

2015 SIMULIA Community Conference

Simpleware & Abaqus: Bridging 3D Image Data & Realistic Simulation

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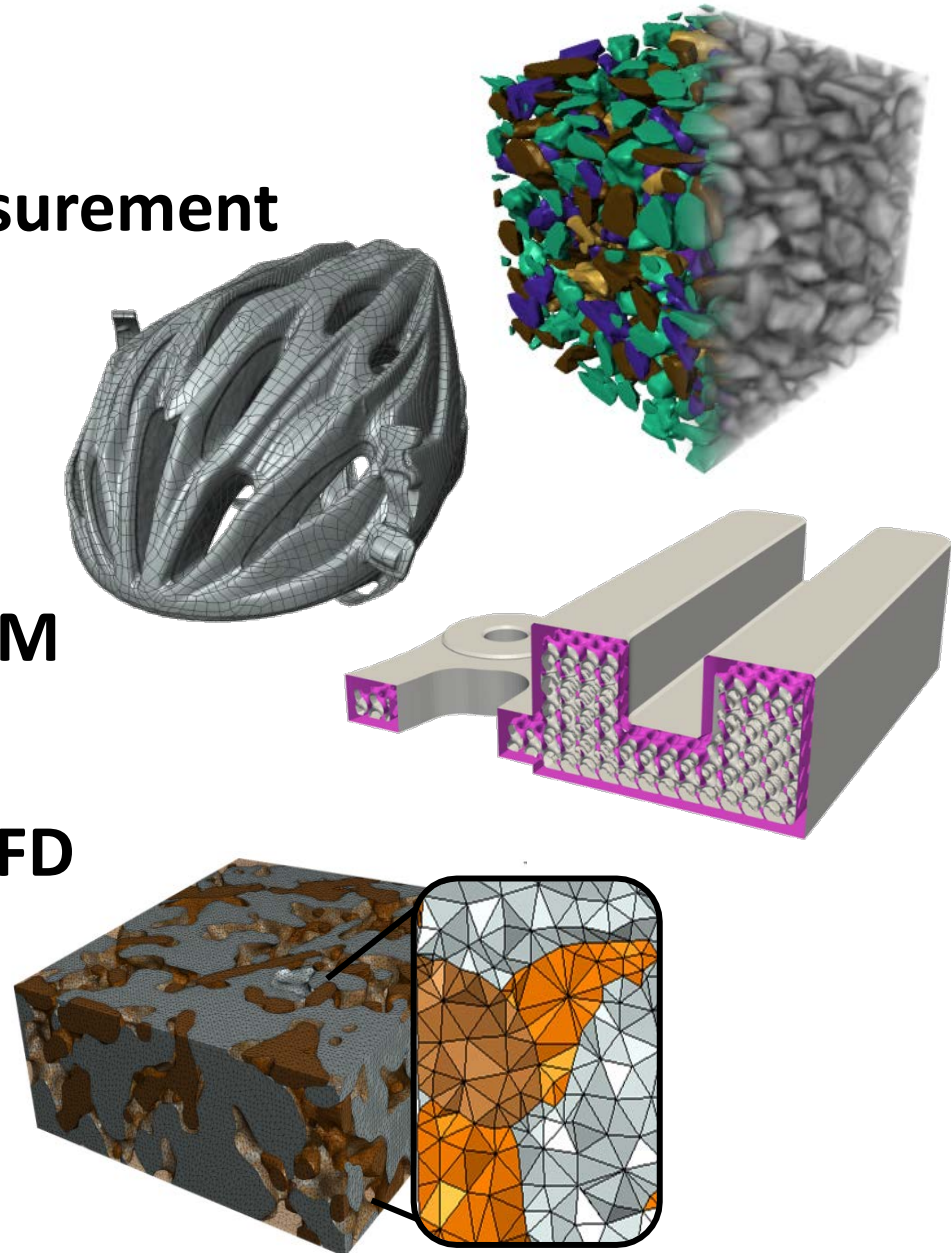


3D Image based Simulations



SIMPLEWARE WORKFLOWS

- Visualisation & Measurement
- 3D Image to CAD
- 3D Image / CAD to AM
- 3D Image to FEA & CFD



