

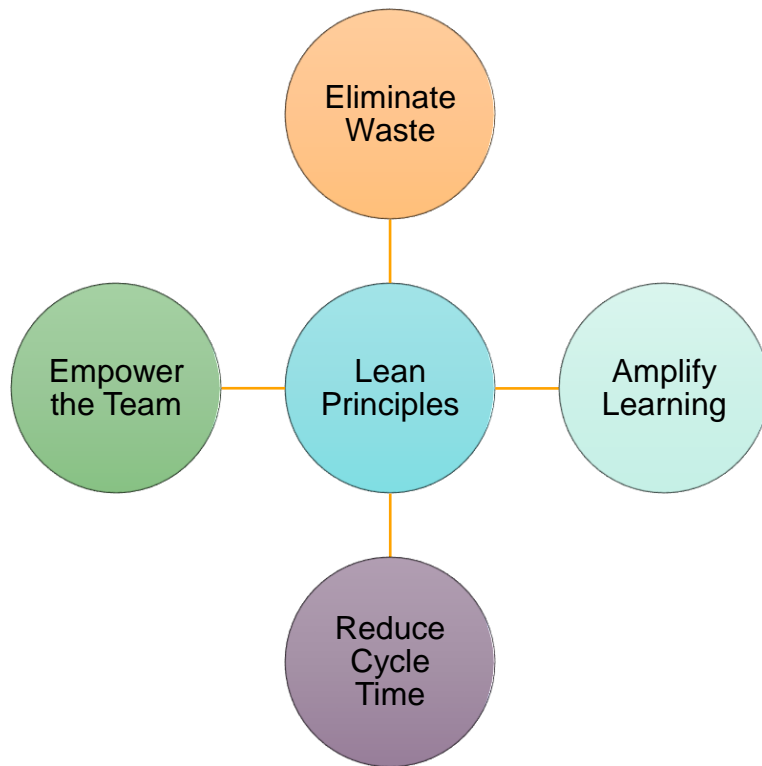
Altair SimSolid 无网格结构仿真分析

精益原则

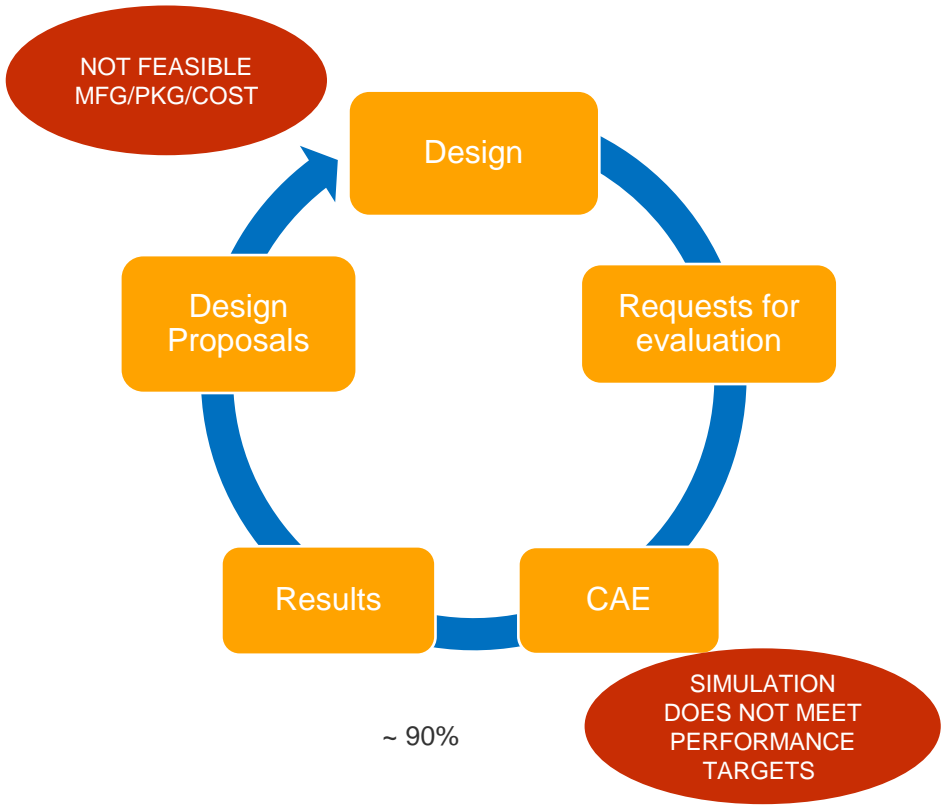
- 消除浪费
- 缩短周期

过程

- 识别挑战/问题
- 规划当前状态并了解一次性通过率
 - 什么是“**turn-back**”
- 设计未来状态流程
 - 输入
 - 储备
 - 输出



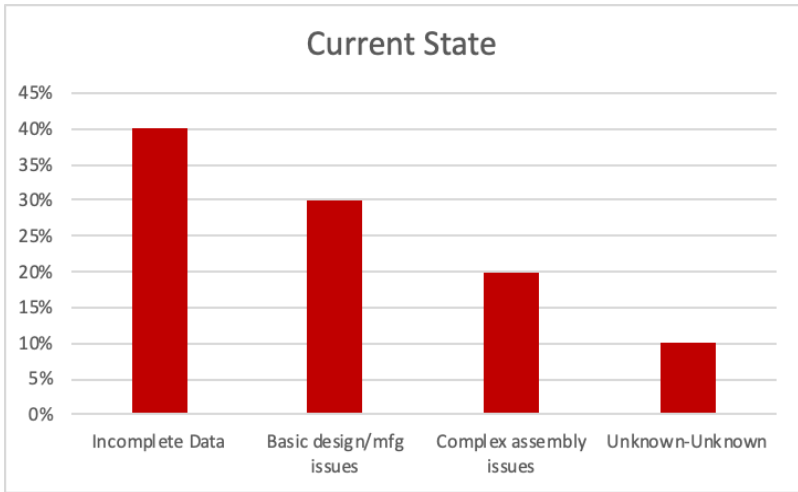
传统的虚拟开发流程



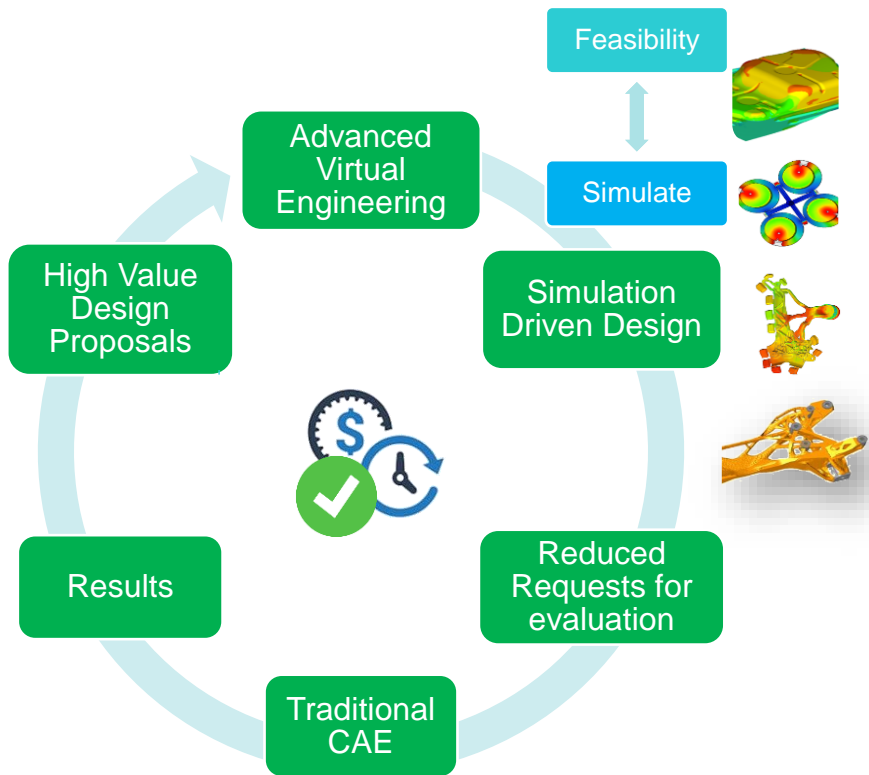
虚拟验证过程

- 10% “First-pass”
- 90% “turn-backs”

Notional Data



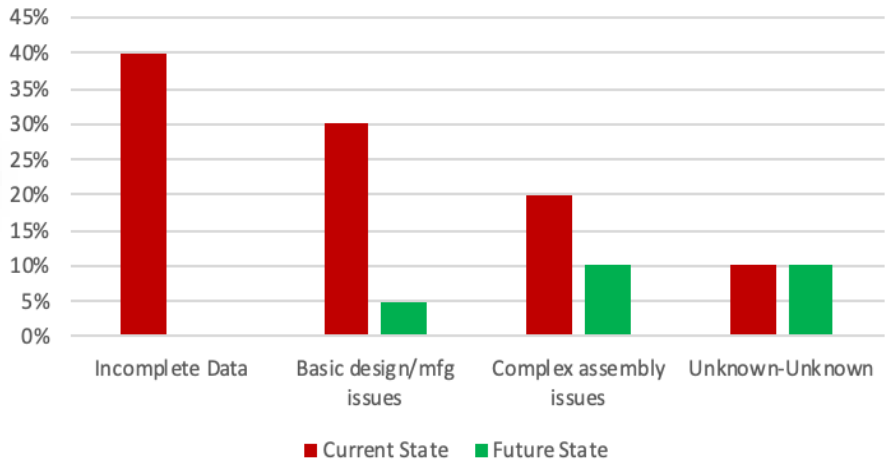
更先进的虚拟开发流程(Lucid)



虚拟验证过程

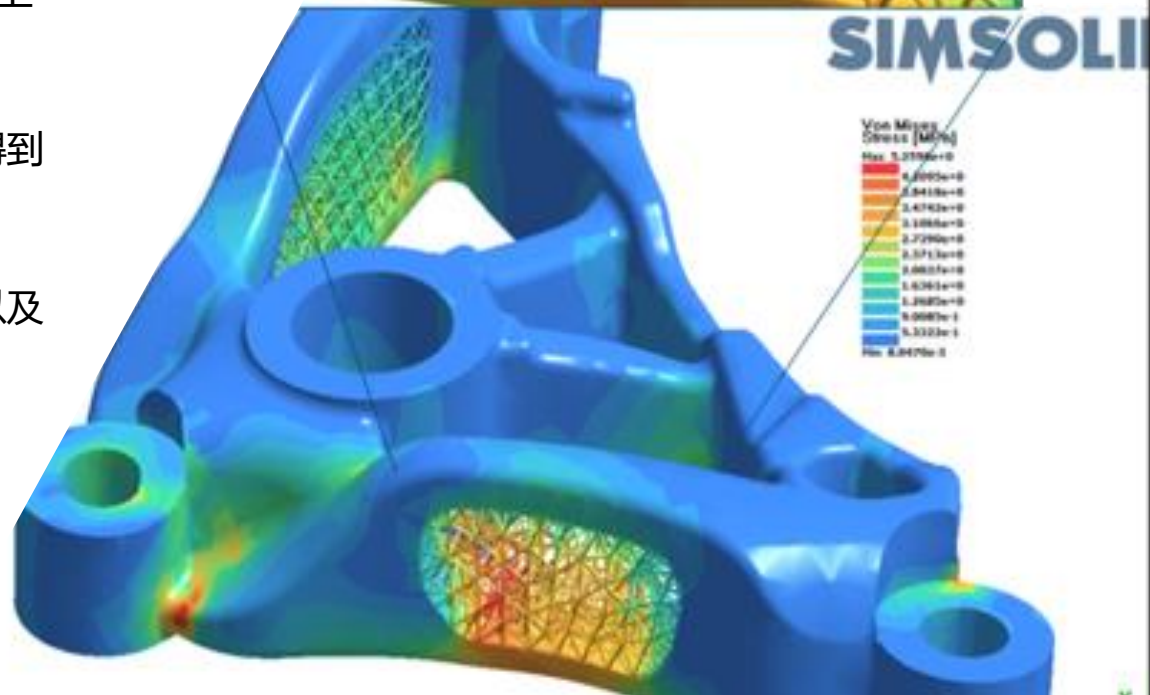
- 20% to 25% “First-pass”
- 75% to 80% “turn-backs”

