Ansoft Human Body Model

The human body model used was purchased from Ansys.

The body model used in the Medtronic SAR analysis was the 4mm model. Previous FCC approved Medtronic SAR submission for the Gen2 device family used Remcom xFDTD simulations with a 5mm resolution body model.

Origin

This CD contains Ansoft's male human body model. This model is protected by copyright.
The model was created with medical applications in mind. Therefore, the body shape is the shape of a patient lying on a flat table. The table would be parallel to the YZ direction, and the X direction would be the vertical direction. This is a convention often encountered in MRI, Magnetic Resonance Imaging.

The 300+ parts of this model were created for Ansoft by Aarkid, www.aarkid.com . This company can provide a wide variety of custom designs.

Geometric accuracy

The CD contains models with three levels of accuracy:

(1) Directory sm3_files_accurate contains the original geometries without simplification. The HFSS and Maxwell models of the entire body is about 130 MB and generates about half a million tetrahedra.

(2) In directory sm3_files_2mm the geometries have been de-featured such that an accuracy of 2 mm or better remains relative to the original files. A handful of very thin parts have been omitted. The HFSS and Maxwell models of the entire body is about 70 MB and generates well over 200,000 tetrahedra.

(3) In directory sm3_files_4mm the geometries have been de-featured such that an accuracy of 4 mm or better remains relative to the original files. Furthermore, the skeleton and the muscles have been omitted completely. The organs are still there. This model is intended to be used for faster simulations.

Material parameters

Directory material_properties contains datasets of relative permittivity ε_r and conductivity σ. The "info" subdirectory contains a description of how to use these in HFSS and Maxwell. They have already been incorporated in the HFSS and Maxwell models on the CD to define frequency-dependent biological materials. When you use these, error messages related to the datasets may appear. These can probably be ignored.
The material parameters have been obtained from multiple sources. One of them is mentioned in the document in the "info" subdirectory. Sometimes the data from different

sources differ by as much as ten percent. We recommend that you verify the material parameters that are really important in your application.
The body models don't contain explicit objects for fat and for skin. Parts of the body that are not explicitly occupied by organs, muscles or bones are likely to have material properties somewhere between water and fat. That is, of course, dependent on location. For now, we have assumed that the body contains little fat, and have simply assigned ε_r = 50 and σ=0.5 outside organs, muscles and bones. As for the skin, below 2 GHz this is electrically very thin, and a separate skin object or boundary condition is not needed for most applications. If you want, you can use the Layered-Impedance Boundary Condition in HFSS to represent the skin.

Simulation strategy

Since simulations with hundreds of thousands of tetrahedra require a lot of RAM and CPU time, we recommend the following strategy:

(1) With HFSS, consider solving with low-order basis functions. In HFSS 10, this is set with a checkbox under the Advanced tab in the analysis setup.
(2) Choose the geometry that has an adequate accuracy for your application.
(3) Define objects that are not needed as "non-model" or delete them.
(4) Use a Boolean Split to remove sections of the body that are not needed.
(5) In case of meshing difficulties with the most accurate model, try different settings of model resolution, e.g. 0.01 mm, 0.1 mm. Also, consider removing fat objects 5 and 9.