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A New Basic Designing of Smart Array Antenna

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***Abstract*- The most application of communication, need antenna with changeable direction of radiation with high gain, also without mechanical motion (moving-less), with a higher electric signal reliability. The changeable radiation increase the reliability to communicate at different destination .**

This paper present a new basic design array antenna depended on basic calculation method, to calculate the radiations from more one source, to obtained an array factor excitation to change the direction and increase the gain. The designed a new generation array antenna was manufactured and tested, the results show an improving in increasing the radiation factors with motion-less. Also shows an efficiently with better response.

Key words: Smart antenna, element and Model

I. INTRODUCTION

In an array of identical elements, there are at least five controls that can be used to shape the overall pattern of the antenna. These are like the geometrical configuration of the overall array (linear, circular, rectangular, spherical, etc.) , the relative displacement between the elements, the excitation amplitude of the individual elements the excitation phase of the individual elements and the relative pattern of the individual elements[1].

The radiation pattern of single – element antennas is relatively wide and gives low value of directivity, in many applications its necessary to design antenna with high directivity to meet the demand of long distance communications, this can only be accomplished by increasing the size of antenna.

Enlarging the dimensions of single elements often leads to more directivity, the other way is to use more than one element without increasing the size of elements, the total field of the array determined by the vector addition of the field radiated by individual elements, this assumes that the current in each elements is the same as that of the isolated elements, this assumes that the current in each elements is the same as that of the isolated elements[2].

To provide this very directive pattern it is necessary that the field from the elements of the array interfere constructively (add) in the desired direction and interfere destructively (cancel each other) in the remain space By varying the phase shift between elements, a beam or multiple beams can be pointed towards a given direction This forms the basis of the large electronically steered radar system currently being deployed. Collectively these systems are known as phased arrays [3].

I. MATHEMATIC MODULE

The main component of the type of Yagi antennas is Folded Dipole Plus to one reflector and Directors and To understand the process

$$E_t = E_1 + E_2 = \hat{a}_\theta j\eta \frac{kI_0 l}{4\pi}\left\{\frac{e^{-j[kr_1-(\beta/2)]}}{r_1}\cos\theta_1 + \frac{e^{-j[kr_2+(\beta/2)]}}{r_2}\cos\theta_2\right\}$$

of changing the direction of radiation using phase by Two element array assuming situation two infinitesimal horizontal dipoles **(1)** positioned along the z axis as shown in fig. 1. The total field radiated by the two elements is equal to the sum of the two and in the Y Z plane.

β is the different in phase excitation between elements. Assuming far–field observation and referring to fig. 1.

$$\theta_1 \simeq \theta_2 \simeq \theta$$

$$\left.\begin{aligned} r_1 &\simeq r - \frac{d}{2}\cos\theta \\ r_2 &\simeq r + \frac{d}{2}\cos\theta \end{aligned}\right\} \text{ for phase variations}$$

$$r_1 \simeq r_2 \simeq r \qquad \text{for amplitude variations}$$

So the equation reduces to

$$E_t = \hat{a}_\theta j\eta \frac{kI_0 l e^{-jkr}}{4\pi r}\cos\theta[e^{+j(kd\cos\theta+\beta)/2} + e^{-j(kd\cos\theta+\beta)/2}]$$

$$E_t = \hat{a}_\theta j\eta \frac{kI_0 l e^{-jkr}}{4\pi r}\cos\theta\left\{2\cos\left[\frac{1}{2}(kd\cos\theta+\beta)\right]\right\}$$

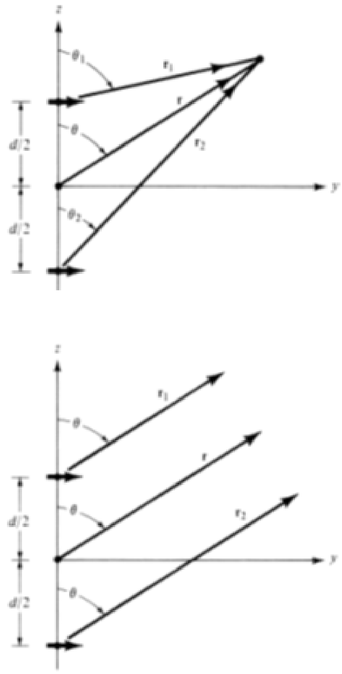


Fig. 1. Two infinitesimal dipoles [1]

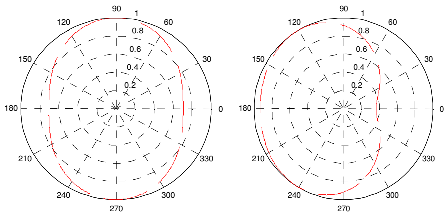
The total field of the array is equal to the field of the single element positioned at the origins multiplied by a factor which referred as array factor according to the equation (2).

$$(AF)_n = \cos[\tfrac{1}{2}(kd\cos\theta + \beta)] \quad \textbf{(2)}$$

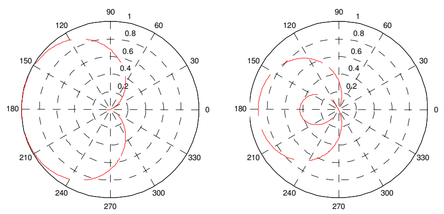
Fig (1.a

The array factor can exited by many parameter, the simulation assumptions are fixed all parameter and change the β to see different in radiation direction.

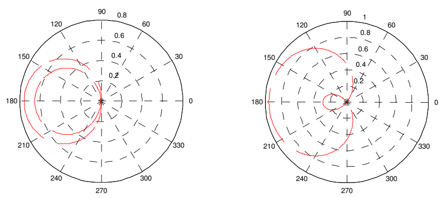
The measured and theoretical normalized radiation patterns are found using Matlab simulations, for different phase angles as presented in the following figures.