Projected Improvement

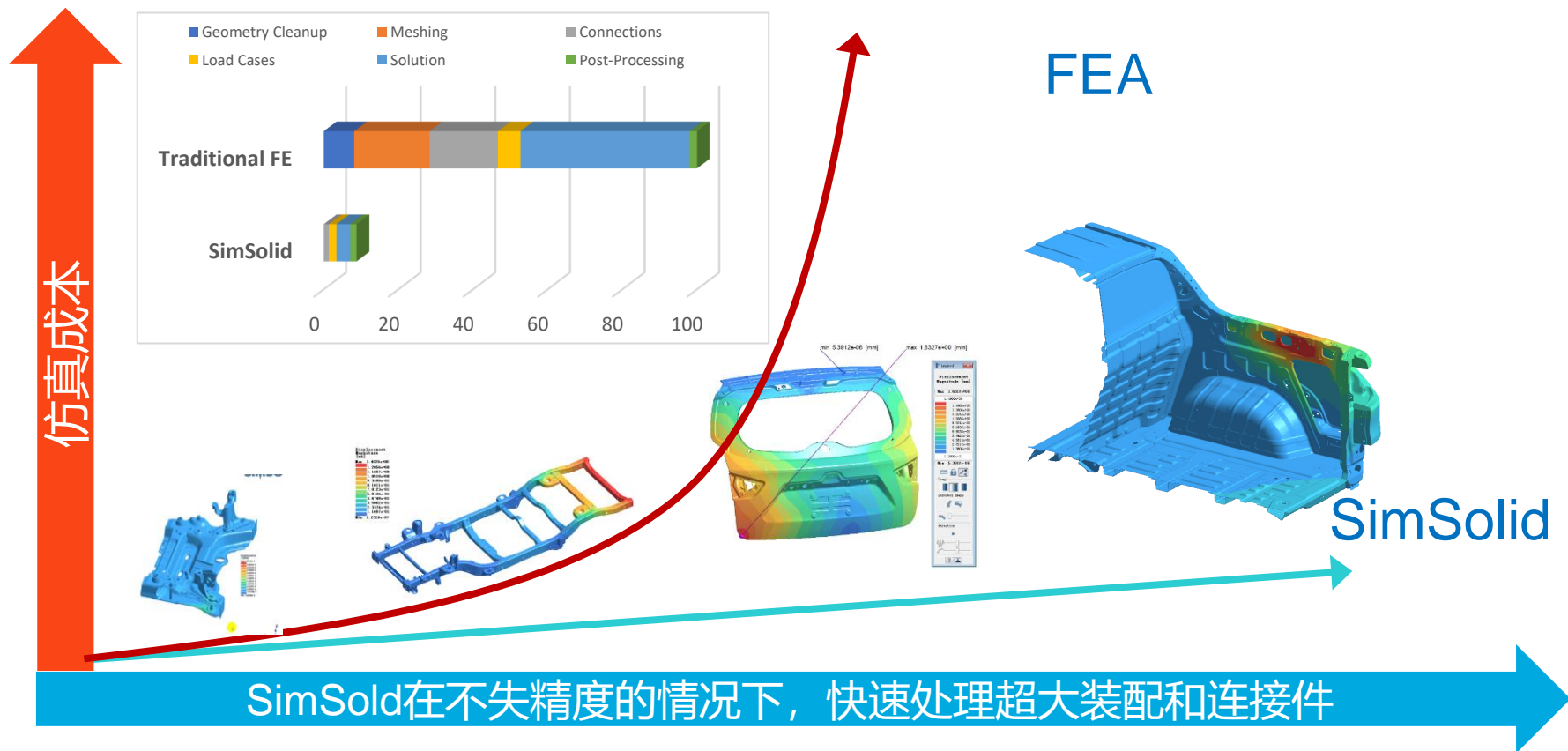


SimSolid – 真正革命性的仿真

- ❑ SimSolid 是一款结构仿真软件，可直接在原始的、未简化的 CAD 装配体上运行，无需创建网格。
- ❑ SimSolid可以在几秒或者几分钟内得到分析结果。
- ❑ SimSolid可以在桌面计算机、云端以及 HPC上运行。

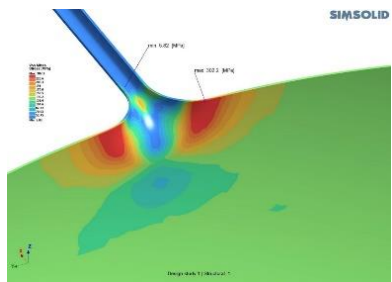


有限元技术的革新—SimSolid无网格分析方法



SimSolid的分析功能

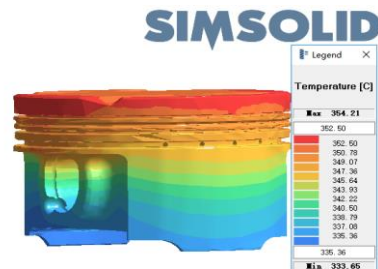
静强度分析



模态分析



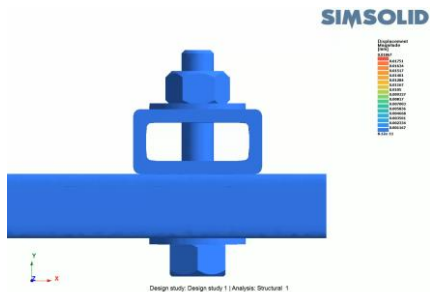
稳态/瞬态热分析



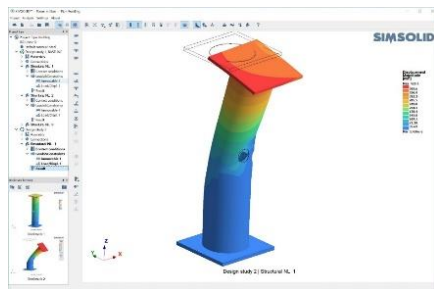
瞬态/频响/随机振动分析



螺栓预紧序列工况



大变形/接触/弹塑性



热固耦合分析

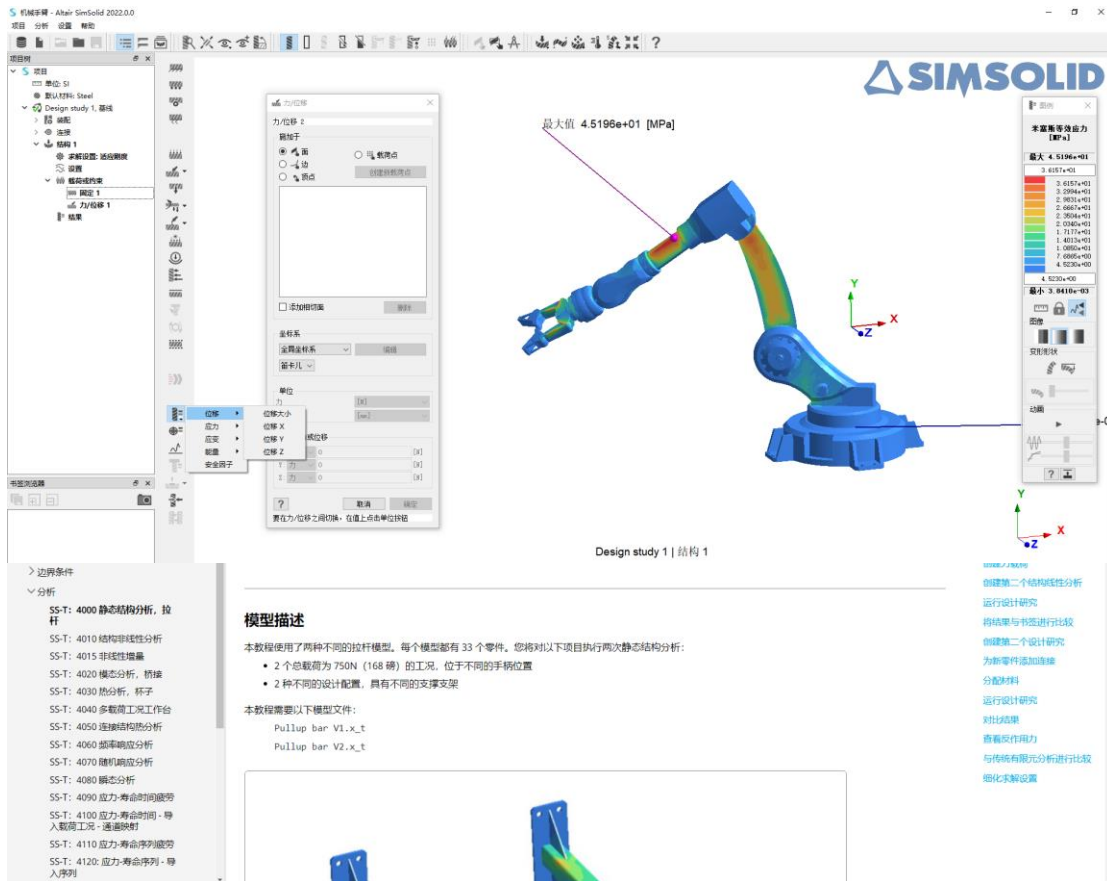
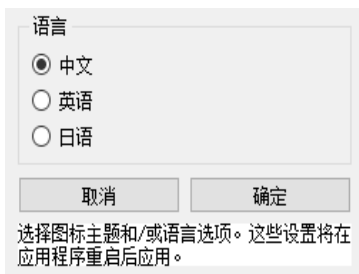


疲劳分析



支持中文

- 中文界面
- 中文帮助文档
- 文件中文命名



SimSolid特色功能介绍

可拓展的材料数据库

编辑材料数据库

材料数据库文件名称
C:/Users/kaili/AppData/Roaming/Simsolid/SIMSOLID-Material-DB.xml

材料筛选器 按名称筛选 添加 重置

材料
 (A) Generic Materials
 (A) 钢材

材料数据库设置

SI 单位 IPS 单位

应力 mega_pascal [MPa]
 密度 [tonnes/mm³]
 热膨胀 [1/(degree C)]
 热导率 [W/(mK)]

修改材料数据库设置 取消 确定

材料名称
钢材

单位制 国际单位制 材料类型 各向同性

属性 值 单位

机械属性

- 弹性模量 2.100000000e+05 [MPa]
- 泊松比 3.000000000e-01 [dimensionless]
- 密度 7.850000000e-09 [tonnes/mm³]
- 极限拉伸应力 3.800000000e+02 [MPa]
- 拉伸屈服应力 2.070000000e+02 [MPa]
- 压缩屈服应力 2.070000000e+02 [MPa]
- 默认失效准则 米塞斯等效应力
- 热膨胀系数 1.200000000e-05 [1/(degree C)]

疲劳属性

- 应力-寿命 (SN) 曲线
- 曲线的定义方法 根据极限抗拉强度估算
- 应力定义 拆断
- 疲劳强度系数 (SR1) 8.497000000e+02 [MPa]
- 第一疲劳强度指数 (b1) -1.500000000e-01 [dimensionless]
- 循环持久极限/转变点 (NC1) 1.400000000e+06 [dimensionless]
- 标准 S-N Strain-life curve

热属性

Strain amplitude
Reversals

Plastic strain
Elastic strain
Total strain

通过右击材料项编辑材料属性

Altair Material Data Center

Search Materials
Clear all filters

Filters
 Type
 Search Types
 Metal (542)
 Plastic (23478)
 Connection (7)
 Search Producers
 Allanyx (24)
 almaak (157)
 Altuglas (1)
 APK (4)
 APM (4)
 ARKEMA (273)
 Provider
 M-Base (22423)
 MatDat (550)
 Sabic (55)
 Software
 Search Softwares
 SimSolid (23028)

Showing results for SimSolid X

Name	Density(Mg/mm3)	Young's Modulus(MPa)	Yield Strength
10 CrMo 9 10	7.85e-9	1.63e+5	3.32e+2
Ck 25	7.85e-9	2.10e+5	3.07e+2
MM 247	7.20e-9	1.65e+5	5.69e+2
Al-Mg-Si	2.70e-9	7.30e+4	3.1e+2
42 CrMo 4	7.85e-9	1.91e+5	8.75e+2
Ck 100	7.85e-9	2.10e+5	2.93e+2
St 46	7.85e-9	1.70e+5	1.62e+2
13 CrMo 4.4	7.85e-9	2.13e+5	3.1e+2
Al Mg 4.5 Mn	2.70e-9	8.50e+4	2.26e+2
16 CrMo 54	7.85e-9	1.72e+5	1.91e+2
42CrMo4	7.85e-9	2.09e+5	8.4e+2
15 Mo 3	7.85e-9	2.11e+5	3.5e+2

10 CrMo 9 10
 Info Properties Plots CAE Model
 Select Software
 SimSolid
 Select Model
 Model
 Select Unit
 N mm s Mg(t)
 Material Id
 1000
 Download

