE

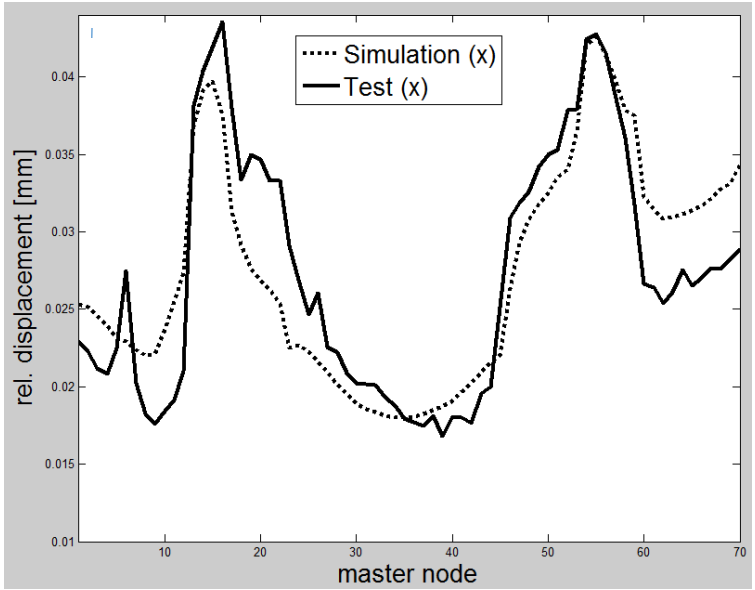
Filtering

- CS transformation from Global to Local
- Converting to punch format

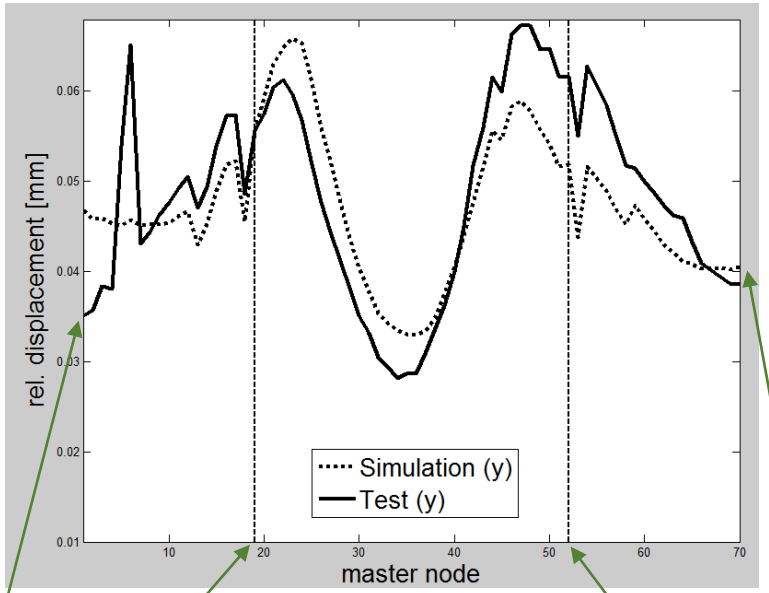
E-LINE evaluation



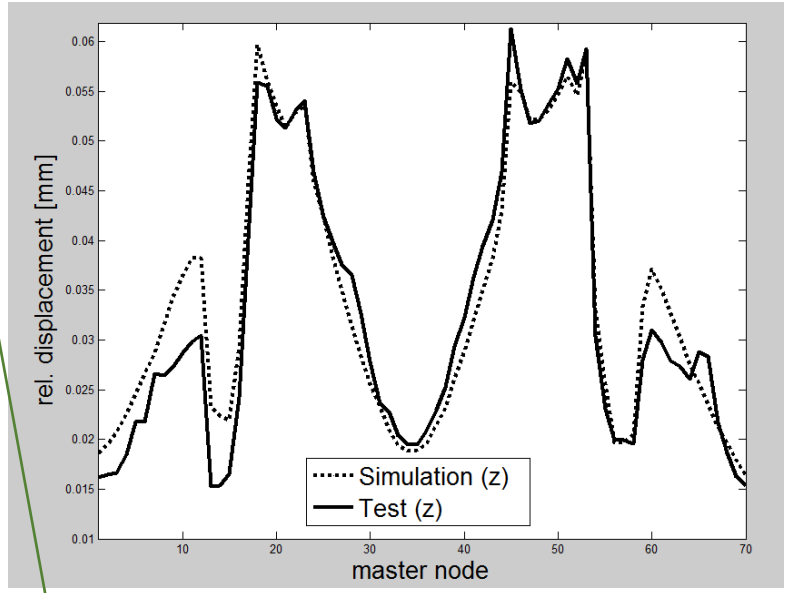
x - along the gap

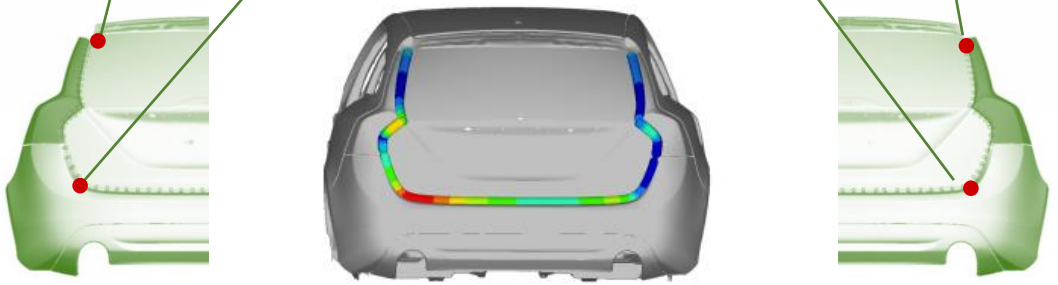


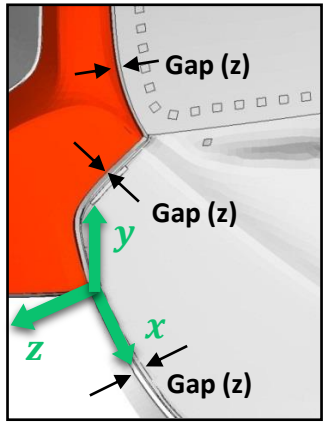
y - “flush”



z - gap direction







Volvo Design Process

- Occupant Comfort
