ECE 6345
Spring 2024

Homework 6

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1) Assume a phased array of rectangular microstrip patches is built using a grounded substrate having $\varepsilon_r = 2.2$ and $h = 0.1524$ cm (corresponding to 60 mils). The frequency is 12 GHz. At this frequency the normalized wavenumber of the TM$_0$ surface wave is $\beta_{\text{TM0}} / k_0 = 1.0225$. Assume that the element spacing is 0.75 λ_0 in both the x and y directions. Make a Pozar circle diagram for this case that applies for either scan blindness or grating lobes. (Because the normalized wavenumber of the surface wave is so close to unity, the same diagram should apply for both cases.) For ease of plotting, choose a plotting scale so that k_0 corresponds to a convenient dimension (e.g., 2 cm). Please use a drawing tool (e.g., what is in Word or PowerPoint) to make nice circles, so the diagram looks accurate. It is sufficient to draw the visible space circle and the four circles that are the nearest neighbors to it.

2) Use the Pozar circle diagram above to answer the following questions.

   ▪ What is the maximum scan angle θ_0 that one can have in the E plane to avoid both scan blindness and grating lobes? Give an exact answer.

   ▪ Assume that one is scanning the main beam at $\phi_0 = 30°$. What is the maximum scan angle θ_0 that one can have in this plane to avoid both scan blindness and grating lobes? Give a graphical answer.

   ▪ Assume that one is scanning the main beam in the plane $\phi_0 = 30°$, and that one has scanned the beam angle θ_0 so that scan blindness occurs. At what angle ϕ_{sw} (with respect to the x axis) will the surface wave field be adding up in phase along the substrate? Give a graphical answer. (The Pozar circle diagram will show you which Floquet wave is causing the scan blindness)

   ▪ Assume that one is scanning the main beam in the plane $\phi_0 = 120°$, and that one has scanned the beam angle to $\theta_0 = 60°$. At what angles (θ_g, ϕ_g) (in spherical coordinates) will a grating beam point? Give an exact answer. (The Pozar circle diagram will show you which Floquet wave is causing the grating beam.)