Indian Institute of Information Technology Nagpur

ANTENNA WORKSHOP

Course : WAVEGUIDES & ANTENNAS(ECL-307)

Topic : Broadside Array (Frequency 1800MHz)

Course of work for assignment

Day 1: Received assignment question & Started simulation in CADFEKO software

Day 2: Fabrication of the antenna on the basis of simulation results

Day 3: Testing of fabricated antenna on Vector Network Analyser

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Antenna Theory:-

According to the standard definition, "An arrangement in which the principal direction of radiation is perpendicular to the array axis and also to the plane containing the array element" is termed as the broad side array.

Hence, the radiation pattern of the antenna is perpendicular to the axis on which the array exists.This is a type of array in which the number of identical elements is placed on a supporting line drawn perpendicular to their respective axes. Elements are equally spaced and fed with a current of equal magnitude and all in the same phase. The advantage of this feed technique is that array fires in broadside direction (i.e. perpendicular to the line of array axis, where there are maximum radiation and small radiation in other direction). Hence the radiation pattern of broadside array is bidirectional and the array radiates equally well in either direction of maximum radiation.The capability of an antenna to increase the quality of the performance depends on their parameters such as number of elements, spacing between elements, phase and amplitude excitation. The main parameters for linear array antenna are the number of elements and spacing elements which must be taken into consideration.

They may also be arranged in vertical and in this case radiation will be horizontal. Thus, it can be said that broadside array is a geometrical arrangement of elements in which the direction of maximum radiation is perpendicular to the array axis and to the plane containing the array clement. A typical arrangement and Radiation pattern of a broad side array is shown in The bidirectional pattern of broadside array can be converted into unidirectional by placing an identical array behind this array at distance of fed by current leading in phase by 90^o

Construction and Procedure:-

Consider array consists of two elements which are dipoles. Simulation is done on CADFEKO software

1. Firstly knowing the frequency at which the transmission is done along with shape and size of antenna.

2.In Broadside array elements are arranged in horizontal plane with spacing between elements and radiation being perpendicular to the plane of array (i.e. normal to plane of paper).

3.Calculate the wavelength(lamda) by using formula $\frac{c0}{f}$. where $c0$ is the speed of light in vacuum $3 \times 10^8 m/sec$ and f is the frequency of antenna 1800MHZ

4. From the construct section take a line and set appropriate coordinates by considering length $\lambda/2$ as total height of dipole , both the dipole having same height and separated by equal distance from origin.

5.Take suitable coordinate to adjust both dipole with distance between them is $(\lambda/2) \times 0.6 \times 2$

6.Select a suitable frequency range in which the resonating frequency lie between them(In our case the range is 1700MHZ to 1900MHZ) make sure that your all the dimensions are in meters.

7.While constructing a dipole make sure that you select local radius of 1.5mm (It may vary depending on the radius material being used). For this assignment we have used material of 1.5mm radius.

8.Make union of both the dipoles and give the voltage source in the middle of the length of both the dipole individually.Apply a far field for visualizing more results

9. Apply mesh by selecting a suitable mesh radius (in our case 0.002)i.e in m also check CM validate for evaluating all the correct results.If there is error then change the mesh radius and evaluate again.

10. Click on feko solver to compile and run simulation . After compilation open postfeko to observe the results. In postfeko use Cartesian ,3D ,Polar,plots and smith chart to observe the result

Results of simulation:

In the process of achieving resonance, simulation various lengths are assigned to antenna and the observations are noted down.

The length of dipole is chosen to be $\lambda * 0.4773$ and distance between dipoles to be h*0.6*2 for achieving resonance as it has shown more relevant values.

