



The new
HyperMesh
- Samcef
interface.

Deployment and
industrial
applications at
Eurocopter.

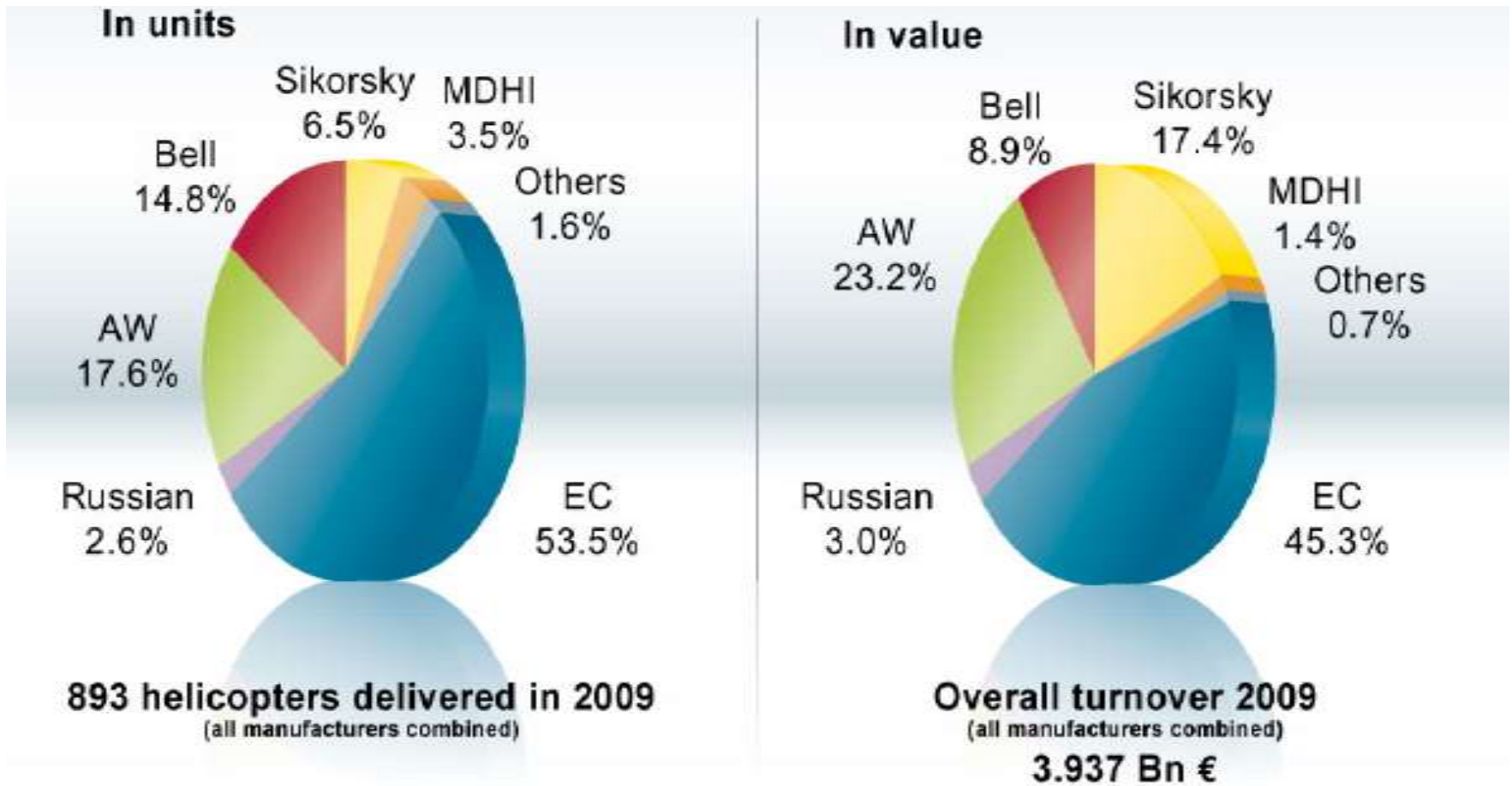
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Dynamic systems dpt.

Presentation plan

- ❑ Eurocopter overview
- ❑ Stress computation performed in Eurocopter
- ❑ Samcef solver (strength and weakness)
- ❑ Development of Hypermesh / Samcef interface
- ❑ Development of Samcef / Hyperview interface
- ❑ Industrial cases performed and feedback
- ❑ Road map
- ❑ Conclusions

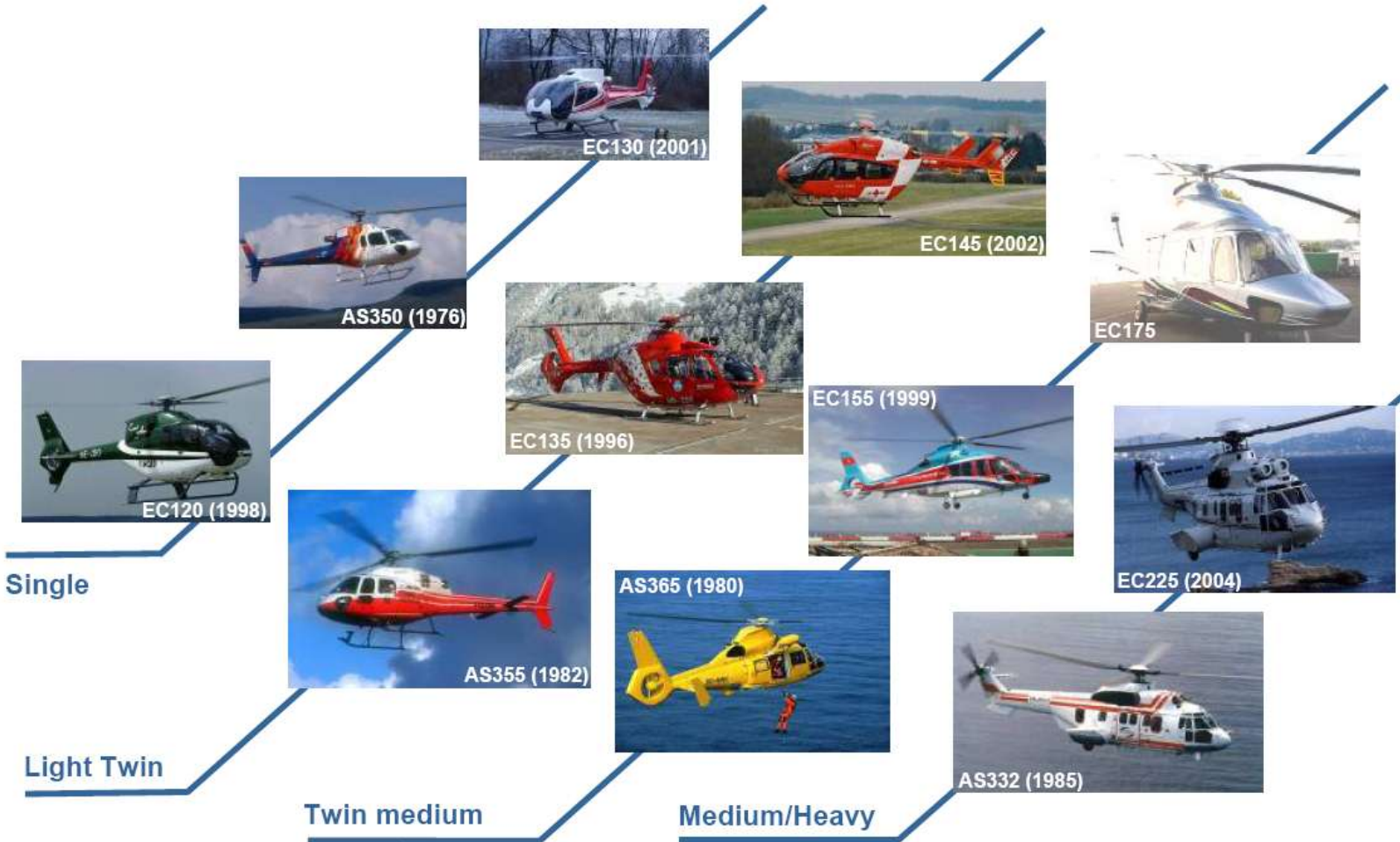
Eurocopter overview (1/3)