Presentation overview

Company Values

Image-based modelling

Applications

Summary

Simpleware: Our Values

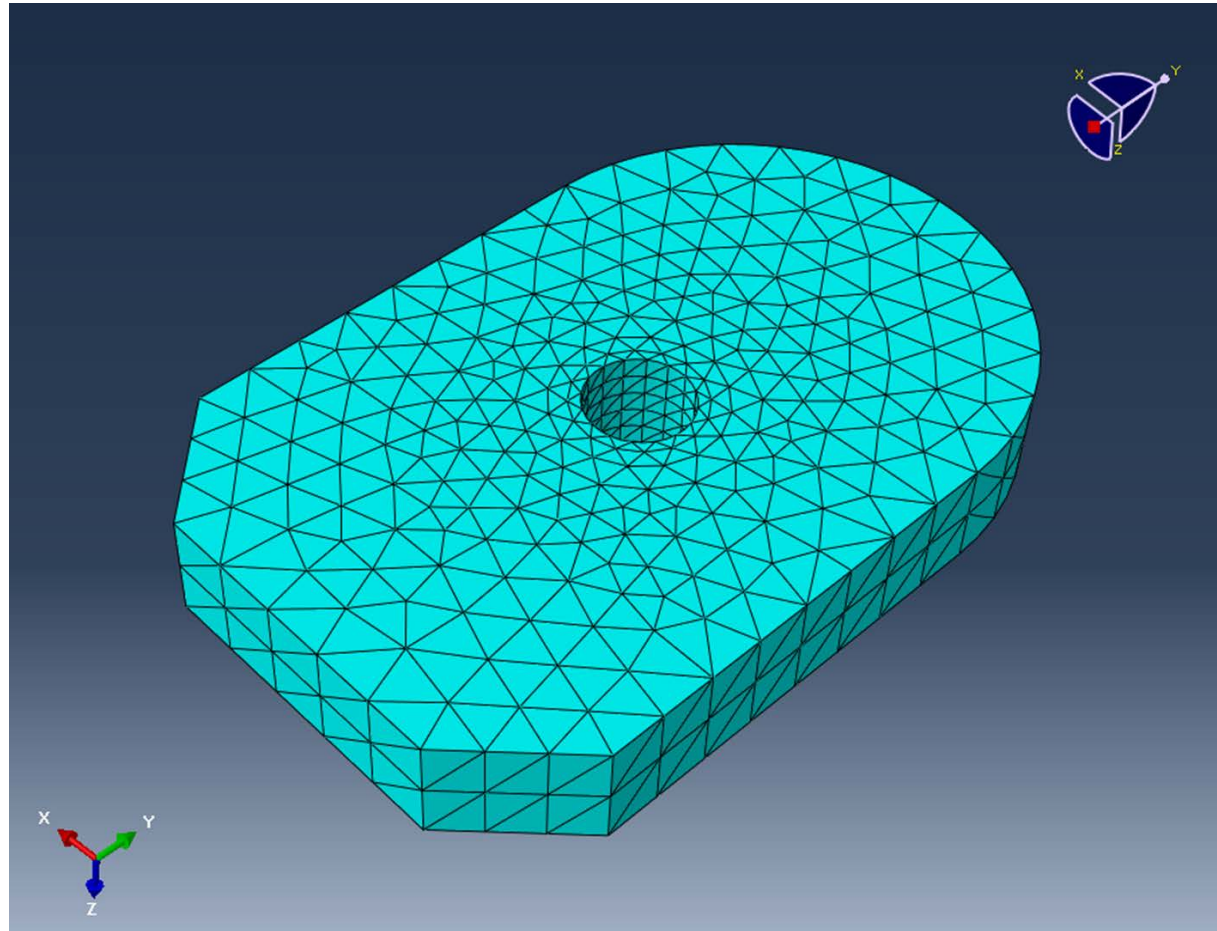
We deliver industry leading Solutions for creation of 3D Image based models and simulations

- Key inventors in image-to-mesh techniques to generate simulation ready models of highly complex structures
- Worldwide customer base supported by global sales channel
- Offer software & services
- Expertise in Materials/Composites, Oil & Gas/Geo-Technics, NDE, Reverse Engineering, NDE, Life Sciences & 3D Printing, Automotive
- Develop customised models with a skilled services team
- Dedicated training on-site or in our offices
- Enjoy the best possible technical support & guidance via web, email and phone



CAD vs Image based Simulations

- Typical CAD to FEA workflow



CAD v Image based Simulations

- How do you build models from pixels?