- Squeak and Rattle noises
- Laboratory tests

- Simulations
- E-Line Method

- Numerus combination of components to simulate – plethora of loadcases
- Robust and automated CAE tools

Squeak & Rattle

CAD

CAE

ANSA

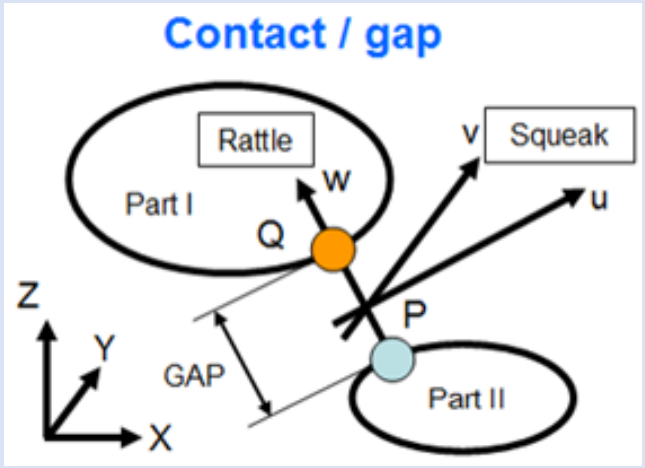
LS-DYNA

µETA

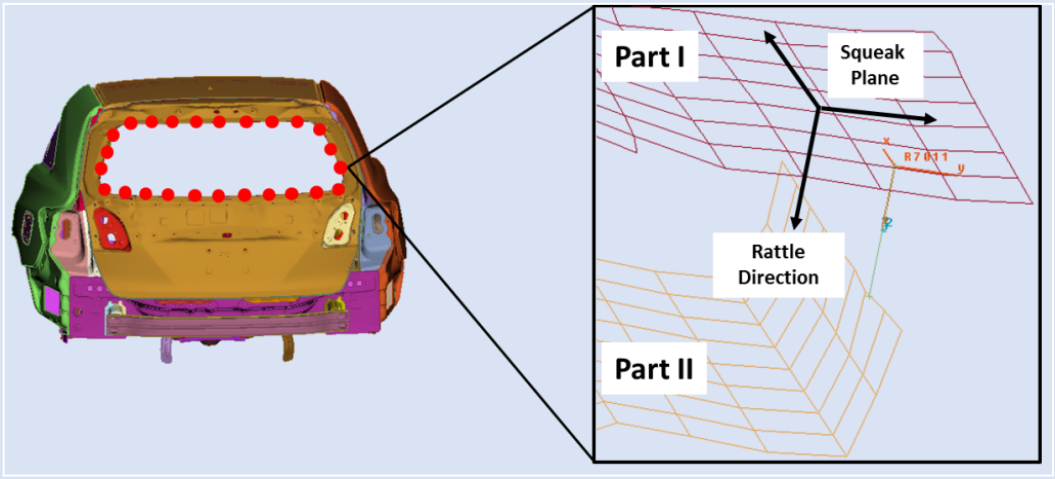
- Handle of CAD data
- Use of E-LINE method
- Complete solution in simulation of S&R

