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DESIGN OF O-SHAPED YARN ANTENNA WITH DGS FOR S-BAND , C-BAND AND X-BAND APPLICATIONS

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Abstract—This paper presents a flexible wearable antenna on fabric jeans. The antenna proposed is in ISM frequency band of 2.4 and 5.8 GHz. It is both low cost and easy to integrate on clothing. The design was simulated using CST and the fabricated antenna provided a return loss of -20.43dB and a -17.62 dB at 2.4 and 5.8 GHz frequencies.

Index Terms—microstrip antennas, patch antennas, feed, millimetre wave propagation

INTRODUCTION

Now a day, the wearable textile materials of the antenna seems to be a great extent in the miniaturization of wireless devices. The demand of the wearable antennas in rise because of their use in smart clothes in wireless communications. Basic requirements for wearable antennas are a planar structure and flexible construction materials. A novel wearable reconfigurable antenna is designed to provide optimal on-body performance at 2.4 GHz and 5.9 GHz in Industrial, Scientific and Medical bands (ISM). This wearable antenna is constructed in the area of 11mm × 11mm and it is based on the micro strip feeding connection that depends on switch for providing two frequency bands. The copper and flexible polyurethane foam respectively makes the conductive and ground planes. Here, copper acts as a conductor and polyurethane foam provides isolation between the human body and the antenna. Here micro strip feeding is provided for enhancing the reliability of the O-shaped antenna. Textile antennas are a special class of antennas that are partially or entirely made out of textile materials, in contrast to conventional antennas, which consist of rigid materials. The textiles composing a textile antenna are divided into electrically conductive fabrics, denoted electro textiles and applied for the radiating and grounding parts, and dielectric materials for the insulating parts of the antenna.

Denim is a sturdy cotton warp-faced textile in which the weft passes under two or more wrap threads. This twill weaving produces a diagonal ribbing that distinguishes it from cotton duck. While a denim predecessor known as dungaree has been produced in India for hundreds of years, denim itself was first produced in the French city of Nimes under the name "sergé de Nîmes".

Slots or defects integrated on the ground plane of microwave planar circuits are referred to as Defected Ground Structure. DGS is adopted as an emerging technique for improving the various parameters of microwave circuits, that is, narrow bandwidth,

cross-polarization, low gain, and so forth. Several applications of DGS in the field of filters, planar waveguides, amplifiers, and antennas are presented.

DESIGN PROCEDURE

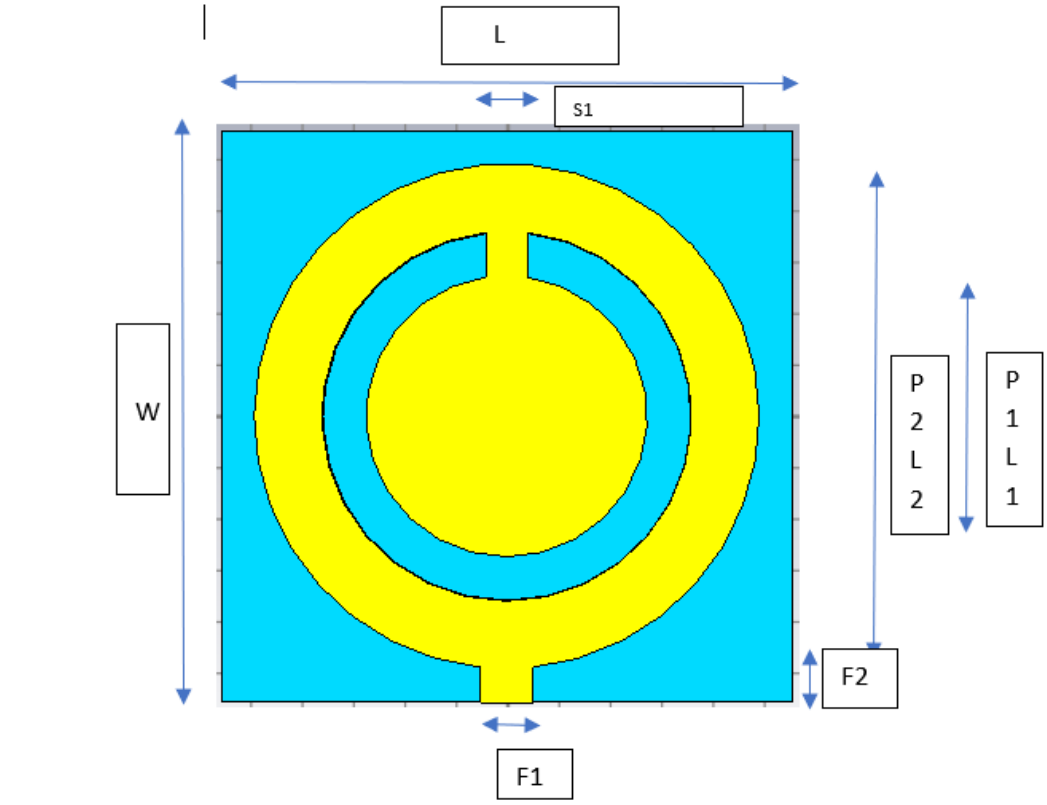
A tiny, high performance, on body antenna is constructed and operated over the 2.4 and 5.8 GHz ISM bands. The impedance of the O-shaped wearable antenna is 50 Ω at the frequency bands of 2.38-2.52GHz and 5-5.9 GHz and additionally the radiation efficiency that better than 50% are imposed. The major consideration of the wearable antenna is less weight and flexibility in an all dimensions. Then SAR guidelines for electromagnetic radiation also considered, because an average region of 1g of human tissue absorbs 1.6 W/kg of power. The stable radiation performance and stable reflection coefficient are achieved by minimizing variations through the body morphology, movement and location of the antenna.