Length of dipole(h)	**Distance between dipoles(d)**	**Resonating frequency(Ghz)**	**Reflection Coefficient(dB)**
lamda*0.4699	h*0.55*2	1.85	-21.8784
lamda*0.47	h*0.55*2	1.85	-21.875
lamda*0.4715	h*0.55*2	1.8456	-21.9045
lamda*0.4725	h*0.55*2	1.84175	-21.9115
lamda*0.4745	h*0.55*2	1.83405	-21.9245

lamda*0.4773	h*0.55*2	1.82339	-21.9423
lamda*0.4773	h*0.6*2	1.80047	-30.55
lamda*0.4793	h*0.55*2	1.81586	-21.9532
lamda*0.48288	h*0.55*2	1.8023	-21.9588

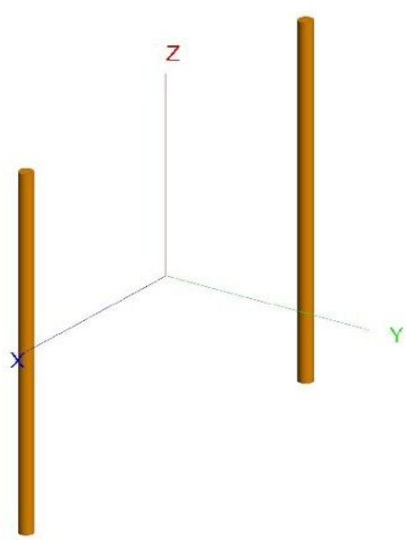

Fig 1: 3D view

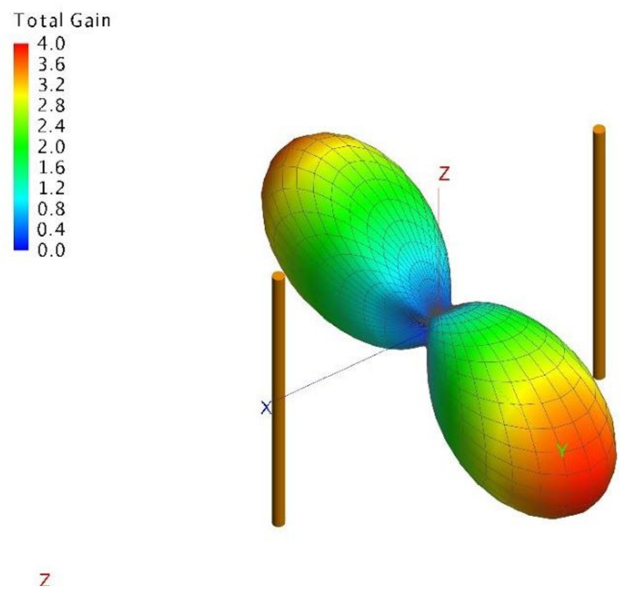

Fig 2: 3D view of radiation pattern

