Including R in FDTD as per equations (6a,6b,10a,10b,10c, and 10d)

For k = 1

For k = 2, ..,NDZ, if G = 0 , so this will be the same.

At K = NDZ+1. This depends on should be the same.

Current update for all nodes (K=1,…,NDZ):

Code:

%FDTD

clear

clc

L\_total = 150e-6; % Total length of the line (m)

R = 1200;

L = 250e-9;

C = 1e-10;

Rs = 10;

NDZ = 50; % Number of spatial steps

dz = L\_total / NDZ; % Spatial step delta z

v = 1/sqrt(L\*C); % Phase velocity (m/s)

%dt = dz/v; % Magic time step (dt = dz/v)

dt = 1e-16; % Time step delta t

t\_max = 10e-12;

t\_steps = round(t\_max / dt); % Number of time steps

% allocate voltage and current arrays

time = (0:t\_steps-1)\*dt;

V = zeros(NDZ+1, t\_steps);

I = zeros(NDZ, t\_steps);

% 1.Step input (1V source)

Vs = 1 \* ones(1, t\_steps);

% 2. Sine wave (100 GHz)

%freq = 100e9; % Frequency in Hz

%Vs = sin(2\*pi\*freq \* time);

% 3. Trapezoidal pulse (custom function)

%for i=1:length(time)

%Vs(i) = trapezoidalPulse(time(i));

%end

% FDTD Loop for Time Stepping

for n = 1:t\_steps-1

V(1, n+1) = (Rs\*C/2\*dz/dt+0.5)^-1\*((Rs \*C/2 \*dz/dt-0.5)\*V(1,n)-Rs\*I(1,n)+0.5\*(Vs(n+1)+Vs(n)));

for k = 1:NDZ

if k>1

V(k,n+1) = V(k,n) + dt/(dz \*C)\* (I(k-1,n) - I(k,n)); % Update voltag

I(k-1,n+1) = I(k-1,n)-(dt/(L\*dz))\*(V(k,n+1)-V(k-1,n+1))-(R\*dt/L)\*I(k-1,n);% Update current

end

end

V(NDZ,n+1) =V(NDZ,n)+dt\*(I(NDZ-1,n)/(C\*dz));

end

y\_FDTD = V(NDZ,:);

% Plot the results for the voltage at the load

figure(1)

plot(time/1e-12, V(NDZ,:));

xlabel('Time (ps)');

ylabel('V Load (Volts)');

title('FDTD Simulation of Transmission Line with unit step input');

%title('FDTD Simulation of Transmission Line with 100 GHz Sine Wave Input');

%title('FDTD Simulation of Transmission Line with Trapezoidal Pulse Input');

grid on

THz model with AWE.

Due to the rounding issue at each model the following output is obtained.

Frequency response:

A graph with a line

AI-generated content may be incorrect.

Unit step response:

A graph of a graph

AI-generated content may be incorrect.