Relative Displacement

Theory

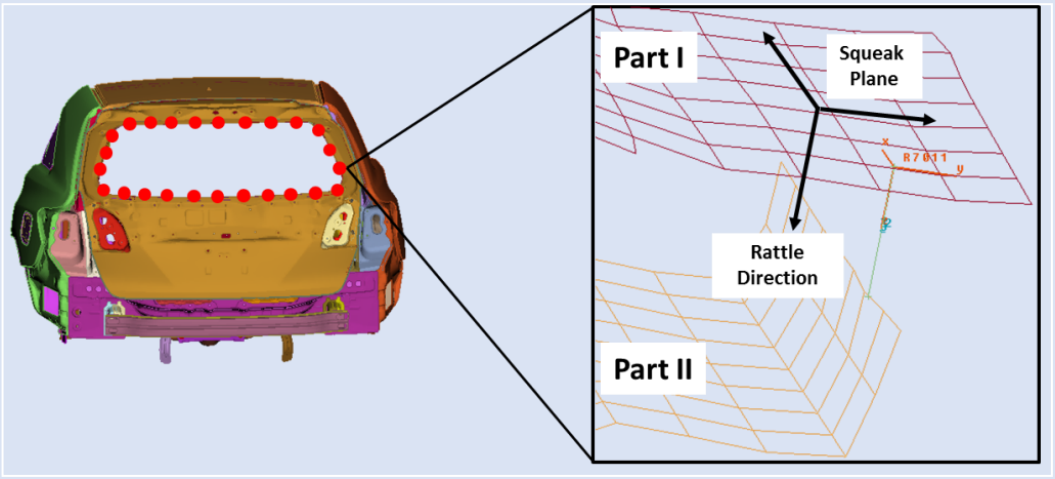


ANSA



Relative Displacement

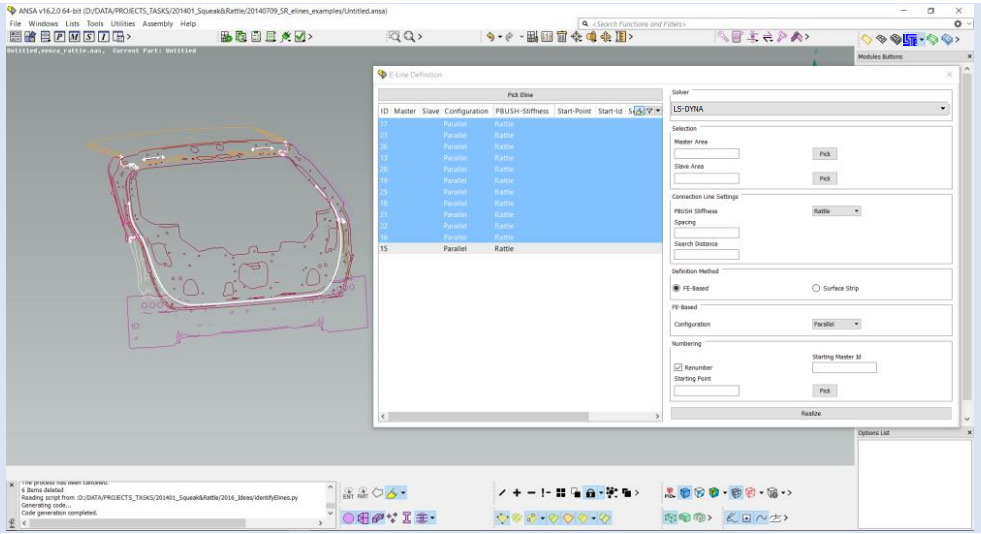
ANSA



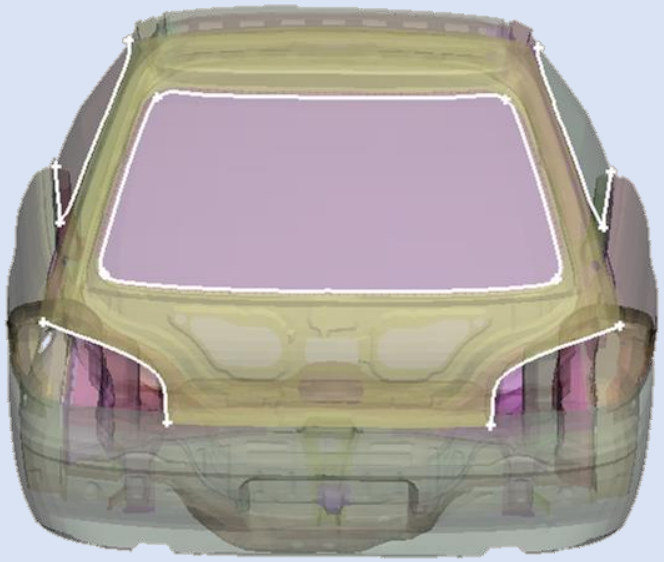
- E-Line – Curve along which the relative displacement will be measured
