More on Maxwell—Postprocessor, etc.

ENGS 120

For the fourth problem set, you will have some additional challenges in using Maxwell.

1. Post processing.

   The real power of the post processor is in the calculator. The Calc menu lets you choose a plane, line, or number calculator. We'll start with the Plane calculator.

   a. **Plane calculator**.
   The calculators are all RPN calculators. If you've used HP calculators you know what this is all about. The upper screen is a "stack". The lower screen is a set of buttons that put values in the stack, or do operations. The operations affect either the top entry on the stack, or if they are binary operations, the top two. The power of the plane calculator is that each entry holds (invisible to you) the values on the whole plane.

   Example: calculate the energy for an electrostatics problem. You could try this with your solution for the capacitance between cylinders.

   i. Energy per unit volume in electrostatics is ½**E**·**D**. So we can get E and D just by clicking the E_vector and D_vector buttons. They should appear as the top two entries in the stack.

   ii. We need the dot product, so hit the "dot" button under operations. Now the top of the stack contains the dot product, equal to twice the energy density.

   iii. We could now go back to the postprocessor (return, the bottom left), and plot the value, using the options under post:plane (not post:plot—that's a shortcut that enters the right thing in the calculator for you and plots it). You get a list of plot options, each of which will plot whatever is on the top of the stack in the plane calculator.

   iv. Back in the plane calculator (you could skip plotting, and just proceed with this, or go back to the calculator—the values will still be there): If you want total energy, you need to integrate energy density. Just hit integrate, and you get the values in each region, including the estimate of energy outside the region if you use balloon boundaries, and the sum of all of them. Seeing how much energy is associated with the balloon boundary is a good way to check whether your region is big enough. You want most of the energy to be in the region you simulated—if the balloon part is more than perhaps 10% of the total you probably want to increase your drawing size so that you simulate that part of it more accurately.

   Can you figure out how the enter a constant scalar, like one half, and multiply by that? If not, you can just divide the result by two manually. You might want to familiarize yourself with the push, pop, and exchange buttons as well.

   b. **Line calculator**. This is useful if you want to know the field at points along some line or curve. This calculator operates on values along a line, but before you can use it, you need to define that line. So you need to go to the post:line menu in the postprocessor first, and:

   i. Define a line. Chose post:line:define, and you can then enter a line, drawing in manually, enter an arc, or "enter object", which very helpfully gives you the line or curve bordering an object. Note that you once again have a "zoom" option. You will get a list of vertices of the line, and the line will show up in white on the drawing. If you like what you've got, choose a name and hit "execute". You can go on and define more. When you've got the lines you are interested in, return. Don't worry about the Yes/No box next to the name of the line—that is just if you want to go back and edit them, or delete them.

   ii. Entry. Under Post:line:entry, pick out the line you want to deal with.

iii. Value. This operation puts the value on the top of the stack in the plane calculator into the line calculator, for the line you selected under “Entry”. (You might check that you have what you want in the plane calculator, e.g. the magnitude of E (there is a “magnitude” button…))

iv. At this point, you have values for that line in the plane calculator, so you could go mess with them if you wanted to, but you could also go right ahead and plot them, with…

v. Plot Choose Post:line:plot, and you get a plot. Note that on this, or any plot, you may see granularity in the solution that doesn’t make physical sense. If you wanted to do better, you could go back to the Setup-solution menu before running the solver, and manually make a finer mesh. You aren’t required to do that for this homework set.