Shared Files for “EM Simulation Model of a Clinically Used RF Head Coil”

Shared Files:

- NOVA_transmit_coil_model.aedt (contains the 3 current source and 14 current source model)
- read_Ansys_HFSS_data.m
- current_coefficient_calculation.m
- compare_matches_coil_vs_model.m
- B_asymmetric_sphere*.mat (* from 1 to 8) (contains the complex B fields from our simulation model)
- mask.mat (mask for the sphere phantom)
- current_coefficients_for_channel_*.mat (* from 1 to 8) (contains the current coefficients for our simulation model that are used in the paper)

We have provided the Ansys HFSS model with 3 current sources per channel and 14 current sources per channel. The MATLAB codes are adjusted to the 14 current sources per channel version. You will have to modify the codes to do the calculations for 3 channels instead of 14.

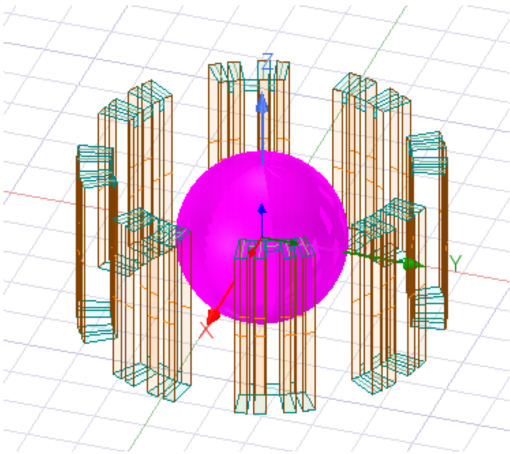
Two methods of using the given files:

1. If you do not have additional experimental data or NOVA coil simulation data, you can use the current coefficient values we have calculated in the paper, given in current_coefficients_for_channel_*.mat for each channel. Below, in the instructions on how to use the model, you can skip (3) and directly move to calculations with the given current source coefficients.

2. If you want to recalculate the current source coefficients, you can use the code current_coefficient_calculation.m and follow all the steps below for more details.

Instructions on how to use the Ansys HFSS NOVA transmit coil model (with 14 current sources per channel):

1) After placing your phantom in the coil and running the simulation, obtain the magnetic field produced by each current source. In order to obtain the magnetic field for each channel:



Step 1: The variable UM shows the magnitudes of the current sources at the upper side. LM shows the magnitudes of the current sources at the lower side in mA. Similarly UP and LP show the phase in degrees for each current source. (MM shows the magnitude of the current sources in the middle, for the 3 current source model.) For example, UM12 indicates the current source numbered 2 in channel 1. Set the magnitude of one of the current sources to 10 mA while the others have a magnitude of 0. The phases should all be 0.

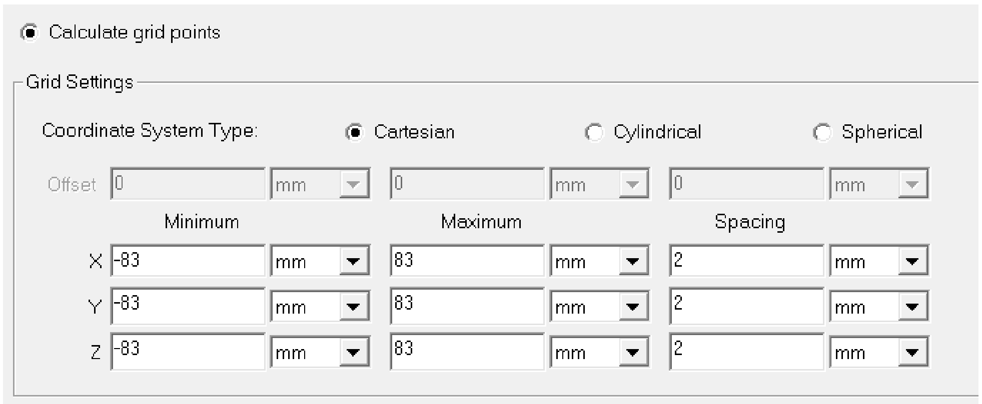
Properties

Name	Value	Unit	Evaluated V...	Type
UM11	10	mA	10mA	Post Processing
UM12	0	mA	0mA	Post Processing
UM13	0	mA	0mA	Post Processing
UM14	0	mA	0mA	Post Processing
LM11	0	mA	0mA	Post Processing
LM12	0	mA	0mA	Post Processing
LM13	0	mA	0mA	Post Processing
LM14	0	mA	0mA	Post Processing
LM16	0	mA	0mA	Post Processing
UM15	0	mA	0mA	Post Processing
UM16	0	mA	0mA	Post Processing
UM17	0	mA	0mA	Post Processing
LM15	0	mA	0mA	Post Processing
LM17	0	mA	0mA	Post Processing

Step 2: Go to the calculator from HFSS → Fields → Calculator. Write the equation for the B field: CVc : *(Smooth(<Hx,Hy,Hz>), 1.25663706143592E-06)

(H field → Smooth → Constant mu0 → *)

Step 3: Export and define your data points to match the simulation or experiment data you will compare the model with.



While exporting the data, we suggest that you keep the file names as:

This will make things easier in Step 2, reading all the files in MATLAB.

Repeat Steps 1 – 3 for all current sources.

Step 4: For the mask of the phantom, similarly from the Field Calculator:

Number → Vector → x =1, y=1, z=1

Material Operation → Conductivity → Multiply

Smooth

Magnitude

Scl : Mag(Smooth(cond*(<1, 1, 1>)))

When you export this according to your dimensions, you will get the mask for the phantom.

2) With these magnetic fields, run the code read_Ansys_HFSS_data.m in MATLAB to convert the data to *.mat files for faster calculation. Repeat for each channel.

3) (Could be skipped if you do not have NOVA experimental or simulation data) Modify the code current_coefficient_calculation.m in MATLAB according to your data. The code current_coefficient_calculation.m expects complex B field data to estimate the current source coefficients for the model. You can modify the code (the matrices BE and BES) so that it can estimate the field for complex B_1^+ data. The estimated current source coefficients are stored in magnitude and degrees. This makes it easier to input them into the Ansys HFSS model and check the results.

4) The code compare_matches_coil_vs_model.m uses the B field data in MATLAB to compute the estimated fields from the simulations. You can place your own experimental data and the simulation data in the code. You will have to change the dimensions of the matrices. The parts that use the NOVA experimental data must be commented out so that the code can be run without the experimental data, using the current source values and magnetic fields from our simulation given in the GitHub page.

5) Alternatively, you can place the calculated current source coefficient values into the Ansys HFSS model and export the resulting B field.

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