Leaf-Shaped Dual Band Antenna for Wearable Application

N. J Ramly, M. K. A Rahim, M. E Jalil, N. A Samsuri, R. Dewan
Communication Engineering Department, University Technology Malaysia, Faculty Of Electrical Engineering, University Technology Malaysia, 81310 Johor, Malaysia
nurul.jannah@fkegraduate.utm.my, mkamal@fke.utm.my, ezwanjalil@gmail.com, asmawati@fke.utm.my, raimidewan@gmail.com

Abstract – This paper presents the design of leaf shaped dual band flexible textile antenna. The textile antenna designed at 1.8GHz suitable for Long Term Evolution (LTE) and 2.8GHz WiMAX application. To enhance the flexibility of the proposed antenna and for the comfort of the user, denim textile is used as a substrate material. The conductive copper tape is used as the conducting element. The study also describes the energy coupled effect of two different sizes of leaf shaped to the antenna current distribution where it change the impedance and radiation characteristic of the antenna.

Index Terms — dual band, leaf-shaped, wearable antenna, LTE, WiMAX

I. INTRODUCTION

The demand of wearable of wearable devices for mobile wireless communication industries are consistently producing devices which are compact, robust, portable, unobtrusive, cost-effective and easy to use. Fabric-based antennas is one of the promising options to meet these requirements. The corresponding smart technology of fabric antenna plays important role in potentially replacing wired-communication networks in the future. This smart technology more lightweight and subsequently this smart technology can be wear in daily life. The fabric antenna is integrated to the cloth fabric as it is more likely to be adopted by the end-users.

The features of the fabric antenna technology satisfies the requirement of the current trend of antenna with reduced the size and diverse use of materials. The aforementioned antenna can be implemented in various applications. For example, in military field, the antenna can be integrate to a ‘monitoring suit’ at which when worn to an army body, it capable to remotely transmit vital reading location of enemy to a responsible professional, thus assisting the army in the decision making for the nextmove. Various advantages of this system includes ease of fabrication, simple fabrication process, and conformal systems that provide assurance or security advantages in which the conventional antenna can be at risk damage. Some reported papers provide a review of various aspects of wearable antenna system based fabric [1]-[3]. For this study, a dual band textile antenna with leaf shaped structure is designed for LTE (1.8GHz) and WiMAX 2.8GHz that is commonly used as communication channel for wireless devices.

II. ANTENNA CONFIGURATION

Fig 1 shows the geometry of the leaf-shaped textile antenna. A leaf shape dipole antenna fed with 50 Ω connector is simulated using Computer Simulation Technology (CST) Microwave Studio Software. The antenna has an overall size of 65mm x 75mm. The antenna was constructed on denim textile [4] as a substrate which has εr = 1.67 and tanδ = 0.025. Low loss tangent and permittivity reduces the surface wave loss and improve the bandwidth of antenna [5]. The initial diamond shape of the antenna is chamfered with radius equal to 10mm. Based on parametric study of the leaf-shaped and the initial diamond shape, the leaf shape antenna looked very promising for wearable application consequently for the antenna design and fabrication.

![Figure 1: Leaf-shaped dual band antenna textile design](image)

Table I: Parameter of leaf-shaped dual band textile antenna

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dimension (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of leaf shape A (Ls A)</td>
<td>25</td>
</tr>
<tr>
<td>Width of leaf shape A (Ls B)</td>
<td>25</td>
</tr>
<tr>
<td>Length of leaf shape B (Ls A)</td>
<td>20</td>
</tr>
<tr>
<td>Width of leaf shape B (Ls B)</td>
<td>20</td>
</tr>
<tr>
<td>Gap (g)</td>
<td>1</td>
</tr>
<tr>
<td>Thickness of substrate</td>
<td>0.67</td>
</tr>
<tr>
<td>Thickness of copper tape</td>
<td>0.035</td>
</tr>
<tr>
<td>Space between two size of Leaf Shape (Slf)</td>
<td>24.18</td>
</tr>
</tbody>
</table>
III. RESULTS AND DISCUSSION

Fig. 2 shows the simulated reflection coefficient of dual band textile antenna for three different value of spacing between two different sizes of leaf-shaped. As shown in the figure, as the space is increased and decreased by a value of 2mm, the corresponding curves shifted to the right and left respectively.

![Figure 2: Simulated reflection coefficient for three different spacing between two sizes of leaf-shaped antenna](image)

When the space of between the antennas pair is near to each other, some of energy for one antenna will probably coupled to each other. Energy coupled between elements can affect the original current distribution. Therefore it changes the antenna impedance and radiation characteristics. Fig. 4(a) and (b) shows the surface current at 1.8GHz and 2.8GHz respectively.

![Figure 4: Simulated surface current for leaf-shaped dual band textile antenna](image)

IV. CONCLUSION

A leaf-shaped dual band textile antenna operates at 1.8GHz and 2.8GHz has been designed and simulated. The antenna made from textile material works on LTE and WiMAX application. As the antenna design is for wearable purpose, wideband criteria are greatly concerned issue to ensure the antenna perform well with the intended applications. Dielectric coupling alters the current distribution and affect the radiation pattern. These are the challenges for researcher to design and produced wearable antenna.

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REFERENCE