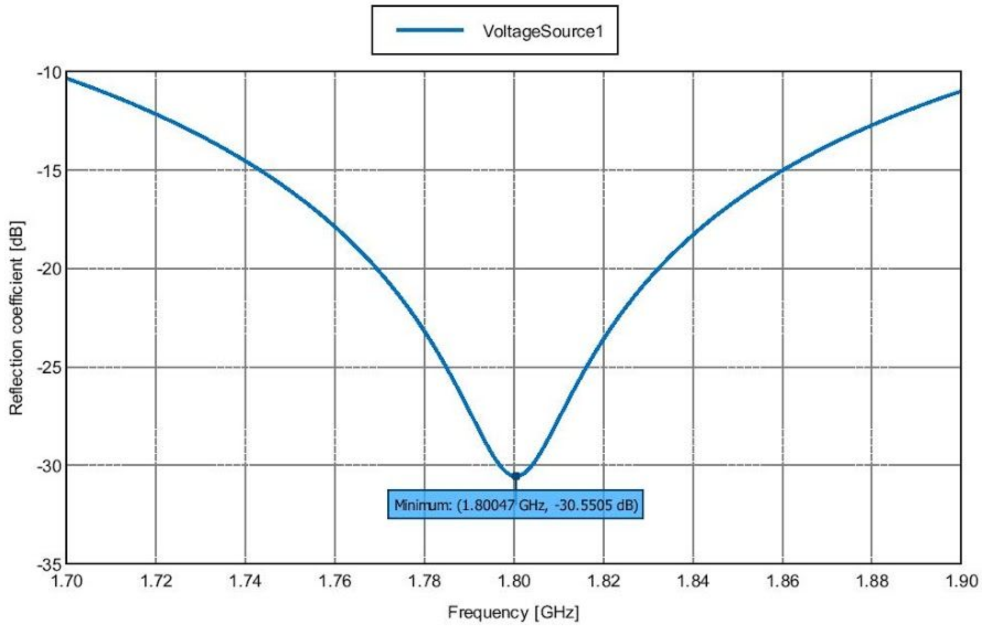

Fig 3: Cartesian plot for voltage source 1

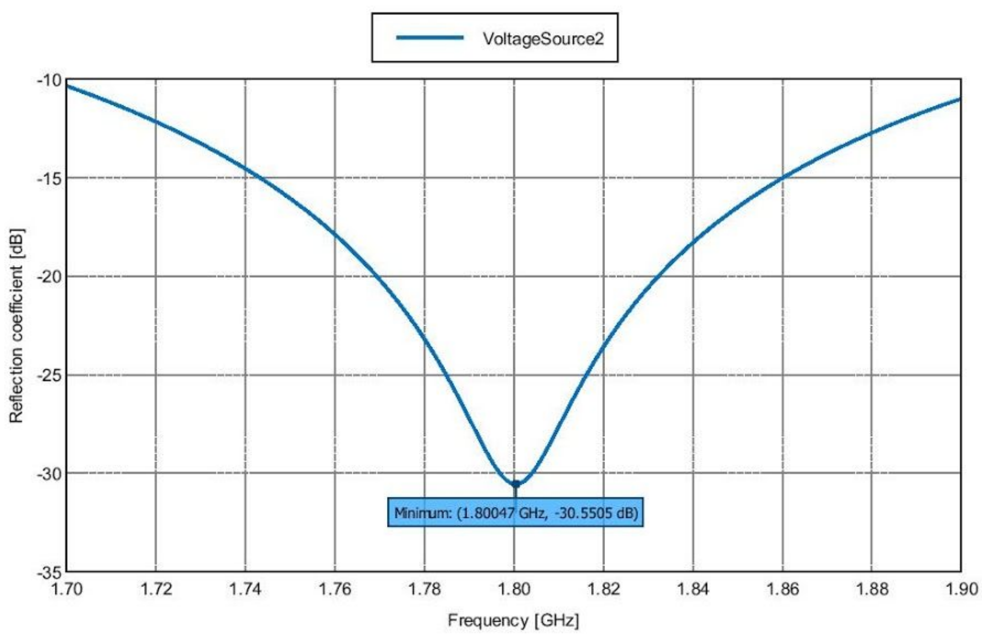

Fig 4: Cartesian plot for voltage source 2

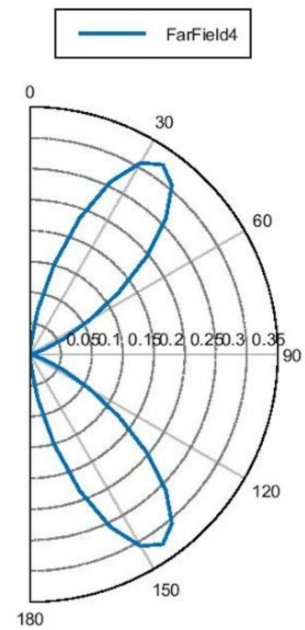

Fig 5: 2D plot of radiation pattern for optimum distance

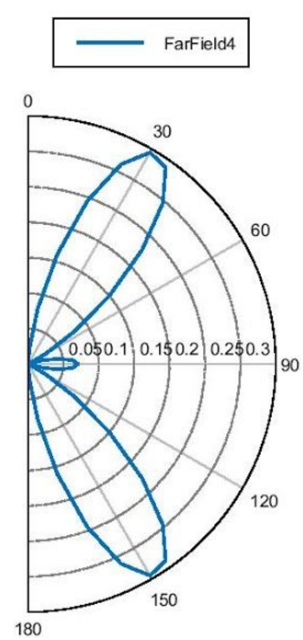

Fig 6: 2D plot when dipoles are placed far away than optimum values

Results of Vector Network Analyser:

The fabricated antenna is tested with a Vector Network Analyser which has shown the following result. The simulated antenna result is of short span(1.7Ghz to 1.9Ghz)

