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Development Analysis of Superstrate Magneto-Hydrodynamic Antenna

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ABSTRACT
In this paper ,we experimentally investigates various stages of antenna design, starting from patch antenna,DRA placed over patch antenna, applying DC Bias voltage to hybrid combination of DRA over Patch. The effect of Antenna parameters applying magnetic bias along with DC bias has also been observed. It has also been observed that when superstrate layer of array has been placed over the DRA, the antenna gain increases from 6.6db to 9.28 db.The various parameters of Antenna like Gain, reflection coefficient has been analyzed for various design

Keywords
DRA, Superstrate., Radiation pattern, Magnetic bias

1. INTRODUCTION

The use of wireless communication and mobile phones has changed our life style. Through the evolutionary process of Technical development, a number of antenna has been designed for supported application. In the field of mobile communication, military, aeronautics, Antenna high gain, Reconfigurability, miniaturized size, large bandwidth is the major areas in which research is required.Microstrip antenna was commonly used antenna since 1970s due to its compact size, but it suffers from disadvantage of low bandwidth and less gain.[3][2].DRA antenna have received a lot of attention since last two decades due to its light weight and high radiation efficiency. The major limitation of DRA is its Low bandwidth[4][1].The concept of MHD (Magnetohydrodyanamic) [6][7] is used in the design of antenna. Magneto hydrodynamics involves a combination of both electrical and magnetic fields in order to induce mechanical flow in a fluid that is made conductive by dissolving an electrolyte in it. This paper experimentally investigates the various stages of Antenna design [5]. The various results of gain has been simulated using Ansoft High frequency Simulator (HFSS)and investigated experimentally. In this paper various cases of antenna design has been investigated and analysed.

2. ANTENNA DESIGN DECRIPTION

Figure 1 shows a annular ring of perfect conductive material of radius 5mm and 12.5mm respectively on copper ground plane. The dimensions of rectangular ground plane are 80*80 mm^2 .Standard SMA feed is connected at the center point of annular ring for RF excitation. Figure 2 shows two cylindrical tubes of Propylene Random Copolymer pipes (PPR) of radius 5mm and 12.5mm and height 12mm respectively mounted on annular ring. The cylindrical tubes are filled with sea water. The dielectric properties of sea water can be changed by varying electric and magnetic field. Figure 3. shows the design of antenna when DC Bias voltage is applied to antenna. Figure 4 shows the design of antenna when magnetic bias is applied at bottom along with DC bias. The design is further analyzed when magnetic bias is applied at the side along with magnetic bias as shown in Figure 5 .Figure 6. shows the design of Antenna when it is embedded with superstate layer on top, keeping desired air gap along with DC and Magnetic Bias. Circular array of Patches are used as Superstrate.The antenna gain can be increased by using superstrate layer. It has been further observed that by changing the position of superstrate circles as shown in Figure 7, an improvement in gain can be obtained. The gain can further be enhanced by increasing the number of circular patches on superstrate layer. Figure 9 shows design of antenna when circular patches on both sides of superstate are applied.