SimSolid全球典型客户



NISSAN MOTOR CORPORATION



VE COMMERCIAL VEHICLES
A VOLVO GROUP AND EICHER MOTORS JOINT VENTURE



用户评价

用户评价

4 天
到 20 分钟



25x 到 100x
速度提升



RENAULT

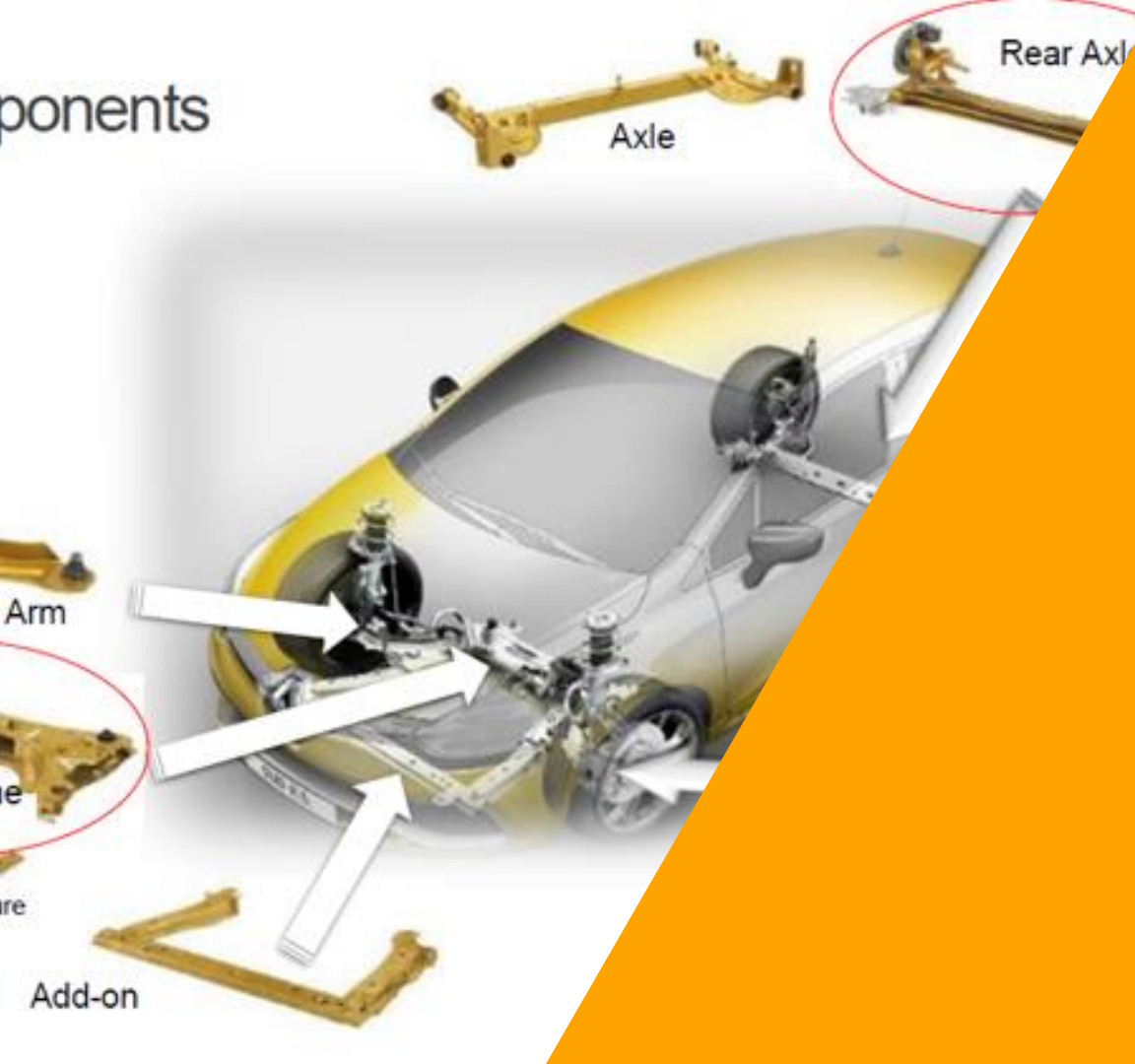
2 天
到 30 分钟



所有的用户评价:

<https://web.altair.com/simsolid-media-testimonials>

ponents



© Altair Engineering, Inc. Proprietary and Confidential. All rights reserved.

SIMSOLID车辆行业的应用

SIMSOLID在车身系统上的应用



Comparison Virtual vs Real

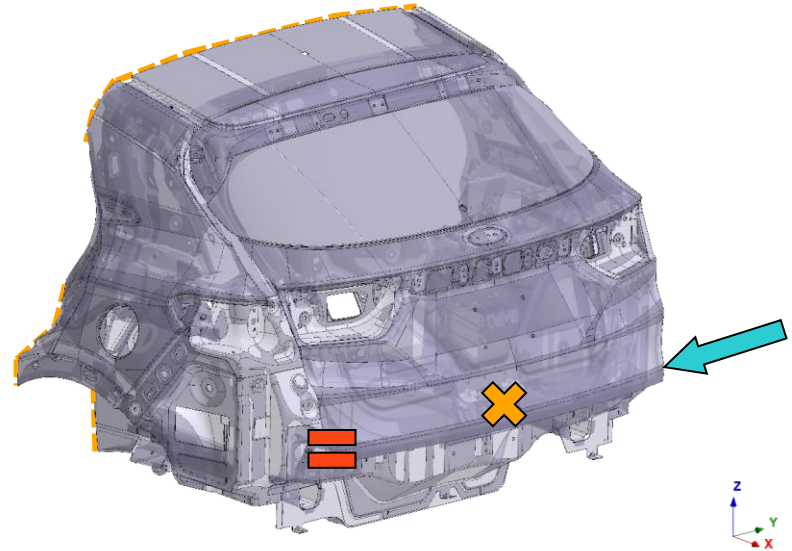
Nonlinear analysis of geometry and material

- SUV liftgate.
- Stiffness analysis.
- Assembly with 152 components.



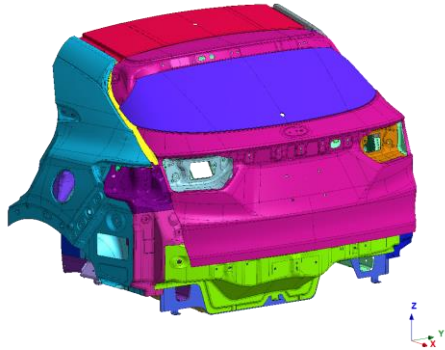
Liftgate Stiffness Analysis

- **Goal**
 - Evaluating the liftgate residence of a lateral load.
- **Boundary Conditions**
 - Restriction DOFs 1, 2 and 3 on the cut planes.
 - Restriction DOF 1 on latch.
 - Load applied on the button end of the liftgate.



Preprocessing

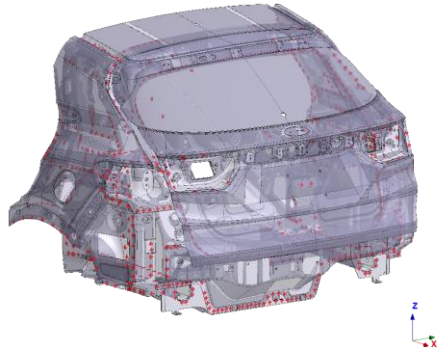
 SIMSOLID



Material

- 18 diferente materials
- Non linear materials

 SIMSOLID



Weld Points

- 943 points

 SIMSOLID

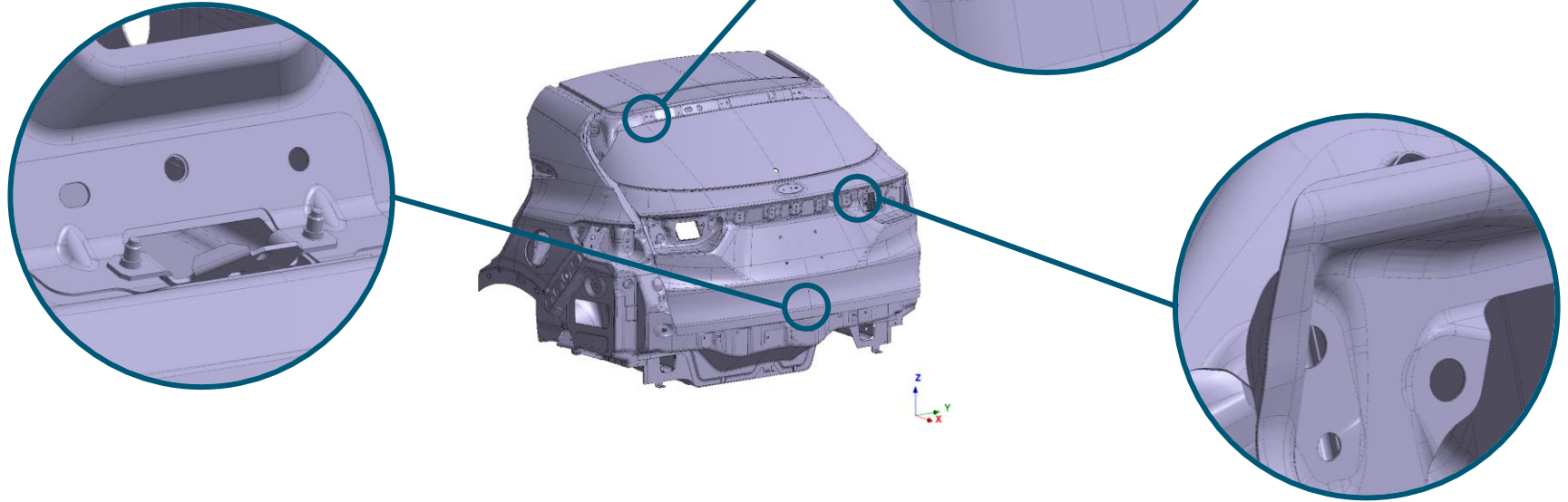


Adhesives

- 7 adhesives

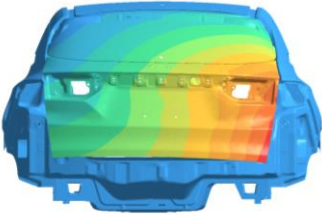
SimSolid preprocessing time – 3 hours
FEA preprocessing time - 80 hours

Complex Geometry



Results

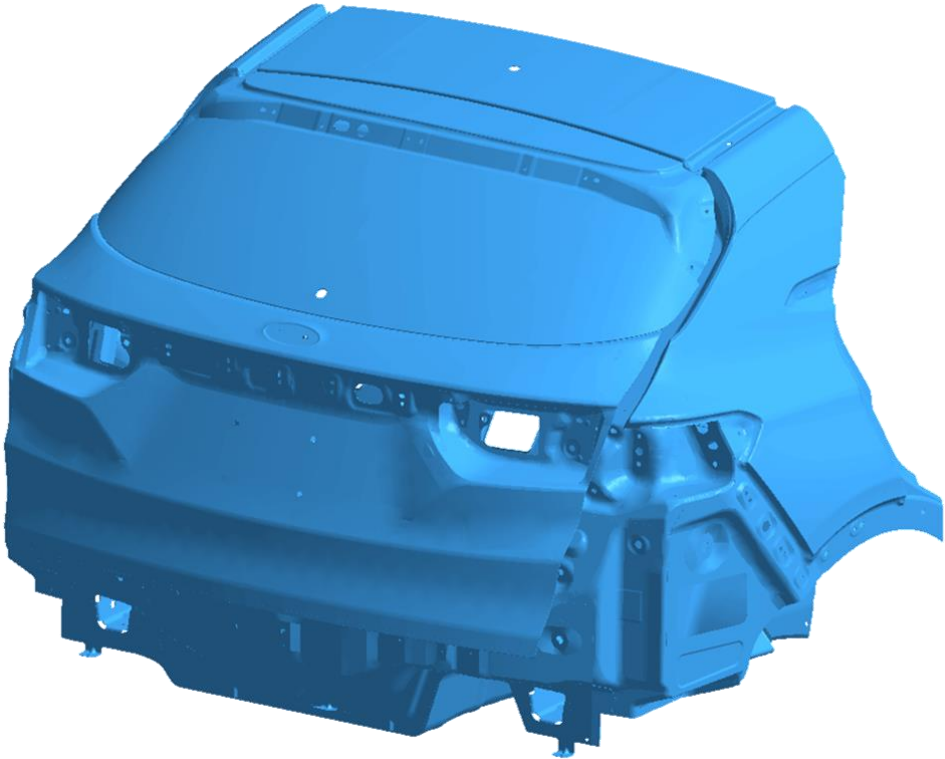
Displacement	
FEA [mm]	1.5
SimSolid [mm]	1.4



SimSolid



FEA





Este estudo com o SimSolid foi 8x mais rápido frente ao método clássico de elementos finitos, o que é um excelente tradeoff à ser aplicado nas fases de conceitualização do produto, onde as mudanças de design são dinâmicas e constantes.

Egidio Veronese Junior, Ford, Virtual Development Leader

Ricardo Albuquerque, Ford, Virtual Development Leader



STELLANTIS



Comparison Virtual vs Real

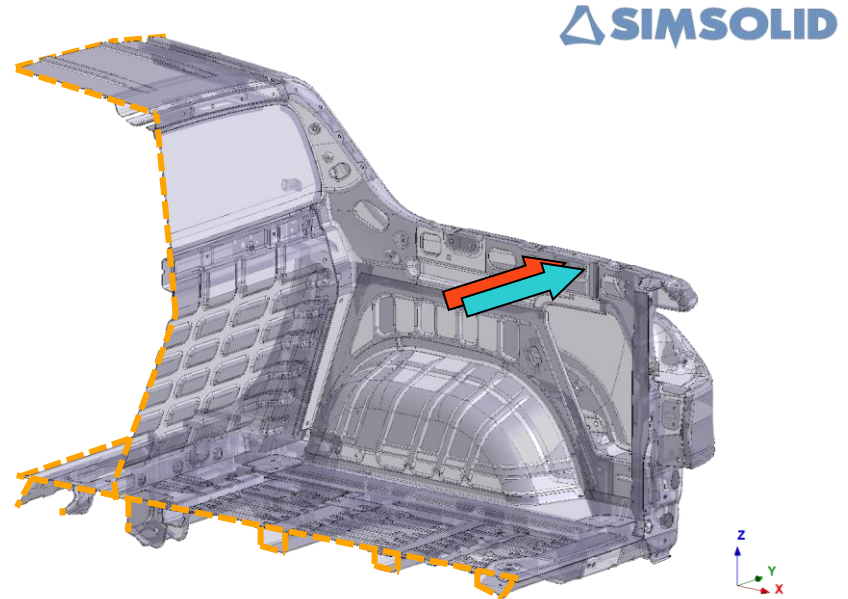
Linear static analysis

- Stiffness analysis on the anchorage points.
- Assembly with 262 components.