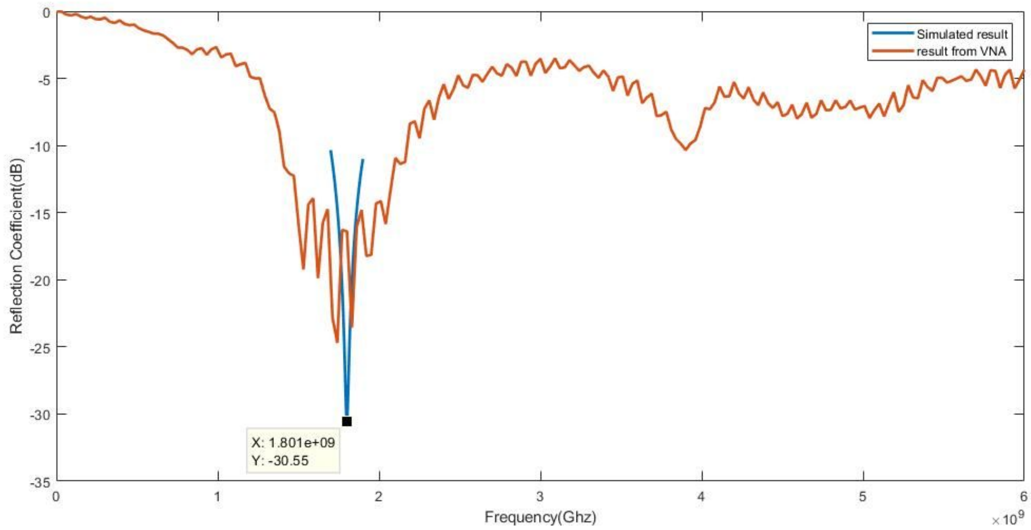

Fig 7: Observed resonance for simulated antenna(Blue)

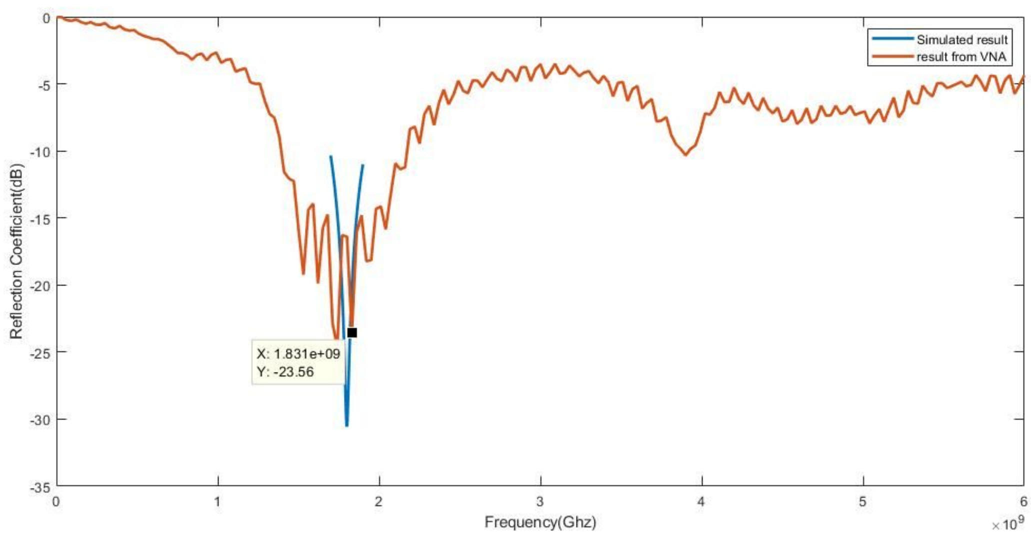

Fig 8: Observed resonance for fabricated antenna(Orange)

Comparision of simulated antenna and fabricated antenna:

	Simulated	**Measured**
Frequency	1.80047Ghz	1.83Ghz
Coefficient of reflection	-30.55dB	-23.56dB

Observations and conclusions:

1.After simulating the antenna in software by varying the length and distance between the dipoles, it is observed that

- ❖ Length of dipole has major effect on the resonance frequency
- ❖ Distance between the dipoles has major effect on the coefficient of reflection value

2. As we increase the distance between the dipoles, side lobes started to appear as shown in figure 6 which is not required for the case of fabrication, as the resultant radiation of two dipoles is expected to be totally on the broadside as shown in figure 5.

3.Gain of the designed broadside antenna is observed to be a maximum of 5

Fabricated Antenna: