Plan And Testing of Micro Strip Antenna Using HFSS Software

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Abstract- *A Microstrip reception apparatus comprises of leading patch on a ground plane isolated by dielectric substrate. This idea was undeveloped until the upset in electronic circuit scaling down and vast scale combination in 1970. After that many creators have depicted the radiation starting from the earliest stage by a dielectric substrate for various setups. This work, a test encouraged Microstrip radio wire outline for the usage of two dimensional clusters with independently bolstered emanating components is displayed. The execution of the reception apparatus component both disengaged and in a 4 £ 4 settled cluster topology is dissected HFSS recreation programming. Models of the reception apparatus component and of the cluster are made and measured for the trial approval of the plan we got radiation designs, return misfortune, input impedance, E-field, H-field and current disseminations that are reproduced for this proposed radio wire with Ansoft-HFSSsoftware.*

Keywords- Microstrip antenna, HFSS software, two dimensional antenna array

I. INTRODUCTION

As of late request of Microstrip radio wires are expanded because of its utilization in high recurrence, fast information correspondence applications. Printed reception apparatuses are practical and can be obliged in the gadget bundle. Microstrip recieving wires are best type of radio wires since they are light weight, low profile, minimal effort, simplicity to dissect, create and are perfect with the incorporated circuits.

Reception apparatus clusters have been broadly utilized in an extraordinary assortment of utilizations, exploiting their bar shaping [1], adaptation [2] and design nulling [3] potential outcomes. Furthermore, the conduct of the cluster can be altered continuously by independently tuning the bolstering signs of the distinctive individual radiators, giving versatile arrangements [4, 5]. Microstrip innovation has turned into an across the board alternative for the execution of reception apparatus exhibits, inferable from its notable points of interest, likeness, simplicity of fabr ication and minimal effort, particularly after the improvement of various upgrade systems, went for checking the conventional downsides of this technology(limited transmission capacity, spurious radiation of the bolstering lines,). In reconfigurable executions of recieving wire exhibits, the nourishing signs of the transmitting components must be independently controlled, which requires these signs to be separately led from each of the tuning circuits to its relating emanating component. In spite of the fact that this is direct in straight exhibits, by essentially expanding the bolstering lines of the radio wire components to the edge of the circuit board [6], the transmission line format process may turn into a

Testing errand for two dimensional exhibits, particularly for applications where a substantial number of components is required [7]. This is overcome in [8], with a topology in view of semi Yagi radio wires, in which the tuning circuits for each column of the cluster are set in an opposite plane. Essentially, in Microstrip innovation, test nourishing methods are more proper.

Than others in light of Microstrip transmission lines for these cases, as the connectors related to the individual patches can be introduced in the ground plane, where the vital hardware is associated (Figure 1). In spite of the fact that test nourished Microstrip radio wires introduce innately lessened working data transfer capacities in the request of 1{2% at low frequencies [9], various works can be found in the writing, concentrated on enhancing the impedance transmission capacity of these structures. Transfer speeds around 4% can be acquired by presenting shortcircuited parasitic components [9] or with a H-formed emanating patch [10], giving roundabout polarization. Advance changes can be accomplished utilizing thick air substrates with L-molded tests [11] (26.5%), T-formed tests [12, 13] (33{40%) or with stacked fixes on thick dielectric layers [14] (up to 60%). In any case, other than the normally lessened mechanical steadiness of outlines with air substrate layers, thick substrates by and large offer ascend to high coupling levels between patches, which make them improper for cluster plans.The proposed antenna is designed for the Bluetooth/ WLAN-2.4 applications at 2.4 GHz. Liquid crystals are having some unique combination of properties that make them ideally suited for high density electronic substrate applications.

1. They are having excellent electrical properties up to millimeter wave frequencies.
2. Virtually impermeable to moisture, oxygen and other gases and liquids.
3. Low coefficient of thermal expansion (CTE) 8 or 17 ppm/0C.
4. Very low moisture absorption, < 0.04% by weight.
5. Excellent dimensional stability (< 0.1%) [3].