LEADER IN THE CIVIL AND PARAPUBLIC MARKETS



Eurocopter overview (2/3)

→ THE CIVIL RANGE



Eurocopter overview (3/3)

→ THE MILITARY RANGE



Finite elements computations in Eurocopter group

- ❑ Airframe static (Nastran, Samcef) and crash computation (Radioss)
- ❑ Blades computation (Samcef, Nastran, HWorks)
- ❑ **Dynamic systems** (Samcef, Nastran, HWorks) - Static and fatigue analysis
 - Rotors and suspensions
 - Power transmissions
 - Flight controls
- ❑ Others (Aerodynamics, thermal ...)



Samcef solver (1/3)

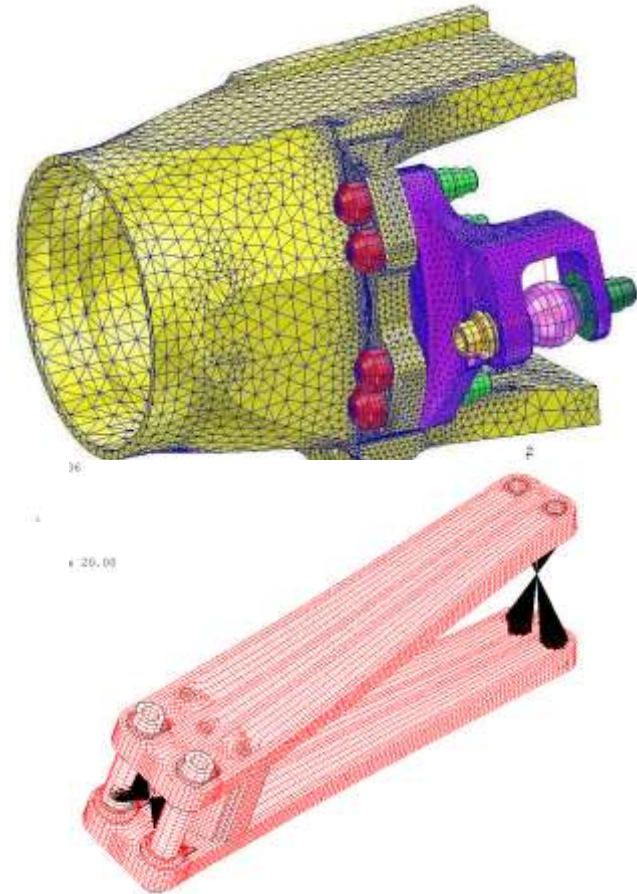
- ❑ Historical solver of Eurocopter French stress office
- ❑ More than 20 years of helicopter FE model in Samcef
- ❑ Recognized in European aeronautic industry
- ❑ Mature solver (40 years old)
- ❑ European solver (Head Quarter in Belgium)



Samcef solver (2/3)

Strengths :

- Variety of element library
- Macro command to make easier model definition
- Contact definition either in linear or non linear analysis
- Power of non linear solver (MECANO)
- Composite definition including volumic composite
- Fracture mechanics



Samcef solver (3/3)

A powerful solver but that suffers of a main weakness :

No modern pre and post processing tool for samcef can be found in the market !

Power of samcef is limited to what can be easily done and time compatible with industrial constraint.

Development of Hypermesh / Samcef interface

- ❑ Eurocopter has chosen Hypermesh / Hyperview has best solution for interfacing Samcef
- ❑ Eurocopter specification sheet in 2009 defining development priority
- ❑ Altair development started end of 2009 under responsibility of Richard Heslouin (Altair France)
- ❑ First official release delivered in March 2010 with basic functionalities
- ❑ Second official release delivered in June 2010 with bug fixes and additional functionalities

Up to now (oct. 2010), Samcef interface allows to :

❑ Completely define standard linear calculation in HM

- Standard elements supported (including pyramidal)
- Isotropic and orthotropic material
- Loads, pressure, displacements
- Local frames and attribution to nodes or boundary conditions
- Nodes, faces and elements groups
- Export Samcef input file

❑ Define any kind of calculation

- “Unsupported card” text windows is available in order to add any card. Recorded inside HM file and content written at the end of samcef input file.
- Then contact, non linear analysis and specific kinematic function can be used even not yet implemented.

Development of Samcef / Hyperview interface

- ❑ Programming under Samtech responsibility
- ❑ SAM2H3D module convert Samcef results in Hyperview (*.h3d) format.
- ❑ Version 1 delivered (oct. 2010) : metallic linear analysis
- ❑ 2 others versions planned for end of 2010.

