SHIELDED DRIVE COILS FOR A RABBIT SIZED FFL SCANNER

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In magnetic particle imaging scanners, two main types of field free space are used, namely the point and the line. When the field topologies are of little influence for the first of them, the line properties strongly depend on the field topology. In fact, all generated fields inside the scanner will influence at different degrees the line shape. Moreover, MPI scanners use low inductivities\high voltage coils to generate the drive fields and high inductivity\low voltage coils to generate the selection fields. Therefore, even a small coupling between the drive coils and the selection coils would results in high voltage peak on the selection coils, which is too constraining to be absorbed by the coils. Instead, it would be preferred to shield the selection coils against the high frequency fields. Doing so leads to the generation of eddy current in the shield, which will in returns change the topology of the drive fields.

We designed the drive coils for a rabbit sized FFL scanner using a boundary elements formulation. The induced current in the shield is calculated using the same approach and compared with the results obtained with a commercial finite elements program using an 3D model of the coil. To validate both modeling, the power loss are compared with analytics formula. Finally, the spherical harmonics decomposition of the unshielded coil and the shielded coils are compared.

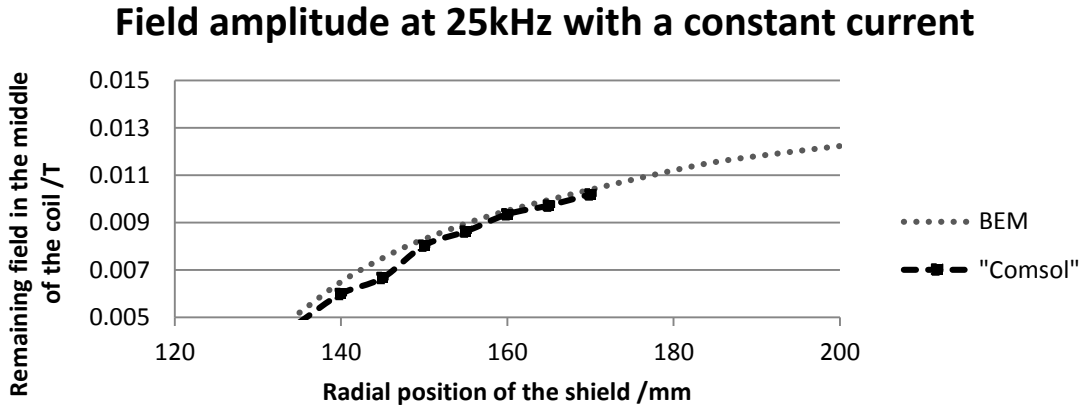

Figure 1: Comparison of the fields in the middle of the coil. Both results are in agreements.

Both methods are able to model the phenomena accordingly to the theory. But, when Comsol© require a mesh with a resolution of the skin depth on the shield (i.e. 0.4 mm in this case), the BEM just need a coarse meshing of the surfaces. The Comsol© calculation required 12 Gb of RAM and 2 hours of calculation per configuration, where the BEM model needed 160Mb of RAM and 286 seconds on the same computer.

The presented methods allowed to correct the efficiency of the coil to take into account the reduction of efficiency of the shielded coil and to plan accordingly the diameter of the shield.