EP440: Engineering Electromagnetics

Spring 2014, J. B. Snively

Numerical Project #N1: Due 4/18/2014 at 5:00 (Email to Snively)!

For this assignment... Investigate following problems in MATLAB.
Submit to me a digital PDF document file including brief discussion on each problem, copies of figures, plus the text of the modified MATLAB code.

Please make note: In the figure, E is plotted as E/eta, so that it has the same amplitude as H.

Using the MATLAB file "emwave.m":

As it is set up, the code generates a standing wave at ~2.4 GHz frequency, with a horizontal dimension sufficient to hold exactly 1.5 wavelengths. Note that the code calculates frequency based on horizontal dimension and number of desired wavelengths to fit in the box. *Note that if you have any plotting issues, first try commenting out the "pause" commands at lines 107 and 114.*

1) Confirm the wavelength, frequency, and horizontal width of the box (you can calculate manually, or refer to variables generated by the m-file).
2) Change the parameter M to instead allow 5 wavelengths within the box (note the change in frequency). Print a plot of your standing wave field variables and instantaneous *S* after the simulation has completed. Discuss in a few sentences the features of *E*, *H*, and *S*.
3) Edit the boundary conditions ("bc" variable to equal "0") to set conditions for an open box. Adjust the limits of the plot to create an appropriate output showing S at some interesting time. Discuss in a few sentences the features of S for the unreflected wave, compared to **2**.
4) Change "bc" to "1" again, and set M=10, G=1/40, T=1/10. Plot your wave field variables at three interesting times: When the wave is left-going, when the wave is reflecting, and when the wave is right-going. Discuss in a few sentences the features of *E*, *H*, and *S*.

Extra Credit: Demonstrate that two waves propagating in opposite directions with initially similar phase also can produce a standing wave. To do this, consider starting with parameters from question **4** above. You will want to add a source to the right side of the domain that is equivalent (but opposite) to the left source. *One hint:* Remove the Gaussian ramp-up on the source terms in line 93/94, to better elucidate the superposition of waves.