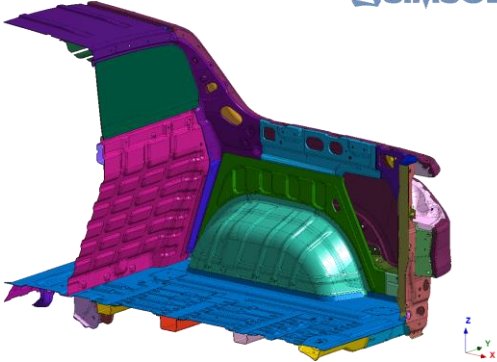
Stiffness on the Anchorage Points

- **Goal**
 - Defining the stiffness on the retention load regions.
 - $F = kx$
- **Boundary Conditions**
 - Restriction DOFs 1 and 2 on the cut planes.
 - Force applied on the Anchorage points.



Preprocessing

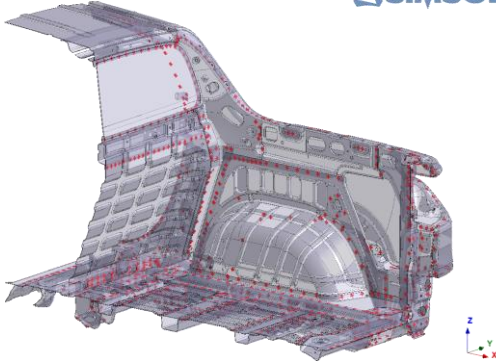
 SIMSOLID



Material

- $E = 205000 \text{ MPa}$
- $\nu = 0.3$

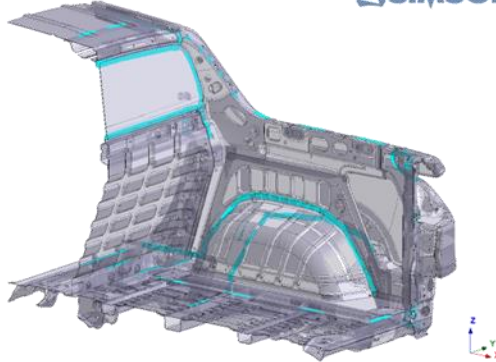
 SIMSOLID



Weld Points

- 1185 points

 SIMSOLID



Adhesives

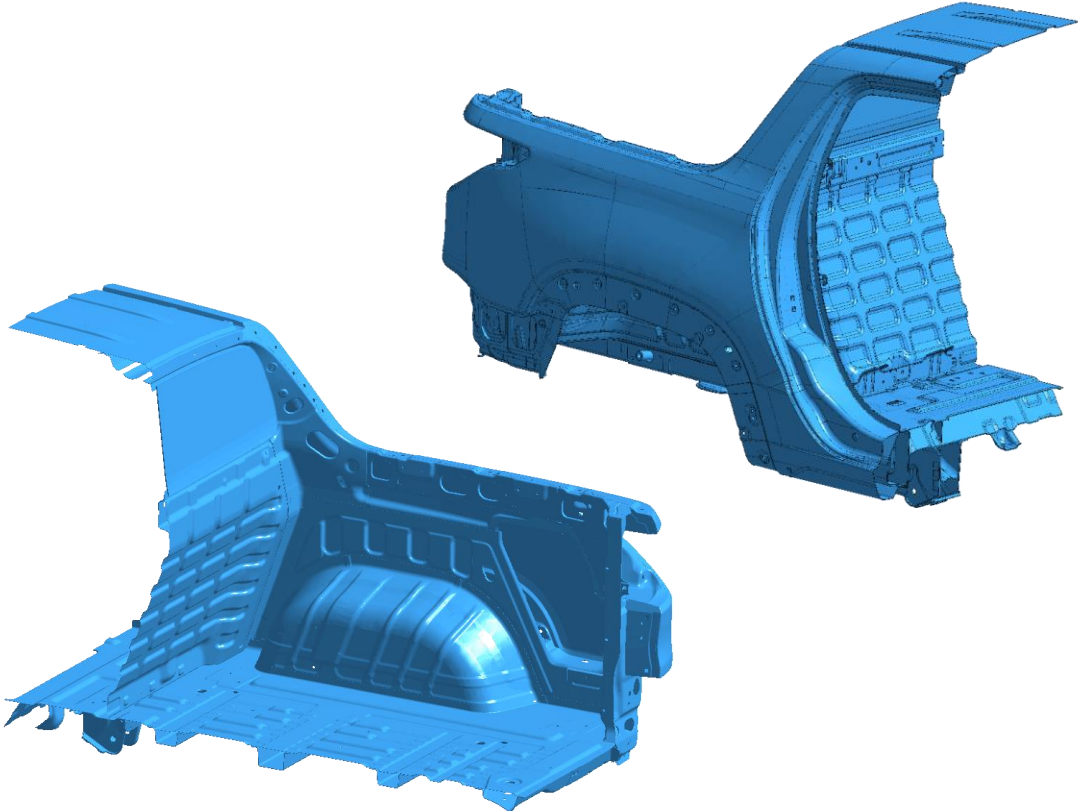
- 63 adhesives

SimSolid preprocessing time - 45 minutes
FEA preprocessing time - 56 hours

Results

Stiffness	01	02
Experimental [N/mm]	375.5	379.8
FEA [N/mm]	351.3	363.2
SimSolid [N/mm]	393.7	387.1

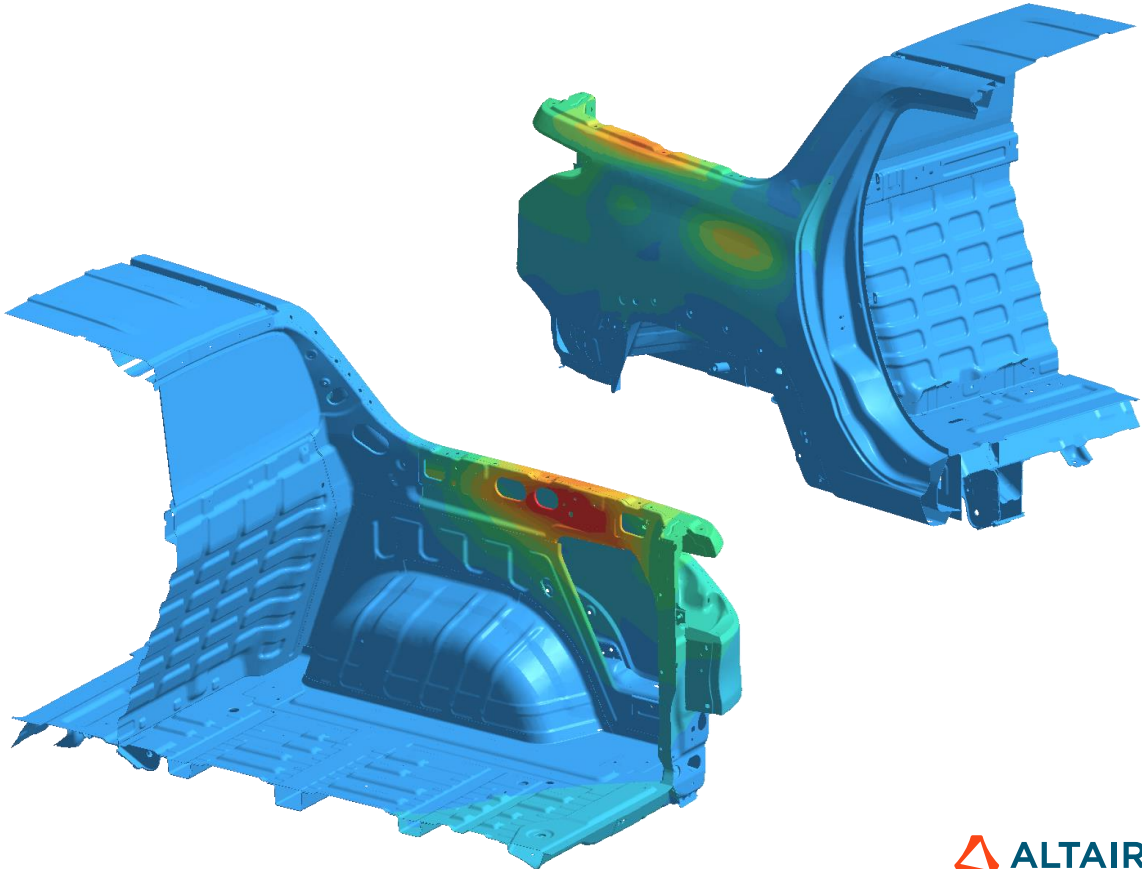
Error %	01	02
FEA	-6.4	-4.4
SimSolid	+4.8	+1.9



Results

Stiffness	01	02
Experimental [N/mm]	375.5	379.8
FEA [N/mm]	351.3	363.2
SimSolid [N/mm]	393.7	387.1

Error %	01	02
FEA	-6.4	-4.4
SimSolid	+4.8	+1.9



Comparison Virtual vs Real

Dynamic analysis

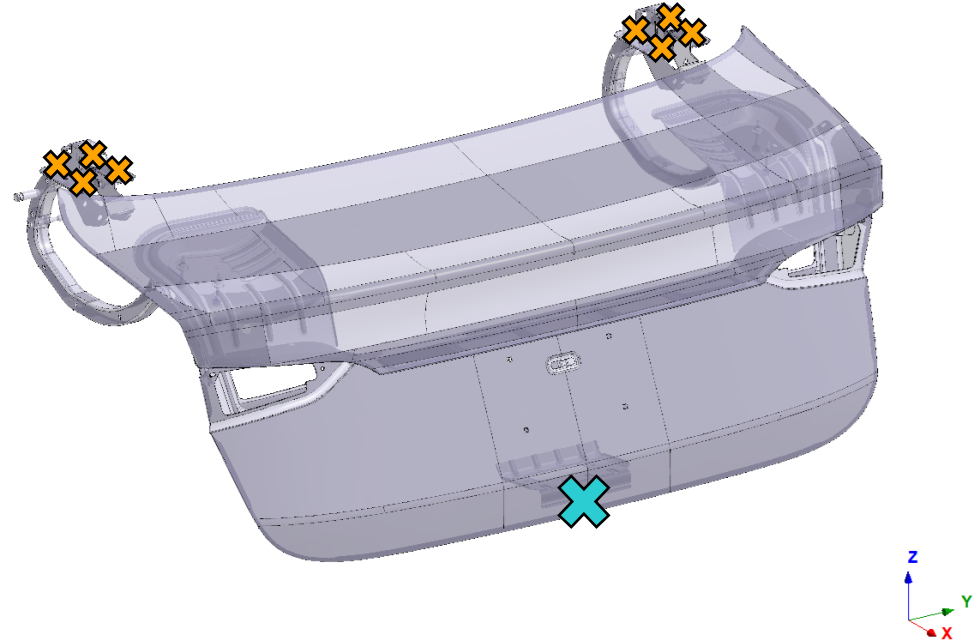
- Sedan liftgate.
- Modal analysis to determine the system natural frequency.
- Assembly with 83 components.



Liftgate Natural Frequency

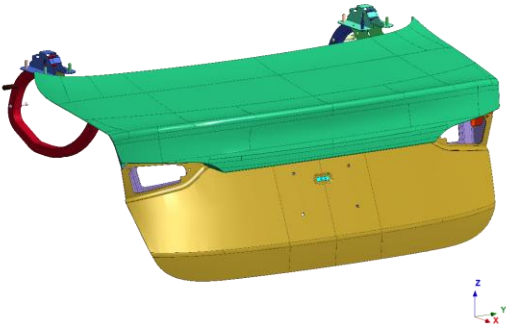


- **Goal**
 - Defining the natural frequency and the frequency modes of the system.
 - $f = \sqrt{\frac{k}{m}}$
- **Boundary Conditions**
 - Restriction DOFs 1, 2 and 3 on the body structure attachment point.
 - Free rotation along Z axis.



