

Stefan Jacques

MADSIS

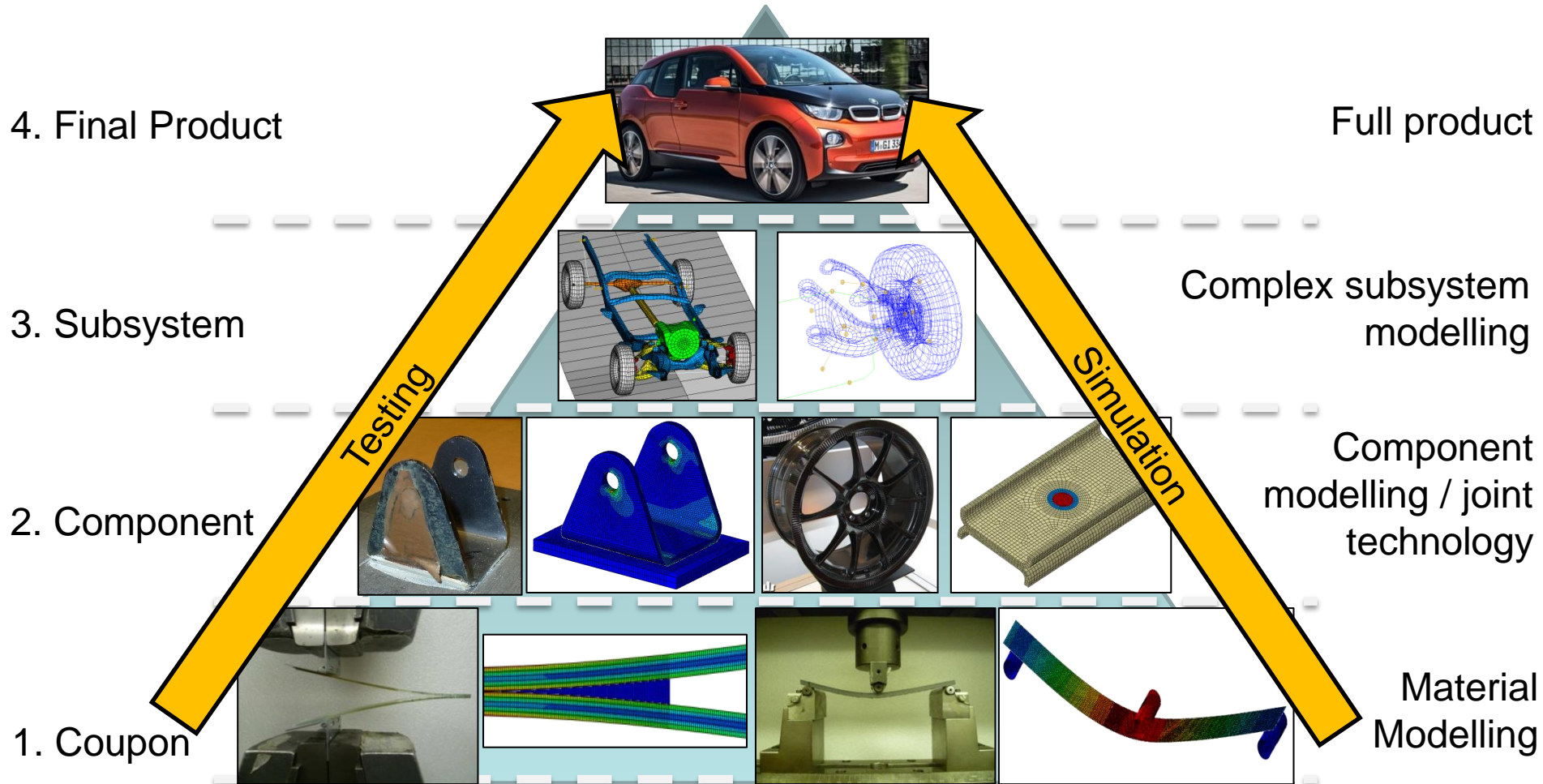
# P3Lab - Simulations

03/12/2014



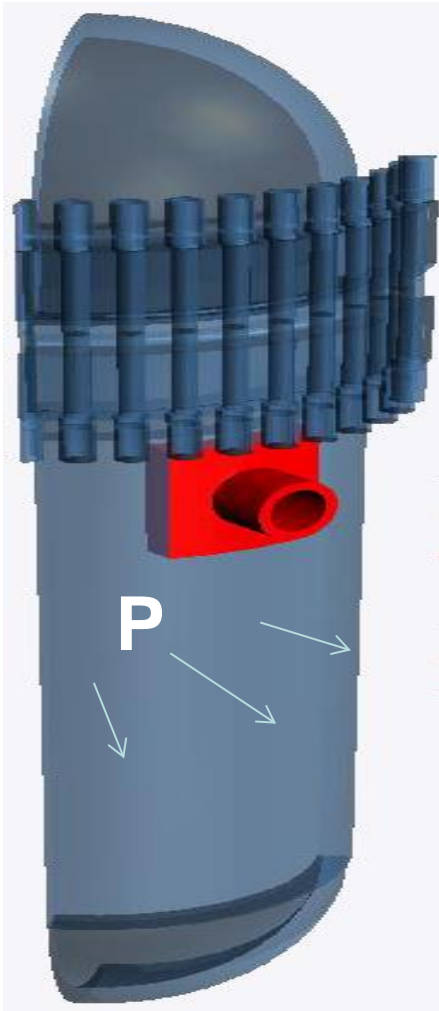
- Why / When use simulations?
- Conclusions
- What can MADSIS offer?
- MADSIM

