EE 6370 --- Antennas
Homework #9
Due April 17, 2019
20 points (Twice a regular homework)

Design and analyze an optimal Yagi array that consists of ten rectangular loops as shown below. The antenna is to be used in an 802.11 wireless network which operates in the frequency band of 2.400 GHz to 2.484 GHz. The antenna is oriented so that the elements are spaced along the *x*-axis and the pattern is directed in the positive *x* direction. The elements are numbered left to right as shown below. The driven loop is on the *yz* plane with the feed located where the loop crosses the *y* axis. Let P_n, *n=1,2,3, ... 10* be the perimeters of the loops, A_n, *n=1,2,3, ... 10* be the aspect ratios of the loops, S_n, *n=1,2,3, ... 9* be the spacing between the elements, and d_n, *n=1,2,3, ... 10* be the diameter of the wire for the elements. The aspect ratio is the ratio between the lengths of the *z* and *y* sides of the rectangles: $A_n = L_n^z / L_n^y$. The values are restricted at the center frequency (2.442 GHz) to the ranges: $0.3\lambda \le P_n \le 2\lambda$, $0.3 \le A_n \le 3$, $0.2\lambda \le S_n \le 0.7\lambda$, and $0.001\lambda \le d_n \le 0.025\lambda$. For the analysis, use NEC with 20 segments per loop and 5 segments per side of the loop.

a) Optimize the **realized** gain of the antenna at **only** the center frequency of the wireless band: 2.442 GHz. The antenna must have a **realized** gain of at least 11.0 dB at the center frequency. Make sure that your design does not violate any of the rules that we set for NEC. Here the realized gain is defined as gain including the effects of the mismatch impedance between the antenna and the transmission line: $G_r = G(1-|\rho|^2)$ where G is the gain and ρ is the refection coefficient at the terminals of the antenna. The antenna will be connected to a 50 Ω transmission line. The programs in the file Sample_Optimizer_NEC_2017.zip will be helpful.
b) Explain your optimization strategy.
c) Make a scale drawing that shows your design.
d) Make a table that shows the dimensions P_n, S_n, d_n in cm's and the ratio A_n for each element.
e) Make a graph of the impedance, the gain, and the **realized** gain on **boresite** of the antenna over the frequency range 2.3 to 2.6 GHz.
f) Make a table of the impedance, the gain, and the **realized** gain on **boresite** of the antenna for the frequencies of 2.4, 2.442 and 2.484 GHz.
g) Graph the 3D antenna pattern for the total gain on a linear scale at the frequencies of 2.4, 2.442 and 2.484 GHz.
h) Include the NEC file used to generate the final antenna in a format that can be read with the command line version of NEC (no parametric entries). Email me a copy of this file.

The students that design the antennas with the highest gain will receive extra credit. The student whose antenna has the highest gain will receive 10 extra points, and the students whose gain is within 0.5 dB of the highest will receive 6 extra points.

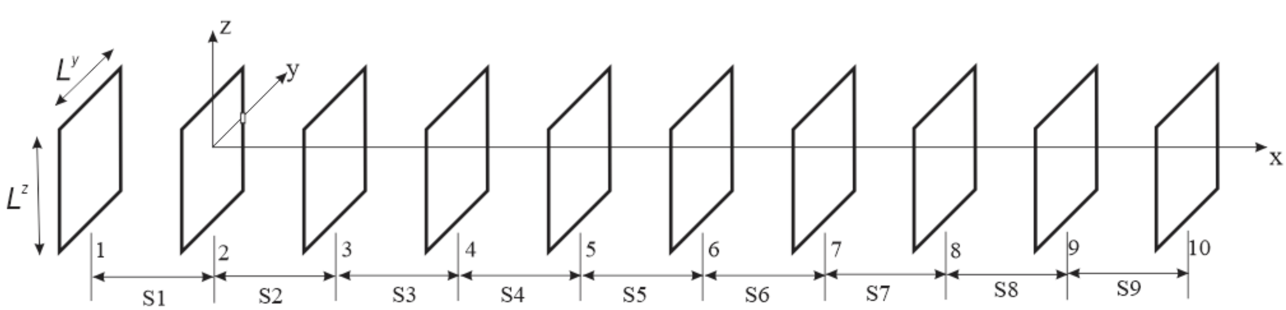

Diagram of the Yagi array geometry.