LAB 10 – Design And Analysis Of A Parasitic Array Antenna

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Purpose:

To design and analyze a parasitic array antenna using a CAD package and compare results with the analysis of a prefabricated antenna in a test environment.

The following lab exercise will require the use of two programs found on the computers in L-19A. Initial antenna geometry will be determined by a program called Array found as a subdirectory in the directory Communic. Select Yag to start. Once you have your segment geometry you will run NEC4WIN and enter the data according to the procedures below. The last exercise involves the implementation of test equipment to gather live data.

Note: Yag is available on the course web page.

Prelab: The antenna to be designed and analyzed will be a 5 element Yagi-UDA antenna. As a pre-lab exercise calculate the lengths and spacings for the first three elements of the array (reflector, driven element and first director). The antenna is to operate at a frequency of 4XX. The XX will be the last two numbers of your student identification number. Include your calculations as part of your lab write up.

Equipment:

- Agilent E4411BSpectrum Anaylyzer
- Agilent 8712ES Vector Network analyzer
- Agilent 8647 RF signal source
- *Computer system with HPIB interfaces to the test equipment and a program called Simfield that displays results (Agilent VEE) in an Anechoic Chamber.

  Note: The equipment listed is used in Part B. If a computerized system of data collection is not in place (the * denotes this part), mounting an antenna on a tube and using an inexpensive television rotor and motor to rotate the antenna in angular increments will yield suitable results. See description at the end of the lab.

  Note: The program Simfield can be made available to professors and instructors of other colleges and universities upon request by contacting me at gswick@niagarc.on.ca .

Procedure:

If lab schedules are set to two hour periods, then these exercise could be performed over two sessions.

PART A:

1. Run Yag. Enter your frequency and wavelength type. (Enter .5) Enter enough directors to make it a 5 element antenna. Acquire a printout of the antenna lengths, spacings and graphic of the antenna.
2. Select Segment Geometry to gain values that will be suitable for entry into nec4win.
3. Printout the antenna geometry.

4. Run Nec4win and enter the appropriate data from step 3 under GEOMETRY. Specify HEIGHT and FREQUENCY as well as status relative to ground. Initially height should be several wavelengths above ground.
5. View the plot of zenith and azimuth in free space and ground plane mode. Provide a printout.
6. While in PLOT mode click ANTENNA to VIEW the 2D orientation of the antenna. Click view twice to see element distribution. Click PULSES and observe results.
7. Go to COMPUTE and gain a printout of RESONANCE over a range of 5 MHz in steps of 0.2 MHz .

PART B:

ANECHOIC CHAMBER ANALYSIS OF 440 Mhz 5 element Yagi.

This process is automated. While the test antenna is rotating in the Anechoic chamber, a computer collects the varying field strength over one rotation and at the same time a program using Agilent VEE will display the results in both rectangular and polar format. The antenna can be characterized in either the E or H field depending on how it is mounted.

1. Mount the 440 Mhz Yagi in the Anechoic Chamber.
2. Adjust the motor position in order that the antenna is set to 0 degrees in the horizontal plane.
3. Close the chamber door and initiate data collection using the computer and associated equipment.
4. Observe the field pattern on the computer screen as it is being developed as well as the power level varying on the spectrum analyzer.
5. When the process is complete acquire a printout of the Polar presentation of the field pattern on the computer.
6. Calculate the front to back ratio of the antenna.