- Creation of the corresponding LS-DYNA keywords

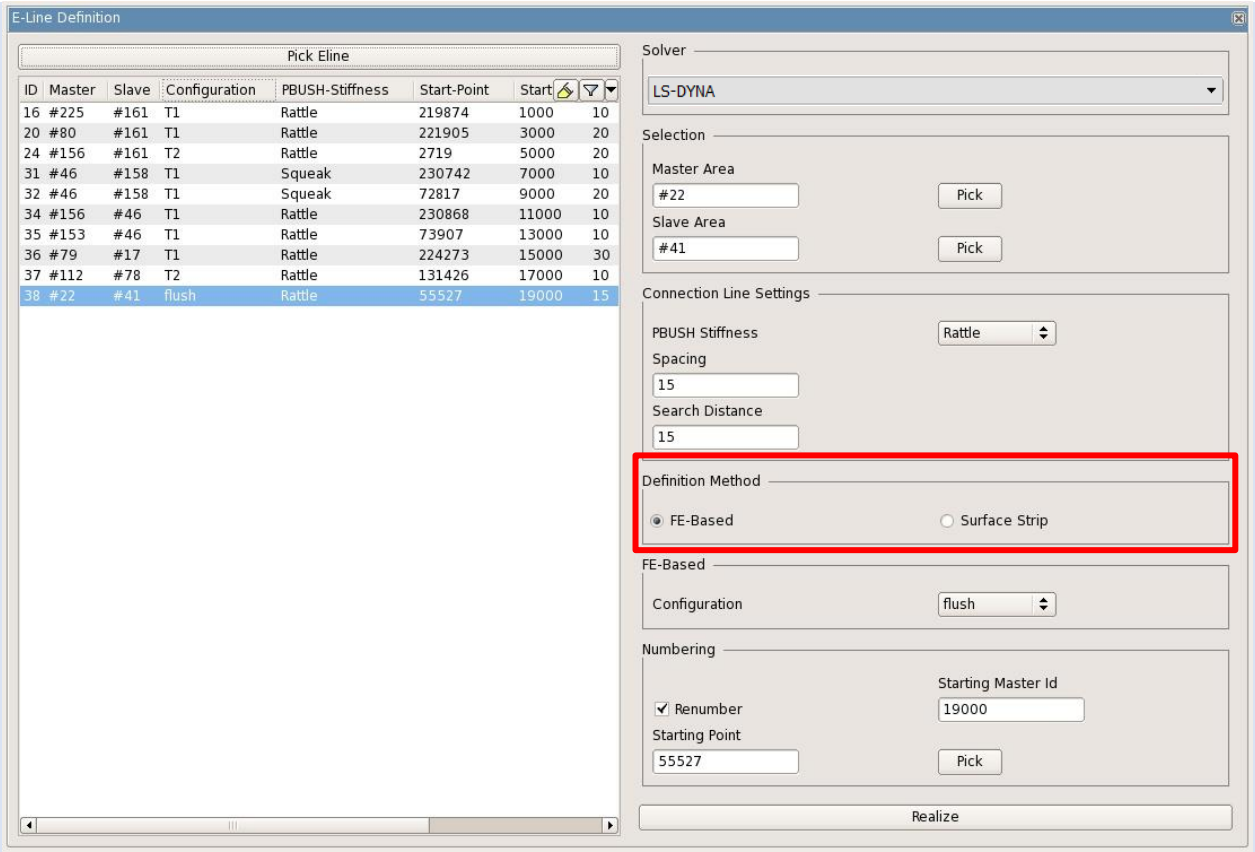
Automatic Identification/Creation

- Identify all crucial areas in the whole model – Contact based
- Creation of all E-LINE entities