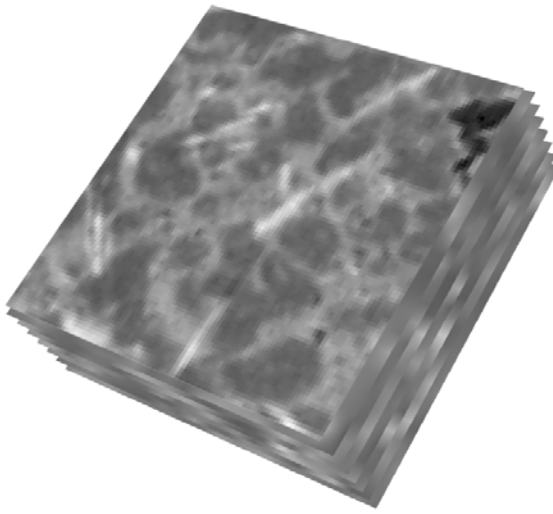
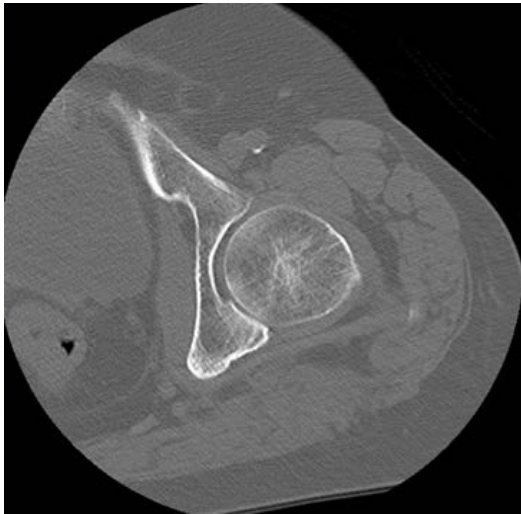
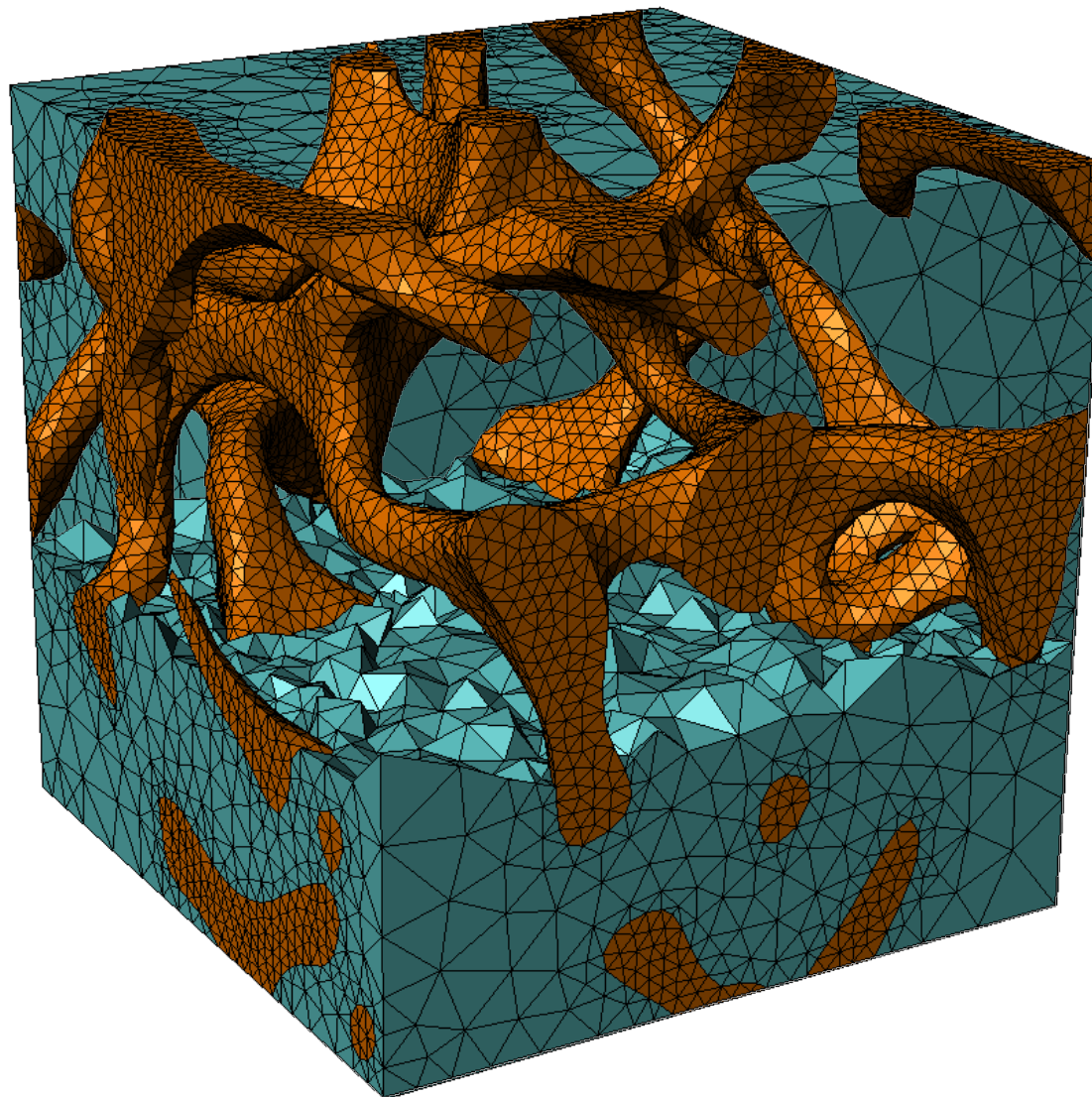


Image-based meshing workflow



Background → Industry Drivers

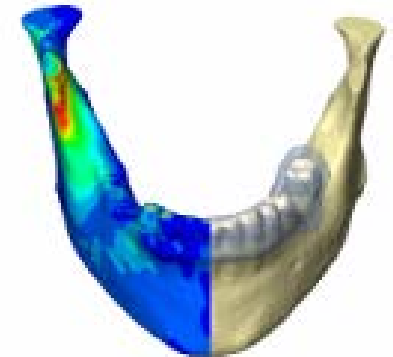
- Growth in 3D Imaging technology
 - Broad Industrial & Medical acceptance
 - Captures both external and internal features



- Increase FE/CFD analysis
 - Capabilities of commercial codes
 - Increased adoption in industrial and medical device (**FDA**) applications