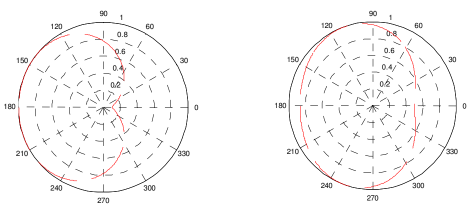
β=0 β=30



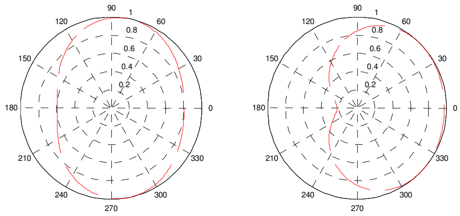
β=60 β=90



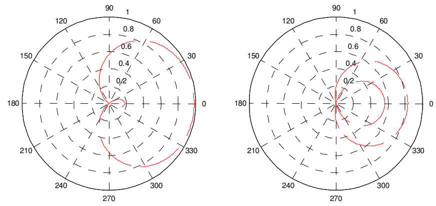
β=120 β=150



β=180 β=210



β=240 β=270



β=300 β=360

Fig. 2. Show the different in phase excitation pattern between elements from 0 to 2 π

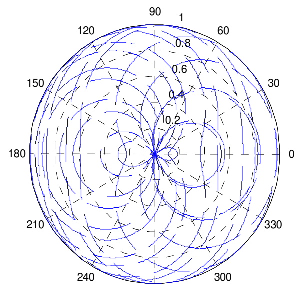


Fig. 3. The summation of all phases pattern in figure(2)

II. DESIGN IMPLEMENTATION

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A smart antenna consists of an array of individual radiation elements, which are placed in a particular configuration . By associating these elementary antennas and by changing the characteristics of the applied signals, the array can present different gains according to the direction of propagation [4]. In this paper, a uniformly patch antennas is considered, and all other measurements, the implemented new design array antenna is shown in Figure 4, where the distance between two antennas, and the radiation phase angle β experimently measured, and other parameters are presented in the following table.
The measurements structures required to connect the antenna within the very high frequencies (VHF) bandwidth shown in figure 4 :

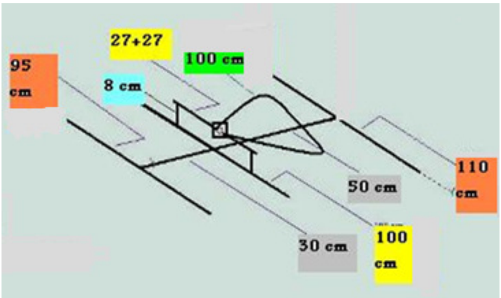

Fig. 4. Structure designed antenna

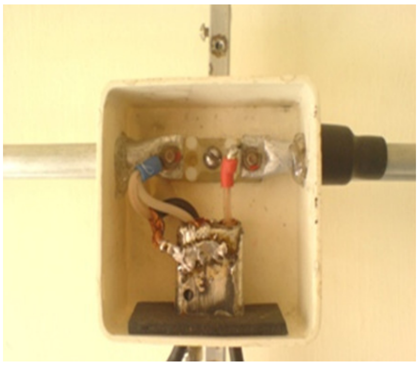

Fig.5.Show the welding of antenna

- Assembling the outskirts of polarity and connect the antenna cable feeding at the main box connections

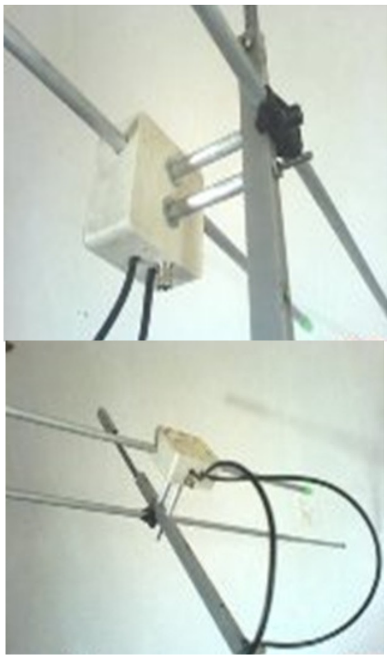

Fig. 6. Show the antenna at finishing

III. RESULTS AND DISCUTION

TABLE 1.
PRESENT THEEXPERMINTAL TEST OF MANOFACTURE ANTENNAA COMPRED WITH YAGI ANTENNA

DATA	Audial Quantity	Practical Quantity
Type	Yagi–Uda -15 element	Yagi- 3 element
Frequency	145 MHz in middle VHF	145 MHz
Decibel	20 dB	14.52 dB
Polarization	Horizontal	Horizontal
impedance	300 Ohms	33.76+j3.91 Ohms
Directivity	14.64 dB	10.396dB

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From table 1 the designed new array antenna of three elements only, show that its fulfillment the requirements comparing to Yagi-Yda ideal antenna, and its size much smolare than Yagi. antenna

IV. CONCLUSION

To make array antenna with changeable radiation pattern, with more gain it is easy to make it without increasing the size of elements by varying some parameters like phases between the elements, without directional mechanical motion. This means increasing the directivity with minimal power dissipation, which mean the ability of the spectrum directional. and provides an efficient electrical energy, which is one of the basics of smart antennas.

The obtained basic measurements of a new designed and implementations of the array antenna, shows that its convenient and small size and can be used in many applications.

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