Comments and Corrections

Corrections to “An FDTD Model for Calculation of Gradient-Induced Eddy Currents in MRI System”

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In the above paper [1], there is an important error in the 3-D finite-difference time-domain (FDTD) update equations (1c)–(1e) of the electric field components in the cylindrical coordinates. This can lead the FDTD researchers to erroneous numerical results. According to that, the coefficients of the current density components in the FDTD update equations (1c)–(1e) of the difference time-domain (FDTD) update equations (1c)–(1e) given as \( \Delta t/\varepsilon \) are wrong and must be \(-2\Delta t/(2\varepsilon + \sigma \Delta t)\). In this step, it is useful to be noted that the sign of the coefficient is negative from Maxwell’s equations. The corrected versions for the electric field update equations are given as

\[
E_{r_i+\frac{1}{2},j,k}^{n+1} = \left( \frac{2\varepsilon - \sigma \Delta t}{2\varepsilon + \sigma \Delta t} \right) E_{r_i+\frac{1}{2},j,k}^n + \left( \frac{2\Delta t}{2\varepsilon + \sigma \Delta t} \right) H_{z_i+\frac{1}{2},j,k}^{n+1} - H_{z_i+\frac{1}{2},j,k}^n \times \frac{r_{i+\frac{1}{2}\Delta r}}{\Delta z}
\]

\[
E_{\phi_i,j+\frac{1}{2},k}^{n+1} = \left( \frac{2\varepsilon - \sigma \Delta t}{2\varepsilon + \sigma \Delta t} \right) E_{\phi_i,j+\frac{1}{2},k}^n + \left( \frac{2\Delta t}{2\varepsilon + \sigma \Delta t} \right) H_{r_i+\frac{1}{2},j,k}^{n+1} - H_{r_i+\frac{1}{2},j,k}^n \times \frac{r_{i+\frac{1}{2}\Delta r}}{\Delta z}
\]

\[
E_{z_i,j+\frac{1}{2},k}^{n+1} = \left( \frac{2\varepsilon - \sigma \Delta t}{2\varepsilon + \sigma \Delta t} \right) E_{z_i,j+\frac{1}{2},k}^n + \left( \frac{2\Delta t}{2\varepsilon + \sigma \Delta t} \right) H_{\phi_i,j+\frac{1}{2},k}^{n+1} - H_{\phi_i,j+\frac{1}{2},k}^n \times \frac{r_{i+\frac{1}{2}\Delta r}}{\Delta z}
\]

\[
E_{r_i,j+\frac{1}{2},k}^{n+1} = \left( \frac{2\varepsilon - \sigma \Delta t}{2\varepsilon + \sigma \Delta t} \right) E_{r_i,j+\frac{1}{2},k}^n + \left( \frac{2\Delta t}{2\varepsilon + \sigma \Delta t} \right) H_{\phi_i,j+\frac{1}{2},k}^{n+1} - H_{\phi_i,j+\frac{1}{2},k}^n \times \frac{r_{i+\frac{1}{2}\Delta r}}{\Delta z}
\]

\[
E_{z_i+\frac{1}{2},j,k}^{n+1} = \left( \frac{2\varepsilon - \sigma \Delta t}{2\varepsilon + \sigma \Delta t} \right) E_{z_i+\frac{1}{2},j,k}^n + \left( \frac{2\Delta t}{2\varepsilon + \sigma \Delta t} \right) H_{\phi_i+\frac{1}{2},j,k}^{n+1} - H_{\phi_i+\frac{1}{2},j,k}^n \times \frac{r_{i+\frac{1}{2}\Delta r}}{\Delta z}
\]

REFERENCES