Since most of the probe fed topologies available in the literature operates at somewhat lower frequencies, the design process, as explained in Section 2, relies on simulations carried out using Agilent Advanced Design System (ADS) and Ansoft HFSS (which provides a more complete 3D model of the structure that might lead to more accurate.

Results at this frequency). In Section 3, the performance of this design in dimensional array topology is studied, assessing its properties in terms of mutual coupling and radiation pattern. Finally, in Section 4, the simulation and optimization are commented, and remainder of paper contains results and conclusion in order both to evaluate and compare the simulation methods and to validate the design.

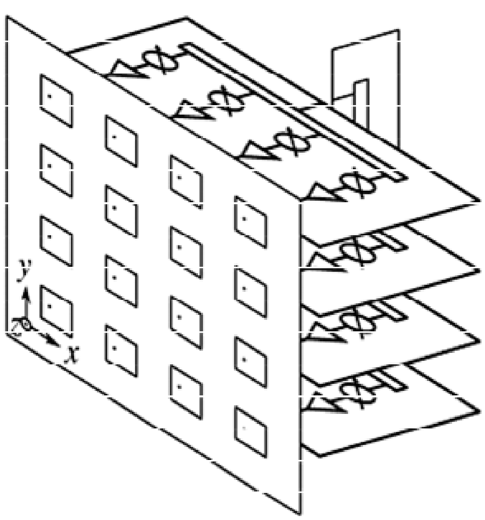

Figure 1: Topology of the Two Dimensional Antenna Array with Individually Fed Radiating Elements

Microstrip recieving wires are alluring because of their light weight, likeness and ease. These recieving wires can be coordinated with printed strip-line sustain systems and dynamic gadgets. This is a moderately new region of recieving wire building. The radiation properties of small scale strip structures have been known since the mid 1950's. The utilization of this sort of reception apparatuses began in mid 1970's when conformal radio wires were required for rockets. Rectangular and roundabout small scale strip resounding patches have been utilized ext ensive ly in an assortment of cluster

Designs. A noteworthy contributing component for late advances of Microstrip reception apparatuses is the present upset in electronic circuit scaling down realized by improvements in extensive scale combination. As traditional reception apparatuses are regularly massive and expensive piece of an electronic framework, smaller scale strip radio wires in view of photolithographic innovation are viewed as a building leap forward. A miniaturized scale strip reception apparatus in its least difficult frame comprises of a sandwich of two parallel leading layers isolated by a solitary thin dielectric substrate [1]. The lower conductor works as a ground plane and the upper conductor works as radiator. Among various states of miniaturized scale strip fix components, for example, rectangular, square, dipole, triangular, roundabout and circular for better radiation attributes we utilize rectangular smaller scale strip fix reception apparatus.

To dissect miniaturized scale strip fix reception apparatus we have,

(1) Transmission demonstrate;
(2) Cavity demonstrate and
(3) Full wave demonstrate.

Transmission line display is easiest however less exact. Hole show is more precise yet complex in nature. Full wave demonstrate is exceptionally precise, adaptable, and can treat single component, limited and interminable clusters, yet are generally perplexing. Among this transmission line display is utilized which gives better physical understanding and give inexact connections to ascertain measurement of fix. Bolster line and coordinating systems are manufactured alongside recieving wire structure.

II. MICROSTRIP ANTENNA DESIGN

The design also checks for maximum power transfer by matching the feed line impedance to the impedance of the patch antenna. The different feeding techniques used for impedance matching are micro strip line, coaxial probe, Proximity coupling and aperture coupling. Micro strip line: In this Impedance matching is easier. And feed can be fabricated on some substrate as single layer to provide planner structure [9].But disadvantage is we must use transformer to match impedance and it excites cross polarization. Coaxial probe: Probe location is used for impedance matching. Ease of insetting and low radiations is advantages of probe feeding. Proximity coupling: Proximity coupling offers some opportunity to reduce feed line radiation while maint aining a relatively thick substrate for the radiating patch. The input impedance of antenna is affected by the overlap of the patch and the feed line, and by the substrates. However due to multilayer fabrication the antenna thickness increases [8]. Aperture

