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EFFECT OF VARIATION IN RELATIVE PERMITTIVITY OF RESONATOR OF DIELECTRIC RESONATOR ANTENNA(DRA)

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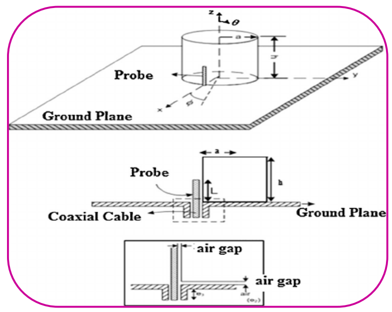
ABSTRACT —

The goal of this study is to observe the improvements in the radiation pattern of a miniaturized antenna. The proposed technique combines a spherical antenna and a Dielectric Resonator Antenna (DRA) to effectively observe its far-field radiations. [1] The radiation patterns of fundamental modesat 5 GHzare presented. With proper design and selection of material it is observed that the s-parameter and the radiation pattern of the proposed antenna vary efficiently. Using the DRA, a volumetric source, improves the radiation power factor of the radiating slot. A figure for the proposed design is presented and the characteristics is studied and compared. The characteristic are based on the materials used to make the DRA's and the cavity in the antenna system. DRA is constructed using materials with different relative permittivity; the relative permittivity of each material is approximately11.5 and 16.9 respectively.



INDEX TERMS — *Dielectric* Resonator Antenna (DRA), Relative Permittivity, S-Parameter, VSWR, Slot

I. INTRODUCTION

ANTENNA miniaturization is becoming increasingly important especially in wireless and low frequency applications. The demand for wireless technology has increased dramatically in the past decade. Antennas which are small, efficient, and integrable into mobile devices must be developed. Alternatively, as the frequency of operation is lowered, miniaturization techniques must be employedtokeep antenna size practical.[2-4] There are two primary techniques to achieve antenna miniaturization. The first is using novel topology to reduce the overall area consumed by the radiating structure. The second is using materials with permittivity, permeability, or both, greater than one; since wavelengths inside such materialsare reduced, the characteristic size of the antenna decreases.[5-6] This study uses the latter technique to achieve antenna miniaturization by employing a dielectric resonator as a superstrate for the antenna as shown in Fig. 1.

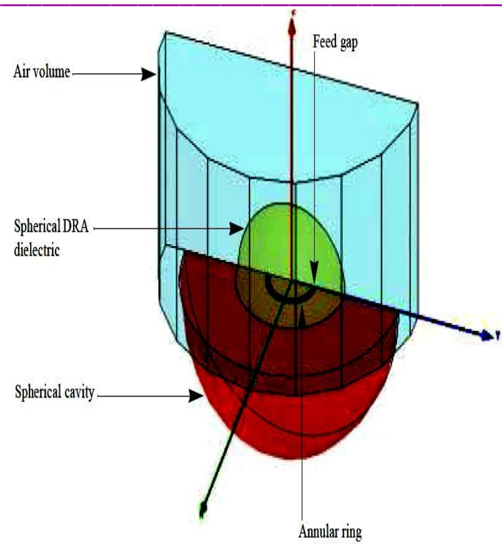


Figure 1:Geometry ofproposedantennawithSDRA

II. DESIGN AND CONSTRUCITION

The antenna is cavity-backed with an annular- slot fed spherical dielectric resonator. The antenna feed is achieved by coaxial excitation across oneside of an annular slot between the cavity and the DRA dielectric. Here, the focus is on the behavior of the antenna itself, not its feed. Therefore, the model will feed with a lumped port across an annular slot. The design's operating frequency is 5 GHz.

Our observations constitutes of three segments. In first condition, we have used a practical antenna using material 1 having relative permittivity of 11.5; secondly, material with relative permittivity of 16.9 has been used. The radiationpatterns,s-parameter of impedance andthefrequencyresponse is obtainedingraphical form.

