Analysis and Design Phase Shifter N - bit Distributed MEMS Ka-band Antenna Design with Fuzzy Aryeh

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Abstract

In this study, the analysis and design phase shifter N - bit distributed MEMS Ka-band antenna design with fuzzy Aryeh, is evaluated, an n-bit phase shifter using variable capacitors or MEMS switches that are located alternately on the wave of the page is created. Capacity to change the bias voltage, effective capacitance of the transmission line and the result is a slow-wave structure is created. Accurate model phase full wave electromagnetic theory of change with the analysis of microwave circuits is possible. Using the finite element method by high frequency structure simulator (HFSS) field in the unit cell is calculated. Fields with unknown parameters of S and also their sensitivity to physical dimensions obtained. The results result, the design of microwave circuits with the concept of n-bit phase shifter is done. Finally, the performance of all the states in the Ka-band phase shifter is checked. desired and interfering signal in order to have a minimum gain. This paper analyzes the performance of the antenna is about style. The existing relationship, to simulate radiation pattern of the antenna to the multipath signal, each of which has three components are applied.

Keywords: Phase N - bit, MEMS distributed, band Ka, antennas, phased Aryeh

INTRODUCTION

Electronically scanned phased arrays for space without physically moving the antennas are important in communication and radar. The main element phased array transmitter phases. A phased array antenna has a separate power may be a large number of phase with the formation of the so-phase transmitters with low loss, low cost and low weight of an array of phased have main role. Transforming the low internal losses and high power ferrite tolerated but complex structure and high manufacturing cost. Semiconductor phase transition in which the PIN diodes or transistors FET is used to ferritic type and size are less expensive to construct, but their use for the loss of domestic very limited also. In recent years the phase transfer using microelectromechanical systems technology to Mnzvrghlbh the limitations presented.

MEMS phase shifter microwave and millimeter-wave frequencies has been developed significantly. Two main methods of design; one way switching and a distributed MEMS transmission line (DMTL) for the phase transition can be seen in the literature. The phase delay of the switching network by using the switching between different paths obtained. The method DMTL variable capacitors on the line and are frequently used to control the phase delay caused by the capacitor or switch modes. Types of transmission lines and combinations of MEMS capacitors can be considered. Parallel capacitive switches is the most famous of a thin metal layer floats on the center conductor plate waveguide (CPW) and connected to the adjacent conductors formed with DC bias voltage is in motion.

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A dielectric layer to prevent metal-to-metal connection between the layer and the center conductor is placed. By applying a voltage between the center conductor layer, layer by electrostatic force with cutting down the voltage, the layer of tension to the initial location. Phase transfer DMTL Rebeiz and Barker was presented first followed by the two-bit phase shifter in the band X; changing a bit in the K band were studied in phase III. Four-bit phase shifter is also distributed resources can be found. During the five-bit phase transmitters using Astabhay short circuit and open circuit by X-band MEMS switches have been proposed. The five-bit phase shifter is a reflection of the MEMS switches have been examined. Generally, in recent years in the frequency range 1- 120 GH Digital phase transmitters with MEMS technology has been developed by research groups.

I. The Importance And Urgency Of The Issue

Most methods are based on the analysis and design of resource-intensive elements for each layer based on CPW are applicable to the particular case. In these methods, the amount of compression obtained by different methods and circuits using a broad concept of the phase change can be deduced. It's all about changing the phase of the methods have been studied by a number of specific bits. For example, the method of transmitting two bits by changing the phase III-bit, three-bit and four-bit is .... different. Together we can change the way the design phase with various bits seem to be necessary. Full wave electromagnetic analysis in this paper is used to describe the performance. Appropriate numerical method used according to the structure of the unit cell and the electromagnetic fields in space is calculated. Given the square; S parameters and sensitivity values for the width and height of the layer is calculated. Using the results of the structure and function of the n-bit phase shifter microwave circuit theory offered to help. Finally, internal losses, losses on patrol and phase generated in different states are obtained.