Coupling: No spurious radiation escapes to corrupt the side lobes or polarization of the antenna. However due to multilayer fabrication antenna, thickness increases. Among this coaxial probe is used for impedance matching, as it is ease of insetting and low radiation and also used with plated for multi layer circuits[10]. Micro strip antennas are versatile in the sense that they can be designed to produce a wide variety of patterns and polarizations, depending on the mode excited and the particular shape of the patch used. The impedance bandwidth of Microstrip antennas is known to be larger for higher values of the substrate thickness and for lower permittivity. However, apart from its impact on the mutual coupling, when the substrate thickness is increased in simple probe fed topologies, the length of the probe is extended accordingly, leading to high inductance values that must be subsequently compensated. The proposed topology, shown in Figure 2, uses a relatively thin substrate layer through which the probe is connected to the first patch, while the layer between the first and the second can be moderately thickened to improve the bandwidth. The coaxial connector is soldered to the bottom layer of a 0.762mm thick ARLON 25N substrate (²r = 3:38 and tan ± = 0:0025 at 10 GHz) and the probe is connected to the specified point in the first patch, edged on the top layer or this substrate. The second patch is placed on top of a double layer of ARLON 25N (1.524 mm).

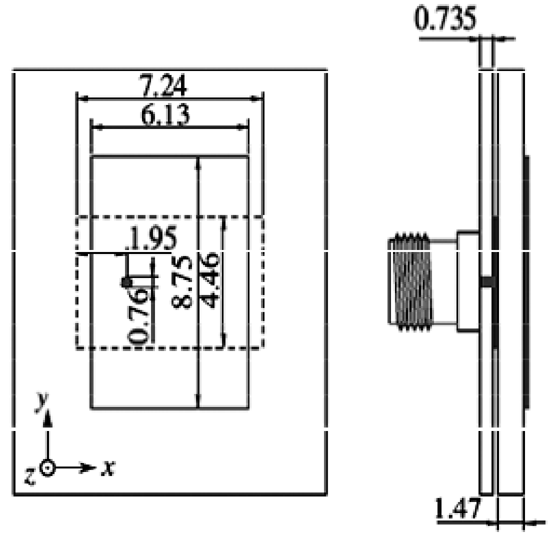

Figure 2: Proposed Microstrip Antenna Dimensions inMillimeters

III. ANSOFT-HFSS

HFSS is an interactive software package for calculating the electromagnetic behavior of a structure. The software includes post-processing commands for analyzing this behavior in detail.

Using HFSS, we can compute:

- Basic electromagnetic field quantities and, for open boundary problems, radiated near and far fields.
- Characteristic port impedances and propagation constants.
- Generalized S and S-parameters renormalized to specific port impedances.
- The eigenmodes, or resonances, of a structure. To draw the structure, specify material characteristics for each object, and identify ports and special s ur f ac e c h ar a ct e ri s t ic s. HF S S g ene ra t es th e necessary field solutions and associated port characteristics and S-parameters.

