

**World-leading software solution for the conversion of 3D images into CAD, Rapid Prototyped and Finite Element models.**

Simpleware's solution is based on a core image processing platform, ScanIP, with optional bolt-on modules for mesh generation and CAD integration.

**ScanIP™ Software**

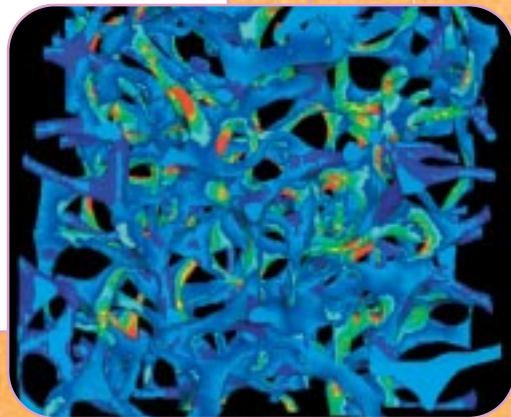
Image Processing and CAD Model Generation

**+ScanFE™ Module**

Volume/Surface Mesh Generation for FE/CFD

**+ScanCAD™ Module**

Integration of CAD Models within Image Data



*Natural Sciences*

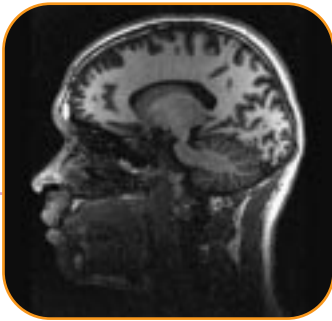
*Biomechanical Research*

*Material Characterisation*

*Implant Design & Manufacturing*



**ScanIP™** image processing software provides a broad range of image visualisation, processing and segmentation tools. Segmented images can be exported as STL files for CAD analysis, RP manufacturing or, with the +ScanFE™ module, imported directly into leading commercial finite element packages.



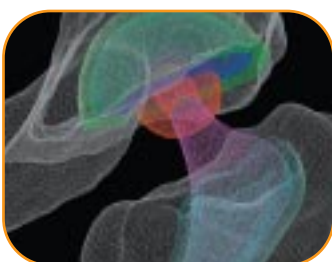
MRI Scan of Human Head

#### Import Formats

- DICOM Version 3.0
- ACR-NEMA Versions 1 and 2
- Interfile
- Analyze
- Meta-Image
- Raw image data
- Stack of 2D images (jpg, tif, etc.)

#### Image Processing Tools

- Rescale, Resample
- Shrinkwrap
- Noise Reduction Filters
- Smoothing Filters
- Metal Artifact Reduction Filter
- Morphological Filters
- Paint/Unpaint
- Confidence Connected Region Growing
- Flood Fill
- Cavity Fill
- Island Removal
- Thresholding
- Boolean Operations
- Overlap Check
- Multi-Part Anti-Aliasing
- Mesh Smoothing Filters
- Mesh Decimation



Surface Mesh of Total Hip Replacement

ScanIP offers an extensive selection of image processing tools to assist the user in visualising and segmenting regions of interest from any volumetric 3D data (e.g. MRI, CT, microCT).

#### Key Features

- ◇ Extensive support for range of import file formats
- ◇ Customisable workspace with multiple 2D/3D viewing modes
- ◇ Powerful segmentation tools including Level Set Methods
- ◇ Metal Artifact Reduction (MAR) Algorithms
- ◇ Volume and topology preserving smoothing\*
- ◇ Robust multi-part surface mesh/STL generation\*
- ◇ STL mesh decimation

For a full list of features please refer to ScanIP Technical Data Sheet



Beetle Mandible  
(University of Göttingen)



Segmentation of foot bones

#### Benefits

3D imaging, combined with the high quality image processing tools provided by ScanIP, permits the visualisation, segmentation and generation of multi-part CAD models even for structures with complex internal architectures. These techniques add a new dimension to areas such as industrial reverse engineering and non destructive evaluation of industrial parts and components, as well as the analysis of biological structures.

- ◇ Intuitive user interface
- ◇ Improved visualisation of complex data sets
- ◇ Model accuracy contingent only on image quality
- ◇ All STL models guaranteed watertight
- ◇ Guaranteed low distortion high quality surface meshes
- ◇ Conforming multi-part STLs generated – ideal for assemblies
- ◇ Direct import into third party CAD or STL based applications

\*Simpleware proprietary technology

**+ScanFE™** provides a robust approach to the conversion of segmented 3D image data into multi-part volumetric models. The techniques implemented are based on proprietary technology and provide unique meshing capabilities for the creation of 3D image based models of unparalleled accuracy and sophistication.



The +ScanFE meshing module bolts onto ScanIP and generates volume and/or surface meshes, contact surfaces and material properties from segmented data. These high quality meshes can be directly imported into a range of commercial FE and CFD packages.

### Key Features

- ◇ Mesh generation from data sets of arbitrary geometric complexity\*
- ◇ Topology and volume preserving smoothing algorithms\*
- ◇ Meshing of multiple structures/regions of interest\*
- ◇ Conforming contact surfaces/interfaces\*
- ◇ User definable adaptive meshing\*
- ◇ Material properties assigned to mesh based on signal strength

*For a full list of features please refer to +ScanFE Technical Data Sheet*

### Benefits

The ease and accuracy with which models can be obtained has opened up a wide range of previously difficult or intractable problems to numerical analysis. These include industrial reverse engineering applications, non destructive testing of complex parts and components, inverse material characterisation of nano and micro-structural composites and foams, and simulations based on patient specific medical models from *in vivo* scans.