II. GOALS HAIR

The overall objectives :

Analysis and design phase shifter N - bit distributed MEMS Ka-band antenna design with fuzzy Aryeh

Detailed objectives :

Detailed objectives:
Gain antenna
Phased Array Antennas
Potential model
Strategy of adaptive antenna
N-bit phase shifter design DMTL
Equalisation
Simulation with MATLAB

Methodology

To be built on CPW MEMS switches have optimum performance it is appropriate that the center conductor is made thinner than the adjacent conductors. Geometric and physical characteristics of the unit cell is as follows: the width of the gap between the center conductor and a 90/120 / 90G / W / G = (all dimensions in microns) and the width of the lateral conductors 100 are considered. 5. The next 4 are Vhadyhay center conductor thickness. The thickness of the silicon substrate 500 and the sex ratio was 11.9 relative dielectric material with conductivity 4.1 × 107 siemens per meter gold conductors are considered. The box with the dimensions 360 × 1000 × 500 100 × 120 with a coefficient of dielectric with relative dielectric 7 and 25 and the metal layer thickness and length Lm = 300 and 60wm = tm = .5 order Ast.tmam this structure exact dimensions and materials with HFSS software using the appropriate method is introduced. HFSS finite element method analysis is done and the wave field of the structure is obtained. S parameters are calculated from the field on a data base for the design.

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III. DEFINITIONS AND TERMINOLOGY

Antenna gain, directional antennas all have the same amount of power radiated in all directions. This is called isotropic antennas known in all respects the same gain directional antennas are Darnd.az other hand, in order to gain some in some way, they gain more than others. Direction in which the antenna has the highest gain antenna or boresight alignment is called. In a receiving antenna, so that the antenna gain and the amount of energy compared to a directional antenna to the receiver delivers all. [1]

Phased Array Antennas: A Phased Array Antenna array of antennas is used. Each antenna array comprising an array element is known. Signals induced on various elements together to form a single output combined. The combination of beamforming signal elements called lawn direction in which the antenna beam pointing direction is called a maximal response. When the signal without any phase change or combined gain of beam pointing direction perpendicular to the line array elements Filed With all the different antennas can be used to adjust the phase difference between the reference beam can be determined.

Gain and the gain of the array is equal to the sum of the individual antennas [2].

POTENTIAL MODEL The response curve as a function of angle, antenna pattern or model is called. This chart indicates the received power from a single power source in a particular direction in the output array. The pattern can be a linear array of 10 equal Alfaslh Germany in Figure 1 has been shown to present .zavyh than has been measured. To provide a reference to the beam angle of 90 ° with it. This model has been normalized so that the maximum gain and the array pointed in the direction of the beam pointing direction of the beam on either side of Shvd.algvy be a slight drop. This amount is called a null position. Rather, a null array is where the answer is zero. But sometimes mistakenly used the term to low Model Shvd.algvy line between two points on both sides of the channel, beam main lobe is called (also summarized the main beam beam) within the main beam between two points half-power beam width is called the half-power. [3]

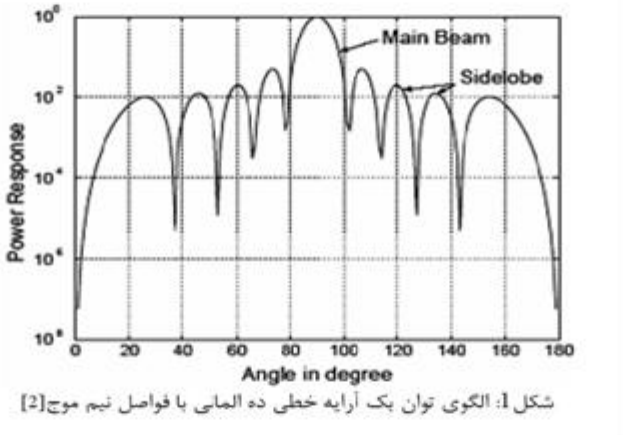

Figure 1: The pattern can be a linear array of ten elements with intervals of half-wave [2]

IV. STRATEGY OF ADAPTIVE ANTENNA

These antennas are adjusting to changes in the RF environment can always be modified so that the beam pattern of the signal to the desired signal and interference signal to the signal direction. This capability enables the communication quality is always high. The effect is similar to the human ability to hear sound from both Dard.mghz human ear and can receive audio intercept and focus on it. Figure 2 shows the radiation pattern of an adaptive antenna. [4]