Preprocessing

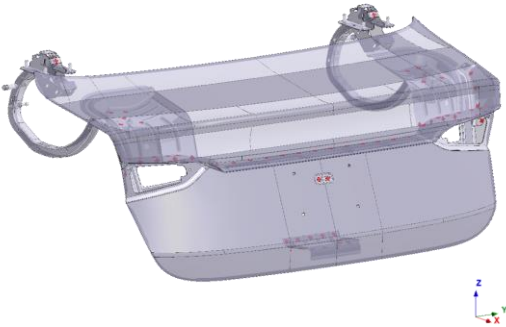
 SIMSOLID



Material

- $E = 205000 \text{ MPa}$
- $\nu = 0.3$

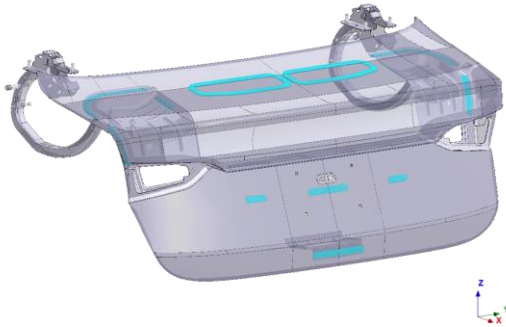
 SIMSOLID



Weld Points

- 76 points

 SIMSOLID



Adhesives

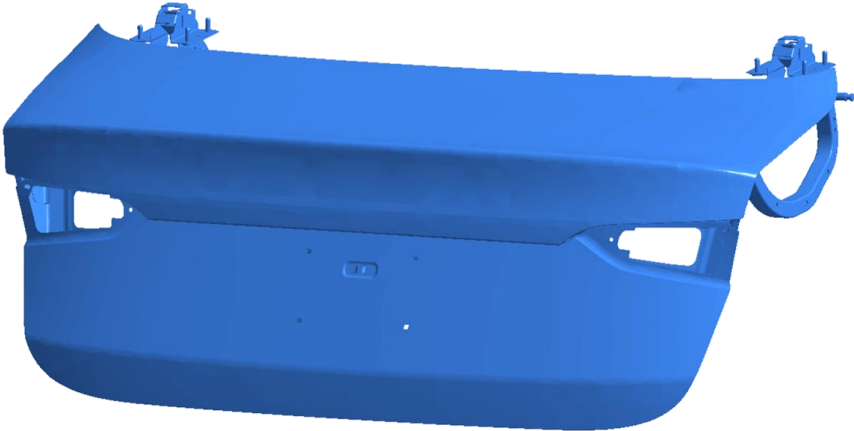
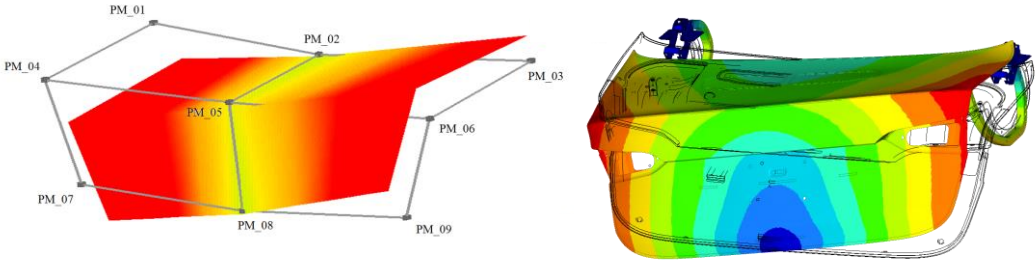
- 63 adhesives

SimSolid preprocessing time - 10 minutes
FEA preprocessing time - 24 hours

Results

Natural Frequency	
Experimental [Hz]	16.3
FEM [Hz]	16.7
SimSolid [Hz]	16.8

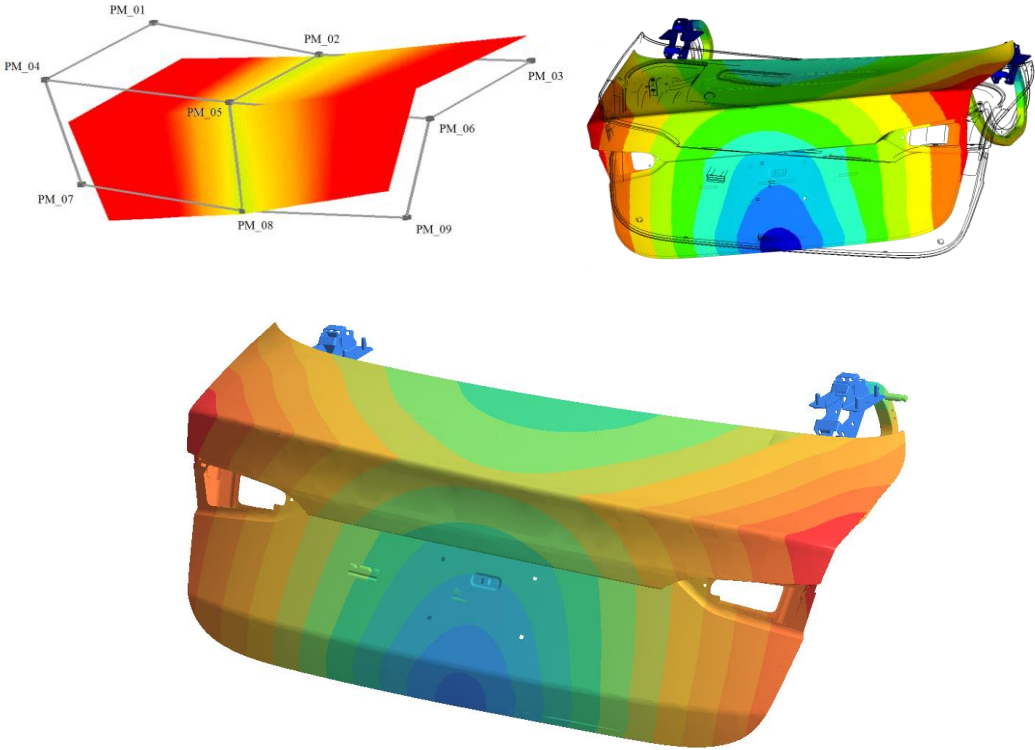
Error %	
FEM	+2.5
SimSolid	+3.1



Results

Natural Frequency	
Experimental [Hz]	16.3
FEM [Hz]	16.7
SimSolid [Hz]	16.8

Error %	
FEM	+2.5
SimSolid	+3.1





O tempo economizado no pré-processamento no SimSolid foi significativo, apesar de ter muito mais D.O.F. nos modelos para a convergência das análises.

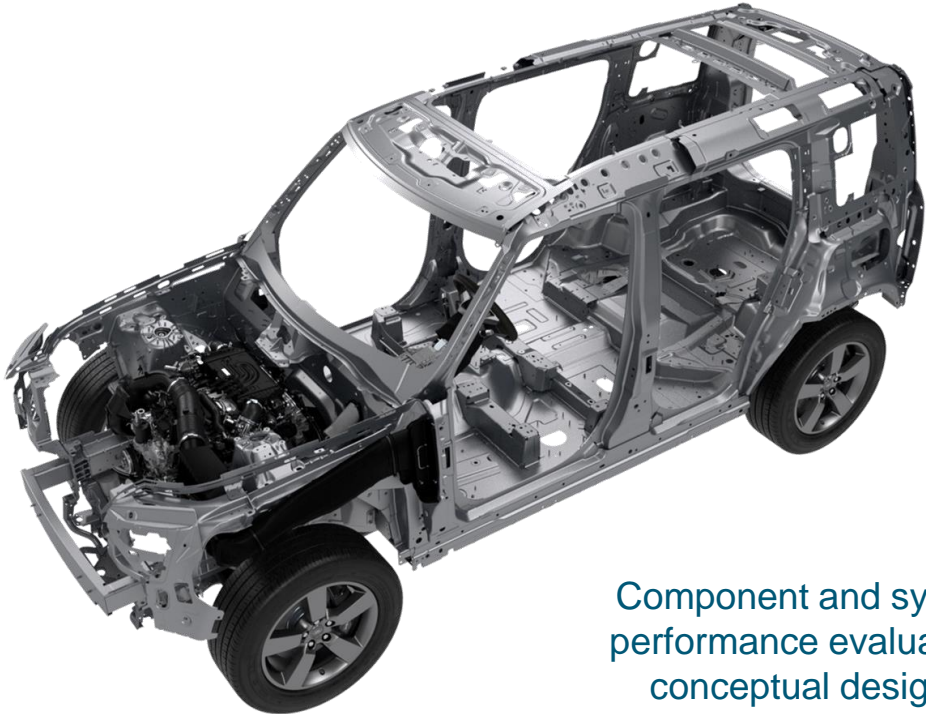
Jefferson S. Carvalho, Stellantis, Virtual Analysis Engineer

Samir S. Saliba, Stellantis, Virtual Analysis Engineer



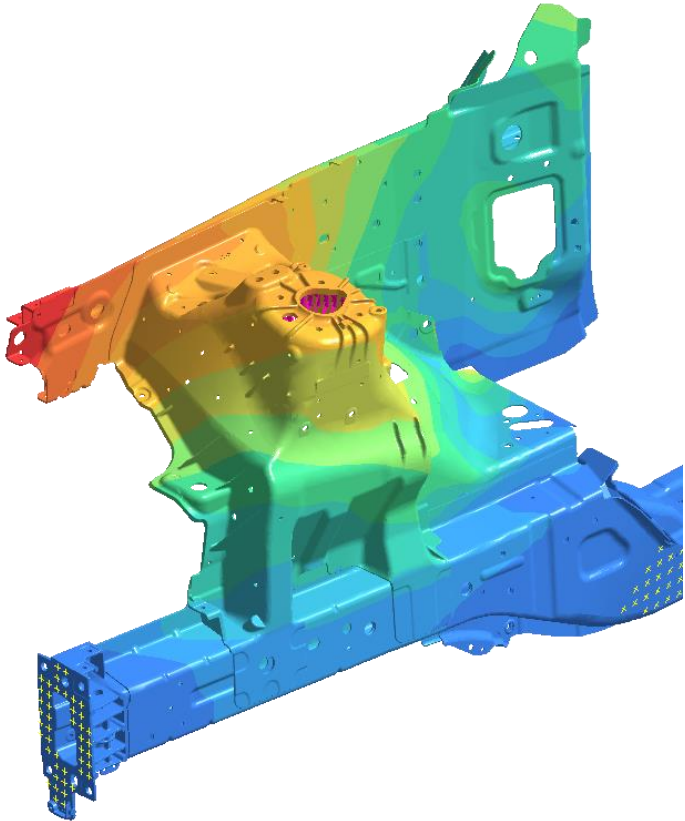
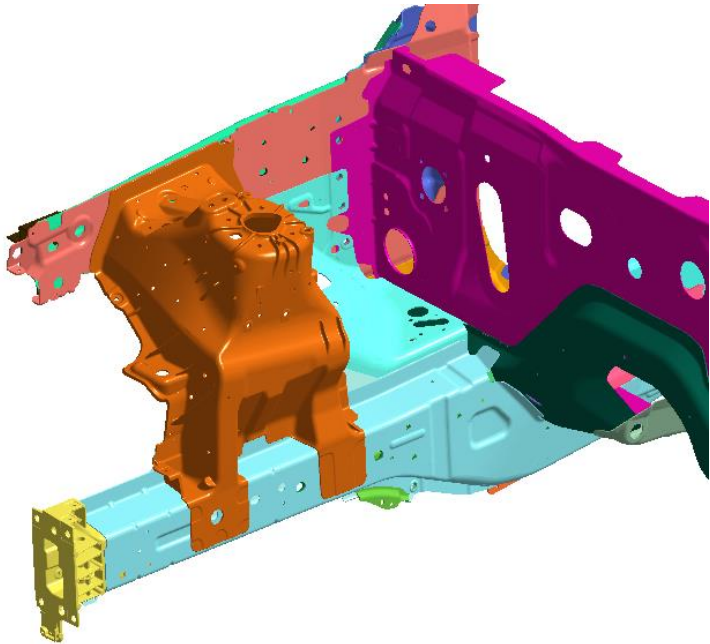


