Electricity and Magnetism II (PHY 322)

2D EM Wave Animation Homework

This homework is all about animating EM waves in two spatial dimensions. We focus on the "TM mode", in which the wave travels (or changes) in the x and y directions, the electric field points in the z direction, and the magnetic field points in the xy plane. Download the files `TM2D.hs` and `GIF.hs` from the course website.

Because these animations are somewhat computationally intensive, I recommend trying an animation with about 100 time steps to begin with. If things look good and the animation seems to be doing what you expect, then you can increase the number to 250 or maybe as high as 500, depending on your patience.

Problem 1 (4 points) The file `TM2D.hs` has examples in which the current density is restricted to one or two points on the grid. Make an animation where the current density oscillates at 4 points which are at the corners of a square, the size of which is one wavelength on a side. Put the four corners of the square somewhere near the center of the grid we are paying attention to.

Problem 2 (4 points) Make an animation where the current density oscillates at every grid point on a line segment whose length is two wavelengths. Put the line segment near the center of the grid.

Problem 3 (4 points) Make an animation where the current density oscillates at 3 points which are at or near the corners of an equilateral triangle, the size of which is one wavelength on a side. One corner will not fall exactly on a grid point, so choose the closest gridpoint to this third corner.

Problem 4 (4 points) Make an animation where the current density oscillates at 3 grid points which lie along a line. These points should be spaced one wavelength apart from each other.

Problem 5 (4 points) Make an animation where the current density oscillates at 4 grid points which lie along a line. These points should be spaced one wavelength apart from each other.

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Problem 6 (4 points) Make an animation where the current density oscillates at 2 grid points spaced one wavelength from each other, but make the oscillations 180° out phase with each other. Place the two points near the center of the grid.

Problem 7 (4 points) Make an animation where the current density oscillates at 2 grid points spaced 1/2 wavelength from each other, but make the oscillations 180° out phase with each other. Place the two points near the center of the grid.