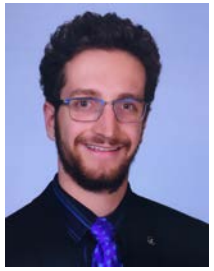
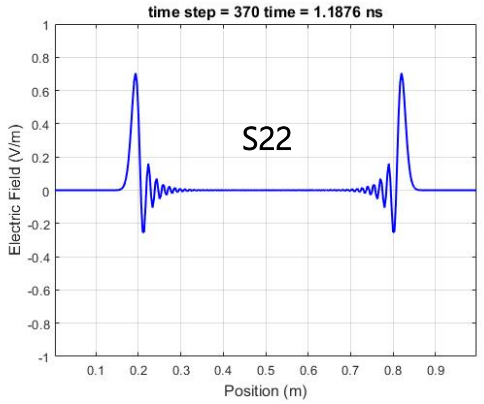
Fourth Order Accurate FDTD Implementation – Tony D'Esposito

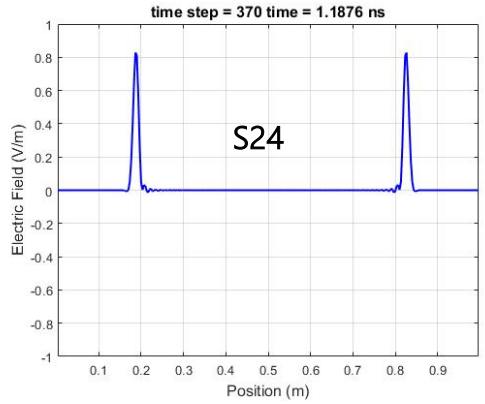
Sample Updating Equation

$$E_x^{n+1}(i,j,k) = \frac{2\Delta t}{2\epsilon_x(i,j,k) + \Delta t\sigma_x^e(i,j,k)}\alpha - \frac{2\Delta t}{2\epsilon_x(i,j,k) + \Delta t\sigma_x^e(i,j,k)}\beta + \frac{2\epsilon_x(i,j,k) - \Delta t\sigma_x^e(i,j,k)}{2\epsilon_x(i,j,k) + \Delta t\sigma_x^e(i,j,k)}E_x^n(i,j,k) - \frac{2\Delta t}{2\epsilon_x(i,j,k) + \Delta t\sigma_x^e(i,j,k)}J_x^{n+\frac{1}{2}}(i,j,k)$$



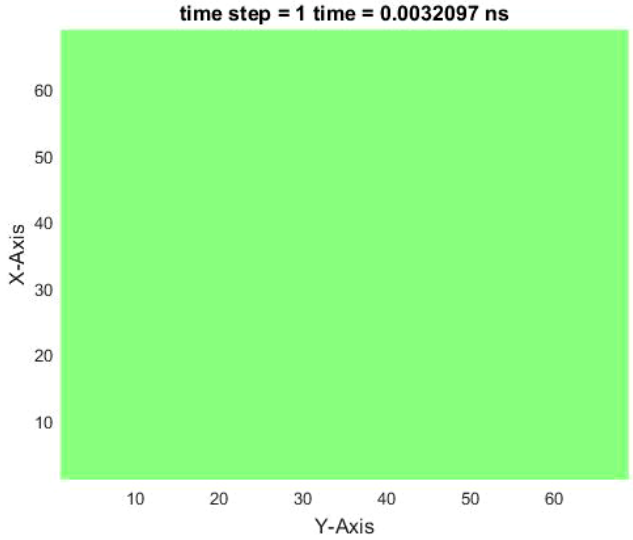
Gaussian Pulse Propagation in 3D domain



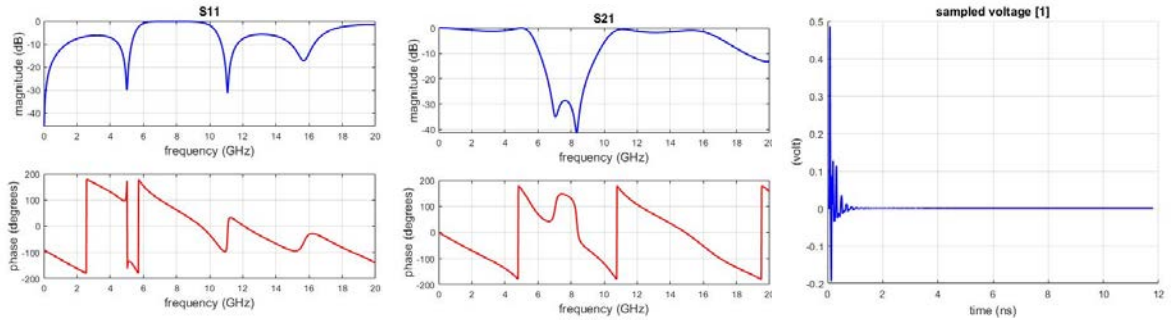


Simulation Set Up

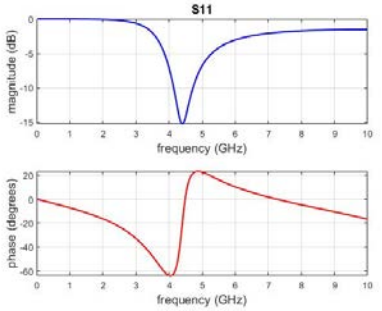
- Domain: 1x1x1 meter (300x300x300 cells) for 3D. Entire domain is filled with air.
- Source: infinite sheet of Jz source in the YZ plane. **5 cells per λ_{min} gaussian pulse.**
- Simulation time: ≈1.18 ns. **Δt** based on stability criterion. 0.5 courant factor.
- PEC boundary without any reflections



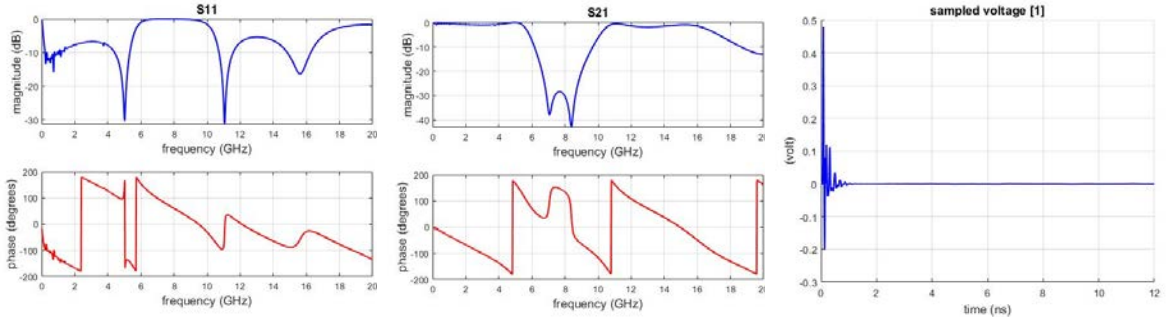
S22



S22



S24



S24