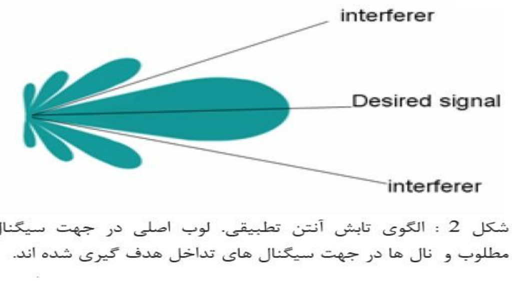

Figure 2: Adaptive antenna radiation pattern. The main loop of the desired signal

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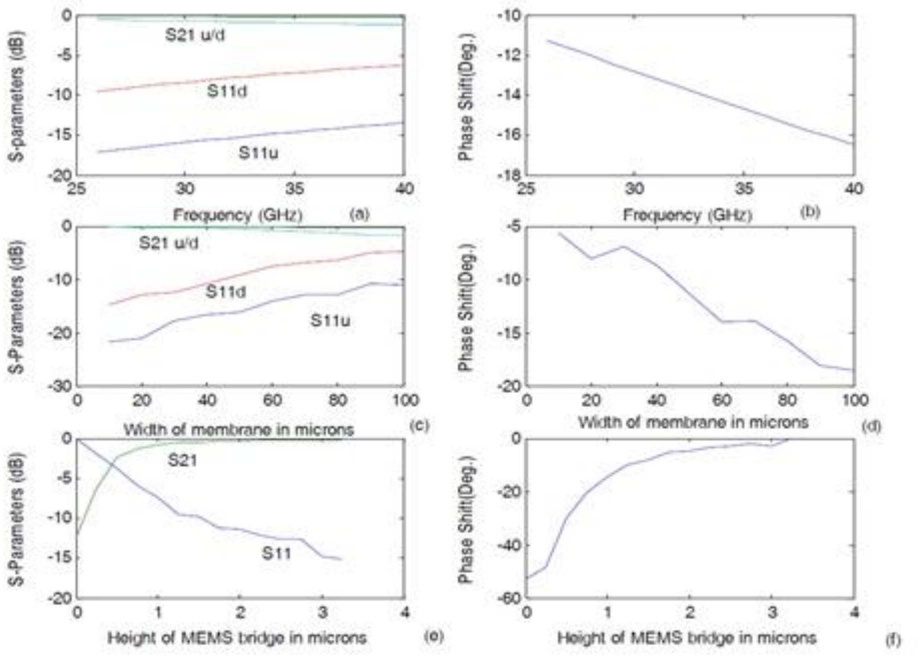
and the signal to interference signals have been targeted.

V. Full-wave analysis and extraction parameters S

Using the finite element method analysis by HFSS frequency range 26-40GH S parameters are extracted. Figure 3 can be seen in the graph. high losses are also reduced the height of the layer also increases the phase difference is instead of wasting raises the bias voltage needed. This phase can be justified due to the layer with CPW center conductor in a plane parallel capacitor acts. Increase the width and height are both increasing capacitance. S21 phase of a capacitor in parallel relation

$$\Delta\varphi = -\tan^{-1}\frac{c\omega z_0}{2}$$

Obtained. Can be seen that the phase difference is increased thus far. With all the factors, the layer width and height of 3.25 to a high of 60 to a low height of 1.75 looks good. Addressing the need for full-wave analysis using parallel capacitor model as an admittance and parties we assume a transmission line. Here are 60 and 120 within the 3.5 to 0.25 for air and dielectric. Capacitance with this profile .02pf [5] obtained. S21 phase for Drfrkans 30GH, 5.4 degrees obtained for transmission lines with a length of 150 microns parties 10.8 ° phase difference is obtained when the phase difference of 16.2, while the phase difference for the unit cell of the form (3) and section b approximately 12.5 ° is obtained which shows a dramatic difference. The full wave analysis is necessary. According to this section, the n-bit phase shifter design is done using these results. [6]



شکل ۳ : پارامتر های S سلول واحد (a) پارامتر های S در حالتهای بالا و پائین (b) اختلاف فاز (c) حساسیت پارامتر های S بر حسب پهنای لایه (d) تغییرات فاز (e) حساسیت ها بر حسب ارتفاع (f) تغییرات فاز .