Front Shock Tower



Component and system level performance evaluation at the conceptual design phase

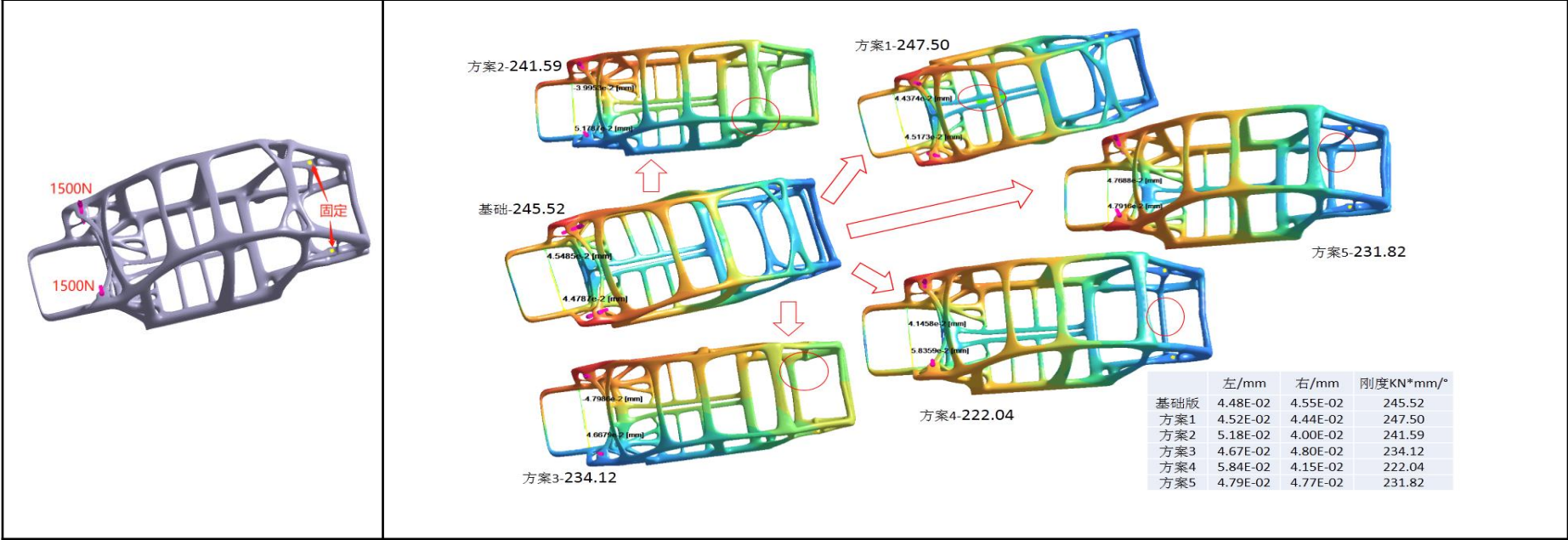
SimSolid Results



<3% with FE
CAD to results: 20 minutes in SimSolid
vs. 2 days in conventional FE

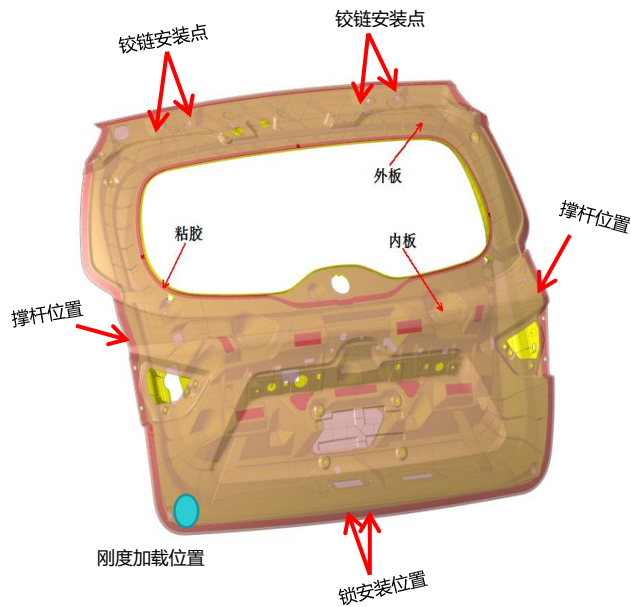
长城汽车股份有限公司：白车身拓扑方案快速验证分析

SimSolid15min内验证6个拓扑优化方案
加速拓扑方案的转化



成都航天模塑股份有限公司：基于SimSolid的全塑尾门力学分析 模型与工况

全塑尾门，以塑代钢。内板材料为PP+LGF40，外板材料为PP+EPDM-TD20，分析如下四种工况：



1、强度

铰链安装点、锁安装位置约束dof1~6，撑杆位置施加300N载荷，同时施加4.5G（向上）重力场载荷。

2、刚度

铰链安装点约束dof1~6，锁安装位置约束dof1~3；在左侧缓冲垫区域施加+X方向50N载荷。

3、模态

分析前8阶自由模态。

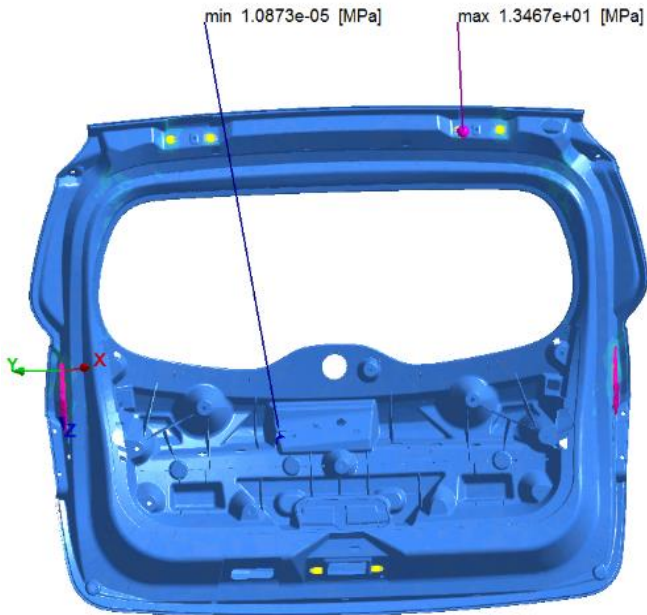
4、热变形

铰链安装点、锁安装位置约束dof1~6，施加温度载荷54°C。

成都航天模塑股份有限公司：基于SimSolid的全塑尾门力学分析 强度分析结果

SimSolid

Max Von Mises 13.47
MPa



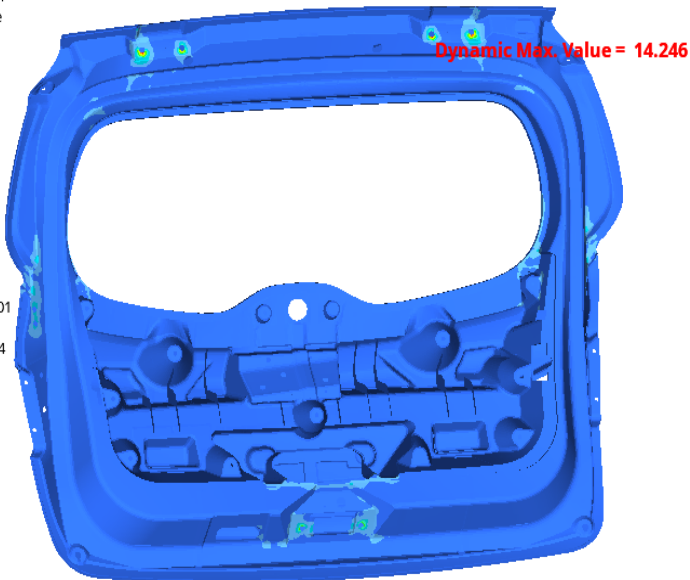
Error 5.8%

OptiStruct

Max Von Mises 13.47
MPa

Contour Plot
Element Stresses (2D & 3D)(vonMises, Max)
Analysis system
Simple Average

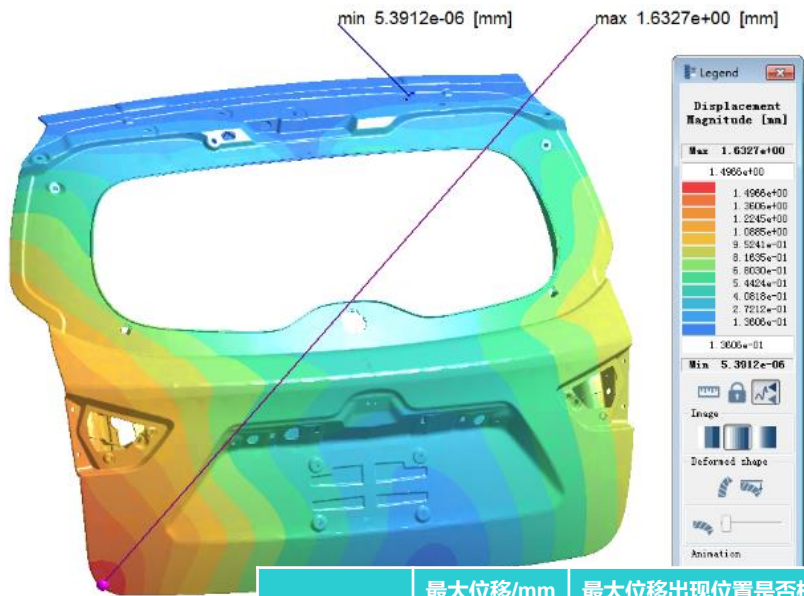
1.425E+01
1.266E+01
1.108E+01
9.498E+00
7.915E+00
6.332E+00
4.749E+00
3.166E+00
1.583E+00
2.397E-04
No Result
Max = 1.425E+01
Grids 76444
Min = 2.397E-04
Grids 205704



成都航天模塑股份有限公司：基于SimSolid的全塑尾门力学分析 刚度分析结果

SimSolid

Max Displacement 1.633 mm



Error 4.3%

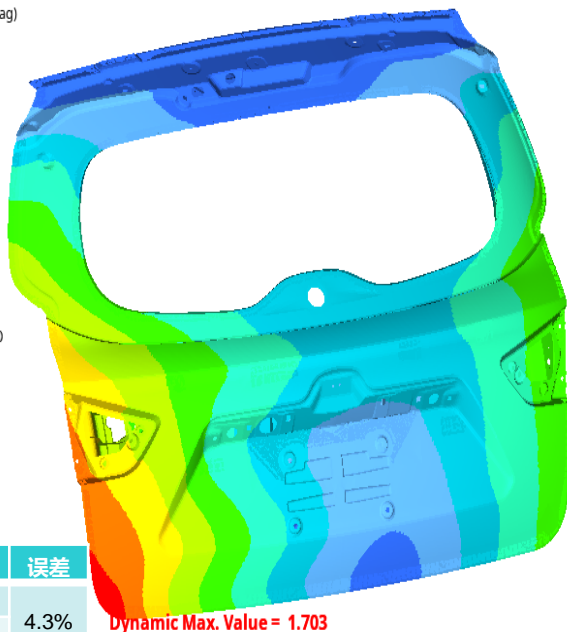
OptiStruct

Max Displacement 1.703 mm

Contour Plot
Displacement(Mag)
Analysis system

Legend
Displacement Magnitude [mm]
Max 1.6327e+00
1.4966e+00
1.4966e+00
1.3806e+00
1.2245e+00
1.0688e+00
9.5244e-01
8.1835e-01
6.8030e-01
5.4424e-01
4.0818e-01
2.7212e-01
1.3606e-01
1.3606e-01
Min 5.3912e-06
Image
Deformed shape
Animation

1.703E+00
1.513E+00
1.324E+00
1.135E+00
9.459E-01
7.567E-01
5.676E-01
3.784E-01
1.892E-01
0.000E+00
No Result
Max = 1.703E+00
Grids 213073
Min = 0.000E+00
Grids 76191



	最大位移/mm	最大位移出现位置是否相同	计算时间/min	误差
SimSolid	1.633	是	13	4.3%
OptiStruct	1.703	是	3	
实验	1.65	是	/	

成都航天模塑股份有限公司：基于SimSolid的全塑尾门力学分析 模态分析结果

Error <4.5%

一阶扭转

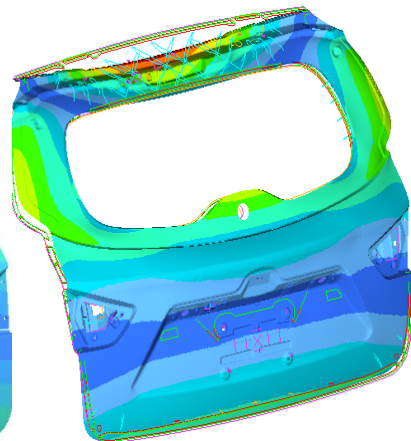
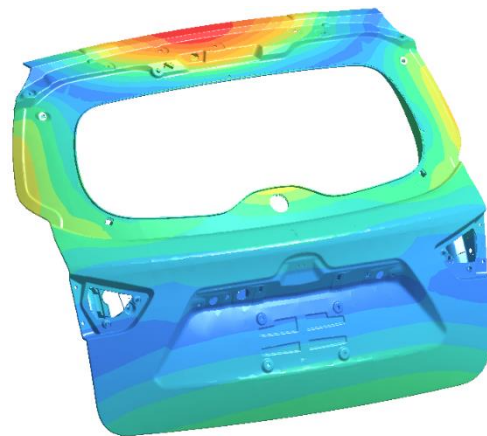
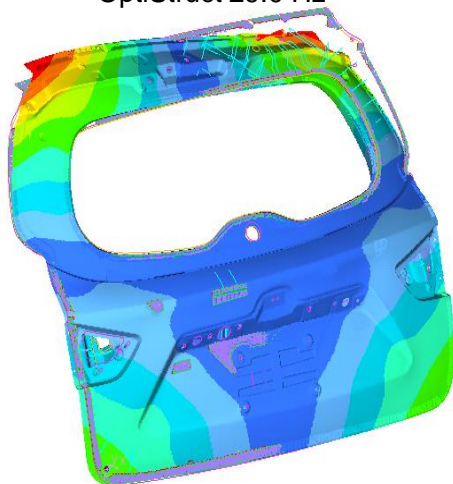
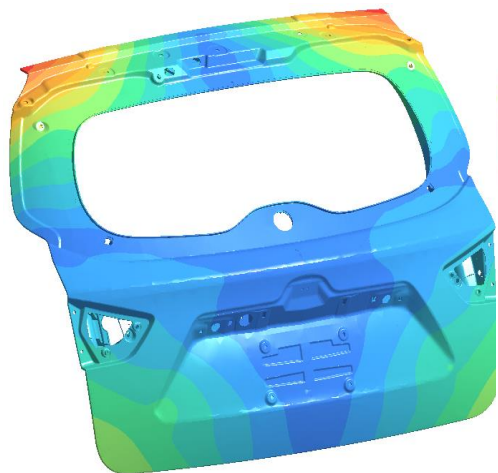
二阶弯曲