Definition Method



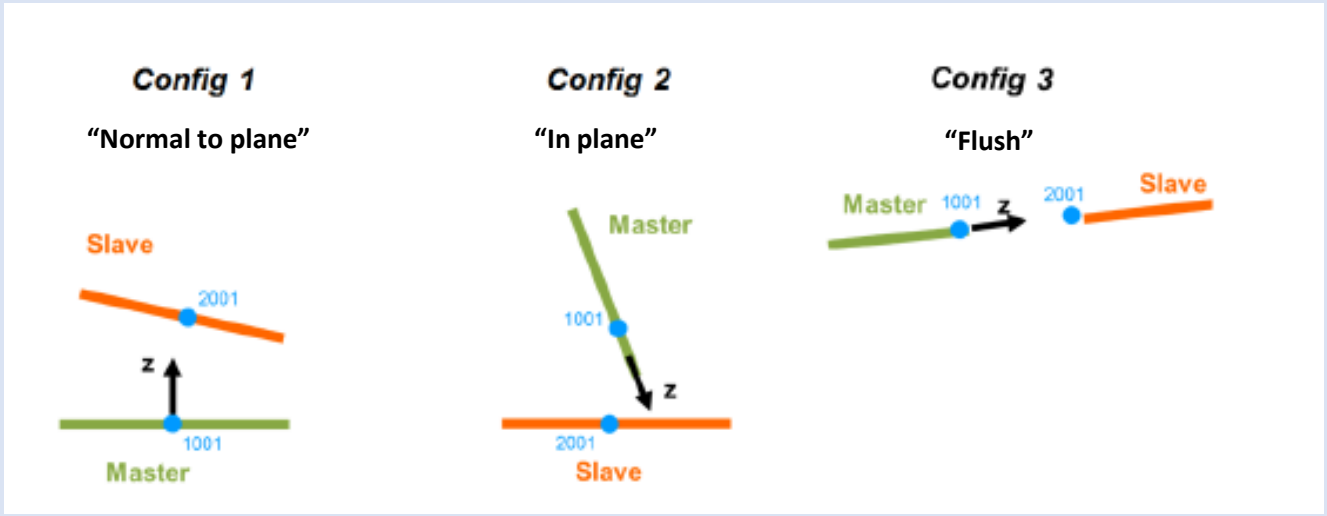


- Orientation of the Components – FE Based
- Shortest Distance – Surface Stripe

FE - Based

Configurations

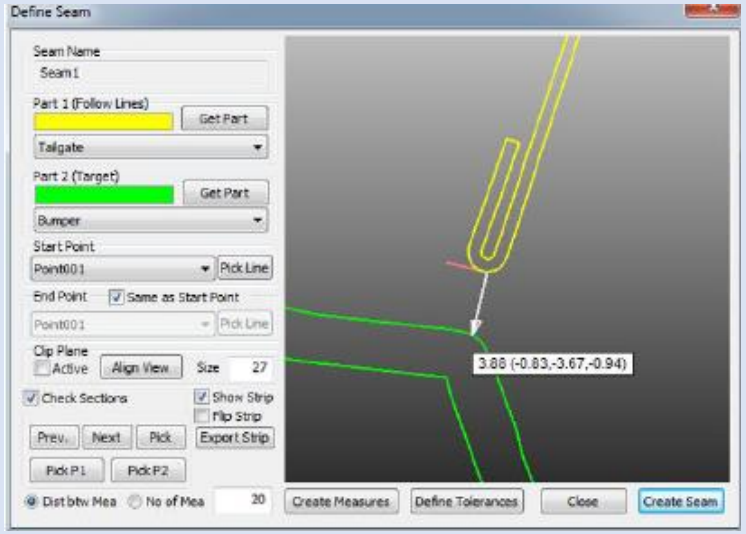