Figure 3: Pramtrhay s unit cell (a) parameter s at the top and bottom (b) differences in phase (c) the sensitivity of the parameter s in terms of the width of the layer (d) changes phase (e) the sensitivity in terms of (r) phase changes.

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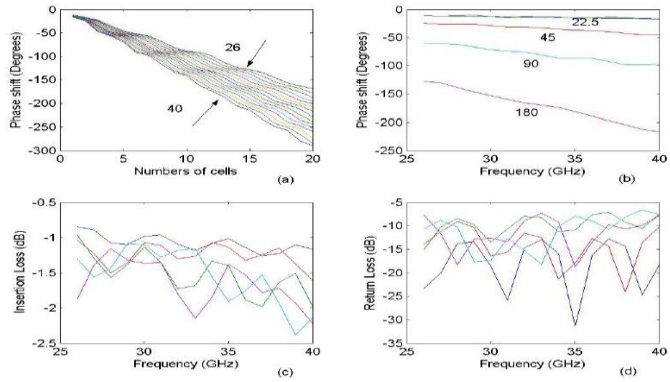

شکل ۴ : (a) اختلاف فاز در فرکانسهای مختلف (b) اختلاف فاز تغییر دهنده های تک بیتی (c) تلفات داخلی (d) افت بر گشتی.

Figure 4: The phase difference at different frequencies (b) single-bit phase shifter (c) internal losses (d) fall back.

VI. N-BIT PHASE SHIFTER DESIGN DMTL

Using the S parameters of the unit cell of the full-wave analysis of microwave circuits before and Theory you can get the phase change characteristics. The unit cell parameters S are known as bipolar consider the changing phase of bipolar several successive be seizing. It would be best to use the transfer matrix T is the total transfer matrix multiplication can be easily calculated. [7] N phase delay unit cell calculated at the same frequency for different values of N in Figure 33 GH (4) have been plotted. The curves of Fig. 4)) can be seen that each of the phase change a bit 11.25, 22.5,45, 90,180 degrees can be respectively the number 1, 2, 4, 8 and 16 on CPW MEMS switches fulfilled. So that in terms of frequency and other parameters such as internal losses and losses on patrol is also acceptable. 31 will be the number of switches that can be changed in all forms of the phase n (n = 2,3,4,5) got bit. [8]

To obtain information on the different modes, we use the following equation:

$$T_t = T_d^{nd} \times T_u^{nu}$$

Where Td and Tu and transition matrices and nu nd unit cells are the high and low states. [9]

S matrix of the transition matrix in each case was calculated by subtracting the phase lag phase of S21 in various positions known

Is. Thus, 2-bit phase shifter 90 and 180 degrees, 3, 90 and 180 degrees with 45-bit, 4-bit, 5-bit and finally with 180,90,45,22.5 degree with 180,90,45,22.5 , 11.25 and their composition design. two or three or four or five bits used. For an explanation on how to change the design phase should be noted that, depending on the size of the S parameter sensitivity analysis (figure (f, e, d, c, 3)) conducted as part of the curve in Figure 3 f one micron in width and height for 60 micron layer S21 approximately 15 ° phase difference is obtained. Close successive phase of a cell can be multiples of 15 - degree obtained. [10]

It should be noted that the above design method can be used at other frequencies. Repeating the process of designing custom digital phase shifter phase obtained at different frequencies. For example, 4-bit phase shifter for all 16 modes, internal losses, losses on patrol in frequency and phase error 33GH (center frequency) shows. For an explanation of the figure (4) part b, a phase of HFSS is applied to the unit cell and calculate the total for the four-bit S-matrix is obtained. Calculation of total S outputs with full wave analysis with HFSS, a MATLAB M file is written. These values are drawn when the entry forms will be created. The points are connected with discrete values. 5.4 It is clear that such cells

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are not to be expected that the phase difference is approximately 33.39 creation. [11]

Another important consideration is couplings. We can say that using sensitivity analysis of the parameters s are selected such that the S11 is as small as possible and minimize reflection (matching condition is very important and without it, it does not accumulate in successive phases of the network of relationships S parameters are given two consecutive network) as a reflection of the low reverse clutch is so low. Analysis of the structure of the unit cell as a result of a cell and beat them to obtain the parameters, it is confirmed. [12]