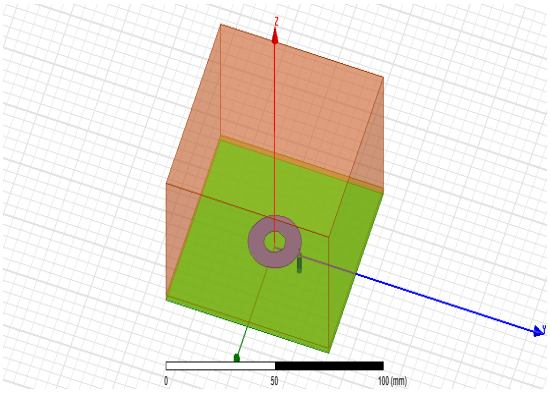

Figure 1: Annular Ring

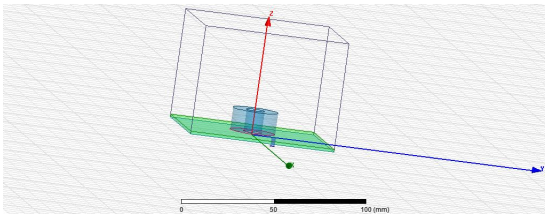

Figure 2: DRA on annular ring

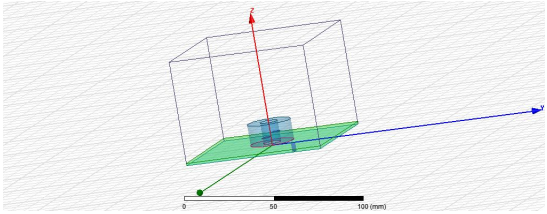

Figure 3: DRA on annular ring with dc

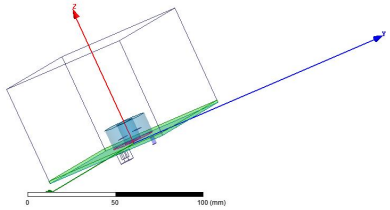

Figure 4: DRA on annular ring with dc and magnetic bias applied bottom

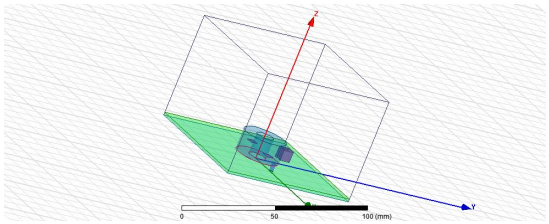

Figure 5: DRA on annular ring with dc and magnetic bias applied side

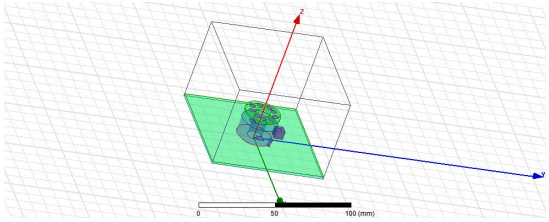

Figure 6: DRA on annular ring with dc and magnetic bias applied side with superstrate

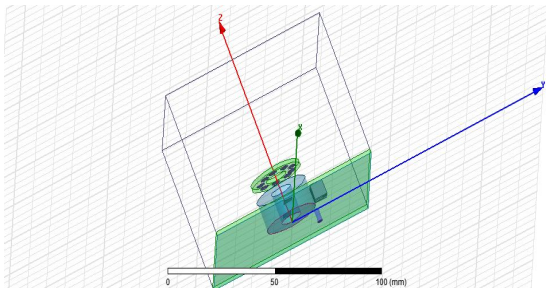

Figure 7: Superstrate circle position changes

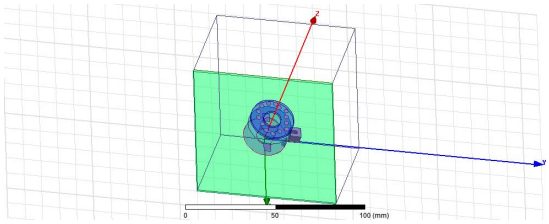

Figure 8: Number of circles increases in superstrate

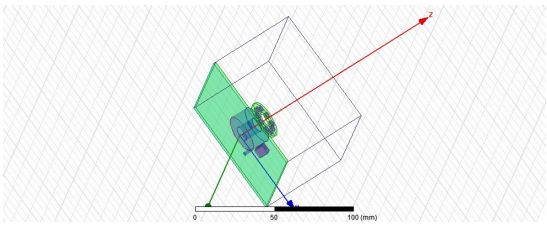

Figure 9: Circles on bothside of superstrate

3. RESUTS AND DISCUSSION

The designs of antenna has been simulated using Ansoft high frequency simulator,HFSS.The measured reftection coefficient charactertics S_{11} as a function of frequency of antenna for designs 1,2,3,4,5,6,7,8,9 (Figures1-9) are plotted in Figures 10-18. The radiation pattern obtained for various designs 2,3,4,5,6,7,8 9 are shown in Figures 19-26.Simulated return loss results, gain and resonant frequency results for various designs 1,2,3,4,5,6,7,8,9 are shown in Table 1. It is observed from measured results that there is significant improvement in return loss and gain of antenna when antenna is embedded with superstate layer on top. An improvement in gain is further observed by increasing the number of circles in superstate layer.

