ACTA SCIENTIFIC COMPUTER SCIENCES

Volume 2 Issue 11 November 2020

Review Article

Improved Microstrip Dipole Antenna for RFID Technology by Using Metamaterials

Nail Alaoui*

Department Science and Technologies, University of Djelfa, Djelfa, Algeria

***Corresponding Author:** Nail Alaoui, Department Science and Technologies, University of Djelfa, Djelfa, Algeria.

Received: September 16, 2020

Published: October 14, 2020

Abstract

This paper explores an innovative way of designing antennas through metamaterial integration and the miniaturization process. In order to boost frequency usability and reduce the antenna size, we propose a new solution. The interaction between the two divided ring resonators with this resonant component is based on this technique. In this experiment the parameters considered include the resonant frequency, the lack of response, the wavelength, the amount of radiation and the gain and the power produced by an antenna. CST conducts all simulation effects.

Keywords: Radio Frequency Identification; Microstrip Dipole antenna; Metamaterials Antennas; Split Ring Resonators; Computer Simulation Technology Microwave Studio

Introduction

Metamaterials are artificial materials that lend their intrinsic characteristics unusual [1-4]. The scientists' current interest in these materials is substantial due to the electromagnetic properties that Veselago put forward in 1968 [1].

In 1999 Jhon Pendry tested these properties experimentally [5]. A year later, D. R. Smith., *et al*. [6] were granted confirmation to measure the existence of a material by means of a combination of two periodic and homogeneous ring resonators, which can produce negative effective permeability, and metal files that produce negative effective permittivity, thus receiving refraction. Some years back, Caloz CA [7] tried to use a microstrip based transmission line to render left-hand metamaterials.

The first Some studies have developed miniaturization techniques rapidly and have enhanced performance antennas that generally respond to RFID technology [8]. Among the most well-known techniques are fractal patterns [9] and dipole folding [10]. Another technique which uses [11-13] to take the booming growth of metamaterial products. In this context, in this paper we propose a new approach to the evolution of this important RFID tag-oriented technique operating in the UHF range.

Part is dedicated to describing the structure of our metamaterial antenna proposed by the combination of two classic split ring resonators with a microstrip dipole antenna. A analysis of the results is decided in the second section, which is a gain derived from this system.

RFID technology

Radio Frequency ID is a wireless technology designed to improve traceability, which is now implemented using the barcode. The RFID system is made up of a base station to read the information on the product stored in a chip. The RFID tag is both chip and antenna. RFID tags must have the best frequency features and compact enough to be put on all product types to succeed on this market. For the use of different technologies a number of frequency bands have been assigned. The UHF antennas of 2.45 GHz are the key subject in this article.

Metamaterials antenna

The proposed antenna structure of the metamaterials is composed of a circular dipole shape provided by a distinct port with horizontal excitation and resistance R equal to 50 ohm. The antenna is positioned between the two split ring resonators in the centre.

Its exterior is circular and its interior is square in shape. As shown in below figure 1 and 2.

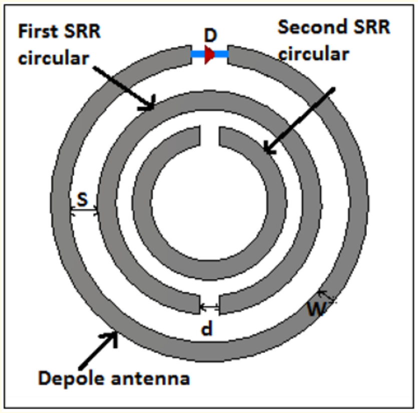


Figure 1: Geometrical parameters and metamaterials antenna.

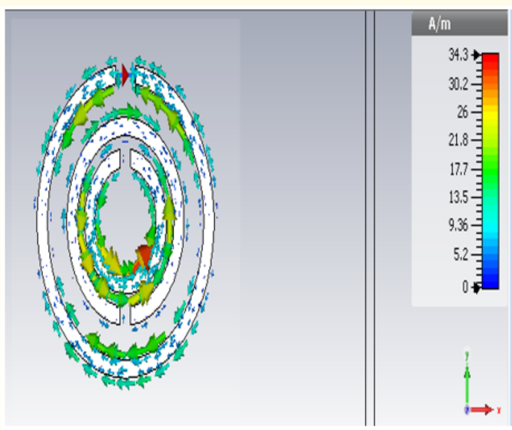


Figure 2: Current circulation in the metamaterials antenna.

The three units are situated on the same plane of a dielectric substratum of a ROGERS RO4232 form, which has a permeability relative to εr = 3.2, a relative permeability μr = 1 and a tangent permeability tan = 0.0018 (conts.fit). This substratum has a cubic geometric structure, a height of h = 0,8 mm and a side of 0.05 mm.

It is circular with a ring-resonator divided in 21 mm and an opening gap "d" of 4 mm and a track width "W" of 2 mm inside the structure. The second split ring resonator is of a circular type within the system and an opening gap "d" of 4 mm and a track width "W" of 2 mm inside the first split.

The first resonator consists of a spherical dipole antenna in horizontal shape, a remote ring "S" equal to 7 mm.