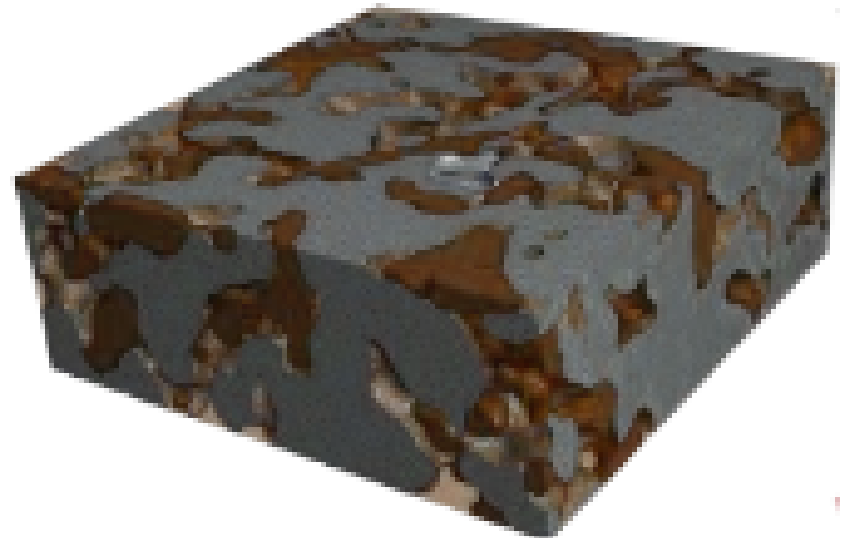
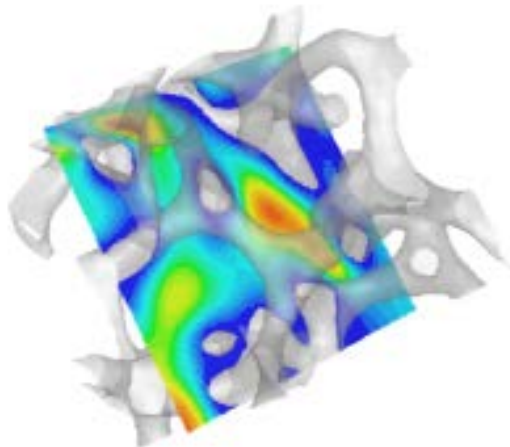
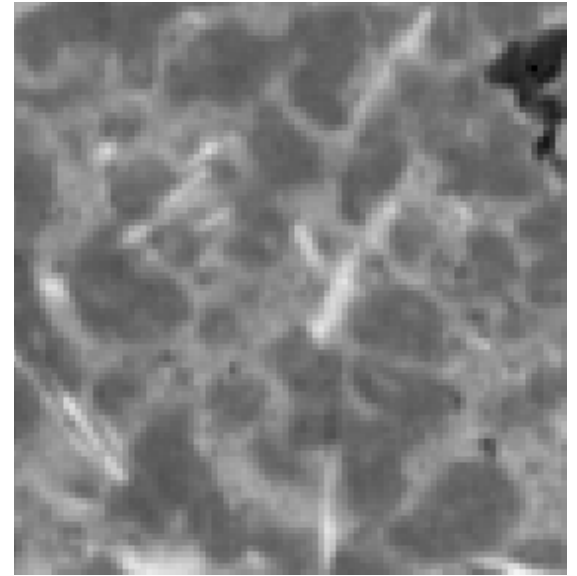


- Demand for more realistic simulation
 - Study the true topology, structure and materials
 - Model the world as it is !



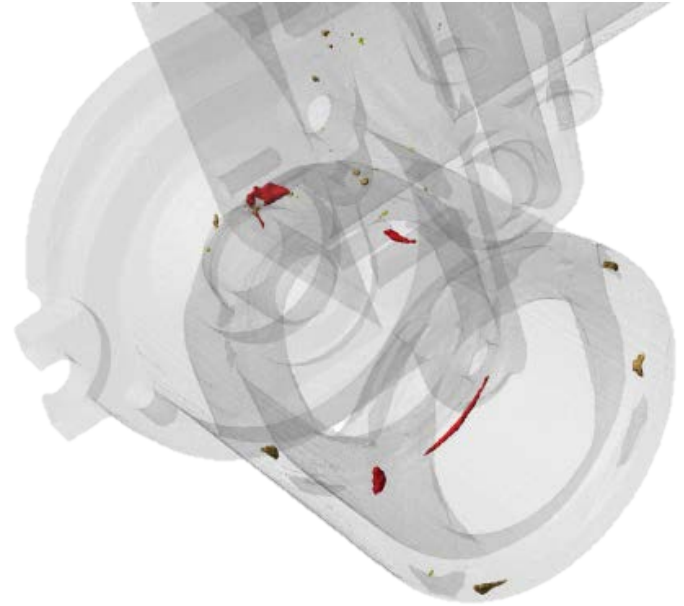
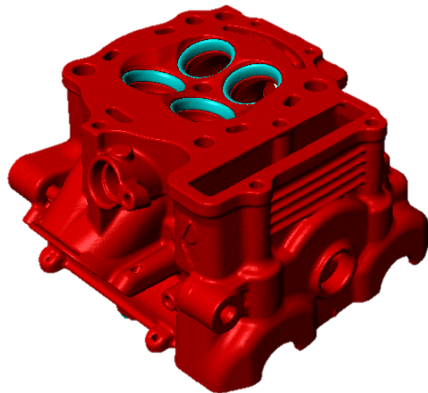
Materials, composites and geotechnical applications

- Oil and gas core analysis
- Non-destructive testing and evaluation (NDT/NDE)
- Material characterisation
- Pore-scale fluid flow
- Composite analysis
- Battery/fuel cells
- Asphalt mixtures



Reverse engineering applications

- Non-destructive testing and evaluation (NDT/NDE)
- Legacy parts
- As-built parts
- Competitor components
- Manufacturing defects
- Damage inspection
- Quality control