Industrial cases performed and feedback

parts

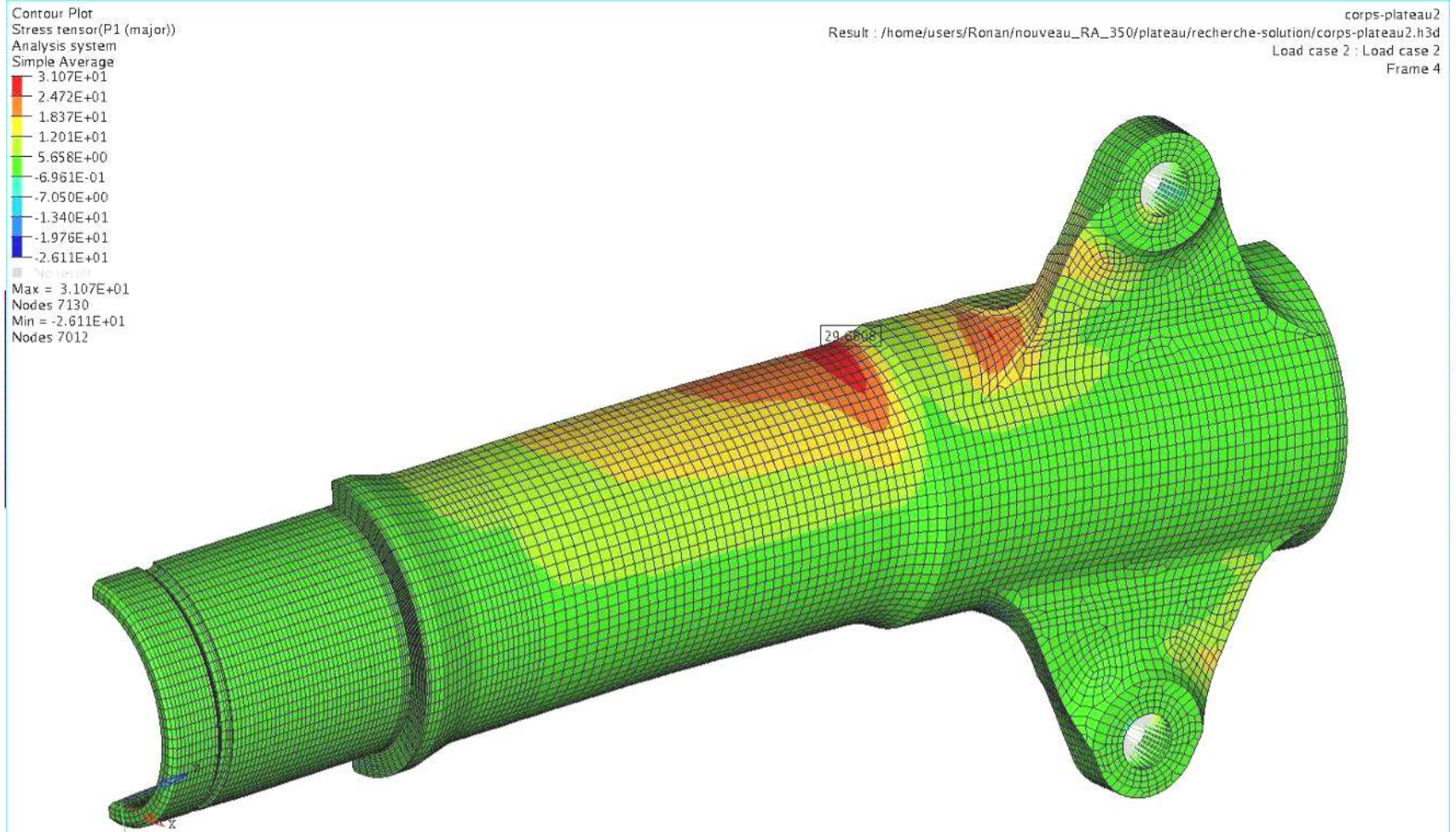
The screenshot shows the HyperMesh v10.0 interface with a 3D model of a mechanical part. The model is divided into three distinct mesh regions: a purple mesh on the left, a yellow mesh in the middle, and a purple mesh on the right. A transition zone between the yellow and right purple regions is highlighted with an arrow and labeled "Hexa-tetra transition by pyramidal elements". The software interface includes a menu bar at the top, a toolbar, a left-hand "Entities" tree, and a bottom toolbar with various analysis and visualization options.

- Important time reduction to mesh parts
- Increase of accuracy

Hexa-tetra transition by pyramidal elements

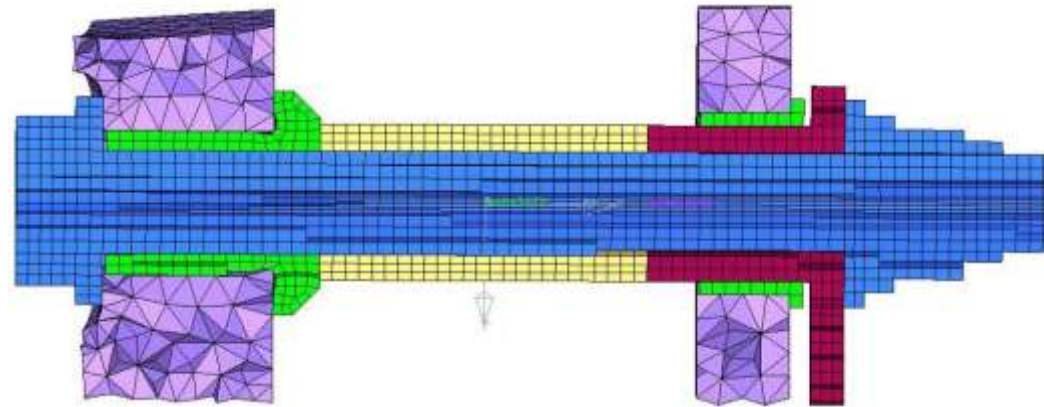
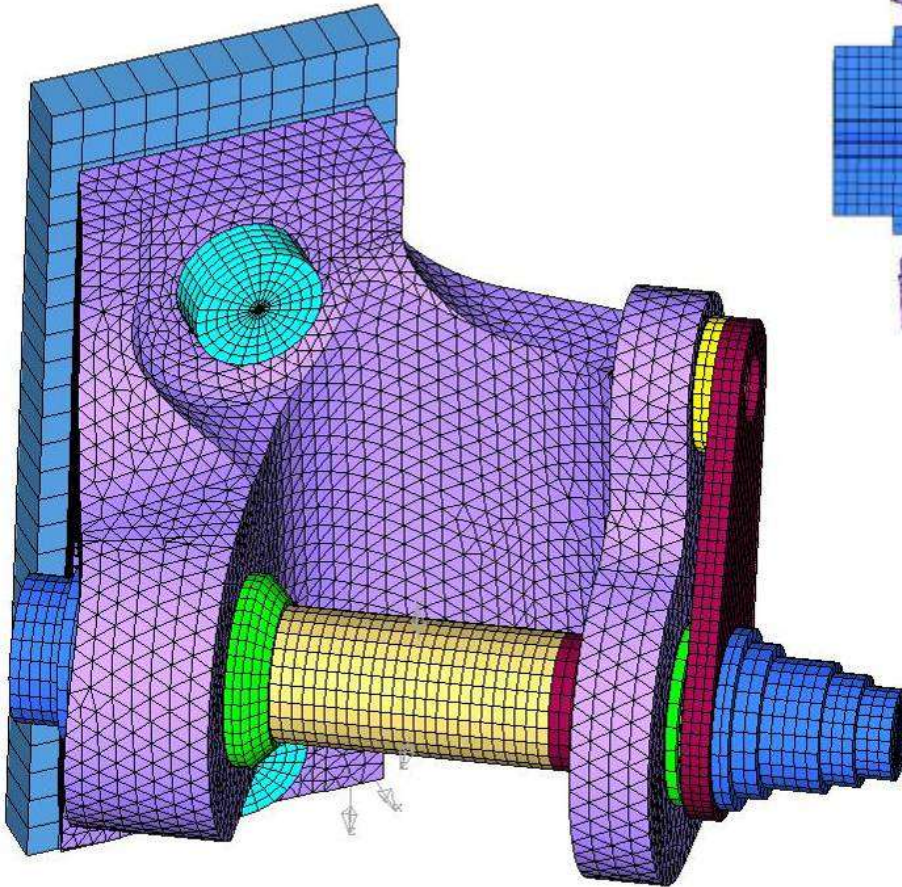
Industrial cases performed and feedback

