Brief Article

The Author

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1 Conductance formulation

$$CR_{i,j-1/2,k} = 1 \times 10^{-9} \qquad X \leq 0 \tag{1a}$$

$$CR_{i,j-1/2,k} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} \left[\frac{0.5AX^2}{\Omega} \right] \qquad 0 < X \leq \Omega \tag{1b}$$

$$CR_{i,j-1/2,k} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} \left[AX + 0.5\left(1 - A\right) \right] \qquad \Omega < X \leq (1 - \Omega) \tag{1c}$$

$$CR_{i,j-1/2,k} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} \left[\frac{0.5A\left(1 - X\right)^2}{\Omega} \right] \qquad (1 - \Omega) < X \leq 1 \tag{1d}$$

$$CR_{i,j-1/2,k} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} \qquad 1 \leq X \tag{1e}$$

2 Calculate the derivatives

$$\frac{\partial}{\partial X_{i,j,k}} 1 \times 10^{-9} = 0 \tag{2}$$

$$\frac{\partial}{\partial X_{i,j,k}} \left[\frac{0.5AX^2}{\Omega} \right] = \frac{AX}{\Omega} \tag{3}$$

$$\frac{\partial}{\partial X_{i,j,k}} \left[AX + 0.5\left(1 - A\right) \right] = A \tag{4}$$

$$\frac{\partial}{\partial X_{i,j,k}} \left[\frac{0.5A\left(1 - X\right)^2}{\Omega} \right] = \frac{0.5A}{\Omega} \frac{\partial}{\partial X_{i,j,k}} \left(1 - X\right)^2 = \frac{0.5A}{\Omega} 2X = \frac{A\left(1 - X\right)}{\Omega} \tag{5}$$

$$\frac{\partial}{\partial X_{i,j,k}} 1 = 0 \tag{6}$$

3 Conductance derivative

$$\frac{\partial CR_{i,j-1/2,k}}{\partial h_{i,j,k}} = 1 \times 10^{-9} \qquad X \leq 0 \tag{7a}$$

$$\frac{\partial CR_{i,j-1/2,k}}{\partial h_{i,j,k}} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} \left[\frac{AX}{\Omega}\right] \qquad 0 < X \leq \Omega \tag{7b}$$

$$\frac{\partial CR_{i,j-1/2,k}}{\partial h_{i,j,k}} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} [A] \qquad \Omega < X \leq (1-\Omega) \tag{7c}$$

$$\frac{\partial CR_{i,j-1/2,k}}{\partial h_{i,j,k}} = \Delta C_i \Delta Z_k \frac{K_{i,j-1/2,k}}{\Delta R_{j-1}} \left[\frac{A\,(1-X)}{\Omega}\right] \qquad (1-\Omega) < X \leq 1 \tag{7d}$$

$$\frac{\partial CR_{i,j-1/2,k}}{\partial h_{i,j,k}} = 0 \qquad 1 \leq X \tag{7e}$$