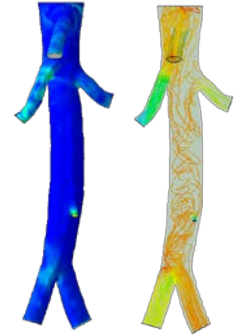
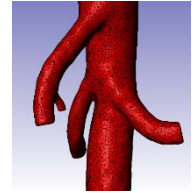
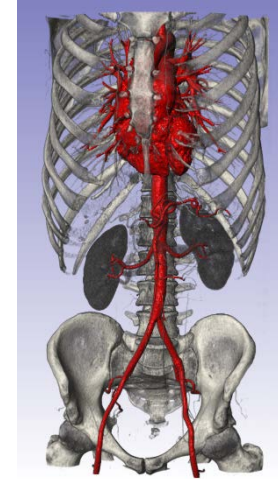


Life sciences applications

Generic body models

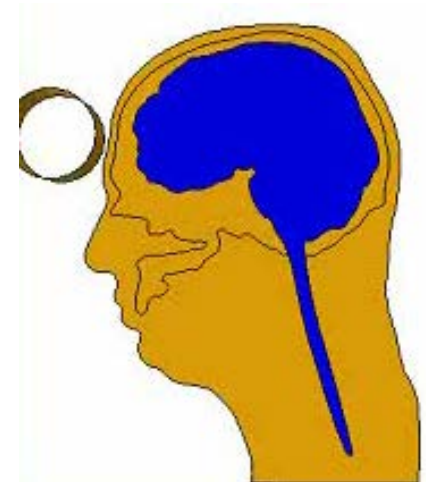
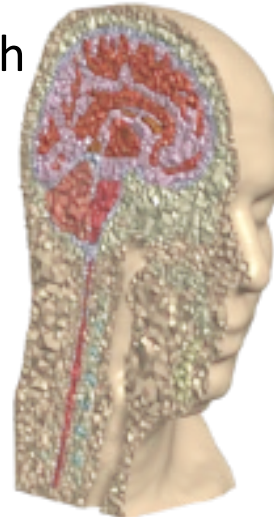
Patient specific models

- Implant design & analysis
- Orthopaedics, stents, electrical stimulators
- Musculoskeletal modelling
- Physiological flows (airways/vessels)



Interaction with consumer products

- Combining image based models with CAD for range of products
- Protective clothing
- Contact lenses
- Seating
- Cell phones, headphones etc.



