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Additional Information

Dual-Band Planar Antenna with AMC Screen for On-Body Applications

E. Antonino-Daviu, C.A. Chuquitarco-Jiménez, F. Abderrazak and M. Ferrando-Bataller
Instituto de Telecomunicaciones y Aplicaciones Multimedia, Universitat Politècnica de València,
Valencia, Spain, evanda@upvnet.upv.es

***Abstract*—This paper presents a dual-band planar meander line antenna with an AMC screen for on-body applications. The antenna is aimed to operate at 0.86 and 2.4 GHz. The AMC screen is used to mitigate the effect of the human body into the antenna performance, so it has been designed to work appropriately in the two bands. Simulations of the AMC unit cell and the integration with the meander line antenna will be shown.**

Keywords—On-body antenna, AMC, antenna design, wearable.

I. Introduction

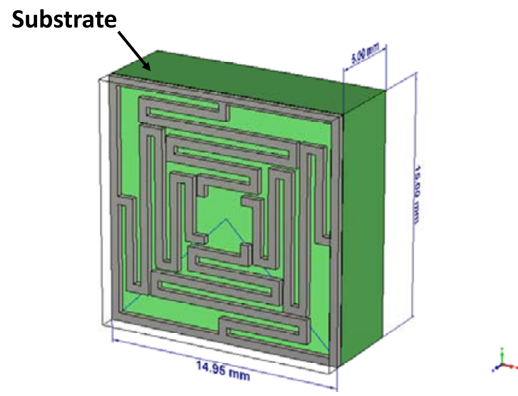
Body-centric applications have benefited significantly by the advent of novel flexible materials and additive manufacturing techniques, which have reduced the cost of fabrication.

One of the major challenges in the design of on-body antennas is to reduce the negative effect of the human body into the antenna behavior. In this paper, a dual-band on-body antenna integrating an AMC surface is proposed to decrease the effect of the human body. The antenna is aimed to work at 0.86 and 2.4 GHz, and the effect of the body will be analyzed.

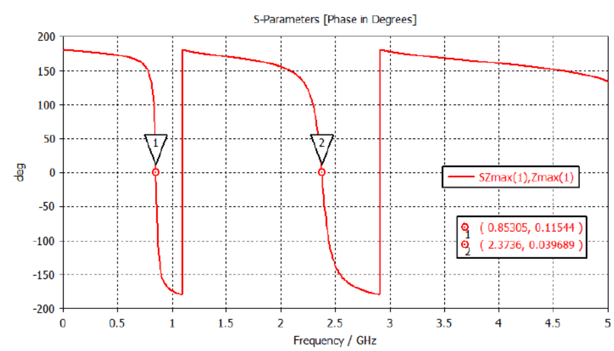
II. Antenna with AMC Screen

A. AMC Unit Cell

Fig. 1 (a) shows the geometry of the unit cell of the AMC surface, which was already introduced in [1]. The unit cell has been designed and optimized to operate at 0.86 and 2.4 GHz, in order to work appropriately when integrated in the antenna. The size of the unit cell is 15 mm x 15 mm, with 5 mm height. Fig. 1 (b) shows the phase of the reflection coefficient of the unit cell, showing good performance (0º phase) at the two target bands. Simulations have been performed with CST Microwave Studio.



(a)



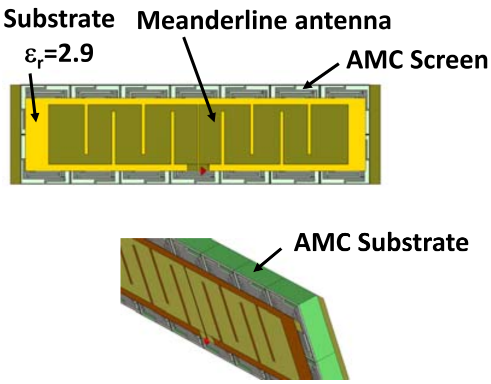
(b)

Fig. 1. (a) Geometry of the unit cell of the AMC surface; (b) Simulated phase of the reflection coefficient of the AMC surface.