VII. EQUALISATION

When multiple users of a frequency used to transmit signals at the receiver by sending them come together. If you are a user n on one frequency, the signal will be received by each element has n components. [13] Since the elements are placed at different spatial positions of the received signal for each element, will have a different combination of these signals can be in the form of an equation n Multivari- not be uttered. [14]

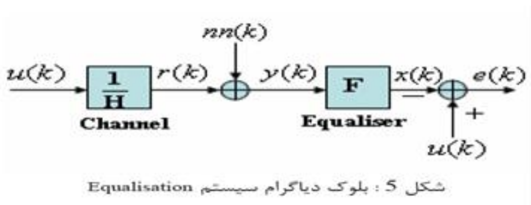

Figure 5: Block diagram Equalisation System

Channel into a block $\frac{1}{H}$ with the transfer function model for them. , U (t) is the signal sent at the instant k. Y (k) mixed signal to noise received by the array, and e (k) signal error. Equaliser effect reduces noise at its output to a minimum. If F = H, then the output will recover Equaliser the same input signal. The channel transfer function is unknown. [15]

To obtain the correct weight matrix, we need a learning process Darym.ty this process every user has a unique series of short training signals such as U (k), which is sent to the station antenna is known. Since the channel is constantly changing, the system must periodically with a series of weight in short periods of time to update .algvrytm LMS algorithm used here is at least square means. [16]

VIII. SIMULATION WITH MATLAB

The LMS algorithm simulation of 0.008 μ is set to 400 MHZ carrier Shdh.frkans Figure 6 indicates the weight applied to the signal line radius curves and angles are listed on the circumference of a circle to show DOA Dhnd.takhyr first signal propagation 100 μs 150 μs is considered the second Vsygnal Shdh.sygnal transmitted signal in white Gaussian with zero mean and unit variance, which each have three multipath components.

form the main component elements appear along with less weight. [17]

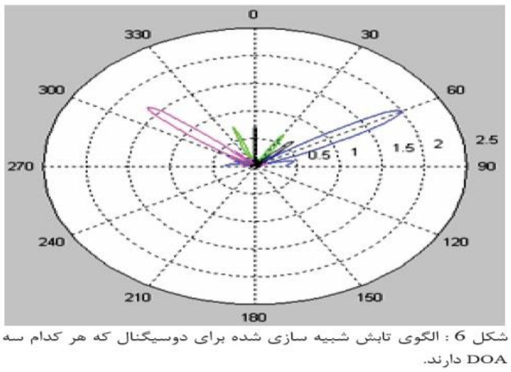

Figure 6: Simulated radiation pattern for the two signals that are DOA, each with three.

IX. THE RESULTS OF THE SIMULATION:

As in Figure 6 can be seen, the algorithm used for shaping the antenna radiation pattern, this feature is that the main lobe of the highest gain in the direction of the desired signal and the signal to the note that the sign of the interference signal based simulation is interesting is that in this system, not only because of fading and multipath components but there is no signal

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attenuation using delay elements may be reflective of the components used to amplify the received signal.

CONCLUSIONS

In this research, analysis and design changing phase N - bit MEMS distribution of Ka-band with antenna design by Aryeh fuzzy, were evaluated in this analysis and design will change the phase of n-bit MEMS distributed because of its intermittent using the concept of single cells was performed. Full-wave electromagnetic modeling and analysis unit cell with HFSS software do its S parameters were extracted. Using these parameters, the overall performance of n-bit phase shifter is obtained by using the theory of microwave circuits. Due to the fact that all 32 states with the right combination of changing one bit 180,90,45,22.5,11.25 degree will be achieved. We have studied them thoroughly. Amount of internal losses and losses on patrol in all 16 states and phase transitions in the frequency range 26-40GH fully calculated. Internal losses average 1.68dB and an average error of 2.33 degrees entire return average was 11.94 dB, which is a good result compared to the available resources. Because the phase change along with the other elements in high-frequency circuits and is used to describe the S parameters in computer-aided design (CAD) is of particular importance to enjoy. View the changing phases of the internal losses, losses on patrol, the phase error is compared with results from several sources in the table.

Each of these resources for the phase change of the number of bits is done. They are also elements of compact model is used. If the wave analysis Rqth used to obtain the values of these elements. We combine the advantages of microwave circuits and apply appropriate analysis and the theory of wave structure is intermittent and can be used together for a bit.

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