Light assemblies (1/2)



Industrial cases performed and feedback

□ Light assemblies (2/2)



- Ease to manage elementary parts
- Ease to define and manage groups
- Visual comfort for model display

Industrial cases performed and feedback

❑ Additional text command “Unsupported cards”

The screenshot displays the HyperMesh v10.0 - Samcef software interface. On the left, the 'Entities' tree shows a hierarchical view of the model, including Assembly Hierarchy, Card (1), Component (8), ContactSurface (35), Domain (132), Handle (64), Material (3), Property (2), and Set (19). The main window shows a 'Control Card' with the following text:

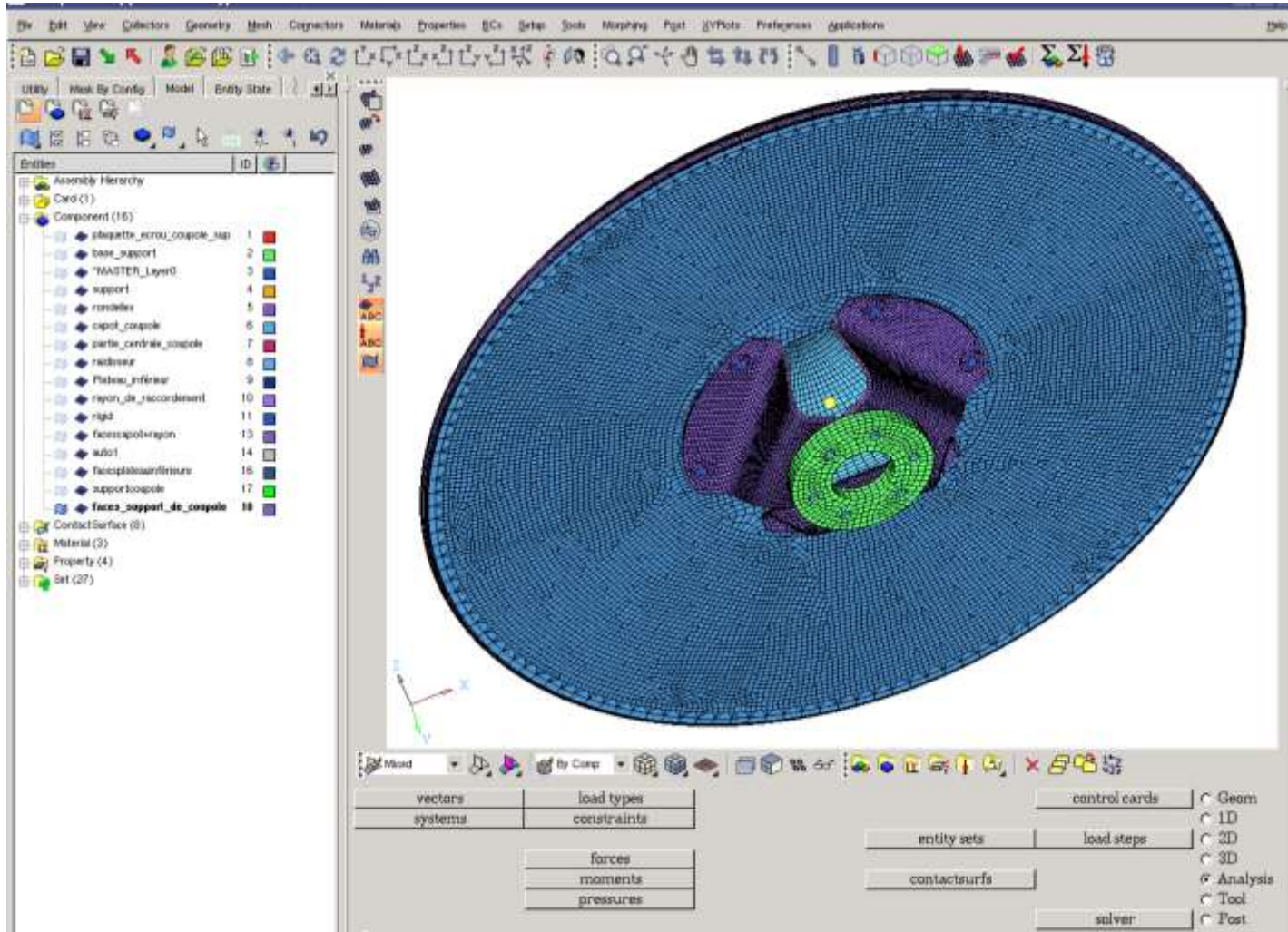
```
..... FONCTION .....  
.FCT CREE FONCTION 1 1 NOM "SERRAGE"  
CREE VALEUR Y U  
ABSCISSE 0. 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.  
ORDONNEE 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.  
CREE (vii)  
  
..... RIGIDITE POUR CONVERGENCE .....  
.MCE 1 100 BUSH N 419128 419138  
.MCE 1 200 BUSH N 419127 419138  
.MCE 1 300 BUSH N 419130 419138  
.MCE 1 400 BUSH N 419131 419138  
.MCE 1 500 BUSH N 419133 419138  
.MCE 1 600 BUSH N 419134 419138  
.MCE 1 700 BUSH N 419136 419138  
.MCE 1 800 BUSH N 419135 419138  
.MCE 1 900 BUSH N 419126 419138  
  
.MCC 1 100 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 200 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 300 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 400 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 500 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 600 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 700 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 800 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
.MCC 1 900 BUSH DISP 1 KTX 2 KTY 2 KTZ 2  
KRX 2 KRY 2 KRZ 2  
  
Node precision 0.00001  
..... CONTACT .....  
-MCT  
11 GROUP "contact_radial_vis_bague" GTAR "contact_radialvis_bague" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
12 GROUP "contact_bague" GTAR "contact_bague" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
13 GROUP "contact_vis_plaquette1" GTAR "contact_letevis1_plaquette" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
14 GROUP "contact_plaquette2_vis" GTAR "contact_plaquette2_vis" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
15 GROUP "contact_plaquette1_ferrure" GTAR "contact_ferrure_plaquette1" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
16 GROUP "contact_plaquette2_ferrures" GTAR "contact_ferrure_plaquette2" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
17 GROUP "contact_ferrure2_bague1" GTAR "contact_ferrure1_bague" $  
OPT 2 UN3 1 NLIM -1 ;  
-MCT  
18 GROUP "contact_ferrure2_bague2" GTAR "contact_ferrure2_bague" $  
OPT 2 UN3 1 NLIM -1 ;
```

A green box highlights the text "UNSUPPORTED CARDS" at the bottom of the control card.