Import



CT



MRI

Process



μ CT, nCT



FIB-SEM

Visualise

Analyse



Serial sectioning



Confocal microscopy

Export

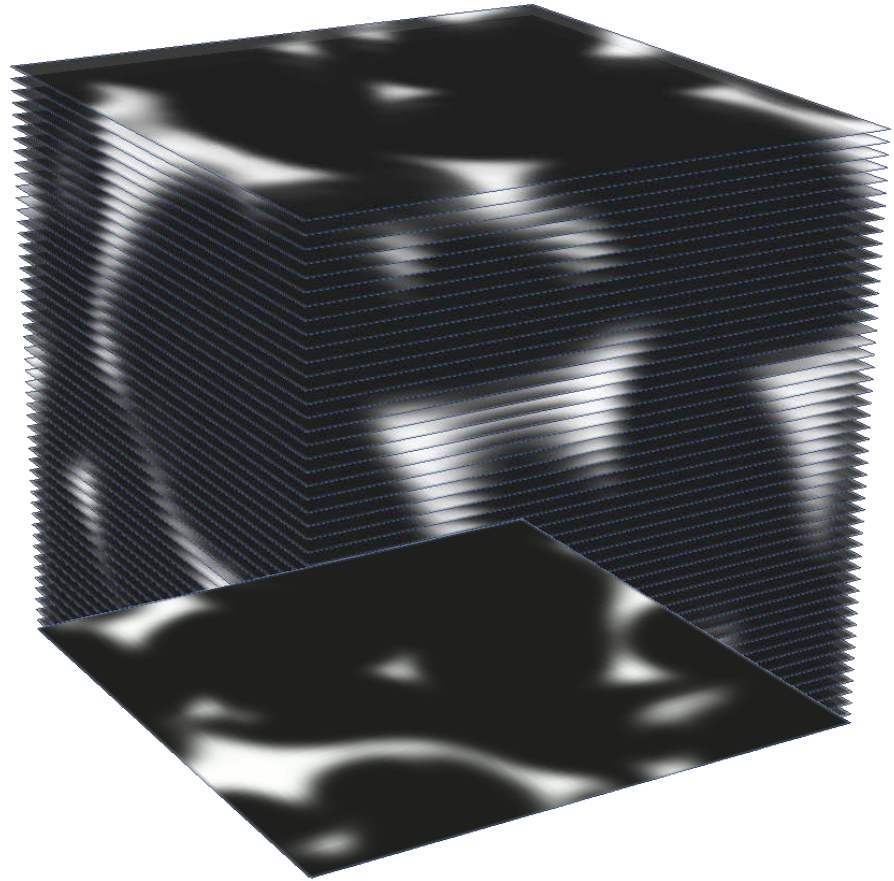
Import

Process

Visualise

Analyse

Export



Import

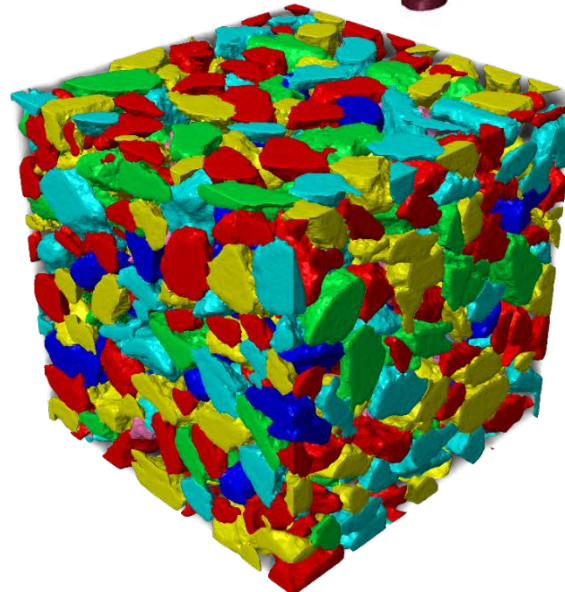
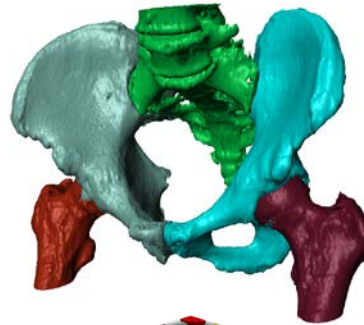
Process

Visualise

Analyse

Export

- Wide range of image filters and transforms
- Manual and automated segmentation tools to define regions of interest
- Mask filters to defeature, smooth and fix regions
- 3D editing tools
- Scripting and macro recording (Python/ C# etc.)



Import

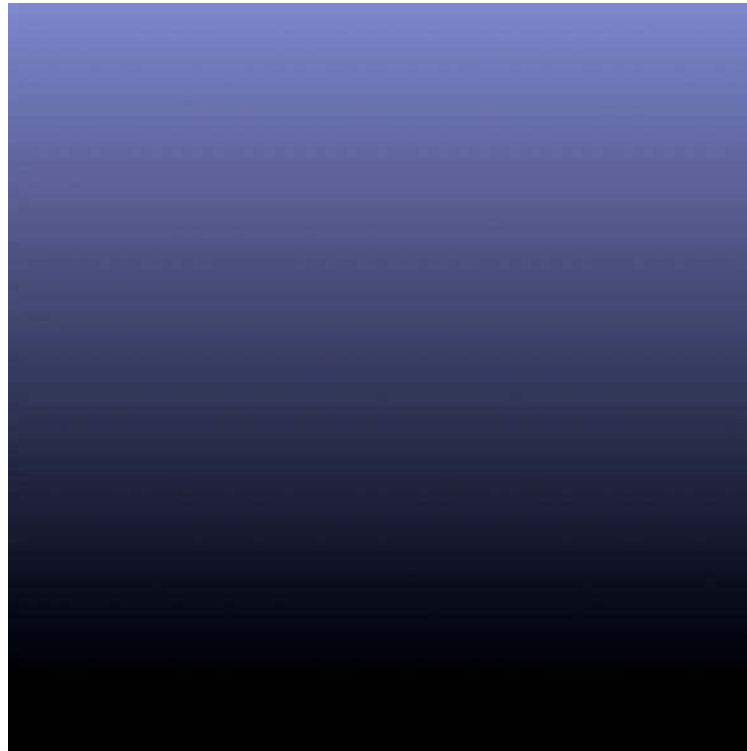
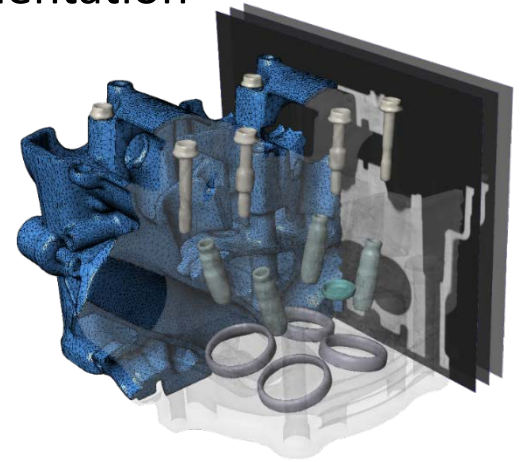
Process

Visualise

Analyse

Export

- Background image volume rendering
- Surface rendering of segmentation
- Clipping and opacities
- 3D stereo mode
- Video Animation toolbox