- ◇ Automated, robust and fast; total time from raw image to model can be minutes
- ◇ Complex meshes generated and solved on “off the shelf” PC
- ◇ Topological/morphological accuracy contingent only on image quality
- ◇ Robust coupled fluid-structure domains meshed
- ◇ Guaranteed low distortion high quality surface/volumetric meshes
- ◇ RP models are exact geometric replicas of FE mesh
- ◇ Direct input of surface and/or volume meshes into FE and CFD solvers

\*Simpleware proprietary technology



*Reverse Engineering of Windscreen Wiper*

### Supported Output Formats

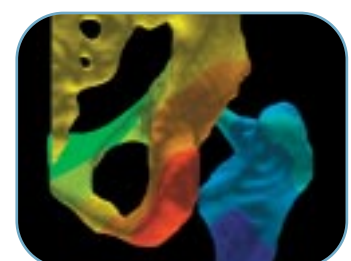
- \*.inp (ABAQUS)
- \*.ans (Ansys)
- \*.unv (I-DEAS)
- \*.dyn (LS-Dyna3D)
- \*.out (MSC.Patran Neutral)
- \*.msh (Fluent)
- \*.stl

### Exported Parameters

- Nodes
- Elements - Volume (hexahedral/tetrahedral), Shell, Linear and Midside Noded
- Contact Surfaces
- Material Properties based on Parent Greyscale Values
- Node/Element Sets

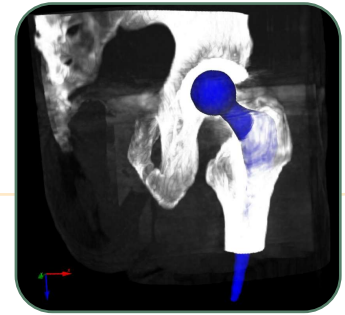


*Upper Jaw of Gharial  
(Natural History Museum)*



*FE of Total Hip Replacement (Stryker)*

+ScanCAD™ allows the import and interactive positioning of CAD models within image data. The resulting combined models can then be exported as multi-part CAD models or, using +ScanFE, converted automatically into multi-part Finite Element or CFD meshes.



Hip with positioned CAD implant (Stryker)

The +ScanCAD module bolts onto ScanIP and provides a range of tools for the integration of CAD models into the 3D image. The module can be used, for example, to obtain patient specific models by positioning CAD models of different implants within a pre-operative scan. Post-operative performance can be simulated using the combined models and multiple scenarios (e.g. sensitivity of stress field to implant alignment, use of different reaming tools, etc.) can be tested straightforwardly.

### Key Features

- User-customisable graphical interface with 2D/3D views
- Direct import of most common CAD formats into 3D image
- Support for multiple CAD imports
- 'On the fly' repair of non-watertight CAD models
- Real-time interactive or keyboard input for positioning
- Constrained motion positioning along user-defined vectors
- Geometry preserving re-sampling

For a full list of features please refer to +ScanCAD Technical Data Sheet

### Benefits

+ScanCAD provides a unique approach to merging CAD and image data whilst preserving the features and fidelity of the scanned image. The functionality provided opens the door to modelling a wide range of problems in medicine and dentistry as well as in consumer product design. Examples include: the incorporation of mobile phone designs into MRI head models to explore EM exposure (or comfort and fit with the ear); the exploration of the effect of stent or cannula insertion on blood flow; and the virtual modelling of dental surgery.

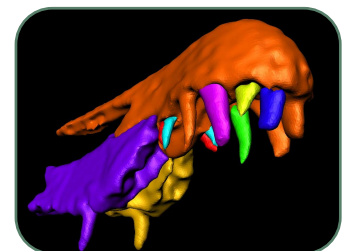
- User friendly interactive environment
- Performance prediction of different designs
- Exploration of surgical variability effects, using patient specific models
- Pre-clinical testing of new implants on a representative sample of patient population

### Supported File Formats

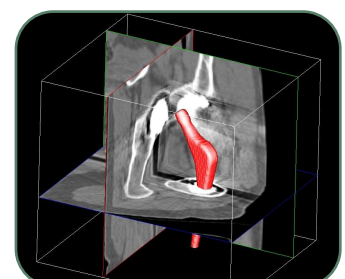
- IGES (\*.iges, \*.igs)
- STEP (\*.step, \*.stp)
- STL (\*.stl)

### Tools

- Binary and Multi-Valued Voxelisation
- CAD Model Import Preview
- Simultaneous Multiple 2D and 3D Views
- Rotational, Translational, User-Defined Motion Constraints
- Surface and Volume Rendering with Transparency
- Combined 3D Volume and Slice View Mode



Reconstruction of Baryonyx Walkeri missing teeth (Natural History Museum)



Positioning of implant in 3 dimensions



**Simpleware is dedicated to providing innovative software and services to bridge the gap between 3D imaging and simulation technologies.**

#### **Simpleware Services**

Simpleware provides complete services to convert 3D images into Finite Element, Rapid Prototyped and CAD models. Models can be provided based on high resolution whole body MRI and CT datasets available in-house. These can be tailored to include the structures of interest and can be provided with different mesh resolutions, contact conditions and inhomogeneous material properties. Alternatively, MRI, CT and MicroCT scans can be commissioned. We also have a dedicated team providing tailored software solutions based on our platform technology.

For further information on our software and services:

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*Non Destructive Evaluation*



*Industrial Reverse Engineering*