# Design Process

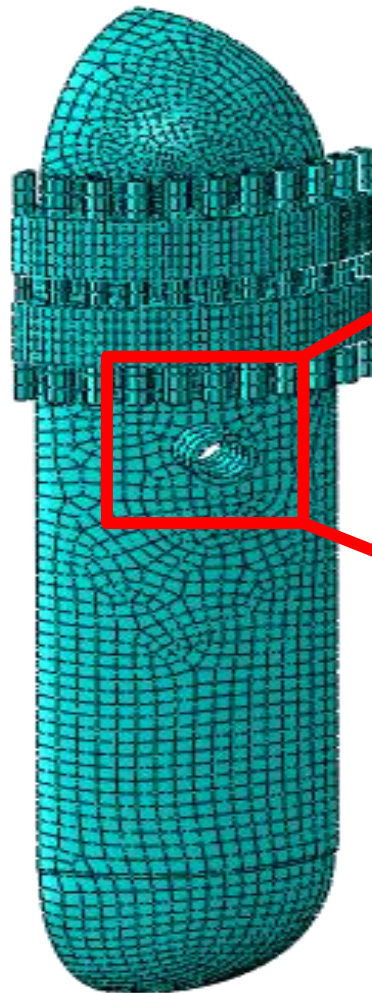


# Finite Elements

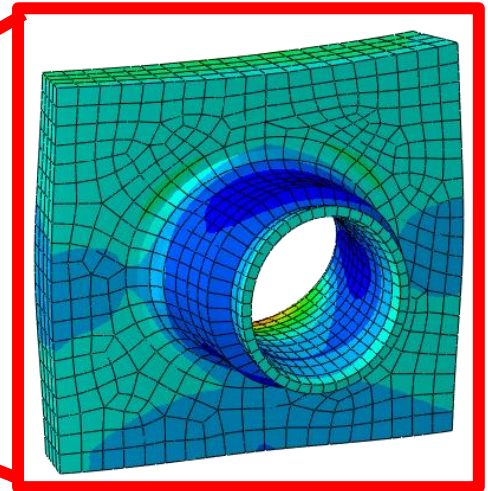
Study object



Mesh

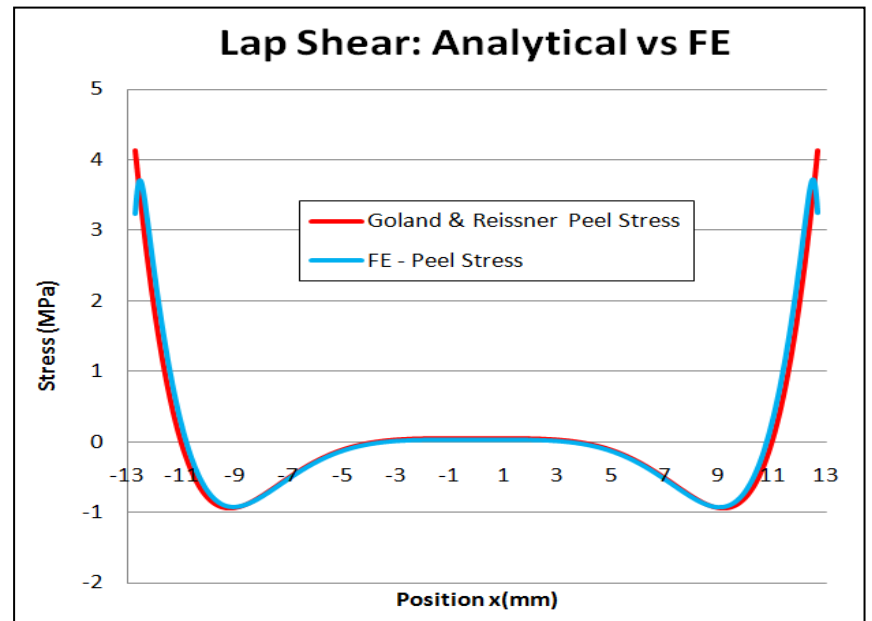
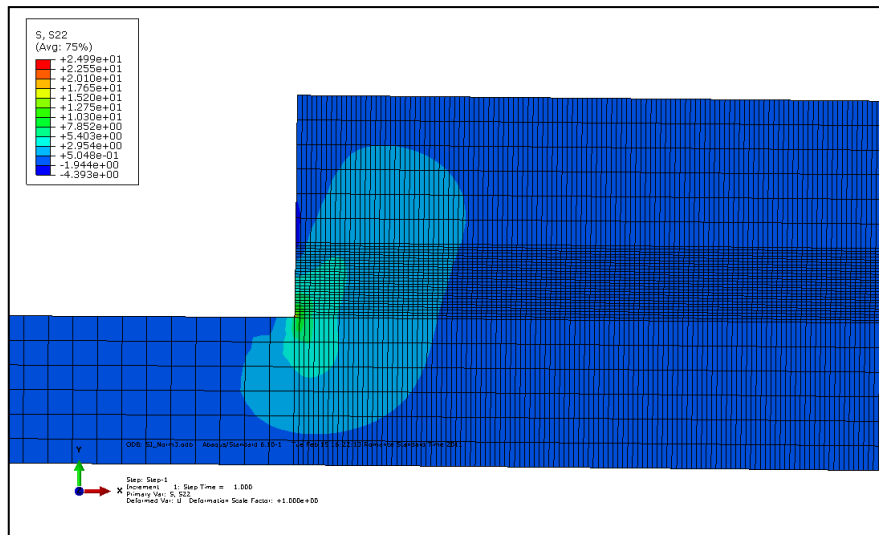
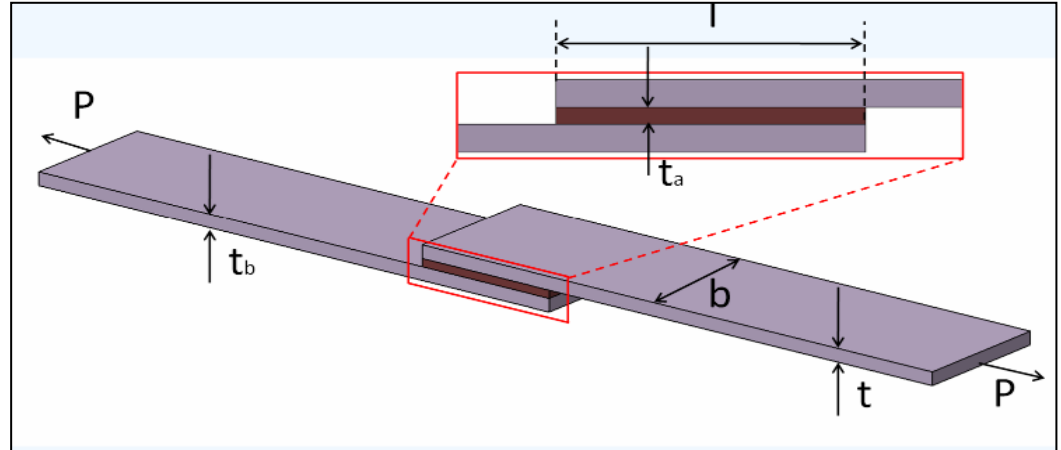
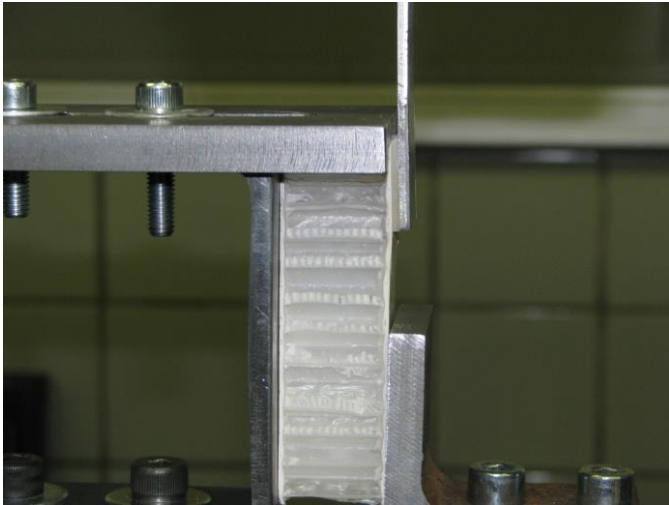


Results



Allowed stress (or force)  
Yes or No ?