- Normal to plane
- In plane
- Flush

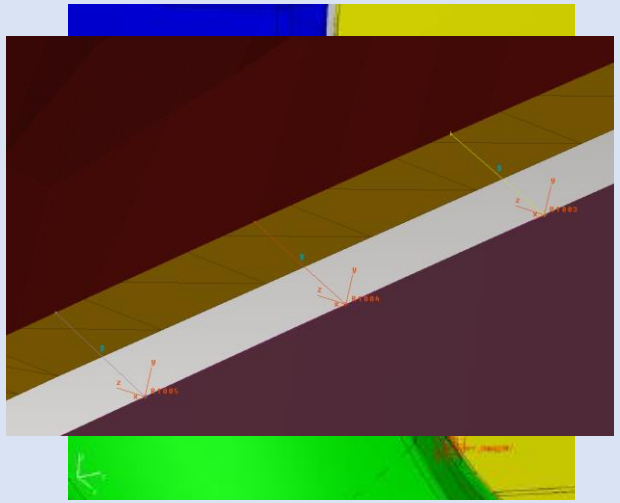


Shortest Distance

Surface Stripe

- RD&T – ANSA
- In line with shortest distance

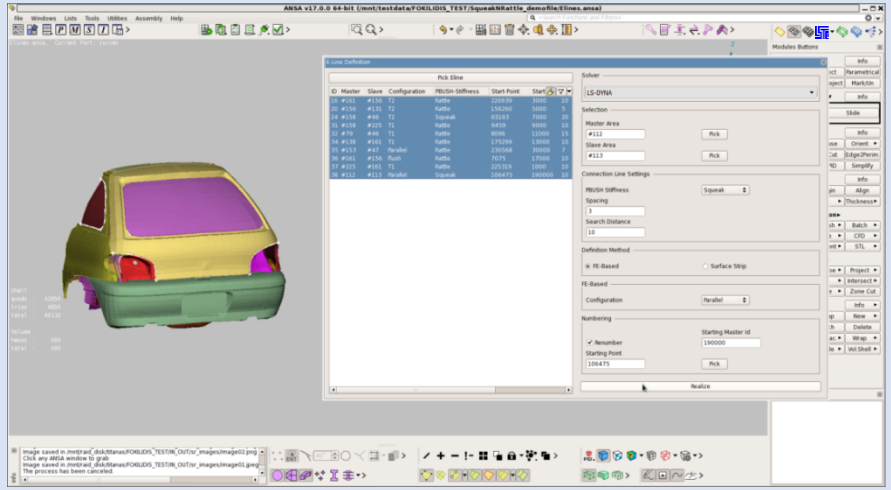




LS-DYNA Loadcase Set Up

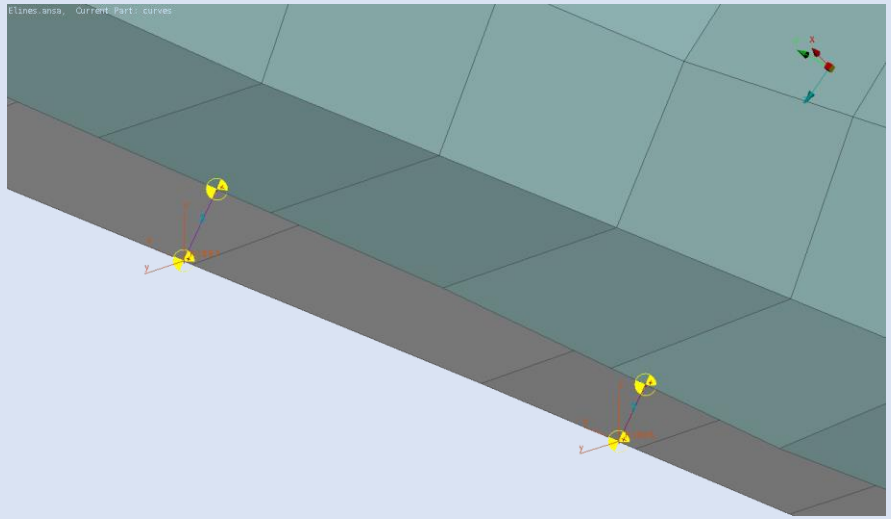
E-LINE Manager

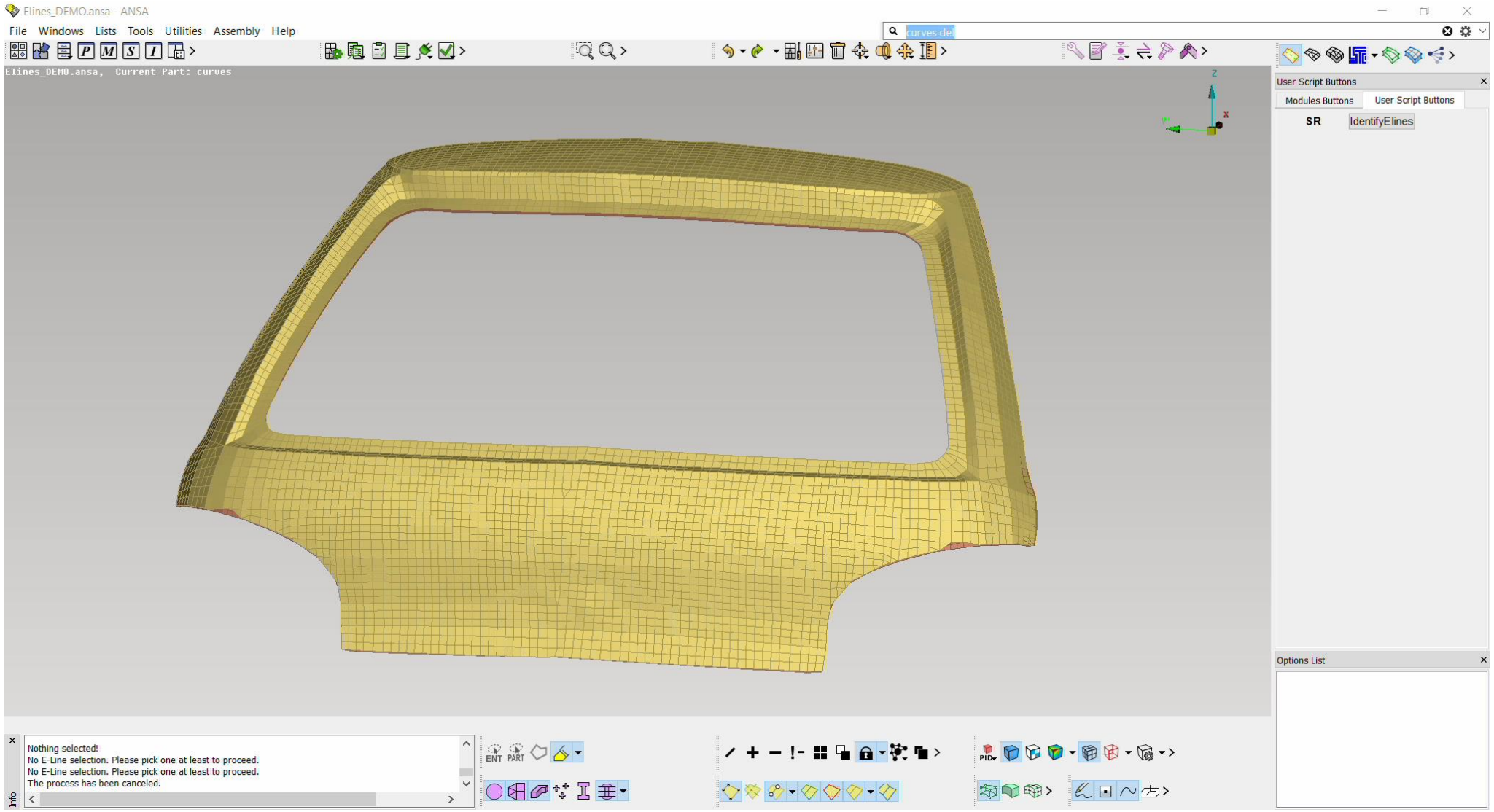
- Easy LS-DYNA set up
- Bulk realization