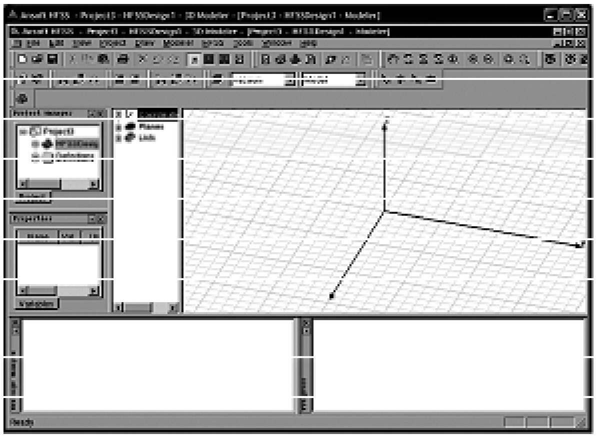

Figure 3: New Window with HFSS Interface

IV. SIMULATION

4.1 Simulation and Optimization

The performance of the proposed design has been studied using the Agilent Advanced Design System Method of Moments (Momentum) electromagnetic simulator. This analysis software, in which the substrate layers are considered infinite, does not support coaxial feeding and, therefore, the simulations have been carried out using an Internal Port, directly placed on the feeding point of the first patch. At the same time, the complete design structure, including the coaxial feeding and the finite substrate layers, has been analyzed using the Ansoft HFSS finite element simulator. Using the results of these two methods, the dimensions of the design have been optimized to increase its impedance bandwidth. The results obtained with both simulation methods for the final design are compared in Figure 4. The antenna presents a bandwidth (jS11j < ¡10 dB) of approximately 1.15 GHz centered at 10 GHz (11.5%). Despite the fact that the probe feeding is not modeled in the ADS simulations, the results obtained with both methods are reasonably similar, yielding analogous values for the frequency of operation and for the impedance bandwidth. The radiation patterns, evaluated at 10 GHz in the E-plane (XZ plane in Figure 2) and in the H-plane (YZ plane in Figure2), have been calculated using ADS and HFSS obtaining gain values of 5.17 and 6.5 dB respectively. The normalized values of the co-polar (CP) and cross-polar (XP) components are compared in Figure 4, as a function of the spherical coordinate µ. For the co-polar components, similar results are obtained with both simulation methods, whereas, for the cross-polar ones, noticeably higher values are observed in the HFSS simulations. A very pure linear polarization is found in the E-plane, with cross-polar levels under ¡30 dB (under ¡50 according to the ADS simulation). However, in the H-plane the cross-polar levels are low in the boresight direction and increase with jµj (although, in the ADS simulation, the ¡30 dB level is never reached).

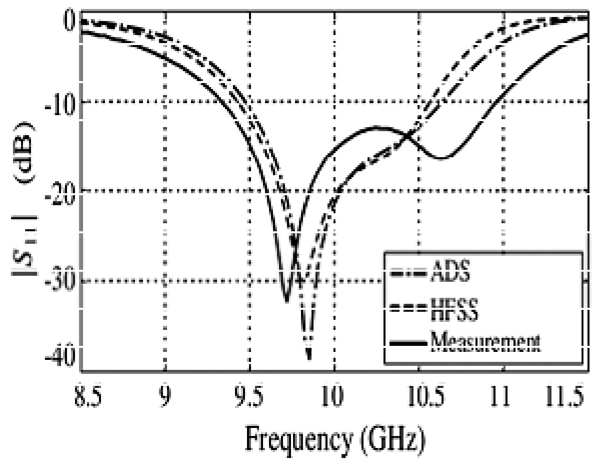

Figure 4: Simulation of the Antenna using HFSS (Finite ElementMethod) and ADS Method

V. SIMULATION RESULTS

The major limitation in micro strip antenna is the narrow bandwidth, which can be stated in terms of antenna’s quality factor, Q. Micro strip antennas are high-Q devices with Qs sometimes exceeding 100 for the thinner elements. High-Q elements have small bandwidths. Also the higher the Q of an element the lower is its efficiency. From Figure 5 and Figure 6 the return loss of –14.5 dB, –18.5 dB and minimum VSWR value 1.36 and 1.45 is

Obtained at the two frequencies. And the rms value and bandwidth obtained from Fig. 7 input impedance plot is 0.7064 and 6.8789 GHz respectively.