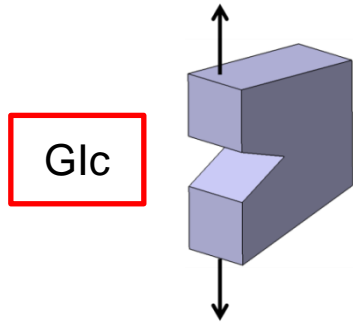
# 1. Material modelling



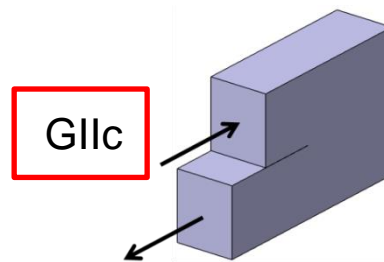


# 1. Material modelling

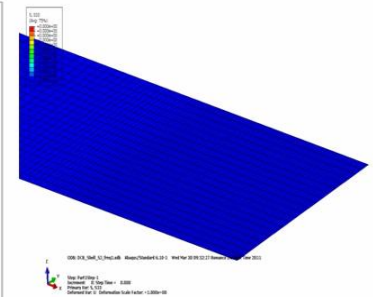
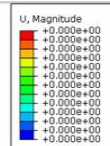
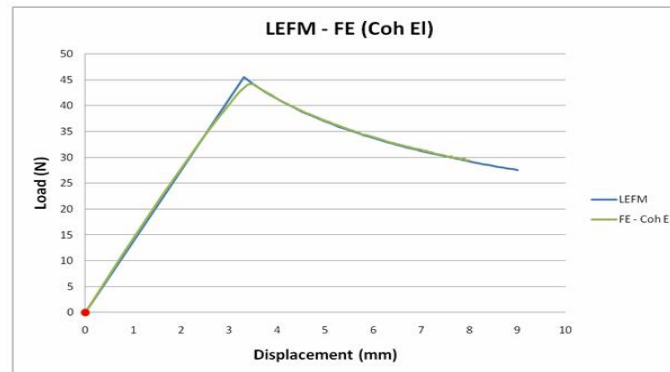
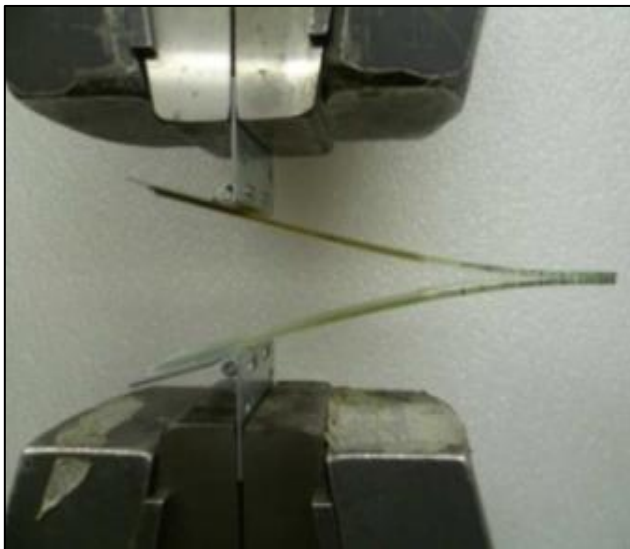
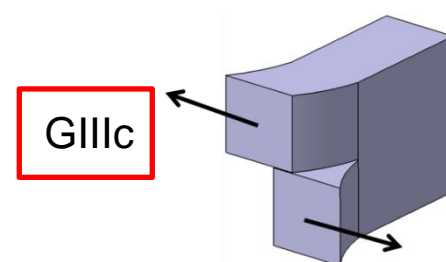
Mode I  
Interlaminar tension



Mode II  
Interlaminar sliding shear

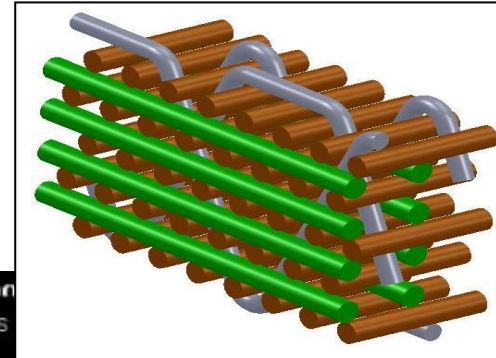
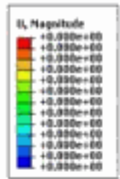


Mode III  
Interlaminar tearing shear



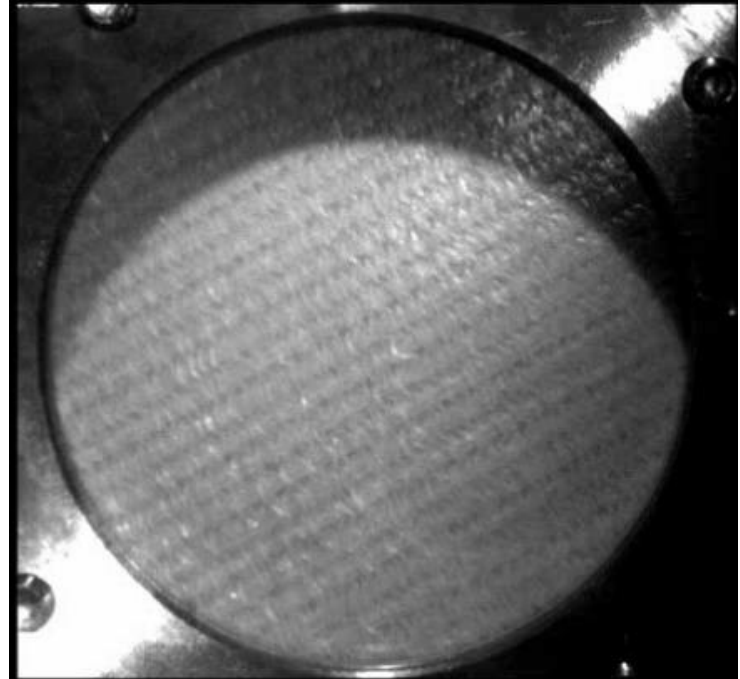
# 1. Material modelling

## Impact of 3D woven thermoplastic composite



Photron  
10000 fps  
Start

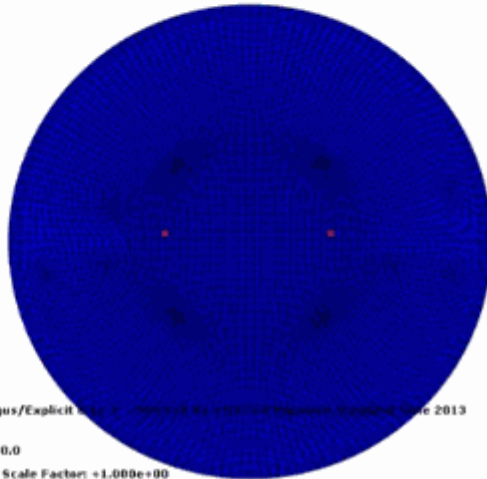
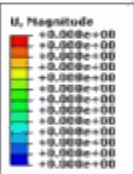
249



