Simpleware: 3D Image Data to Simulation
NAFEMS

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Introduction to Simpleware

Image-based modelling and workflow

Software overview

New features for 2016.09

Simpleware Case studies

Summary
Why Did Synopsys Acquire Simpleware?

The acquisition of Simpleware represents Synopsys’ entry into new markets where the simulation of complex 3D structures addresses product design and data analysis applications in the life sciences, consumer products, aerospace, automotive, defense, oil and gas industries.

- Synopsys has preserved Simpleware’s current product development focus, technical support and sales infrastructure
- Synopsys is adding resources to accelerate product innovation
- Dr Philippe Young continues to lead R&D and technical support

[Synopsys Completes Acquisition of Simpleware](http://news.synopsys.com/2016-05-17-Synopsys-Completes-Acquisition-of-Simpleware)
Simpleware Product Group

Developers of industry-leading software solutions for the visualisation and analysis of 3D image data

- Pioneers in image-to-mesh techniques to generate simulation-ready models of highly complex structures
- Over 130 customers worldwide, supported by global sales channel
- Award winning software solutions and services
- Expertise in Life Sciences, Materials / Industrial Engineering, and applications to Oil and Gas, Automotive / Aerospace and Consumer Product design
- Skilled services team for development of customized models
- Dedicated training on-site or in our offices
- Excellent support & guidance via web, email and phone
Need for Image-based Modeling and Simulation is Rising

• Fast adoption of 3D imaging technology
  – Captures external and internal features,
  – Industrial and medical settings

• Driven by the demand for more realistic simulation
  – Expanding capability of FEA/CFD codes,
  – Ever increasing access to high specification hardware,
  – Allow the study of true topology, structures and materials

• Leading to a growth in image based inspection and simulation
Simpleware Products Bridge 3D Imaging and Simulation of Complex Objects and Shapes
BIG Disconnect: Trying to use CAD-Based Meshing on Something that is NOT CAD

Lost Opportunity for Simulation Use and Workflow Adoption

CAE Group
Original Part to Model
Original Part
CT Scan
Imaging Group

Not able to create FE mesh
3D Image Data
STL Meant for Basic Visualization

Original Part
Original Part

3D Image Data
With Simpleware You Go Directly from Segmented 3D Image Data to High Quality and Robust FE Mesh

CAE Group

Original Part to Model

Original Part

CT Scan

Imaging Group

NURBS (IGES)

STL

3D Image Data
With Simpleware You Go Directly from Segmented 3D Image Data to High Quality and Robust FE Mesh
Enhanced Volumetric Marching Cubes

1. Original greyscale image

2. Mask segmentation and EVoMaC surface (yellow)

3. Remeshed surface with larger edge lengths (orange)
   Note – differences not to scale

4. Snap to parent applied to move coarser mesh back to EVoMaC position (green)
Simpleware meshing workflow
Simpleware meshing workflow
Mesh Control

- Mesh setting
  - +FE Grid
  - +FE Free -10
  - +FE Free -25
  - +FE Free -50
  - +FE Free custom

<table>
<thead>
<tr>
<th>Mesh setting</th>
<th>+FE Grid</th>
<th>+FE Free -10</th>
<th>+FE Free -25</th>
<th>+FE Free -50</th>
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<tbody>
<tr>
<td>No. of Elements</td>
<td>11.636M</td>
<td>2.844M</td>
<td>1.093M</td>
<td>816k</td>
<td>503k</td>
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<td>Porosity [%]</td>
<td>16.83</td>
<td>16.82</td>
<td>16.82</td>
<td>16.82</td>
<td>16.81</td>
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</tbody>
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Shared nodes → Matching interfaces → Accurate meshing
Automotive Applications

• Reverse Engineering
  – Rapidly and accurately reverse engineer legacy parts
  – Scans of parts can be visualized, segmented, quantified and exported for Additive Manufacturing (AM) or exported as multi-part FE/CFD meshes.

Original Part

Visualization, CAD/FE/CFD Model Generation, Measurements etc.
Automotive Applications

- **Non-Destructive Evaluation/Analysis**
  - Inspect defects and changes in density
  - Crack size/length and distribution
  - Surface Characteristics
  - Exported model as NURBS for CAD, or as FE and CFD models for analysis of the effects of cracks or porosity on part performance.

Original Part

Visualization, Defect Quantification, CAD/FE/CFD Model Generation
• *Composite Fasteners*
  
  - Fasteners scanned by Microphotonics using a SkyScan CT Scanner
  - Non-Destructive Evaluation of potential Porosity, Microcracks, & Defects

Courtesy of collaborative project with FCA US LLC
• **Composite Fasteners**
  - Fasteners scanned by Microphotonics using a SkyScan CT Scanner
  - Non-Destructive Evaluation of potential Porosity, Microcracks, & Defects

Defects and Pores not only visualized and quantified, but also **incorporated into FE Mesh**

Courtesy of collaborative project with FCA US LLC
Automotive Applications

- **Materials Characterization**
  - Pore-Scale Flow, Composite Analysis, Quantify porosity/defects/tortuosity and homogenization to calculate effective material properties

  CT, MicroCT or nanoCT scan of Material

  Visualization, Tortuosity, Pore/Crack Size and Distribution Statistics, FE/CFD Simulation, Homogenization etc.
+FE module

- Range of dedicated export formats to major solvers
Summary

Simpleware provides complete 3D image-based software solution to

• ...generate high quality and adaptable **3D image based models** easily and rapidly (STL, NURBS and FE Meshes).
• ...have a software platform to aid with
  – Reverse Engineering
  – Material Characterization
  – Porosity/Defect/Crack Quantification (NDA)
  – Visualization & Measurement
  – FE/CFD Volumetric Meshing
  – Many more applications…
• ... enable the full use of imaging hardware to extract the most value out of the 3D image data it generates
• ... enable synergy between analysts and imaging expert groups to build fast and efficient workflows
Thank You