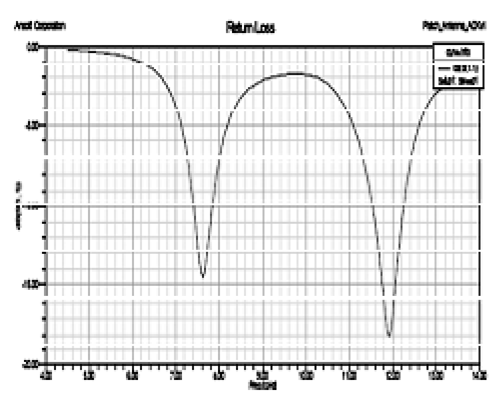

Figure 5: Return Loss

5.1 Microstrip Antenna Design

A prototype of the Microstrip antenna design analyzed In Section 2 has been manufactured for the experimental validation of the simulated results. Plastic screws have been used for the alignment of the complete multi-layer structure. The S11 parameter of the prototype, measured with a vector network analyzer, has been represented in Figure 3, together with the simulated results. The isolated antenna is matched to 50- in the band from 9.33 to 10.66 GHz (16%), which represents a significant improvement with respect to the simulated results. The radiation patterns of the antenna have been measured in the anechoic chamber at 10 GHz. The co-polar and cross- polar components evaluated in the E- and H-planes are compared to the simulations in Fig. 4. The simulated co-polar components are in good agreement with the corresponding measurements, although the HFSS simulation is slightly different when approaching the endfire directions (µ = §90±) in the E-plane. For the cross- polar component, on the other hand, while neither of the simulation methods provides an accurate estimation, the levels of the HFSS results are somewhat closer to the measured values. The polarization purity of the antenna is higher in the E-plane, in which the cross-polar Component is under the ¡30 dB level in almost any direction, whereas, in the H-plane, several oblique lobes of about ¡25 dB can be found.

5.2 Antenna Array

The array topology with individually fed elements designed and analyzed in Section 3 has been manufactured and measured, obtaining approximately the same 16% impedance bandwidth of the isolated element. In agreement with the simulations, the isolation levels between elements with the same kind of alignment are similar and, thus, only one parameter for either alignment is represented in Figure 5. Similar isolation levels, over 20 dB, have been found for both Arrangements. In order to measure the radiation pattern of the array, a simple fixed feeding network based on 4£1 dividers (Figure 1), has been designed and manufactured for the phase distribution studied in Section3. The radiation pattern measured in the anechoic chamber along the plane ‘ = 45± is shown in Figure 6. The main beam is pointing at µ = 21±, 4 degrees under the value predicted by the simulations, with the SLL < ¡10 dB,element both isolated and in a 4£4 array topology has been analyzed using ADS

5.3 Antenna Parameters and Maximum Field Data Values

From antenna parameters the values of Peak Directivity,

Peak Gain, Peak Realized Gain, Radiated Power, Accepted power, Incident power, Radiation Efficiency, Front to backratio, Power and Radiation Efficiency, Max U values areobtained and tabulated in Table 1.

Table 1
Antenna Parameters

AntennaParameters

Quantity	*Value*	*Units*
Max U	2.2718	w/st
Peak Directivity	344.52	
Peak Gain	343.9	
Peak realized gain	97.339	
Radiated Power	0.082864	w
Incident Power	0.19329	w
Radiation Efficiency	0.89825	w
Front to Back Ratio	1238.8	

The infinite sphere radiation setup for antenna parameters are computed and tabulated in the Table-1

Momentum and HFSS. Despite the fact that coaxial feeding is not supported in ADS Momentum and that it considers infinite dielectric layers, t he r es ul ts o bt a in ed w it h bo th met hod s ar e no t substantially different in general. Prototypes of the antenna element and the array with a fixed feeding networ k have been manufact ured and measur ed, obtaining a 16% impedance bandwidth centered at 10GHz. The isolation between the elements of the array was found to be higher than 20 dB.

Finally, the optimum dimension of dual frequency rectangular patch antenna has been investigated. The performance properties are analyzed for the optimized dimensions. In future, the same procedure could be applied to design other planar antennas operating at other frequency levels. The designed patch element could be part of an array.

VI. CONCLUSION

A probe fed microstrip antenna design for the implementation of two dimensional reconfigurable arrays has been presented. The performance of the antenna

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