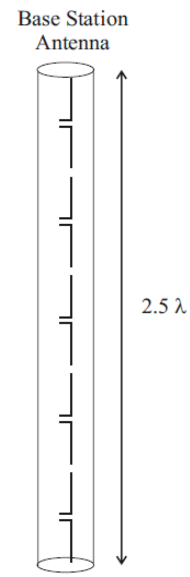
Homework 3: ECE 4370

Line Currents and Link Budgets

1. Cellular base station antennas tend to focus power along the horizon where all the paying customers operate. To do this, the antennas are manufactured with stacked, in-phase half-wave dipoles (see the 5-element example in the figure to the right) such that the total radiating current may be represented by



$$\tilde{I}(z) = \begin{cases} I_0 \left|\cos\left(\frac{2\pi z}{\lambda}\right)\right| u\left(\frac{N\lambda}{4} - |z|\right) & \text{for odd N} \\ I_0 \left|\sin\left(\frac{2\pi z}{\lambda}\right)\right| u\left(\frac{N\lambda}{4} - |z|\right) & \text{for even N} \end{cases}$$

Where N is the integer number of stacked dipoles and u() is the unit step function. Assuming ideal efficiency, make a dB-polar plot of the θ-pol elevation-cut gain pattern of a base station antenna for the cases of N = 3, 5, 7 and 9. Graphically estimate the peak gain and half-power beamwidth in θ for each case. Multiply the linear value of the peak gain and the HPBW angle for each case. What do you notice? (**15 points**)

2. A cellular transmitter sends 200 mW into a 12 dBi gain antenna at 700 MHz. A cellular handset receives at this frequency with, on average, a -2 dBi antenna. If the handset requires at least -85 dBm of received signal strength to maintain a voice conversation, how far away could the handset operate *in free space*? (**5 points**)