Wideband Fractal Dielectric Resonator Antenna for Fixed and Mobile Military Communications

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Abstract: **National Nuclear Emergency Support Team (NEST) requires an entire 4GHz spectrum to respond immediately to any type of radiological accident or incident anywhere in the world. For these activities a wideband, low loss antenna is required for establishing fixed or mobile communication. In this paper a strip fed Dielectric Resonator Antenna is presented to support the complete 4GHz spectrum. Simulation is performed to achieve an impedance bandwidth of 1094 MHz with 2.61 dB maximum gain.**

Index Terms: **Dielectric Resonator Antenna (DRA), 4GHz spectrum, Fixed and Mobile Military Applications.**

I. INTRODUCTION

The 4GHz spectrum for U.S and NATO countries for fixed and mobile military communications spans 4.4GHz to 4.99GHz [1]. Primary uses of this spectrum include PTP microwave, Telemetry and Drone vehicle control. Anti-terrorist Nuclear Emgency Support Team (NEST) uses 4.4-4.99GHz for nuclear extortion to search nuclear materials or nuclear accidents at any location [2]. 4.635-4.66GHz is combined with 4.66-4.685GHz band to form a 50MHz wide General Wireless Communication Service (GWCS) [3]. The 4GHz spectrum is also applied in microwave frequency radiometry from aircraft to measure sea wind speed and rain characteristics due to hurricanes and other storms. The 4.8-4.99GHz spectrum is allocated worldwide to the Radio Astronomy Service (RAS) [4]. To accommodate the entire 4GHz spectrum communication, a wideband antenna is required. Dielectric Resonator Antenna (DRA) with specific geometry could be used as the radiator for this spectrum. DRA is a high permittivity dielectric material antenna which is very useful in many applications such as satellite communication, mobile communication and ISM band applications, etc. [5,6]. DRA holds characteristics like light weight, small dimensions, low metallic loss and high thermal stability [7]. Different types of excitation techniques also make DRA versatile in radio communication applications [7]. The shape of DRA decides the resonating frequency and the desired gain [6]. Rectangular DRA is more advantageous than cylindrical and spherical DRA as it offers more degree of freedom.

In this work a fractal rectangular DRA is proposed to support the complete 4GHz spectrum with acceptable antenna gain. The Strip excitation technique is used to avoid surface wave losses. ANSYS HFSS software [8] is used to simulate the proposed antenna.

II. ANTENNA GEOMETRY

For developing the DRA, a rectangular dielectric material of dielectric constant $\varepsilon_r = 10.2$ is placed on a metallic ground plane of dimension 36×20 mm^2.The initial dimensions for this rectangular DRA is taken as $29.6\times14.3\times26.1$ mm^3.The complete structure is excited with a rectangular strip of dimension 10mm $\times$ 1mm. Two slots of equal dimensions $6\times4\times26.1$ mm^{3}are created over DRA to increase the radiation bandwidth. The different parts of the antenna are shown in Fig. 1. and their dimensions are listed in Table 1.

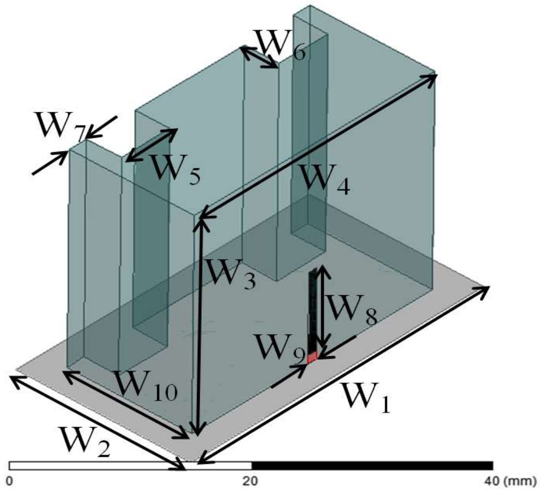

Fig.1. 3-D view of the presented strip fed rectangular DRA antenna

Table 1. ANTENNA DESIGN DIMENSIONS

Parameters	Dimensions
Ground (Copper)	W_1=36mm, W_2=20mm
Slot space	W_7=2.1mm
Slot	W_5=6mm, W_6=4mm, W_3=26.1mm
DRA	W_3=26.1mm, W_4=29.6mm, W_{10}=14.3mm
Feedline	W_8=10mm, W_9=1mm

III. RESULTS AND DISCUSSION

The HFSS simulated reflection coefficient as shown in Fig. 2. of the DRA confirms its bandwidth of 1094 MHz to hold the entire 4GHz spectrum.

The voltage standing wave ratio (VSWR) of the presented antenna is kept under 1.9:1 for the desired frequencies. The radiation pattern shown in Fig. 3. achieves power pattern with maximum gain of 2.61dB.

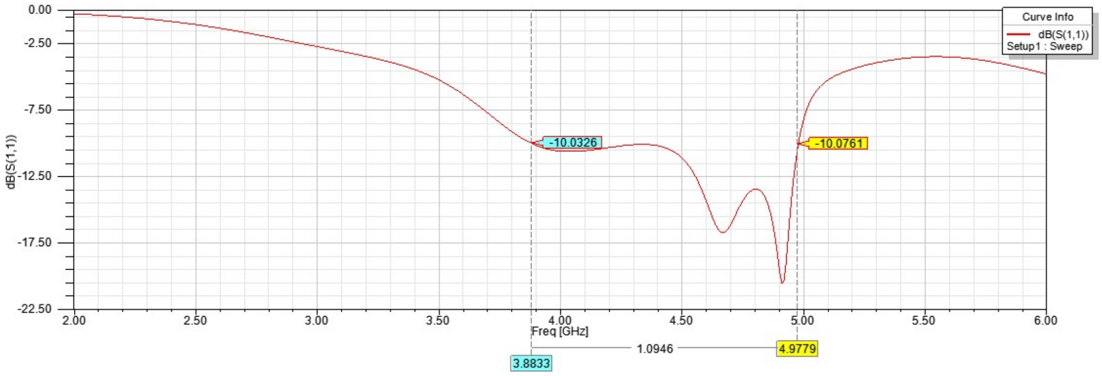

Fig.2. Reflection Coefficient of the presented antenna

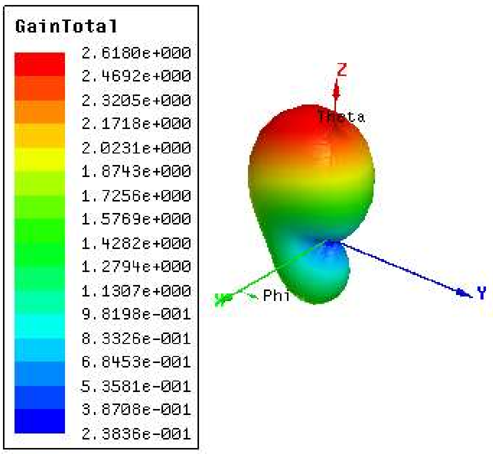

Fig.3. Radiation pattern of the proposed antenna

IV. CONCLUSION AND FUTURE WORK

In this paper, the fractal geometry of DRA is explored to accommodate wide 4GHz spectrum. The antenna is strip fed to achieve a wide bandwidth and reasonable gain. Now the proposed antenna needs to be fabricated and performance parameters are to be measured to verify the simulated results.

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