Enlarge application field by addressing any Samcef card.

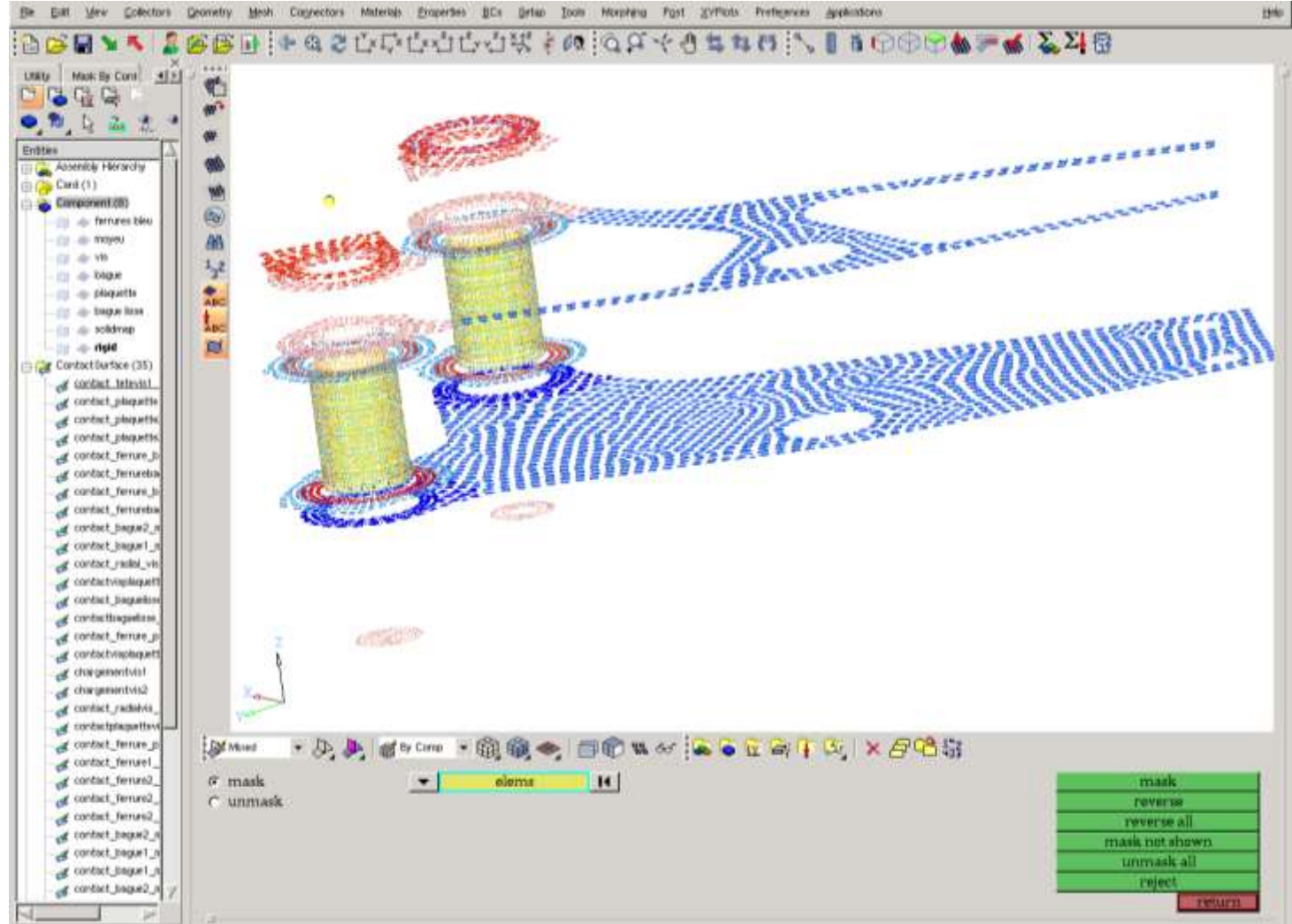
Industrial cases performed and feedback

Complex assembly (1/4)



Industrial cases performed and feedback

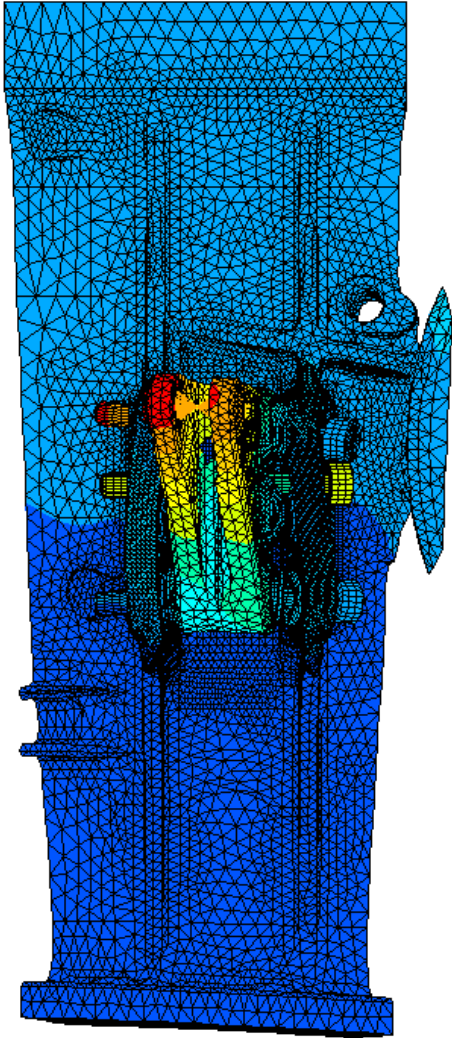
Complex assembly (2/4)



Ease to define, display and control faces groups for contact analysis

Industrial cases performed and feedback

Complex assembly (3/4)