LS-DYNA keywords

- TIED_NODES_TO_SURFACE
- *ELEMENT_BEAM_ELFORM_6
- *DEFINE_COORDINATE_DIR_Z
- *DATABASE_HISTORY_NODE

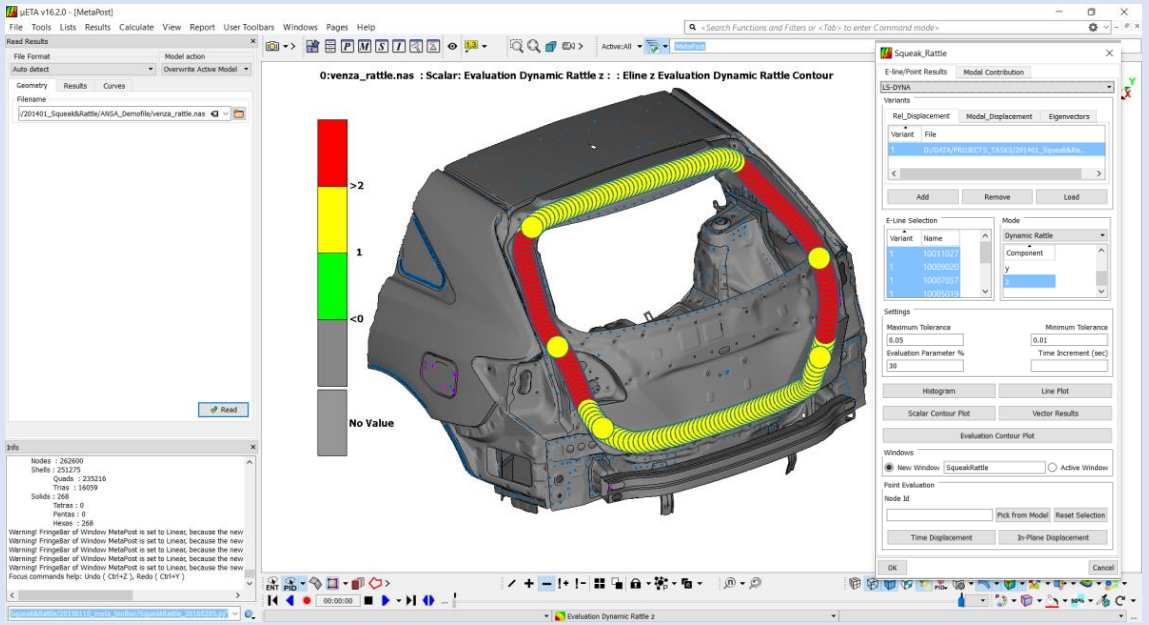



Elines_DEMO.ansa - ANSA
File Windows Lists Tools Utilities Assembly Help
curves del
Elines_DEMO.ansa, Current Part: curves
User Script Buttons
Modules Buttons
User Script Buttons
SR
IdentifyElines
Options List
Nothing selected!
No E-Line selection. Please pick one at least to proceed.
No E-Line selection. Please pick one at least to proceed.
The process has been canceled.
Info

Results Evaluation in µETA

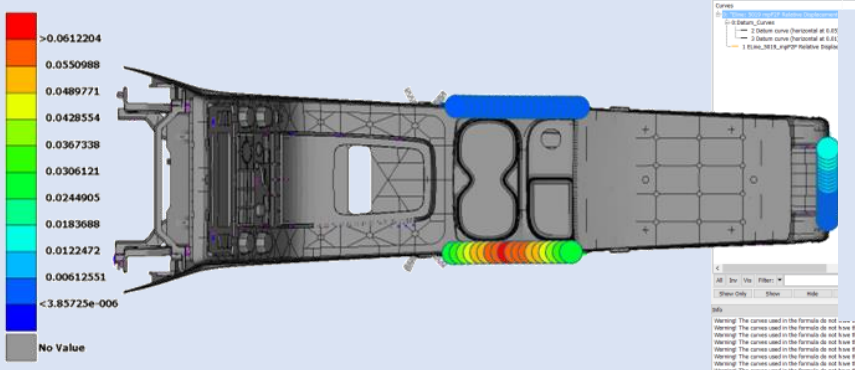
µETA

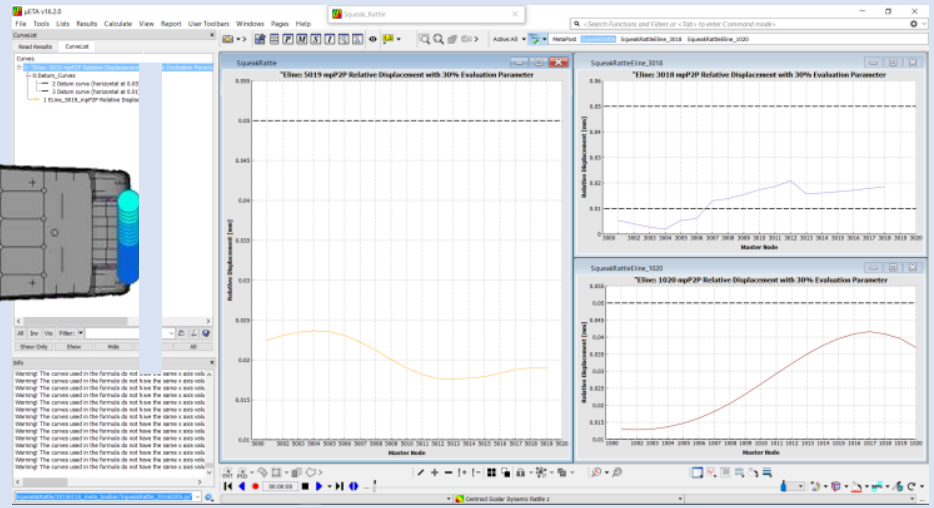
- LS-DYNA nodout file
- Massive evaluation of results
- Automatic Report creation
- Contour/2D plots for the evaluation of the phenomena



Evaluation Dynamic Rattle z

Eline Id	Nodes Ids	Evaluation
10011027	10011000-10011027	
10007057	10007000-10007057	
10005019	10005000-10005019	
10003027	10003000-10003027	
10001048	10001000-10001048	
10009020	10009000-10009020	





Thank you!

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