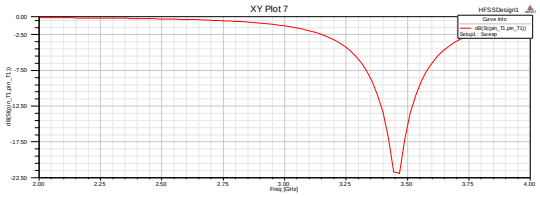

Figure 10: S11 in db vs Freq for design 1

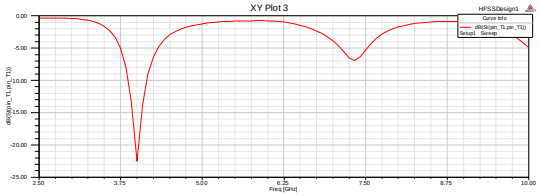

Figure 11: S11 in db vs Freq for design 2

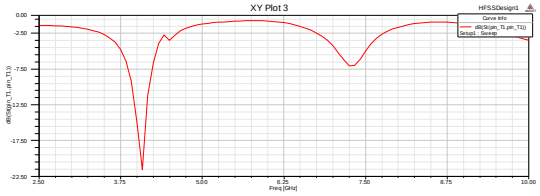

Figure 12: S11 in db vs Freq for design 3

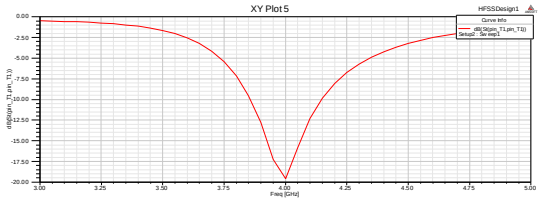

Fig 13: S11 in db vs Freq for design 4

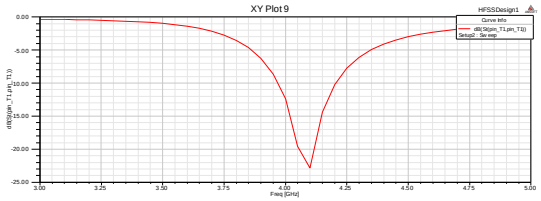

Figure 14: S11 in db vs Freq for design 5

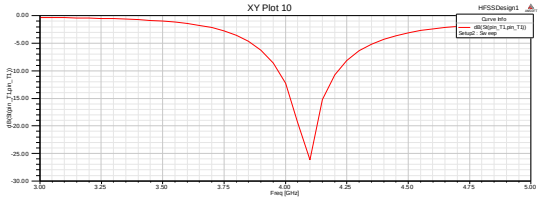

Figure 15: S11 in db vs Freq for design 6

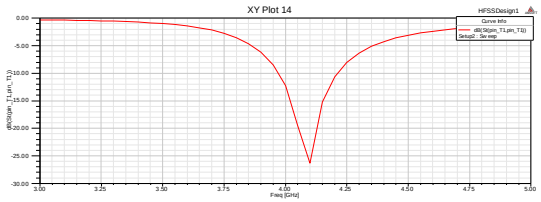

Figure 16: S11 in db vs Freq for design 7

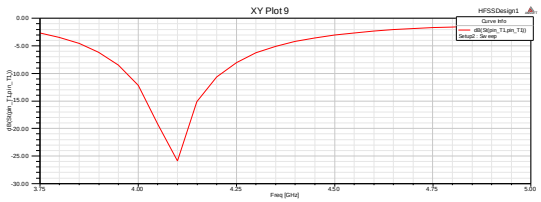

Figure 17: S11 in db vs Freq for design 8

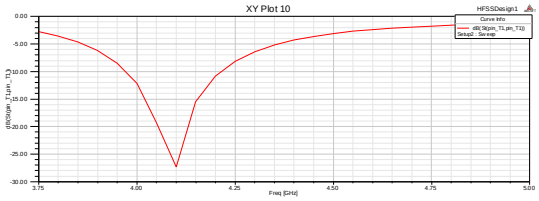

Figure 18: S11 in db vs Freq for design 9

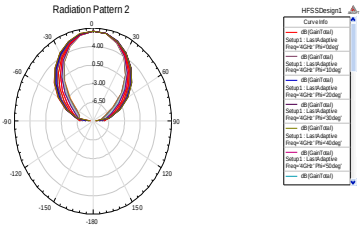

Figure 19:Radiation and Gain Pattern for design 2

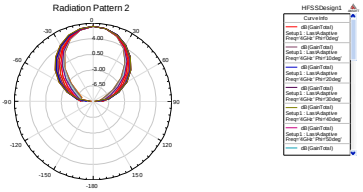

Figure 20: Radiation and Gain Pattern for design 3

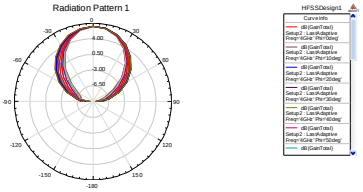

Figure 21: Radiation and Gain Pattern for design 4

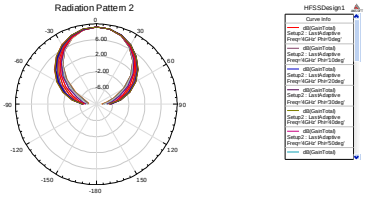

Figure 22: Radiation and Gain Pattern for design 5

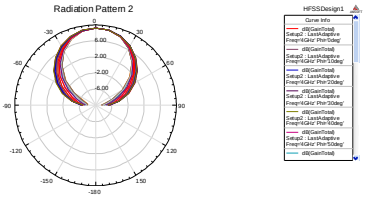

Figure 23: Radiation and Gain Pattern for design 6

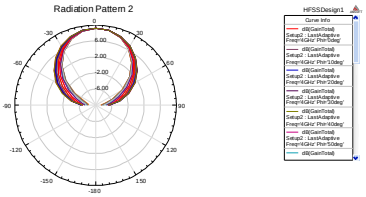

Figure 24: Radiation and Gain Pattern for design 7

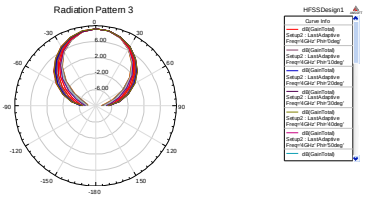

Figure 25: Radiation and Gain Pattern for design 8

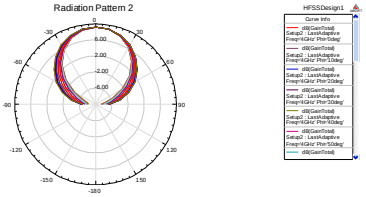

Figure 26 : Radiation and Gain Pattern for design 9