Import

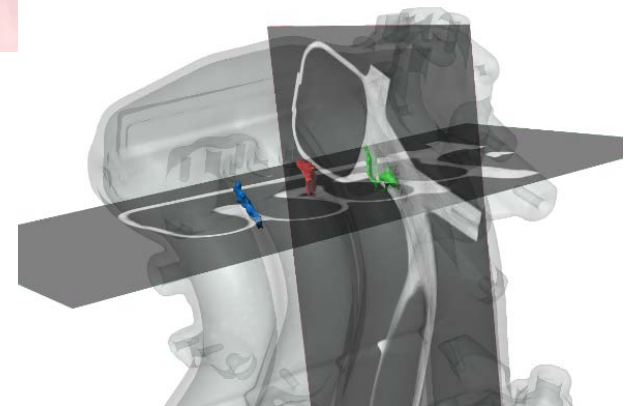
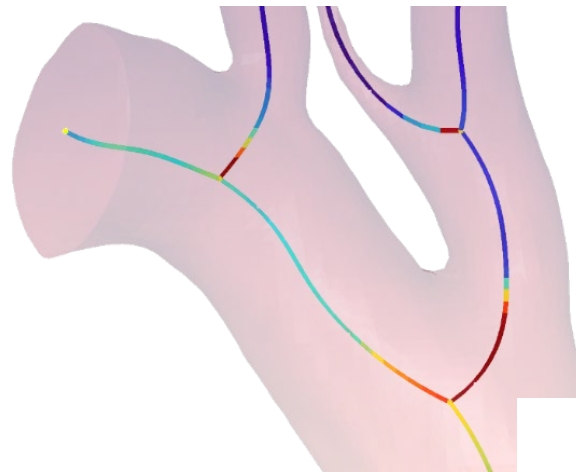
Process

Visualise

Analyse

Export

- Interactive measurement tools – e.g. bone land-marking
- Centreline generation and measurement tools e.g. for cardiovascular systems
- Image and model statistics framework e.g. volumes, surface areas, object orientation
- Implant positioning and evaluation



Import

Process

Visualise

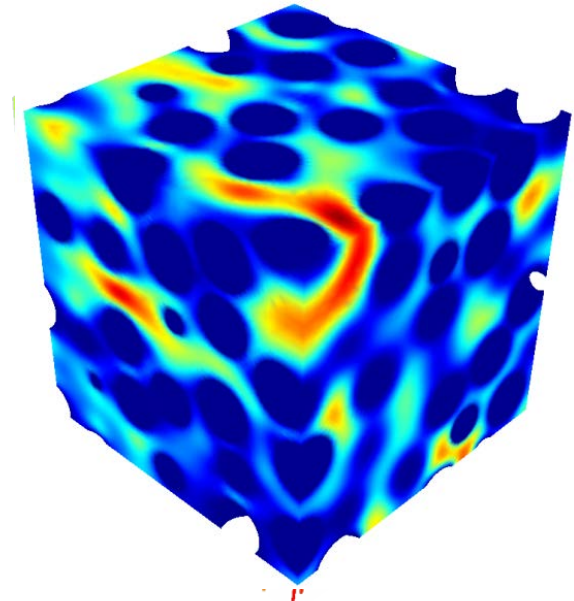
Analyse

Export

Physics Modules



- **+SOLID** – Calculates the effective stiffness tensor and individual elastic moduli of single/multi domain materials
- **+FLOW** - Calculates the absolute permeability tensor of samples of porous materials. Numerical homogenisation is performed using a built-in Stokes solver
- **+LAPLACE** - Calculates the effective properties of materials whose behaviour is governed by the Laplace equation, including electrical conductivity/permittivity, thermal conductivity and molecular diffusivity



Import

Process

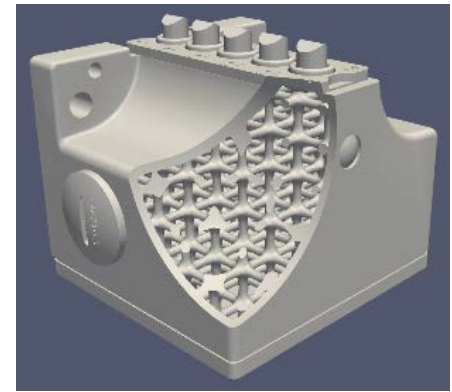
Visualise

Analyse

Export

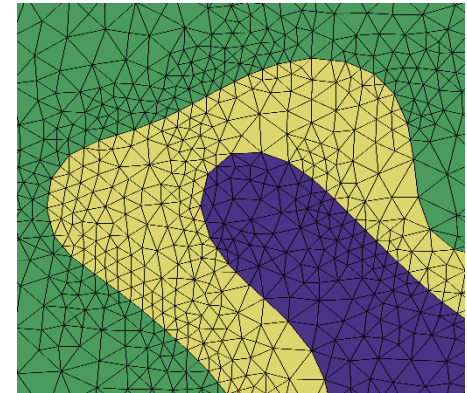
Surface mesh

- Export watertight STL files for 3D printing
- Add internal lattice structures



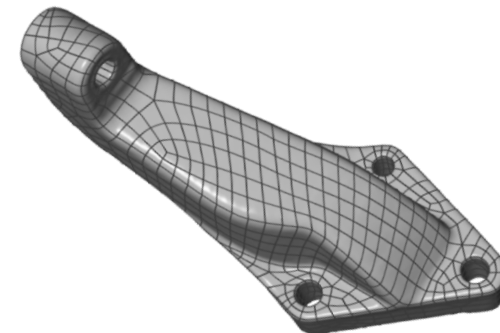
Volume mesh

- Unique multipart meshing algorithms
- Abaqus export format (*.inp)
- Linear or quadratic elements
- Boundary layer generation
- Feature based or user defined mesh refinement
- Greyscale based material properties



NURBS patches

- Fit NURBS patches to surfaces for IGES export



Simpleware modules

Import

CT, MRI, Micro-CT,
Microscopy,
Ultrasound, etc.



