Comparison of Two Different Absorbing Boundary Conditions in Numerical Dosimetry of Animals Using FDTD Code

Y. Alfadhl, X. Chen
Queen Mary University of London, UK

The finite difference time domain (FDTD) technique has been used widely as an accurate and efficient tool for solving Maxwell’s equations within inhomogeneous regions. Evaluations of the interactions of electromagnetic (EM) fields with animals are typically made by measuring the specific absorption rate (SAR). Assessments of the SAR distributions induced inside inhomogeneous animal models have been carried out in several studies using a widely used code ([1]-[2]). The algorithm implemented in this original code was based on the separation of the incident and scattered fields combined with the second order ‘Mur’ absorbing boundary conditions (ABC) [3]-[4]. The separation of the incident and scattered fields eliminates the incident fields from the radiation hitting the outer boundaries. This improves the reflection profiles; however, the utilisation of the ‘Mur’ ABC within this program has raised some concerns about the accuracy especially in the lower frequency band where the fixed distance between the object and the outer boundaries becomes smaller relative to the wavelength.

In this study, a PML (Perfect Matched Layer) ABC has been applied to improve the accuracy of the FDTD numerical dosimetry program. The results have shown that the difference between the results obtained using the ‘Mur’ ABC relative to the results from the PML varies with the radiation frequency. A good correlation has been observed for the SAR computed at frequencies above 900MHz (~ 10%). Conversely, the relative difference between the SAR calculated using the two boundary implementation shows a significant increase of the difference at lower frequencies. It has been noted that the relative difference factor for the models of smaller rats is much larger than for the models of larger ones. This is due to the fact that the larger rat models are achieved by increasing the voxel sizes creating a bigger gap between the model itself and the outer boundary. It is believed that the PML ABC works better than the Mur method at the lower frequency when the object is closer to the boundary. However, further analysis is required to verify the results obtained.

REFERENCES