SimSolid 27.4 Hz

OptiStruct 29.0 Hz

SimSolid 34.2 Hz

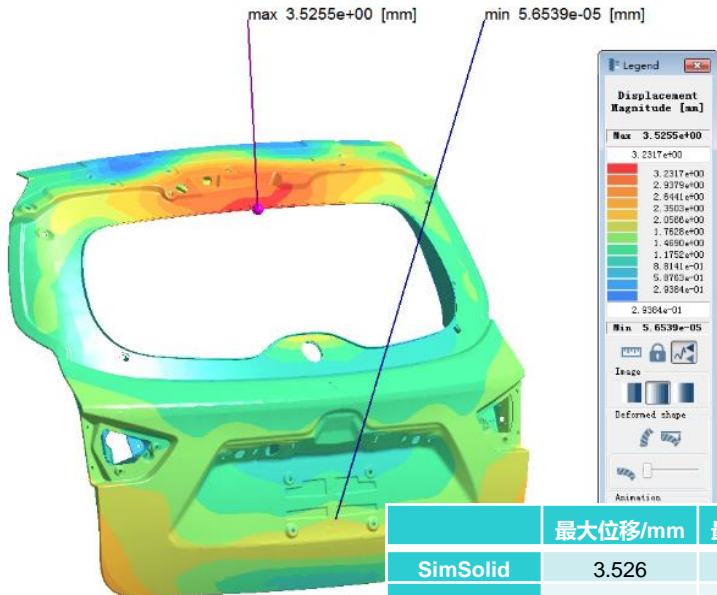
OptiStruct 35.3 Hz



成都航天模塑股份有限公司：基于SimSolid的全塑尾门力学分析 热分析结果

SimSolid

Max Displacement 3.526 mm

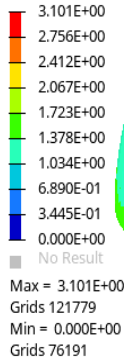


Error 12.1%

OptiStruct

Max Displacement 3.101 mm

Contour Plot
Displacement(Mag)
Analysis system

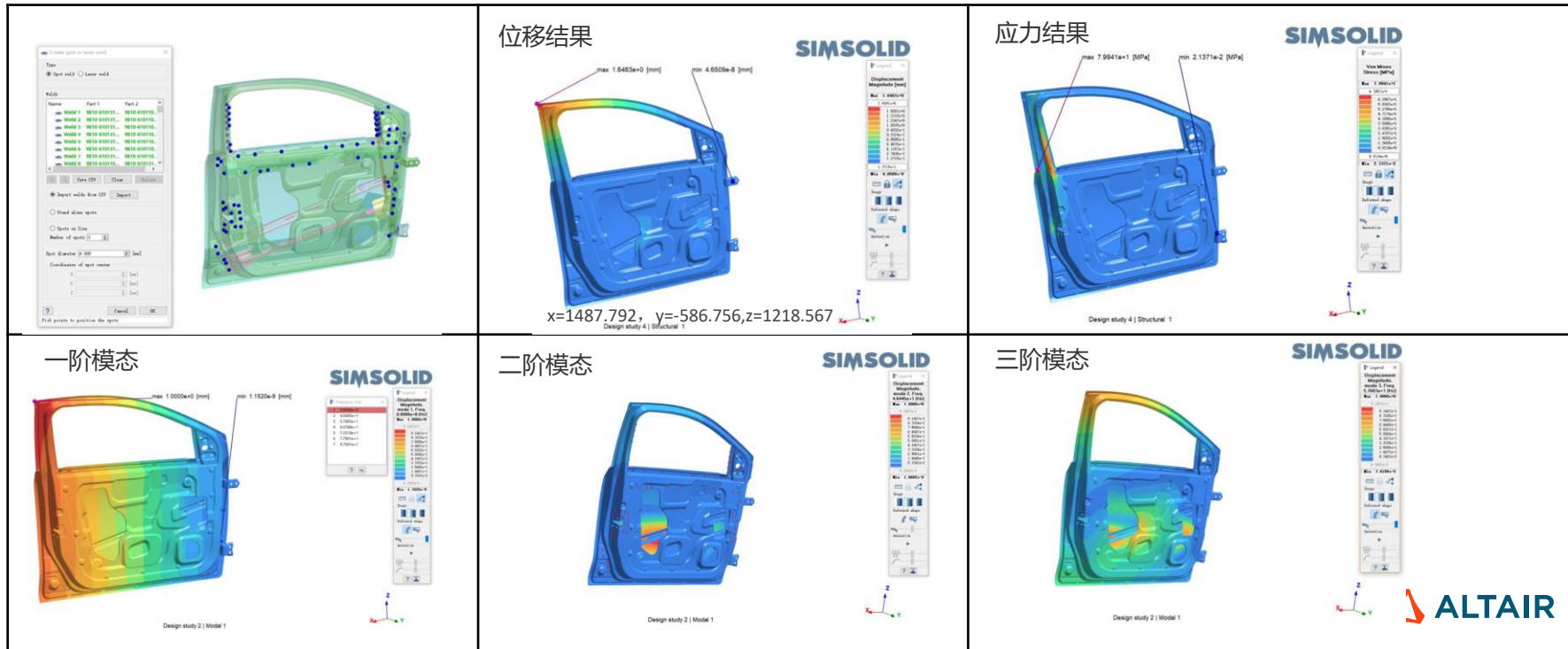


	最大位移/mm	最大位移出现位置是否相同	计算时间/min	误差
SimSolid	3.526	是	34	12.1
OptiStruct	3.101	是	5	%
实验	/	/	/	/

凯毅德汽车系统有限公司：左前门总成静力及模态分析

SimSolid中6分钟完成车门总成静力及模态分析

批量导入焊点、自动创建接触



项目背景



原始方案

新方案

- 项目背景

车身B柱，材料为PP-lxs。该零件有一定刚度要求，若原始方案满足刚度要求，则去除部分加强筋变更为新方案，再次验证新方案刚度。

零件	材料	密度 kg/mm ³	弹性模量 MPa	泊松比
B上	PP-lxs	0.97	2050	0.36

- 分析步骤

- 1、原始方案刚度分析，原始方案SimSolid与OptiStruct精度对比
- 2、新方案刚度分析，新方案 SimSolid与OptiStruct精度对比

- 约束与载荷

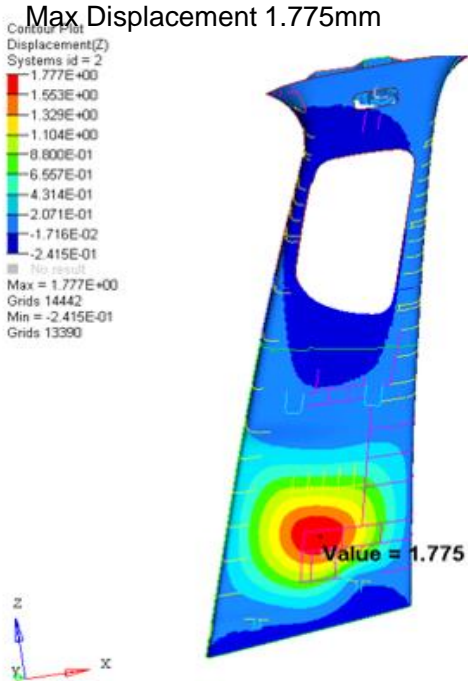
模型约束为卡扣和与顶棚的配合
实验施加工况为直径为50mm圆

原始方案——刚度分析结果

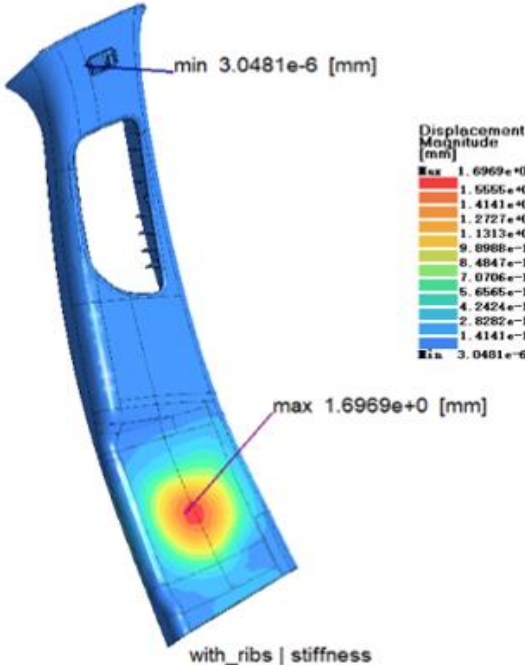
OptiStruct

Error 4.4%

SimSolid



Max Displacement 1.696mm



新方案——刚度分析结果

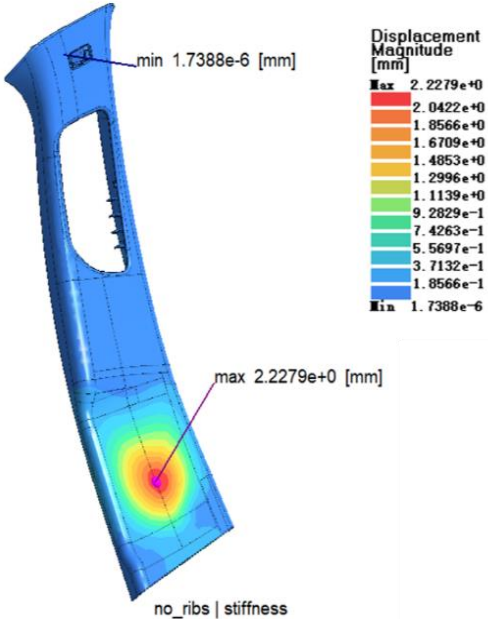
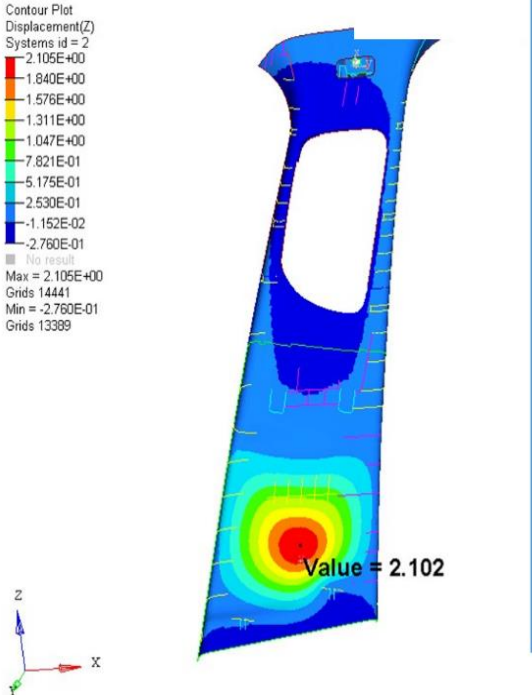
OptiStruct

Error 5.9%

SimSolid

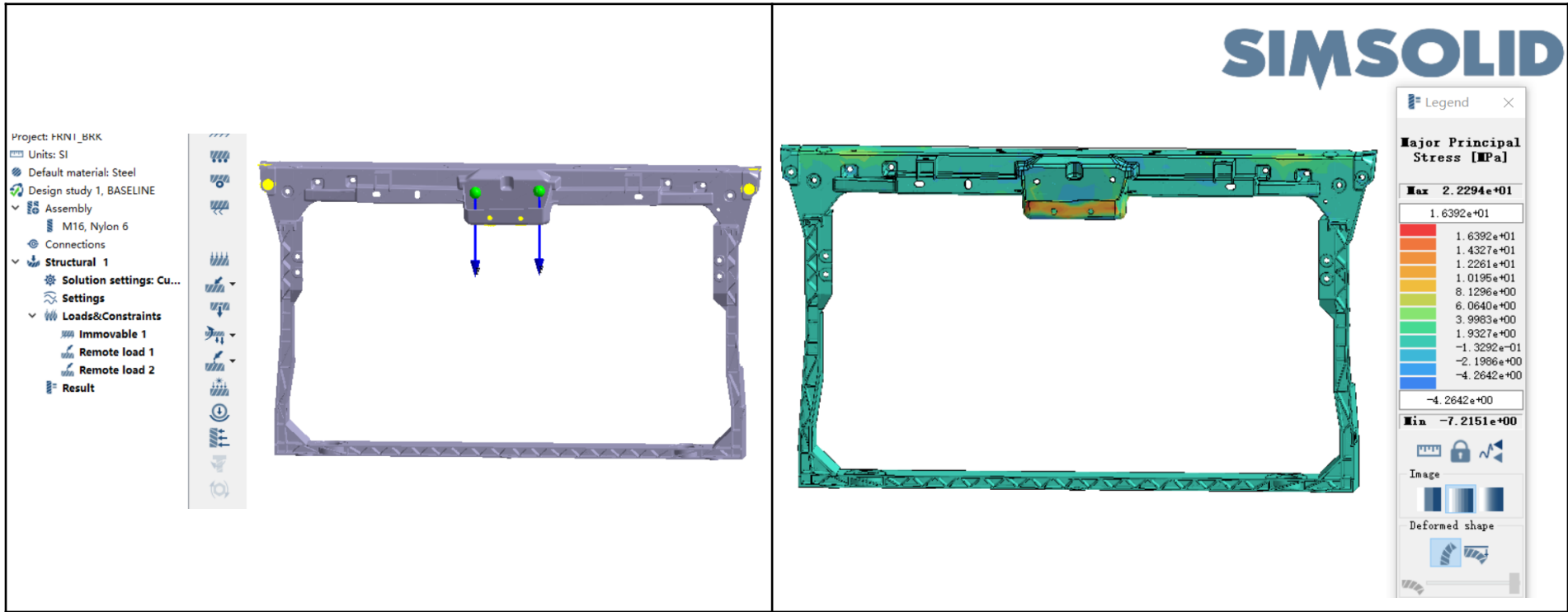
Max Displacement 2.102mm

Max Displacement 2.227mm



宁波华翔: 塑料前端框架的快速仿真

SimSolid快速仿真复杂塑料件
15分钟完成从导入几何到结果输出



Sabic 前端框架刚度与模态分析对比

Automotive Front-end Module – frequency prediction

Mode	SimSolid (Hz)		OptiStruct (Hz)	Shape	Gap %	Shape	Remove mass difference Gap %
1	23.4	Bending of vertical members bottom area	23.07	Bending of vertical members bottom area	1.4%	Similar	-0.2%
2	36.4	Bending vertical member, lower beam moves in y direction	35.4	Bending vertical member, lower beam moves in y direction	2.8%	Similar	1.2%
3	43.1	Bending vertical member, upper beam moves/rotates along y direction	40.6	Bending vertical member, upper beam moves/rotates along y direction	6.2%	Similar	4.6%
4	45.9	Bending vertical in lower area, lower beam rotates along z.	45.1	Bending vertical in lower area, lower beam rotates along z.	1.8%	Similar	0.2%
5	49.1	Bottom beam bending	46.7	Bottom beam bending	5.1%	Similar	3.5%
6	60.5	Upper beam bending	57.2	Upper beam bending	5.8%	Similar	4.2%