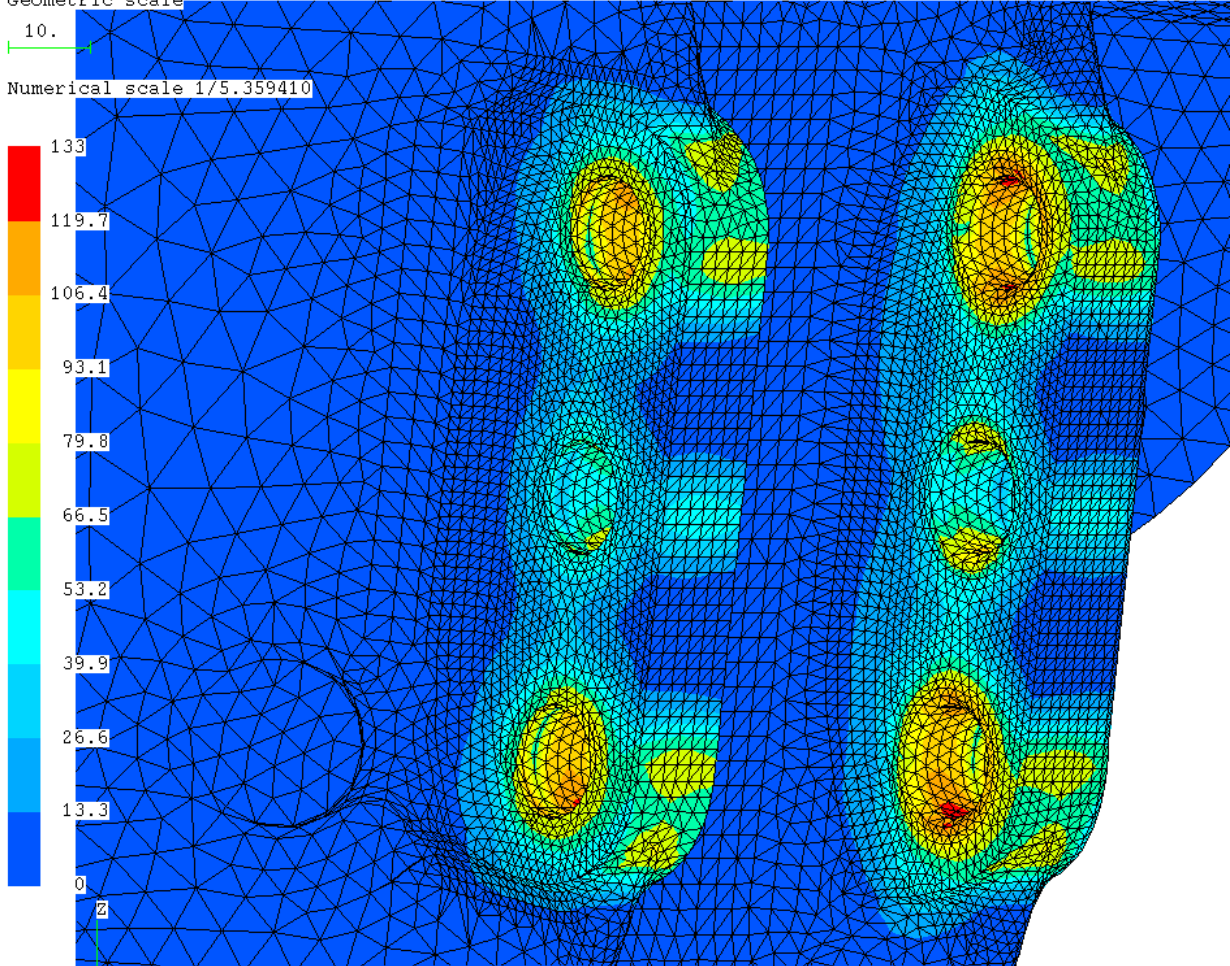
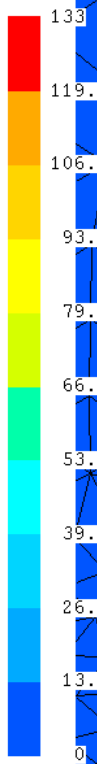


Scalar quantity by node [operations]

Geometric scale

10.

