

# SIMPLEWARE AND FEKO

## Success Story

*“From a design perspective, the anatomically accurate models provided by Simpleware enable simulation of the coils under realistic loading, as well as reliable predictions of the coil performance. The high quality of the tetrahedral meshes meant that computationally efficient FEM+MoM simulations were possible.”*

*Peter Futter, FEKO*

Thanks to:



## Human Body Models for Electromagnetic Testing of MRI Systems

### Overview

Electromagnetic simulation software such as FEKO (a product of EMSS-SA (Pty) Ltd) is used to help optimise magnetic resonance imaging (MRI) systems. The software is able to test design specifications and simulate the effects of high static field strength systems on the human body, exploring how technology can be made more robust without creating an undue level of risk.

Simpleware software has been used with FEKO to provide anatomically accurate human body models for carrying out Finite Element Method (FEM) simulations for 7T head coils and 3T spinal arrays. The FE models generated by Simpleware have been used to help optimise coil and spinal array designs, and to investigate patient absorption of EM and RF energy. The use of Simpleware models by FEKO demonstrates their significant value for simulation workflows, reducing prototyping costs and improving system efficiencies.

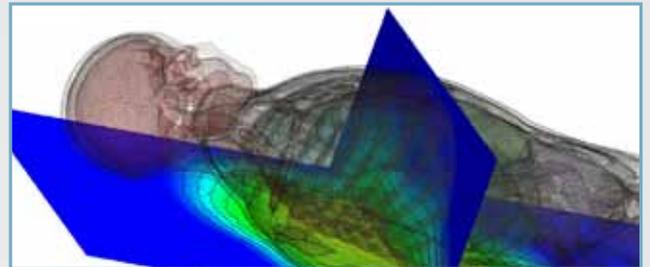
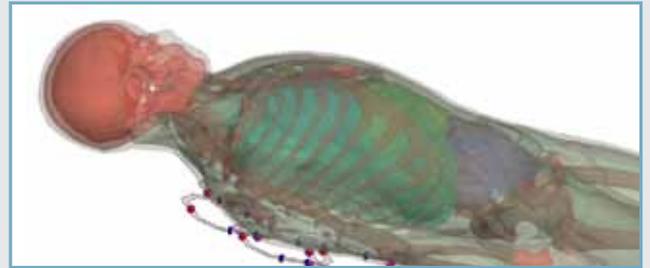
### Characteristics

- » Use of human body models, taken from scan data, for EM simulation workflows in FEKO
- » Testing of 7T head coils and 3T spinal array designs
- » Human body models able to provide high degree of accuracy for simulation
- » Models derived from the commercially available Simpleware library

## SPINAL ARRAY DESIGN AT 3T

FEKO and Simpleware models were used to develop a surface array for spinal imaging at 3T by simulating EM distribution in the human body, with the aim of improving patient safety. The array was tuned and matched at 124 MHz, with neighbouring elements optimised and single-element tuning and matching carried out on the system design as part of testing.

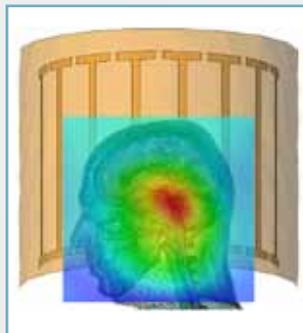
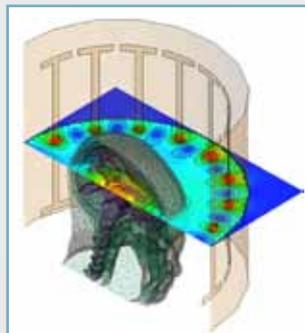
The hybrid MoM/FEM approach was used to carry out a series of simulations on a Simpleware-generated model containing 13 different tissues. This mesh model included 1.36 million elements with an average edge length of 8.3 mm.



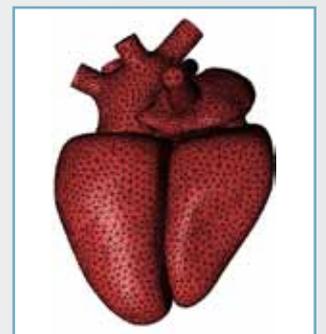
## 7T HEAD COIL TESTING

In this study, a 7T cylindrical birdcage head coil was investigated to test performance (resonance,  $B_1^+$  homogeneity, polarisation efficiency, SAR) and interaction with a human head model. Method of Movement (MoM) simulations were initially used to solve energy fields in an empty coil and a coil with a homogeneous head model.

A hybrid FEM and MoM approach was also employed for a more detailed simulation of  $B_1^+$  field distribution. More anatomically accurate head models provided by Simpleware were used to complete these tests, with models featuring an average element edge length of 6.3 mm.



The Simpleware models used in these projects are part of a commercially available library of human body models generated from CT scans. The library includes a wide range of available model parts, from individual tissues to full body models suitable for FE and CFD analysis.



More information on model availability is available through the Simpleware sister site [www.humanbodymodels.com](http://www.humanbodymodels.com).

### About Simpleware

Simpleware develops industry-leading image processing software solutions for 3D image data visualisation, analysis and model generation.

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