UNIVERSITY OF MANITOBA

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

24.8200 Engineering Electromagnetics

ASSIGNMENT 6

Due Date: Thursday November 16, 2006 **Instructor: J. LoVetri**

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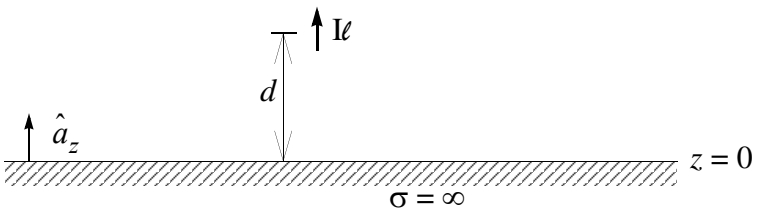
1) First determine the electromagnetic fields associated with a time-harmonic current element of moment $I\ell$ located in free space, and then use that solution and the image principle to determine the surface current density induced on an infinite perfectly conducting plane due to a similar current element located a distance of d above the plane and oriented perpendicular to the plane (see diagram). Is there any power lost in the conducting plane. If so, how much?



2) An air-filled rectangular waveguide, used in a 10 GHz high power radar transmitter, has the following cross-sectional dimensions: a = 2.5 cm and b = 1.0 cm.

a) Show that a possible propagating mode is given by the following field components (identify which mode this is):

$$\begin{cases} E_x = 0 \\ E_y = -j\dfrac{\omega\mu a}{\pi} A \sin\left(\dfrac{\pi x}{a}\right) e^{-j\beta z} \\ E_z = 0 \end{cases} \qquad \begin{cases} H_x = j\dfrac{\beta a}{\pi} A \sin\left(\dfrac{\pi x}{a}\right) e^{-j\beta z} \\ H_y = 0 \\ H_z = A\cos\left(\dfrac{\pi x}{a}\right) e^{-j\beta z} \end{cases}$$

where β is the propagation constant and A is an arbitrary constant (assume RMS magnitudes).

b) If voltage breakdown of the air dielectric occurs at a peak electric field intensity of 5×10^6 V/m, obtain numerical values for the maximum electric field and magnetic field intensities throughout the waveguide. (*I.e.*, determine A and all coefficients in the above expressions.)

c) Find the maximum average power that can be transmitted by the radar without causing voltage breakdown.