ECE5340/6340: Homework 6
FDM with Multiple Dielectrics

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University of Utah, Salt Lake City, Utah
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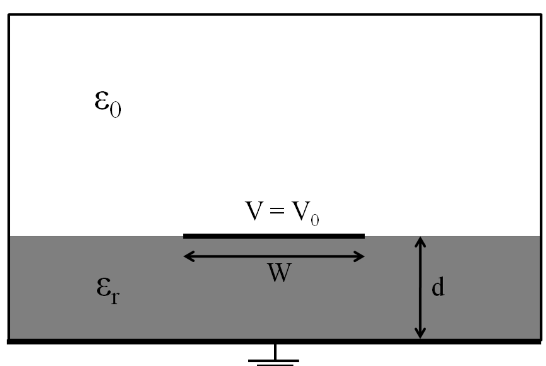
Write your section (ECE5340 or ECE6340) by your name. Turn in a printed copy containing the problem solutions, plots, and the code used to generate them. Remember to comment and format the code so it is legible to the graders. Label the plots appropriately, including units for each axis and for the values plotted. Assume all units to be SI units unless stated differently. Due Wednesday 2/15 BEFORE class begins.

ASSIGNMENT

1. Starting from the generalized Poisson equation, derive Equation (42) from the notes.
2. Write a Matlab function that simulates the voltage distribution of a microstrip line. Allow the user to input the dimensions (W and d) of the microstrip as well as the dielectric constant ϵ_r of the substrate and the voltage difference V_0 between the top conductor and the ground plane. Use the system geometry depicted below:



- Test your simulation under the conditions $W = 1.0$ cm, $d = 3.0$ mm, and $\epsilon_r = 3$. Use a value of $V = 1.0$ V for the potential of the top conductor. Use only Dirichlet boundaries of 0.0 V along the borders of the simulation domain. Choose a simulation boundary size and grid spacing that you think is appropriate in order to obtain accurate results. Plot the voltage and electric field distributions before calculating characteristic impedance.
- Resimulate your microstrip line by applying a Neumann boundary condition along the center of the domain. Recalculate the characteristic impedance. Did you get the same value? How much time and memory did you save by exploiting symmetry?

- Generate a graph of Z_0 vs W for $d = 1.0$ mm and $\epsilon_r = 3$ over the interval $W \in [0.5, 1.5]$ cm. Choose 11 evenly-spaced values (0.5 : 0.1 : 1.5) along the interval and simulate them with your program. Compare these values against the analytical expressions by superimposing them on the same graph (Be sure to cite your source for the analytical expressions). How well does your simulation agree with the closed-form expressions?