ODB: 3DLT\_Frac\_29.odb Abaqus/Explicit 6.12-1 Mon Feb 04 15:37:54 Reference Standard Time 2013



Step: impact  
Increment 0: Step Time = 0.0  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +1.000e+00  
Status Var: STATUS

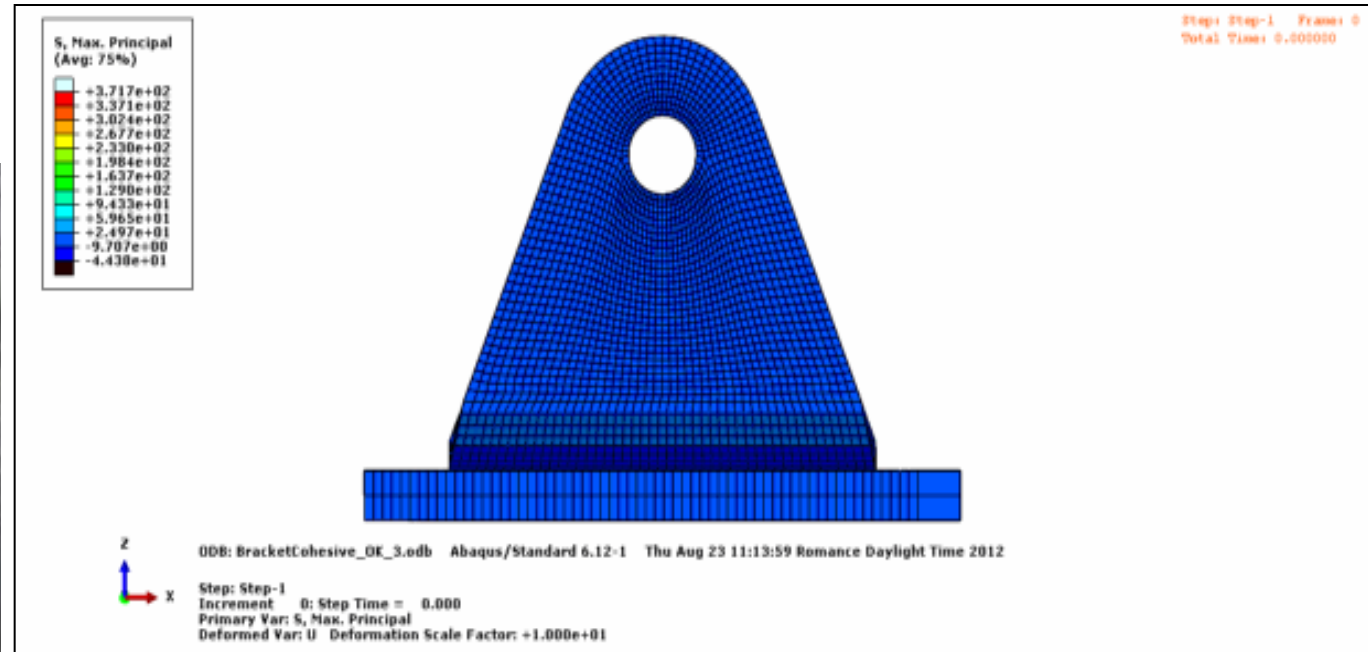
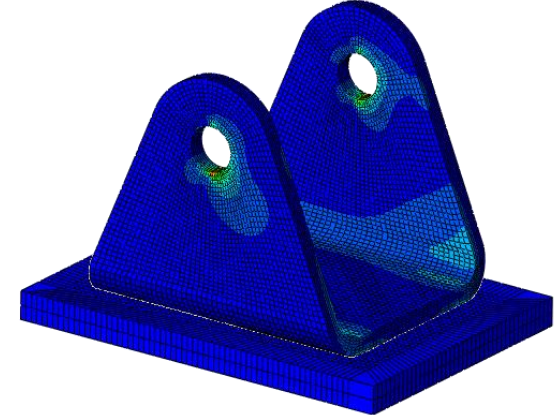
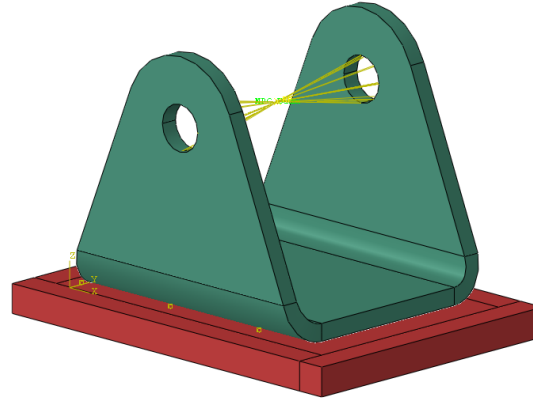


ODB: 3DLT\_Frac\_29.odb Abaqus/Explicit 6.12-1 Mon Feb 04 15:37:54 Reference Standard Time 2013



