Analysis of Woven and Non-Woven Polyester Fabrics Made Flexible CP Annular Ring Textile Antenna

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ABSTRACT

This article reveals the characteristics of a probe-fed wideband circularly polarized (CP) annular ring textile antenna (ARTA). The proposed ARTA is fully flexible due to a conductive stack fabrics configuration for GSM-1800/ISM-2.4 GHz. The foremost aim of this article is to realize its performance under bending circumstances for wearable applications. The combinations of woven and non-woven polyester fabrics are used as a high-low substrate material to attain superb impedance bandwidth (BW) and worthy surface wave efficiency. A decent CP performance is realized by choosing the precise dimension of notches. It has measured and simulated impedance and the axial ratio (AR) BW of 18.33%, 13.88%, 7.86%, 2.86% and 3.97% in the lower and upper band, respectively. The optimization of CP in the upper band is under process. Results clarify that the CPARTA is beneficial for wearable and wireless application under bending circumstances. The proposed method is appropriate where a wide-range of CP bandwidth is essential.

KEYWORDS

Annular Ring Antenna, Circular Polarization, Conductive Fabrics Configuration, Probe Feed, Stacked, Wearable Textile Antenna, Woven and Non-Woven Polyester Fabrics

INTRODUCTION

The ubiquitous progress in the dome of wireless communication technologies in last decade has increased the demand of microstrip antenna (MSA) with small size, more gain and wideband characteristics. The user can be capable of getting the authentic information or data whenever required from the network due to the ubiquitous progress in wireless communication system. The body centric computing and communication apparatus freely exchange the data from neighboring networks and also from shared devices. MSA is stiff in nature, due to rigid substrate material such as FR4, Duroid. Hence, it may obstruct the human body. If such antennas kept on human body, it will irritate the human being. Hence, the absolutely bendable wearable textile antenna is a representative candidate for wireless body centric application (Tanaka & Wang, 2003). It is a noteworthy part referred in clothing for communication purposes such as tracking, health monitoring, navigation and RF harvesting. Hence, the progress of wearable and mobile wireless communication devices is an inspiring and attractive field for a researcher is to design the compact size fully flexible textile antennas with wide band characteristics. The MSA as reported in Lee and Luk (2011), James, Hall, and Woods (1981), Garg, Bhartia, and Ittipiboon (2003), Kumar and Ray (2003), and Constantine (2010) is appropriate agent for body wearable application due to the following inherent potentials

DOI: 10.4018/IJECME.2019070104

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in it such as small shape, insubstantial weight and cost of fabrication is reduced due to the printed circuit board (PCB) technology. Also, the cost of fabrication is minimal in case of wearable textile antenna due to handmade process. The principal objective of this article is to realize its performance under different bending circumstances such as X, Y, Y-45°, Y+45° for its benefits in body wearable application.

BACKGROUND

In the modern-days wireless communication system, the well-organized planning as well as small size antenna plays a very crucial role due to the space limitation. If the size of an antenna is small, lesser will be its efficiency which will vitiate the performance of wireless communication system. However, in these days wireless communication system, the compact and simple antennas perform well than the traditional antennas by holding their radiation characteristics. Hence, there is an enormous platform available for the small size antennas performing at far-reaching frequency range in this age of modern wearable communication system. Usually, each antenna carry out well at a single frequency band demanding separate antenna for alternative task; which will occupy more space and hence it is not desirable as large size antennas bend more than the smaller one. The operating frequency of the CPARTA antenna can be matched over a wide range so that the same antenna can be applied for several channels simply by adjusting thickness of fabrics substrate (Dahele & Lee, 1985).

In continuation with the author’s previous research on the performance comparison of ARTA using woven and non-woven fabrics is reported in Rathod and Mishra (2017). The prototype ARTA projected here in this research paper for CP characteristics using stacked conductive fabrics configuration of conventional notch cut ring shaped fabric antenna is validated using woven and non-woven fabrics combination. The dielectric constant of the woven and non-woven fabrics calculated by cavity resonance method as reported in Sankaralingam and Gupta (2009) and values are reported in Rathod and Mishra (2017), also the measurement of dielectric constant of same has been verified using probe method. The assumed value of dielectric constant of woven (1.44) and non-woven (1.1) polyester fabrics are used as a high-low substrate material to achieve excellent impedance bandwidth and good surface wave efficiency as reported in Yang, Feng, and Dong (2009). The highly flexible due to the use of polyester fabrics as substrate and conductive fabrics as a radiating entity, wide impedance and AR bandwidth makes the proposed CPARTA suitable for wearable, wireless and RF harvesting application. Therefore, the foremost goal of the author here in this paper is to through light on the operational characteristics of the stacked CP wearable ARTA using the combination of woven and non-woven fabric as a substrate material for body wearable, wireless communication and RF harvesting applications (Masotti, Costanzo, & Adami, 2011). The performance comparison of the proposed antenna is compared with few research papers as shown in Table 3.

MAIN FOCUS OF THE ARTICLE

To preserve the overall system performance, periodic replacement of batteries of the sensors networks such as environmental, surveillance, structural and health monitoring is mandatory. But this results in wasted battery life and disposal of it is harmful to the environment. Also, the cost of maintenance is more and sometimes it is difficulty to replace if sensors are inside the human body. If the power is wirelessly supplied to sensors using antennas then it reduces the wired complexity and system will be comfortable and less obstructive if the receiver antenna is fully flexible. Hence, wearable textile antenna must be drapable anywhere on human body also able to pick EM wave from any direction. This is possible if antenna is flexible and CP. Hence, the main focus of this article is to realize its performance under different bending circumstances such as X, Y, Y-45°, Y+45° for its benefits in body wearable application.
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