The design procedure for the O-shaped antenna is developed from the textile materials and the design requirement is mentioned above in this section. Here a flexible polyurethane foam is chosen as a substrate with the thickness h1 1.67 = mm, ε r =1.28 and tan δ = 0.016. The electromagnetic properties of all materials and the effects of textile materials are obtained by characterization techniques. The conductive planes of the O-shaped antenna are made using copper with the thickness of 1mm and the surface resistivity is 0.0171 Ω-mm^2/m. The layout of the O-shaped reconfigurable band antenna, top view and geometrical dimensions of this antenna are shown in Table 2 respectively.

Table I.

Substrate	**Ɛr**
Denim Jean	1.68
Silk	4.5
Cotton	1.5

The Substrate used here is Denim Jean Textile with dielectric constant Ɛr = 1.68.


L
S1
W
P
2
L
2
P
1
L
1
F2
F1

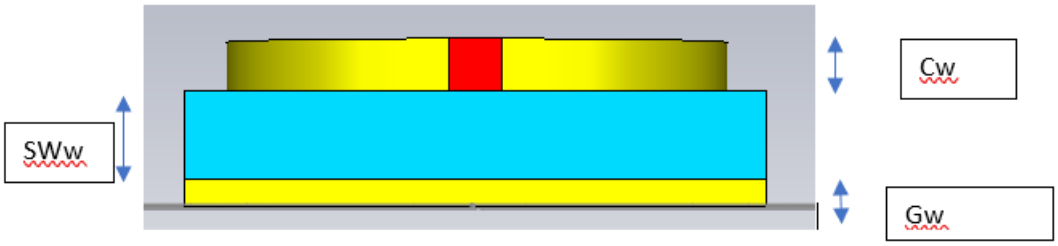

SWw
Cw
Gw

TABLE 2

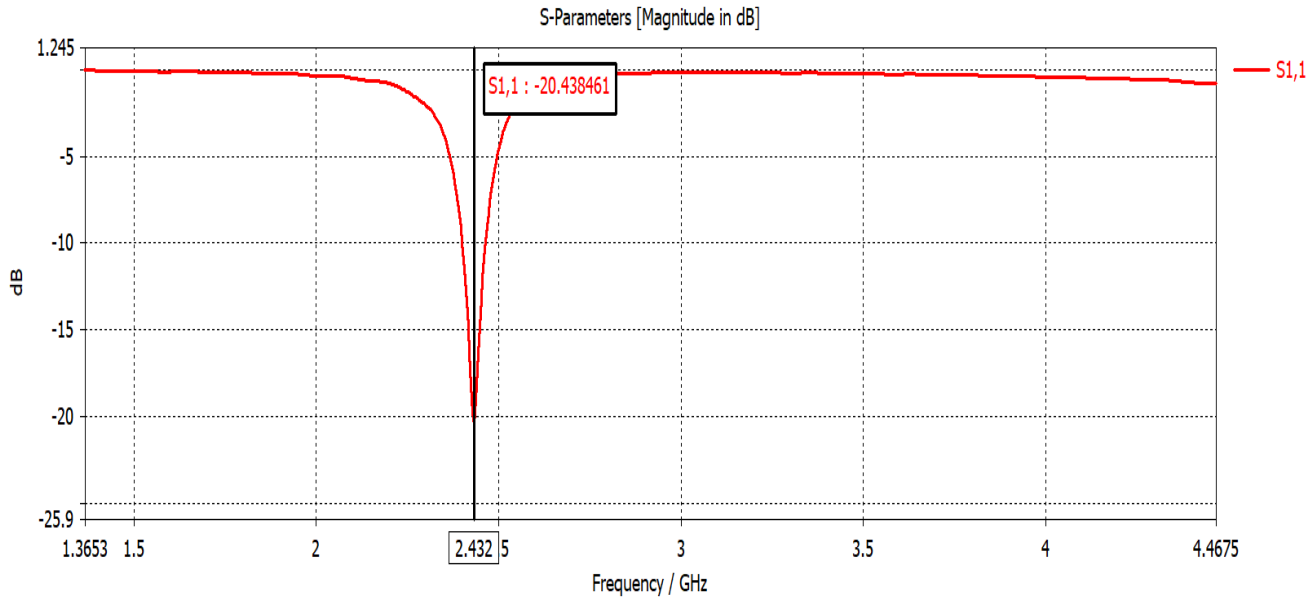
DIMENSIONS OF THE ANTENNA

PARAMETER	DESCRIPTION	SIZE (IN MM)
L	Length of antenna	11
W	Width of antenna	11
P1L1	Length of Patch 1	5.4
P2L2	Length of outer conductor of patch 2	9.7
F1	Length of feed	1
F2	Width of feed	1.53
S1	Length of switch	0.8
SWw	Height of substrate plane	1.67
Cw	Height of the copper	1
Gw	Height of the ground plane	0.5

IMPLEMENTATION AND RESULTS

Based on the calculated measurements for patch dimensions the simulations were carried out in CST software.

S-PARAMTERS:

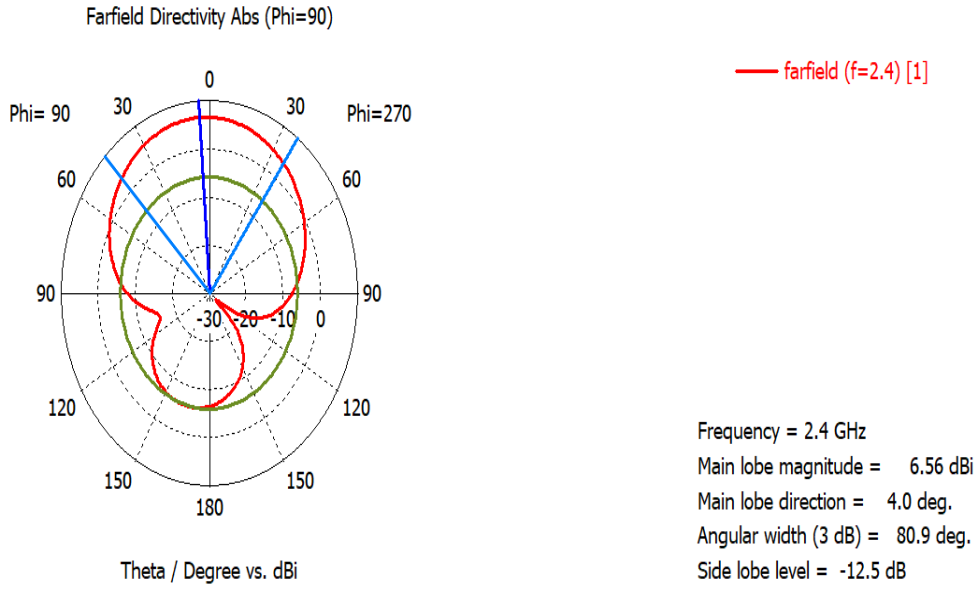


The band obtained has frequency of 2.43 GHz and with return loss -20.43.