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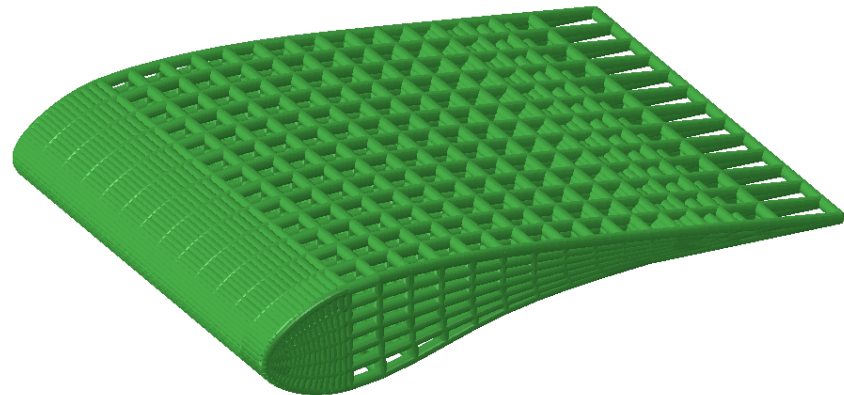
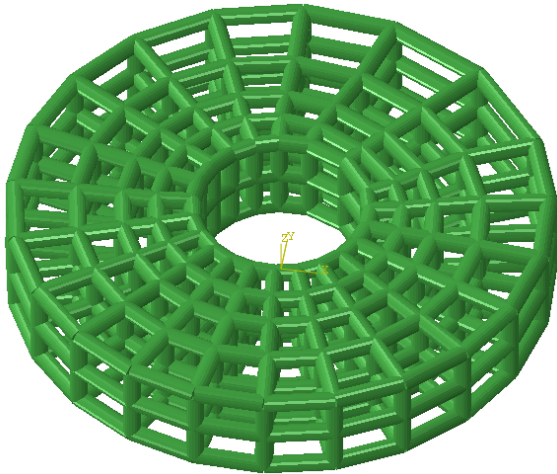
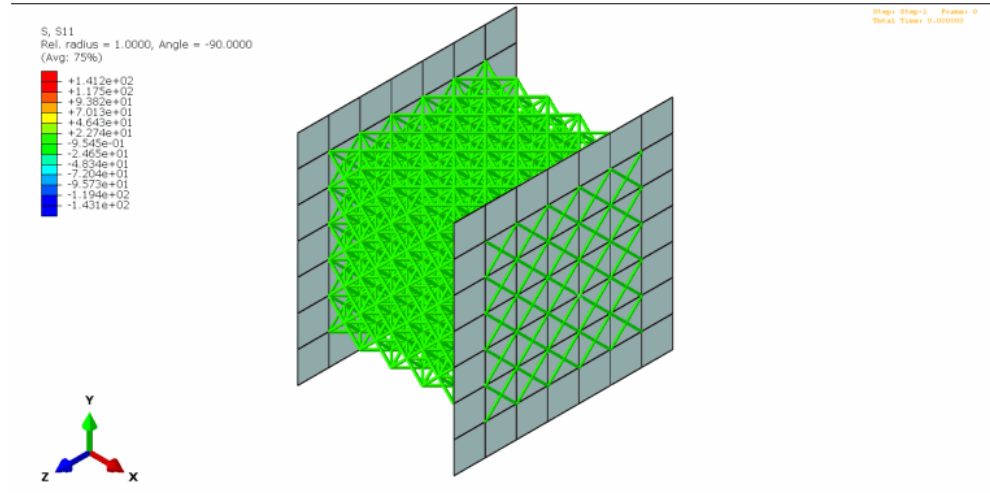
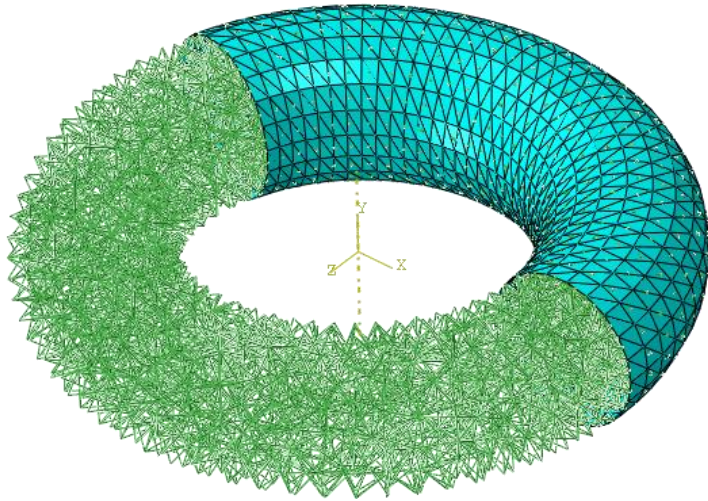
## 2. Joining techniques (e.g. adhesive)



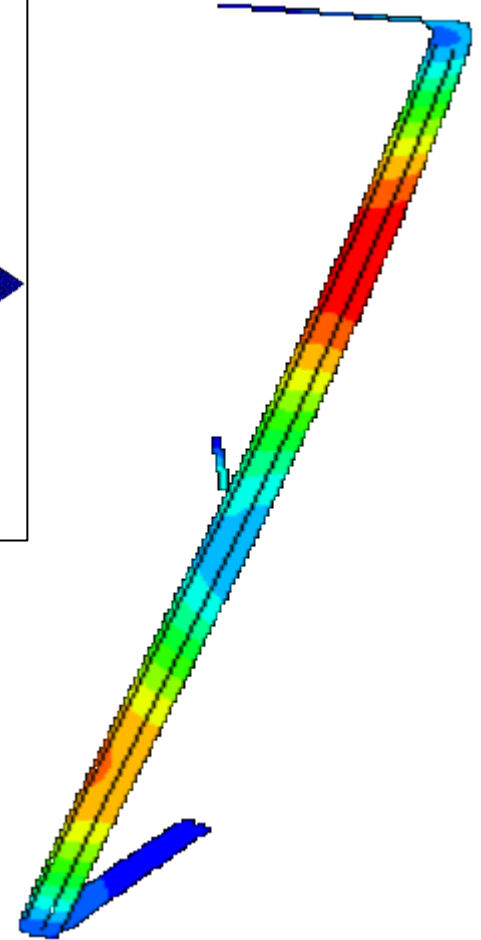
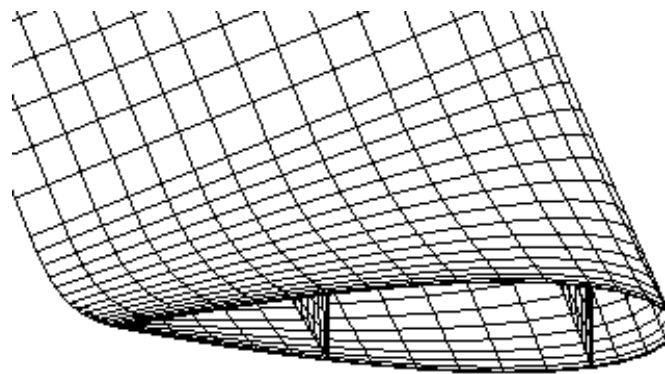
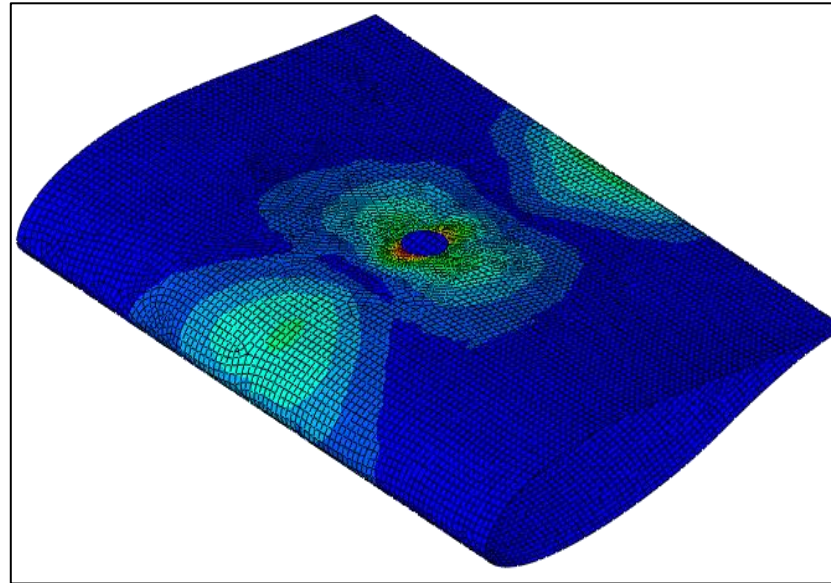