III. SIMULATION

This sectiongives the simulation results obtained using HFSS v10 (High Frequency Structure Simulator) software program, when the materials of DRA is varied as well as the cavityfilling material is also varied. In reference to Fig. 1, the shape of the dielectric resonator is spherical.

Parameters Used: SDRA of radius 12.5mm, Spherical Cavity with radius 25 mm, T.E. Mode2.4 GHz, Annular feed of radius = 1mm,Regular Polyhedron Air Cavity with radius30mm and height 35mm.

A.Simulation result with DRA material 1- (Relativepermittivity11.5)

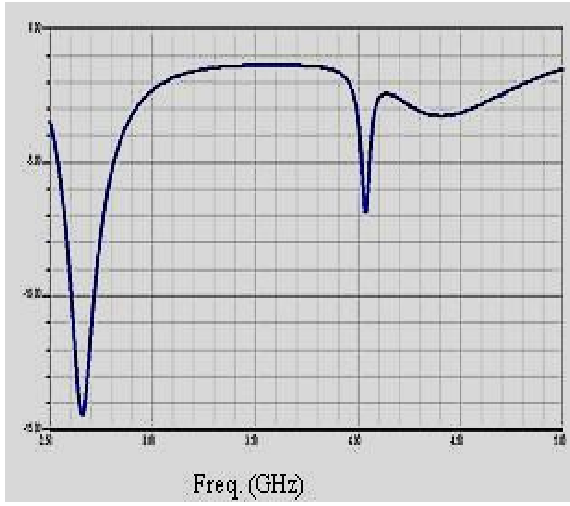


Figure2:Frequency responseoftheAntenna having resonator of relative permittivity 11.5.x-axisFrequencyin GHz and Y-axisshowing S-Lumped Parameter

B.Simulation result with DRA material 2- (Relative permittivity16.9)

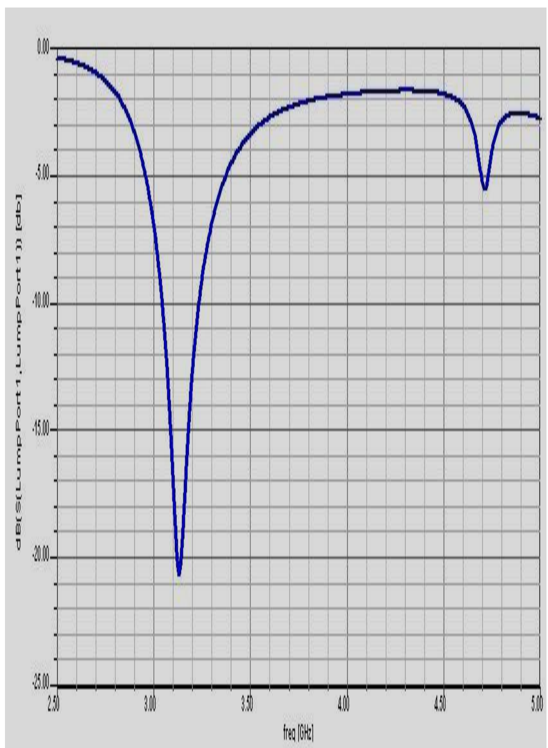


Figure3: Frequency response of the Antenna having resonator of relative permittivity 16.9.x-axis Frequency in GHz and Y- axis showing S-Lumped Parameter

IV. CONCLUSION

We find that the radiation and frequency response vary widely depending upon the relative permittivity of the material used to construct the DRA. As the relative permittivity of the material constituting the DRA increases the size of DRA will decrease. Here, we have obtained the variation in relative permittivity by changing the material constituting the DRA element of the antenna system. As the relative permittivity of the DRA material is increased the radiation pattern of the antenna system is improved (shown in Fig. 2 and 3).

From our observations, we can deduce that the far-fieldradiationpatternsincreaseswith increase in relative permittivity of the material constitutingtheDRA.Also, the relative permittivity of the cavity should be very less than that of the DRA material, in order to obtain an appreciable radiation pattern and frequency response.

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