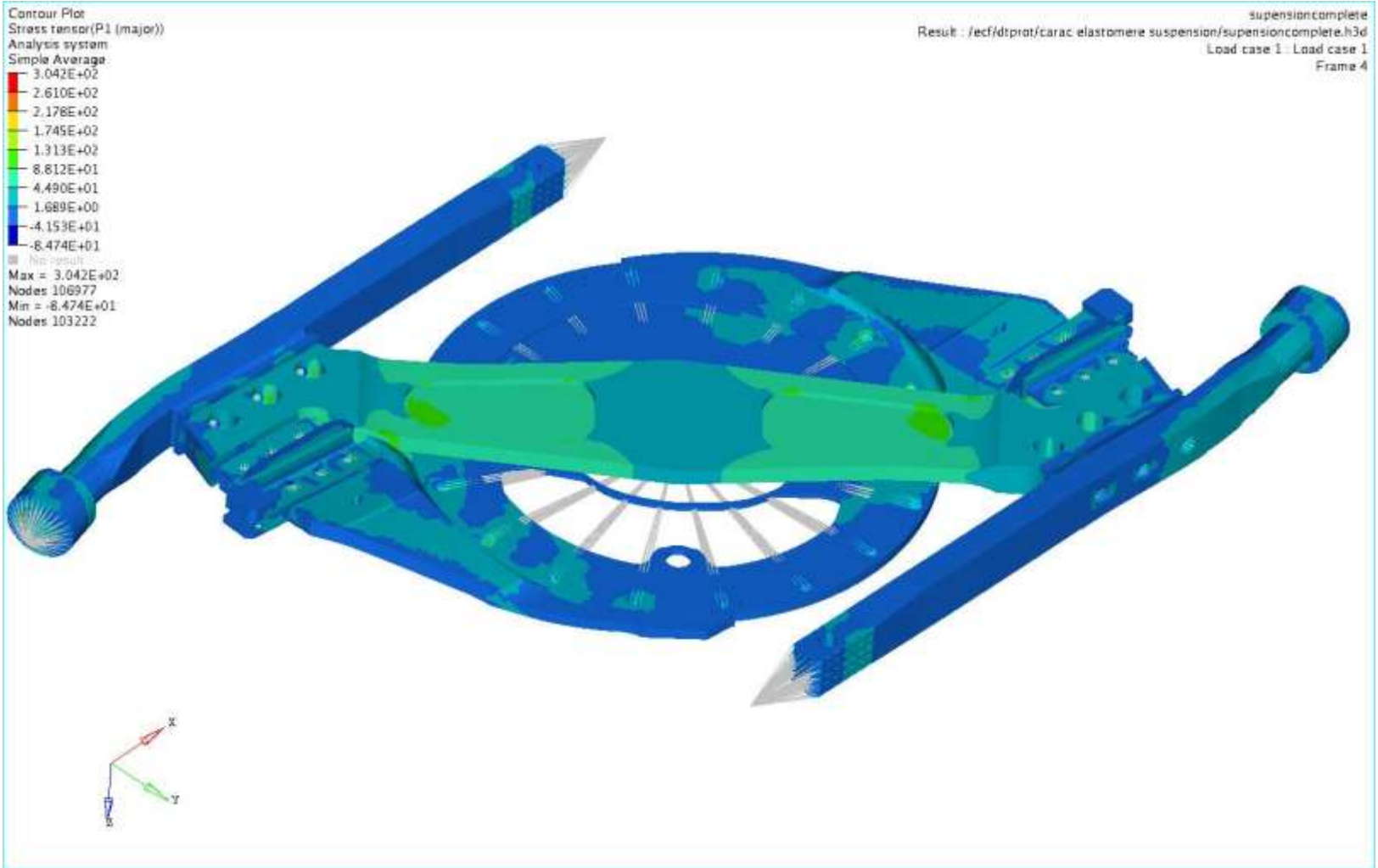
Numerical scale 1/5.359410



Y X

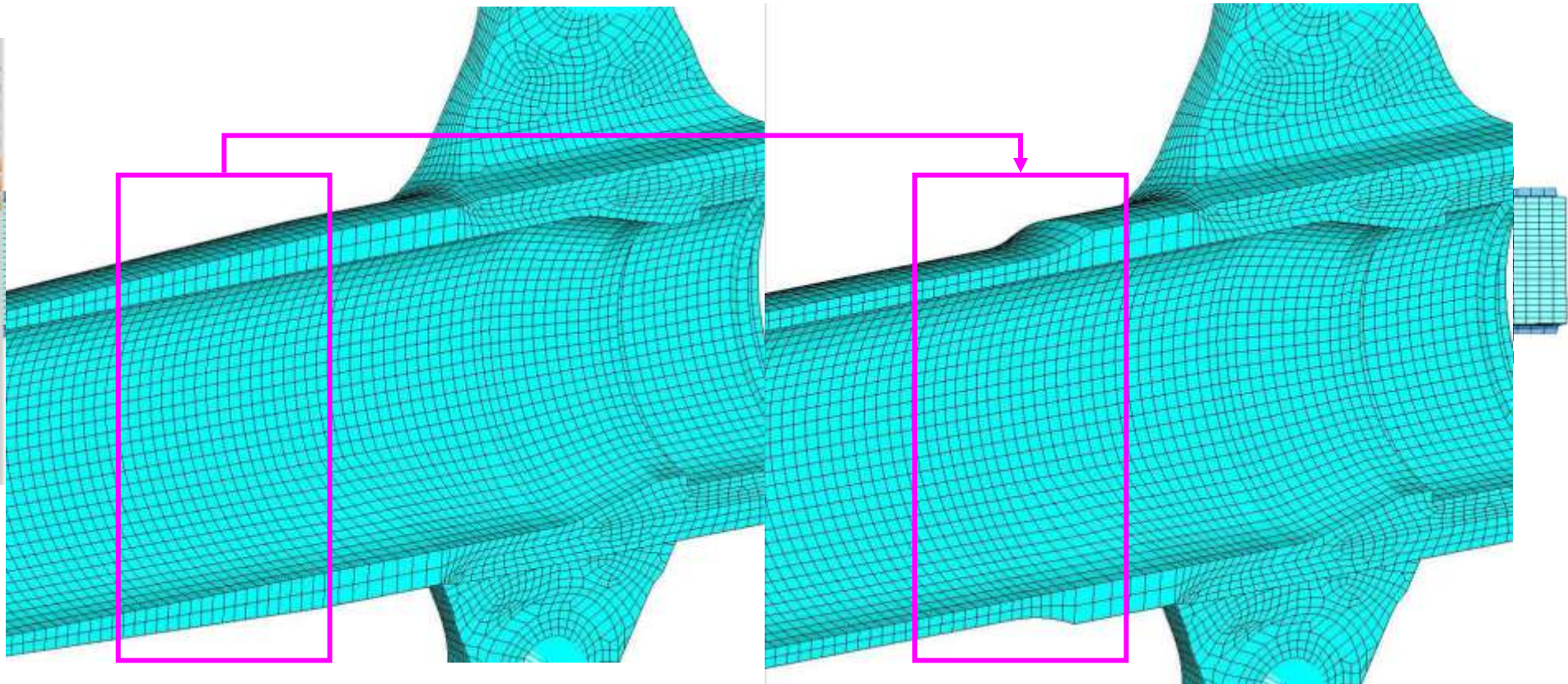
Industrial cases performed and feedback

Complex assembly (4/4)



Industrial cases performed and feedback

- Geometric update managed by Morphing process



Shape modification in 5 minutes by projection on new geometry.

Automatic parametric optimization (coupling with Hyperstudy)

Definition of shapes variables

Design variables

	On	Label	Variable Name	Model Parameter
▶	<input checked="" type="checkbox"/>	Rayon_bas_1	m_1_Rayon_bas_1	m_1.Rayon_bas_1
	<input checked="" type="checkbox"/>	Rayon_haut_1	m_1_Rayon_haut_1	m_1.Rayon_haut_1
	<input checked="" type="checkbox"/>	Rayon_conge_haut_1	m_1_Rayon_conge_ha	m_1.Rayon_conge
	<input checked="" type="checkbox"/>	Rayon_conge_bas_1	m_1_Rayon_conge_ba	m_1.Rayon_conge

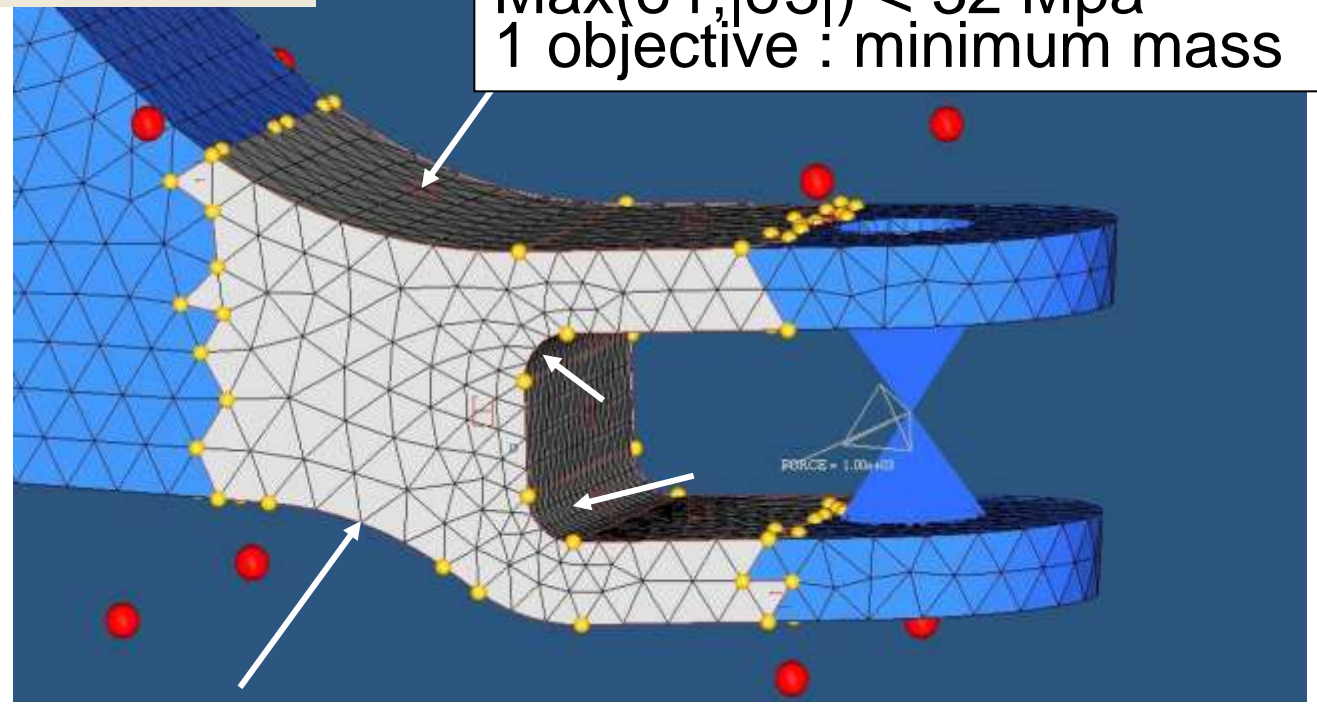
4 radius to optimize
1 constraint :
 $\text{Max}(\sigma_1; |\sigma_3|) < 32 \text{ Mpa}$
1 objective : minimum mass