## 2. Component

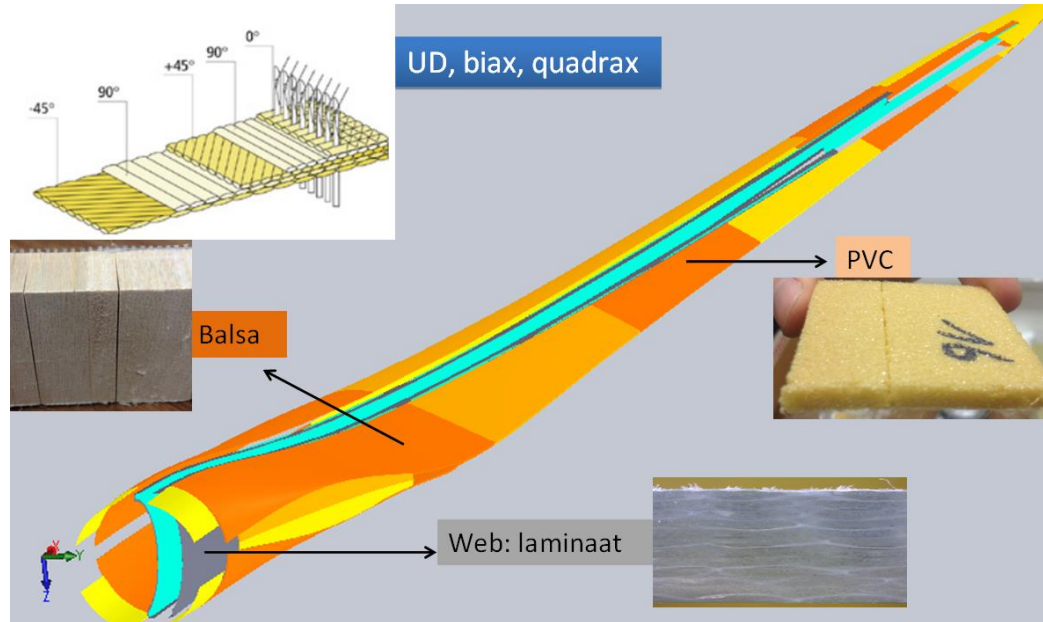
### Additive manufacturing: 3D printed Lattice structures



### 3. Subsystem



# 3. Subsystem



Strain Factors

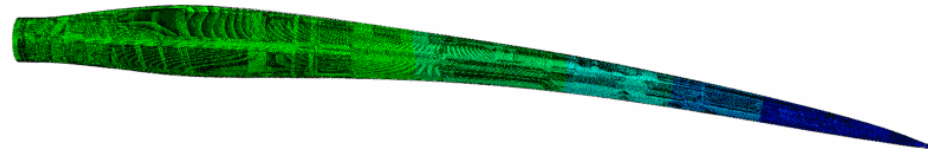


Strain Factors -1.00



OSIR: RBE-Freq.445 - Abaqus/Standard 6.10.0 - P:\Jun 05 10:13:59 Waa-Fusae (james) (2012)

Step: Step 5  
 Mass: 1.0 Value = 13.801 Freq = 0.78802 (cycles/time)  
 Period: 1.2800 (cycles/time)  
 Default Unit: N Determination Scale Factor: +1.000e+02



OSIR: RBE-Freq.445 - Abaqus/Standard 6.10.0 - P:\Jun 05 10:13:59 Waa-Fusae (james) (2012)

Step: Step 5  
 Mass: 1.0 Value = 13.801 Freq = 0.78802 (cycles/time)  
 Period: 1.2800 (cycles/time)  
 Default Unit: N Determination Scale Factor: +1.000e+02

## 4. Final product

### Design vs Manufacturing

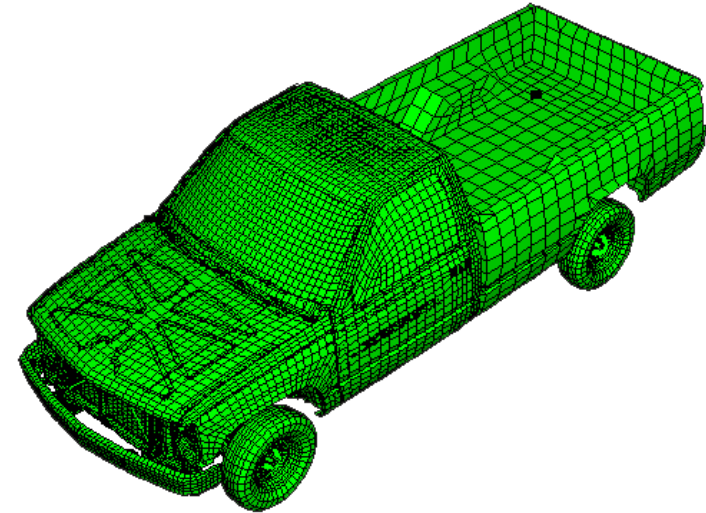
- Reduce scraps
- Cost

### Optimization of Components

- Shape
- Mass

### Damage tolerance

- In service or in production
- What is the influence of defects on the component?



Simulia - Abaqus



## ***Advantages of simulations:***

Accelerates the design process and thus the time to market

A different load  $\neq$  new prototype or test

Reduces the number of tests needed

Reduces the number of prototypes

Makes analyses of complex shapes possible

→ **Reduces the cost**

## ***Disadvantages:***

The need of skilled engineers

Cost of licenses (CAD/FE/...)

## **MA**aterials – **D**esign – **SI**mulations – **S**oftware

MADSIS offers high-quality, efficient and cost-effective consulting services that will accelerate the design process, reduce its cost and shorten your time-to-market.