ScanIP

Image processing, segmentation,
visualisation and measurements

+FE module

Automated and robust
multipart FE +CFD meshing

+NURBS module

Automated NURBS patch CAD
model generation

Physics modules

Calculate effective material
properties using built-in FE solver

+CAD module

Integrating CAD into image
for meshing and visualisation

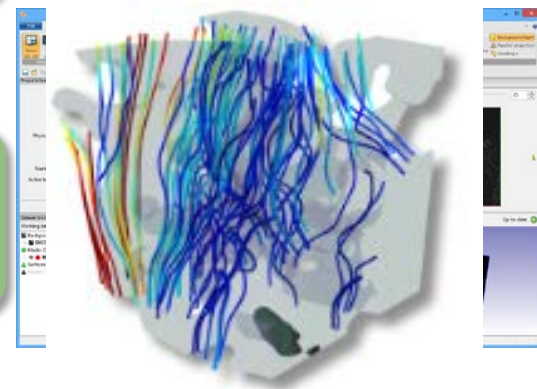
Export

Surface meshes
e.g. STL

Volume meshes
e.g. FE & CFD

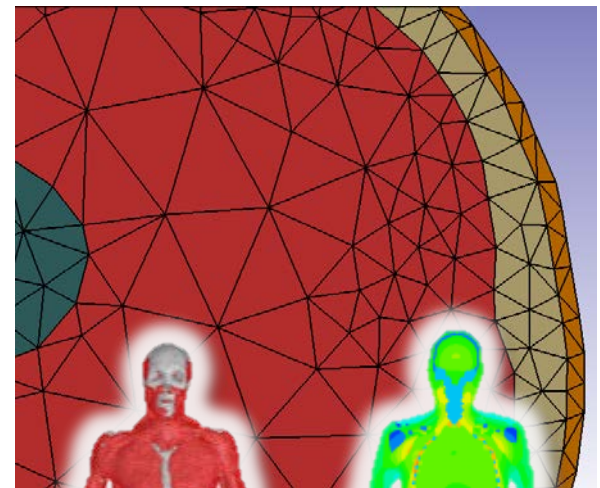
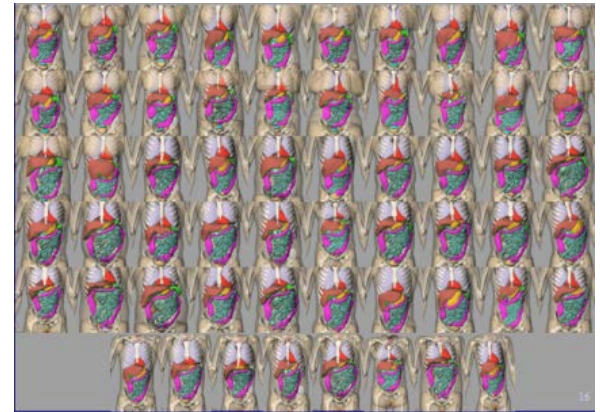
CAD models
e.g. IGES

Material properties
e.g. absolute permeability



Human Body Modelling

- Create models from a library (173+) of segmented anatomies
- Simulation ready models
- Compare simulation results over a population range
- Complexity and scope decided by customer
 - Element/Node count
 - Number of structures
 - Geometry simplification



Summary of Values

Speed up your image to model workflow

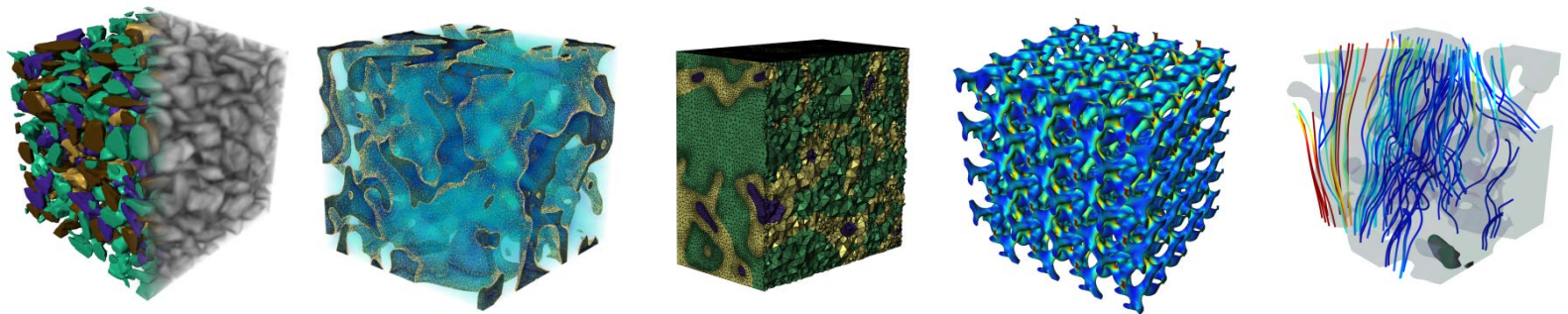
- Intuitive & easy-to-use interface
- Fast and robust capabilities
- Comprehensive documentation and tutorials (with data)

Improve the quality of your image-based models:

- Explore image data with advanced visualization and animations
- Use the best possible segmentation tools available
- Generate industry-leading FE and CFD meshes

Extend the range of applications in a single environment

- Customise workflows with integrated Python/Java/VBasic scripting
- Combine complex multi-source data (CAD, image data)
- Calculate effective material properties
- Human Body Models available for licensing (www.humanbodymodels.com)



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