ECEG 497 **Wireless System Design** **Spring 2023**

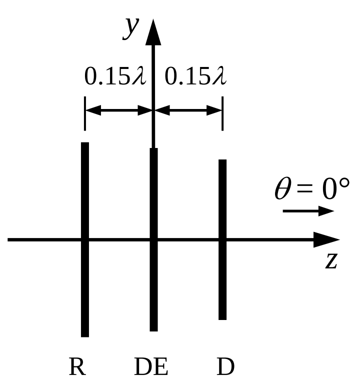
Homework Assignment #10 – not graded

Ungraded Problems:

The following problems will not be graded. They are being provided to help you prepare for the final exam. You should attempt to solve them on your own and then check the solutions, which will be available very soon at the course Moodle site. You will be expected to understand the material referred to in these problems.

1. A three-element Yagi-Uda array has the geometry shown below. An *EZNEC* simulation reveals that the current magnitudes and phases at the element centers have the values shown next to the diagram when the driven element is excited with a voltage of $1 \angle 0°$ V. The current distribution along each element is approximately sinusoidal. If the gain in the $\theta = 0°$ direction is 7.14 dBi, find the gain in the $\theta = 90°$ and 180° directions in the *xz*-plane.
Hint #1: Express the ratio of the relative E-field magnitudes in the $\theta = 90°$ and 180° directions to that in the $\theta = 0°$ direction in dB and then subtract the result from 7.14 dBi.
Hint #2: The element pattern in the *xz*-plane is uniform, so any variation in gain is due only to the array factor.

$I_R = 11.36 \angle 126°$ mA
$I_{DE} = 22.16 \angle 0°$ mA
$I_D = 9.92 \angle -106°$ mA



2. Use *EZNEC* to simulate a two-element Yagi-Uda array in which the parasitic element has a varying length. First simulate a single nominally half-wave dipole operating at 90.5 MHz (WVBU). The wire diameter should be 3/16" (about 4.76 mm), and the dipole should be aligned along the *z*-axis and centered on the origin. Adjust the length until the input impedance indicates resonance (a reactance of less than an ohm or so in magnitude). Now add a parallel parasitic element 0.2λ away along the *y*-axis. Use *EZNEC* to calculate the gain in the two endfire directions for parasitic element lengths from 0.43λ to 0.52λ in 0.005λ increments. The endfire directions correspond to $\phi = 90°$ and 270° in the $\theta = 90°$ (*xy*) plane, but you will need to convert those angles to the elevation and azimuth angles used by *EZNEC*. Plot the gain in both directions vs. length (19 data points per plot) on the same graph using a legend to indicate each curve. Determine the length of the parasite for which it is optimized to act as a director and the length for which it is optimized to act as a reflector.