Design variable properties

Type: Real
Mode: Discrete
Initial value: 0.000000
Lower bound: -4.000000
Upper bound: 2.000000
No. of levels: 13

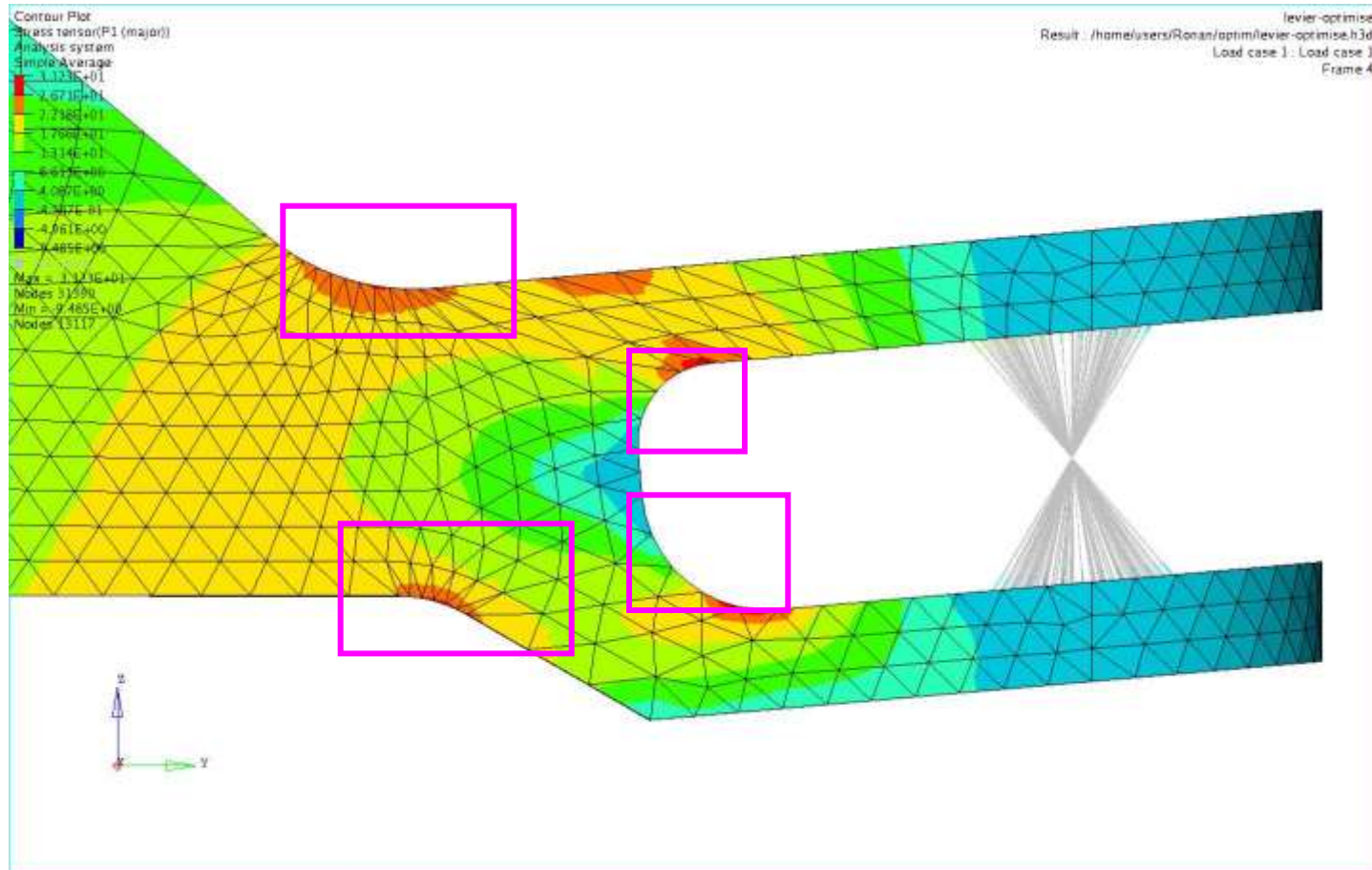
Value table

1	-4.000000
2	-3.500000
3	-3.000000
4	-2.500000
5	-2.000000
6	-1.500000
7	-1.000000
8	-0.500000
9	0.000000
10	0.500000
11	1.000000
12	1.500000
13	2.000000



Automatic parametric optimization

- 3% mass saving. Optimum solution in 19 iterations



□ Hypermesh / Samcef (Responsibility Altair)

- Contact and glue definition : v11.0
- Composite materials (shell and volumic) : v11.0
- Samcef file input reader : post v11.0 (patch)
- Non linear analysis : post v11.0 (patch)

□ Samcef / Hyperview (Responsibility Samtech)

- Sam2H3d v2 : metallic non linear analysis (November 2010)
- Sam2H3d v3 : Thermal and Composite (December 2010)

□ Development

- Altair and Samtech did demonstrate their capability to develop in a short time an interface with good quality level,
- Bugs are minors and fixes are fast : good reactivity of development team,
- Eurocopter appreciate that Altair engaged its own funds do develop interface without asking Eurocopter finance contribution,
- Eurocopter appreciate the partnership relation and technical comprehension of EC needs from Altair team.

Conclusion (2/2)

□ Industrial deployment and feedback

- About 50% of FE engineers have passed to HM/Samcef chain in 9 months,
- HM/Samcef main contributions up to now are :
 - **Consider bigger and more accurate simulation**
 - **Significant reduction of model preparation time**
 - **Exploit more and more Samcef facilities**
 - **Fast design iteration by use of morphing**
- Post treatment facility is new. First industrial cases show an ease of analysis.

□ Global feeling : in a couple of months, HM/Samcef chain demonstrated a very satisfactory efficiency, time saving ratio and increased our simulation skills.

The end ...

□ Questions and Answers