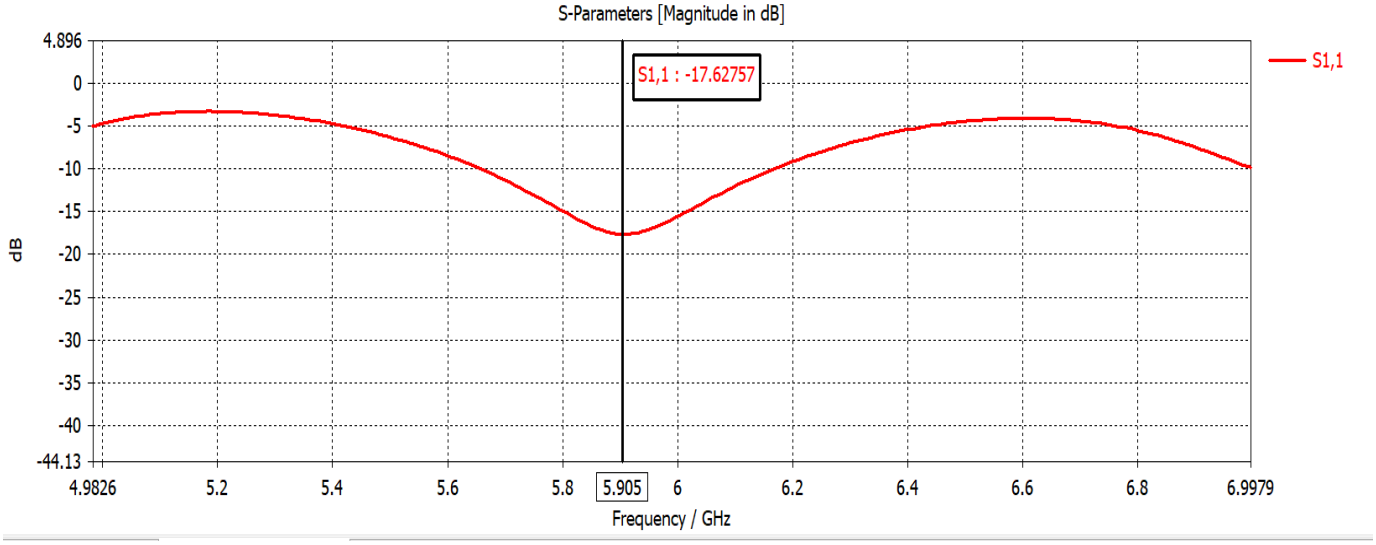
RADIATION PATTERN:

The designed textile antenna operates under 2.4GHz frequency range.

2.4 GHz with gain of 4.969 dB and directivity 6.564 dBi

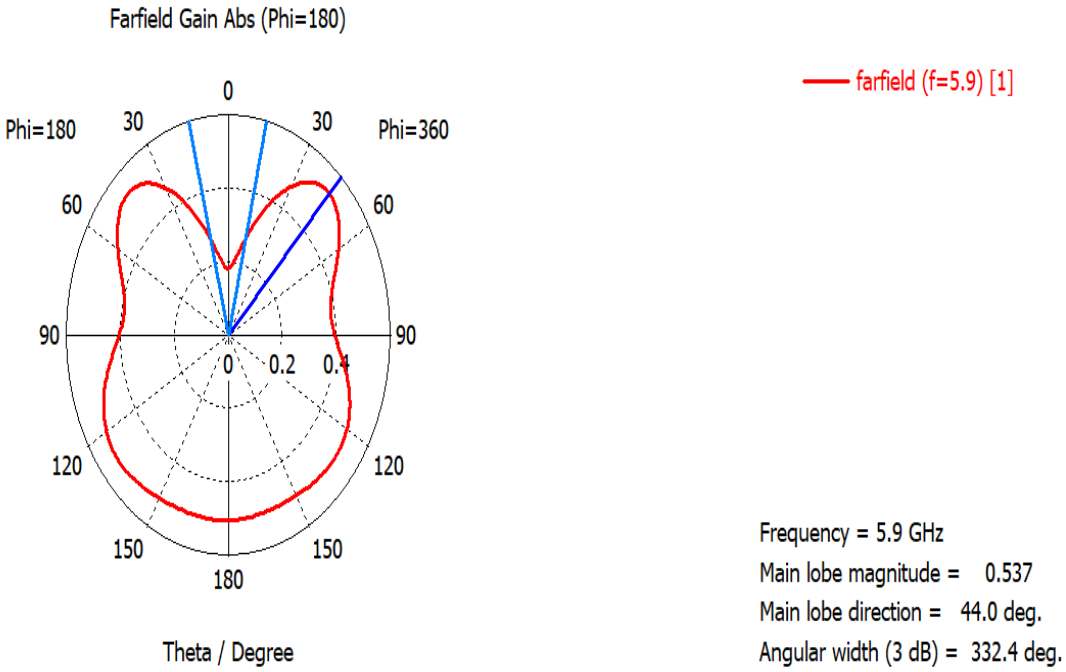


S-PARAMETERS :



The designed textile antenna operates under 5.9 GHz frequency range.

5.90 GHz with return loss of -17.62 dB and directivity 2.370 dBi



CONCLUSION

In this paper, a novel O-shaped reconfigurable antenna with microstrip feeding technique has been introduced for wearable applications. The microstrip feeding provides direct connection between the edge of the conducting plane and bottom plane and this feeding gives better reliability of the antenna design. Here the conducting plane (copper) is synthesized with jean substrate. The O-shaped antenna with a simple slot structure only occupies 11 mm × 11 mm, which is acknowledged as a small antenna for on-body application.

Frequency (GHz)	S11 (dB)	Directivity (dBi)
2.4	-20.43	6.564
5.90	-17.62	2.370

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