RF modeling

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RF modelling is an important tool for coil development and safety assessment in MRI. The exact calculation of the imposed magnetic and electric field distributions at the Larmor frequency is a powerful tool that, if these fields are accurately determined, can provide a treasure of information for the MR developer. This talk will combine the introduction of basic concepts of RF modeling with the exploration of advanced RF modeling applications that address current issues in MR research.

First, an overview is presented of the various methods available for RF modeling. This also introduces some basic algorithms behind these methods. The most important two methods are FEM (finite element method) and FDTD (finite difference time domain). These will be discussed in more detail, including their advantages and drawbacks, typical pitfalls and gridding limitations.

After that, examples of RF modeling applications for simple geometries will be discussed, showing how RF modeling can be used to gain insight into the basic physics of RF coils. Commercial RF modeling packages provide a wide range of visualization tools that really ‘make the electromagnetism come alive’. Apart from fancy images, these visualization tools really help to provide insight into how the fields behave, depending on the choices you make in your coil design.

Subsequently, more advanced applications will be presented including modeling of advanced antenna designs, SAR modeling of multi-transmit arrays and calculating the g-factor distribution for receive arrays. Finally, some examples will be presented of what’s beyond RF modeling: the modeling of gradient fields and the modeling of SAR induced temperature rise.