A C-Slotted Dual Band Textile Antenna for WBAN Applications

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Abstract— A dual band C-shaped slotted textile antenna with artificial magnetic conductor (AMC) is investigated in this paper. The proposed antenna is operates in the 2.45 GHz (lower) frequency band for WBAN applications and in the 5.8 GHz (upper) frequency band for WLAN applications. A diamond-shaped AMC is used to improve the antenna performance and reduce backwards radiation for on-body usage. The proposed antenna is fully fabricated using textiles and utilizes felt as its substrate and ShieldIt Super as its conducting elements. Simulations and comparison against a same antenna without the AMC plane indicated that this conformal antenna operates with good reflection coefficients, gains, and radiation pattern within the desired bands.

Keywords—Dual band antenna, textile antenna, artificial magnetic conductor (AMC).

I. INTRODUCTION

Recently, the rapid development of wireless body area network (WBAN) communication systems has propelled research on wearable textile antennas for various applications. They include their use in bands such as the Industrial Scientific Medical (ISM) band (from 2.4 to 2.48 GHz), Ultra-Wide band (UWB) (from 3.1-10.76 GHz), Wireless Local Area Network (WLAN) or WBAN, (in the 2.4 and 5 GHz bands) etc. [1-8]. Several important frequency bands of operation include which requires the use of such antennas are the

A low profile, compact, easy to fabricate, light weight, flexible, inexpensive is attractive for wearable antenna applications. The antennas’ mechanical flexibility, while serving as its main feature also potentially makes it difficult to predict when operated on the human body. Besides that, such worn antennas with high back lobes may also be easily detuned and cause increased electromagnetic absorption due to its proximity of operation in the vicinity of the human body. The American National Standards Institute (ANSI) and International Commission on Non-Ionizing radiation Protection (ICNIRP) stated that human can absorbed limit 1.6W/Kg per 1g of tissue and 2W/Kg per 10 g of tissue respectively [1]. One of the solutions to controlling the level of back-radiation is to either choose a topology with a ground plane or to introduce a metal plane to function as a reflector. This work chooses to investigate the second option. An artificial magnetic conductor (AMC) layer is integrated with a slotted patch antenna for operation the WLAN/WBAN bands. The antenna is designed to for a dual-band operation in the lower band (from 2.4 to 2.484 GHz) and upper band (from 5.15GHz to 5.8GHz) [2-3]. To validate the effectiveness of the proposed AMC, the performance of the proposed C-slotted antenna is compared with and without the AMC.

II. ANTENNA DESIGN AND MATERIALS

The topology of the proposed dual band textile antenna is shown in Fig. 1. The proposed antenna integrated with an AMC layer between its substrate and ground is shown in Fig. 1(a) and named Antenna A. On the other hand, the same radiator is optimized without the AMC layer and denoted as Antenna B. This is shown in in Fig. 1(b). Both antennas are designed using the same textile materials. Felt with a thickness of 3 mm is used as its substrate, while ShieldIt Super which is 0.17 mm thick is used as its radiating element. Felt has a relative permittivity and loss tangent of 1.44 and 0.044 whereas the ShieldIt conducting element has conductivity of 1.18 x 10⁵ S/m. This dual band textile antenna is designed with slot C-shaped to control the operating frequencies in the lower (2.45GHz) and upper (5.8GHz) frequency bands. To ease fabrication, the overall dimension of textile antenna is same with AMC plane size which is 90x90 mm² as shown in Fig. 1(c). The proposed antenna (antenna A) consists of five layers which is; a ground layer, two layers of substrate, a layer of AMC and a layer of patch as shown in Fig. 1(d). Meanwhile, the layer configuration for antenna B is the same, except that the AMC layer is not incorporated in this design. The