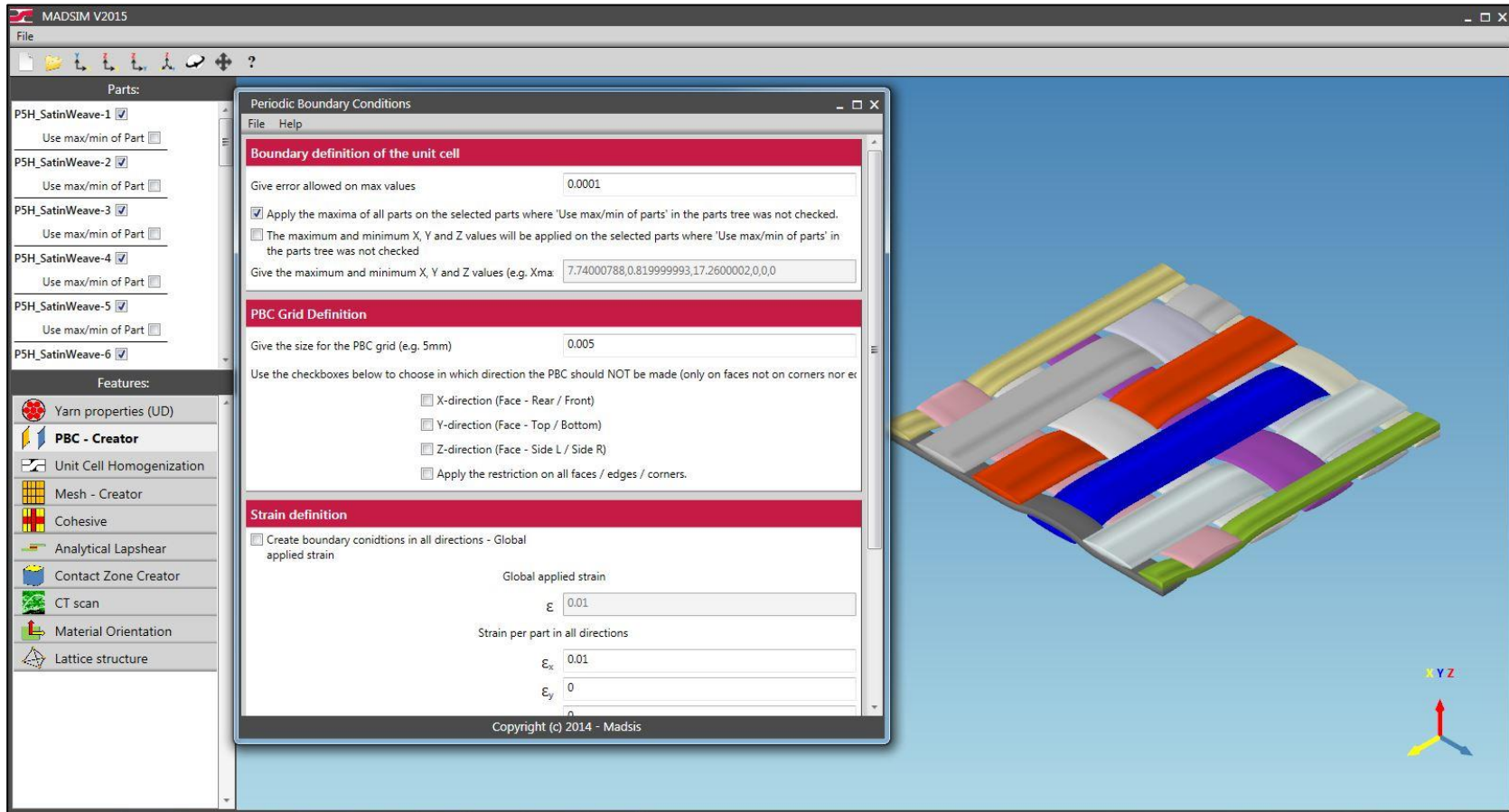
Consultancy

Software

Training

- ⇒ Entire design from CAD to Drawing
- ⇒ Finite Element Analysis (static, dynamic) and analytical analysis
- ⇒ All materials: metals, polymers, composite materials
- ⇒ Adhesive bonding simulations
- ⇒ Failure and damage tolerance analyses
- ⇒ Optimizations (shape, topological...)
- ⇒ Techniques and Instrumentation
- ⇒ Customized software development (scripting and stand alone software)
  - ⇒ Pre / Post processing
- ⇒ Project management

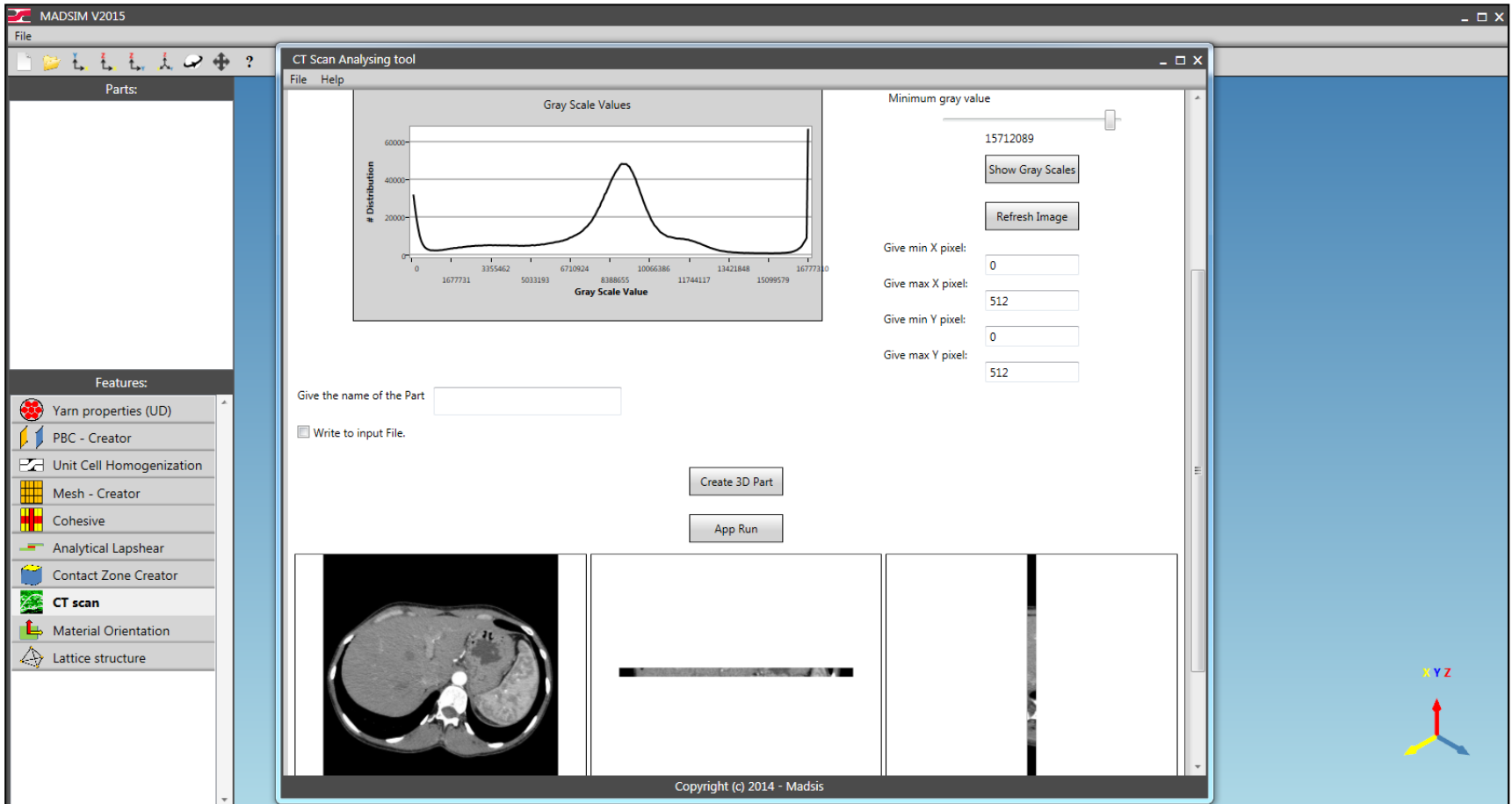
## Meso-scale modelling of composites → Elastic properties