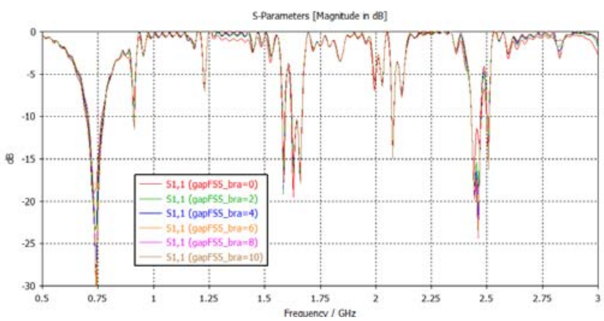
B. Antenna integrated with the AMC screen

A meanderline dipole has been firstly designed to work at 0.86 and 2.4 GHz. The geometry of the antenna can be seen in Fig. 2 (a), where it can be observed that the meanderline dipole has been printed over a very thin substrate (thickness= 51 μm) and relative electric permittivity of ε_r=2.9. The total length of the meander dipole is 101 mm and the width is 22 mm. The dual-band behavior is achieved by exciting the fundamental mode and a higher-order mode in the dipole [2].

Then, the AMC surface is integrated with the meanderline dipole, as shown in Fig. 2 (a). In this case, a finite AMC surface consisting in a group of 14 x 2 unit cells is employed, with an total length of 111 mm. An air gap of 4 mm between the meander dipole and the AMC screen is used. Fig. 2 (b) shows the simulated reflection coefficient vs. frequency, where the dual-band behavior of the antenna is observed.



(a)



(b)

Fig. 2. (a) Geometry of meanderline dipole and the AMC surface; (b) Reflection coefficient of the antenna (diple + AMC surface) for different distances to the body (*gapFSS_bra* parameter).

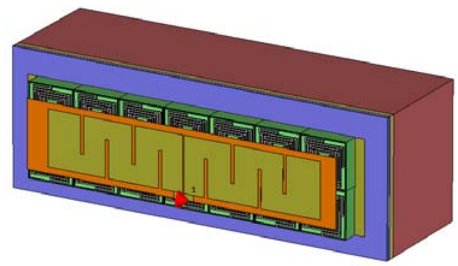
III. Effect of the Body into the Antenna Performance

As the antenna is aimed to operate in an on-body environment, the overall structure (meanderline dipole with AMC surface) has been optimized, taking into account the effect of the human body.

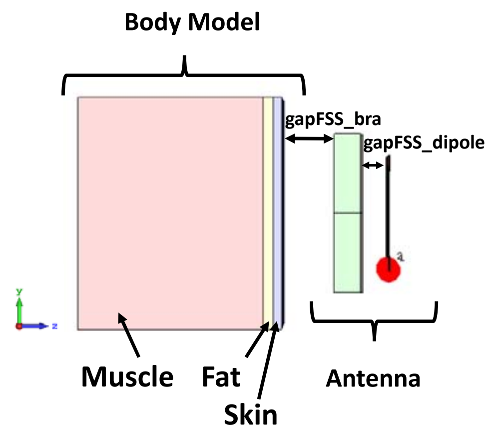
The human body has been modeled by a 3-layer model, as shown in Fig. 3. In this model, the following electromagnetic properties of the human tissues at 2.4 GHz have been considered for the simulation [2]: Skin (1 mm thickness, ε_r =38 and conductivity=1.4), fat (2 mm thickness, ε_r=5.2 and conductivity=0.1) and muscle (29 mm thickness, ε_r=52.7 and conductivity=1.7).

Fig. 2 (b) shows the simulated reflection coefficient of the antenna for different distances over the body. As observed, although a finite structure of the AMC surface is used, there is no effect into the impedance matching of the antenna when the distance to the body is changed, as desired.

The meanderline dipole and the AMC surface will be fabricated with inkjet-printing techniques and measurements will be shown in the conference. Moreover, the effect of the human body will be experimentally assessed.



(a)



(b)

Fig. 3. Antenna over the human body: (a) Perspective view; (b) Side view.

Acknowledgement

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