Table 1:Result table for various design

Design	Name	S_{11}(dB)	Gain(dB)	Resonant frequency (GHz)
1.	Annular Ring	-23.5284	6.6667	3
2.	DRA on annular ring	-21.888	6.6667	3.6363
3.	DRA on annular ring with dc	-20.5869	6.6010	3.6363
4.	DRA on annular ring with dc and magnetic bias applied bottom	-20.8259	6.7000	3.6363
5.	DRA on annular ring with dc and magnetic bias applied side	-22.2335	9.2262	3.6363
6.	DRA on annular ring with dc and magnetic bias applied side with superstrate	-26.1607	9.2333	3.75
7.	Superstrate circle position changes	-26.2500	9.2262	3.75
8.	Number of circles increases in superstrate	-25.8096	9.2857	3.75
9.	Circles on bothside of superstrate	-27.2780	3.4876	3.75

4. CONCLUSION AND FUTURE WORK

In this paper, different techniques to improve the reflection coefficient and gain of antenna are presented. It has been observed that optimized gain of 9.28 db is achieved through design 8, by increasing the no. of circles on superstrate and the optimum reflection coefficient S_{11} of -27.27 db is observed for design 9. Hence, by implementing various techniques of antenna design, gain of antenna is enhanced from 6.6 db to 9.28 db.The various applications of antenna can be 4G, Bluetooth, WLAN and Reconfigurable Wireless network. Future work is to increase the gain of antenna by applying variable magnetic and DC bias voltage, Prepare a lookup table for various gain Vs voltage and automate the system using the microcontroller.

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