Notes:

- OptiStruct model 3.2% more heavy. It is expected frequency in SimSolid is 1.6% higher than in OptiStruct. This is corrected for in the last column

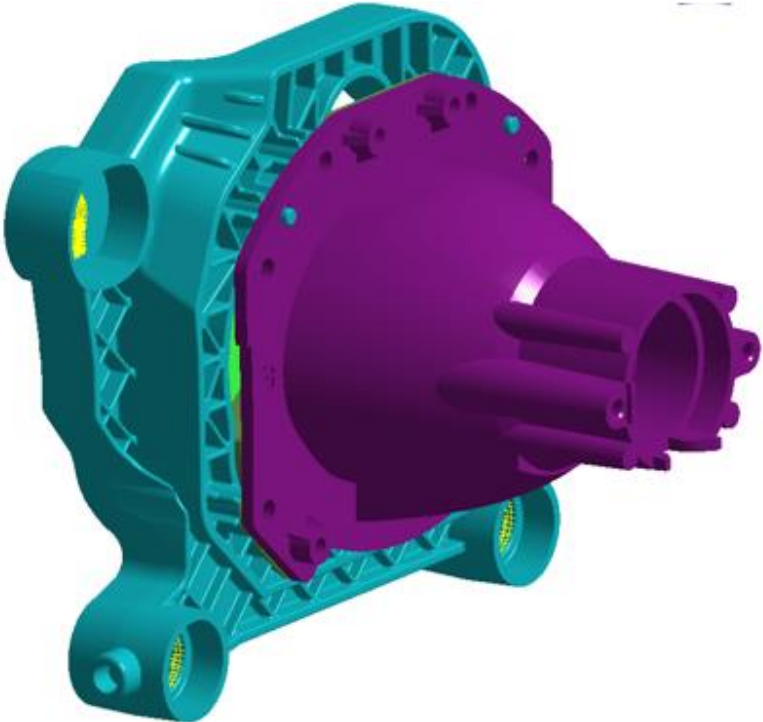
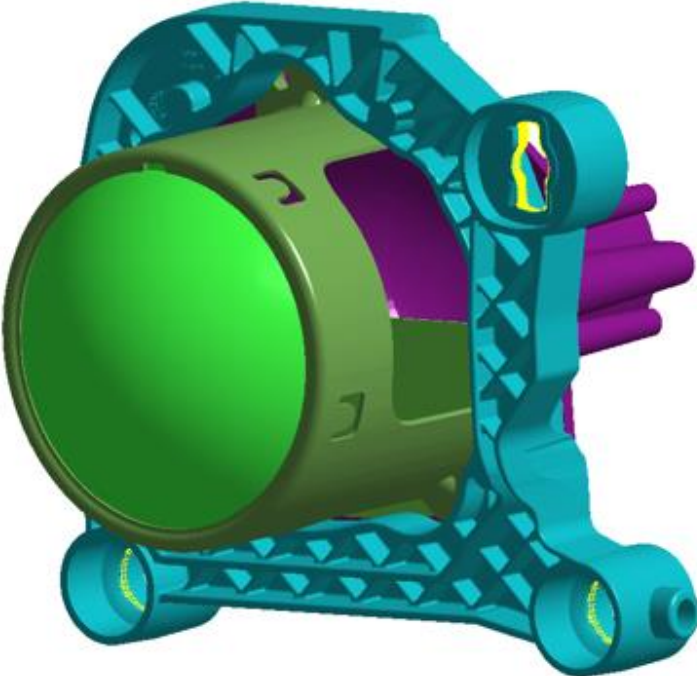


Both frequencies and shapes are close each other.



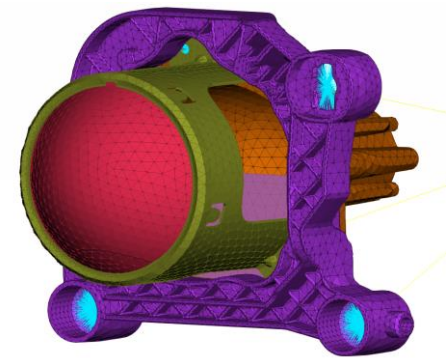
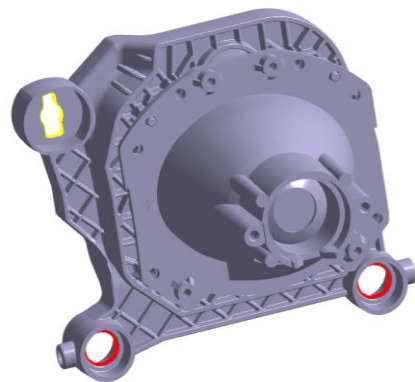
SIMSOLID在内外饰上的应用

汽车车灯透镜组模态分析_SimSolid_VS_Abaqus

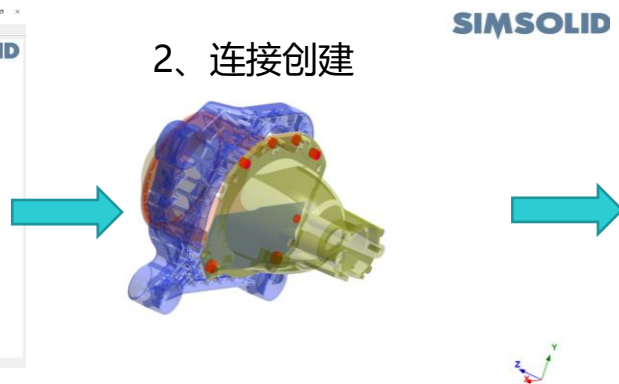


模型与材料

NO.	部件	部件名称	材料	密度 (kg/m ³)	弹性模量 (MPa)	泊松比
1		透镜	GLASS	2520	72000	0.22
2		透镜支架	STEEL	7850	210000	0.3
3		反射镜	ALUM	2780	73000	0.33
4		透镜组支架	PBT-GF30	1310	9000	0.437
5		遮光板	STEEL	7850	210000	0.3

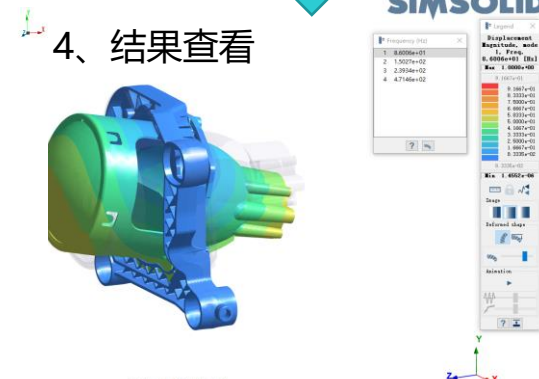


Altair 结构快速验证—— SimSolid建模分析步骤

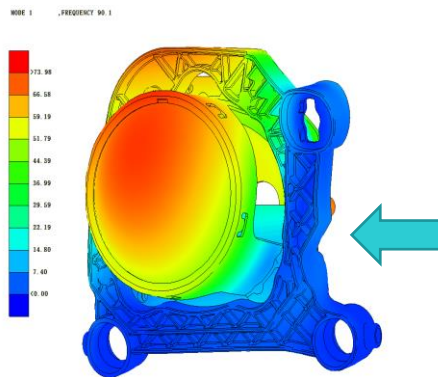


模态对标

Error < 6%

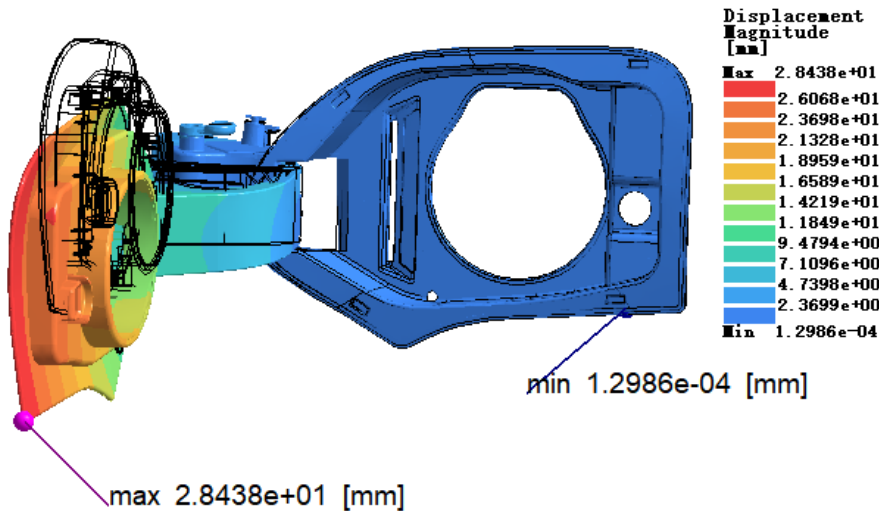


优势：同步设计的仿真
缩短设计周期
仿真流程更稳健



宁波华翔: 充电口盖总成刚度分析

SimSolid快速仿真复杂塑料件
求解时间不到1分钟



最大位移	F=50N	下沉量28.4mm
------	-------	-----------

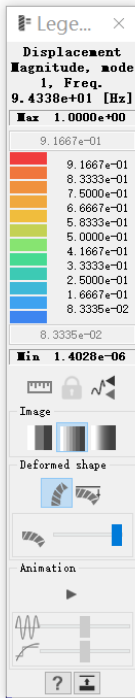
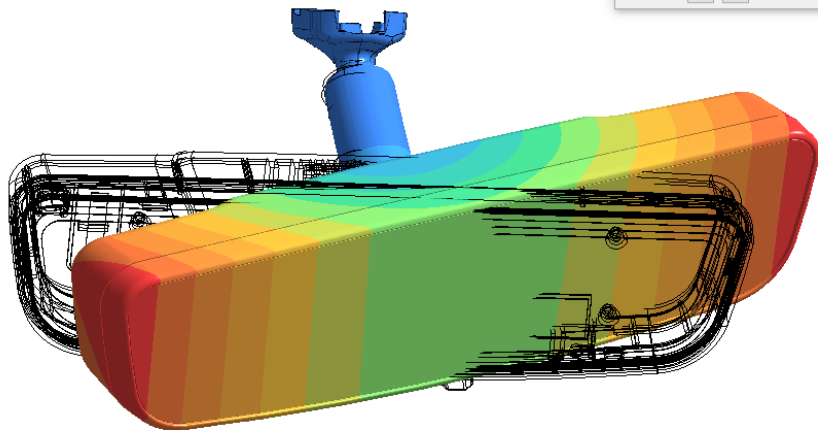
样品编号 Sample No.	测试结果 Results
S1912060101A02 (01-02)	1、 F=50N;下沉量 29.60mm

宁波华翔: 后视镜模态分析

SIMSOLID

第一阶固有频率
94HZ

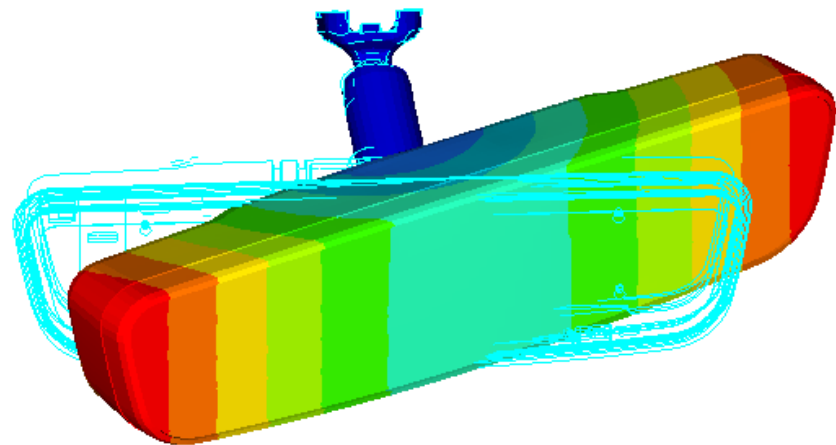
Frequency (Hz)	
1	9.4338e+01
2	1.2016e+02
3	1.4363e+02
4	3.1114e+02
5	3.9531e+02
6	4.1877e+02



OPTISTRUCT

第一阶固有频率
90HZ

Subcase 1 (loadstep1) : Mode 1 - F = 9.052456E+01
Frame 25





THANK YOU

altair.com



#ONLYFORWARD