MADSIM = efficient pre-processor

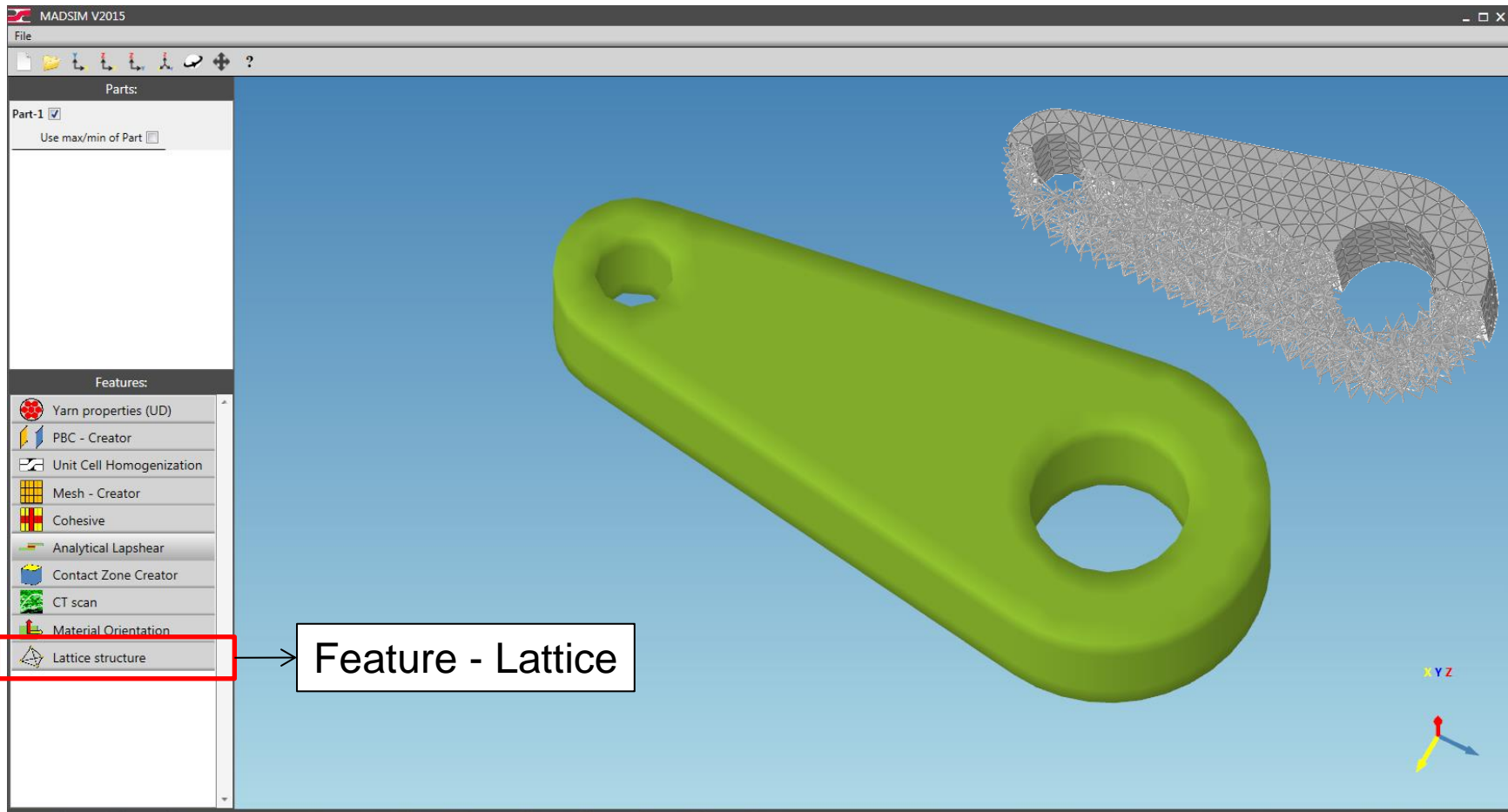


## CT Scan analysis



The screenshot displays the MADSIM V2015 software interface. On the left, a sidebar lists various features: Yarn properties (UD), PBC - Creator, Unit Cell Homogenization, Mesh - Creator, Cohesive, Analytical Lapshear, Contact Zone Creator, **CT scan** (highlighted), Material Orientation, and Lattice structure. The main window is titled "CT Scan Analysing tool" and contains a "File" menu and a "Help" button. The central area features a "Gray Scale Values" histogram showing a distribution of pixel intensities. To the right of the histogram, there are input fields for "Minimum gray value" (set to 15712089), "Give min X pixel:" (0), "Give max X pixel:" (512), "Give min Y pixel:" (0), and "Give max Y pixel:" (512). Below these fields are buttons for "Show Gray Scales" and "Refresh Image". A text input field for "Give the name of the Part" and a checkbox for "Write to input File." are also present. At the bottom of the tool window are buttons for "Create 3D Part" and "App Run". The bottom section of the interface shows three preview windows: a cross-sectional CT scan image of a liver, a horizontal line profile, and a vertical line profile. A 3D coordinate system (XYZ) is visible in the bottom right corner. The copyright notice "Copyright (c) 2014 - Madsis" is displayed at the bottom center.

## 3D printed Lattice structures



# Thank you for your attention

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