In its diameter of 34 mm, less than half the Wavelength λ was calculated to be the dipole antenna measured. This is the same. There is also a 2 mm wide "W" ring. The dipole slot is not distinct from the other resonator hole, in order to ensure consistency in the sense of the present array.

Measurement and results

The results of the simulations reveal that this structure antenna has an extremely small resonance peak of around 1.5 GHz, as shown in the return loss figure curve (Figure 3). As metamaterials are combined, these findings appear partly contradictory. This relation makes it more appropriate for resonances around 1.4 GHz with a Return Loss S11 of -19 dB and the Frequency Band "Bf" of 800 MHz. This related antenna can be enhanced. Owing to the existence of metamaterials, the resonance frequency at 100 MHz is diminished.

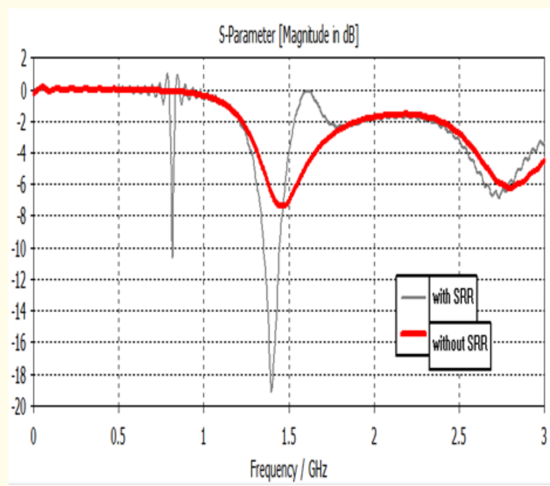


Figure 3: Measure S11 return loss characteristic of antenna.

Thus, we get a second resonance peak according to this design that is lower than the primary resonant frequency of the antenna. This new frequency helps the antenna level to be dramatically increased by over 70%.

In addition to geometrical properties, the above metamaterials boost (gain) by 3.69dB and are of a spatial nature (directivity) equal to 3.71dBi.

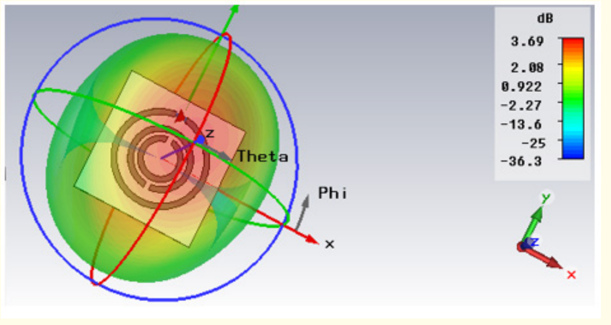


Figure 4: Radiation pattern of metamaterials antenna, to calculate the gain.

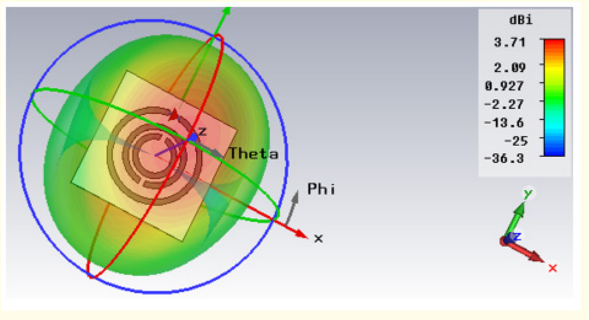
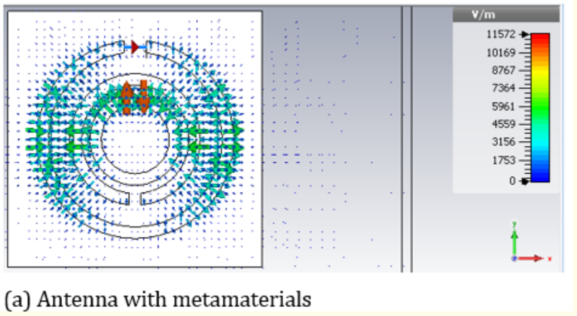


Figure 5: Radiation pattern of metamaterials antenna, to calculate the directivity.

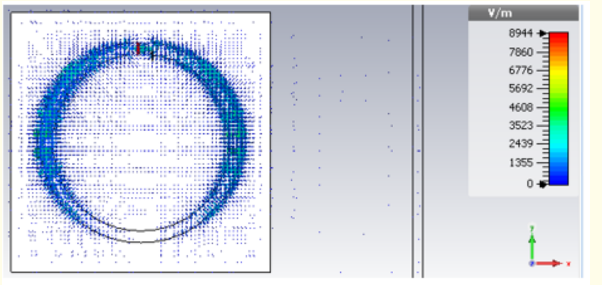
Where from the efficiency antenna as a function of gain and radiation pattern we get a efficiency "η" equal to 99%.

This new antenna improvement technique by method of using metamaterials helps us to increase the antenna 's electromagnetic surface area.

The antenna shown in figure 6 with a gross electric surface area of 11572 V/m and a magnetic surface maximums equal to 46 A/m is seen thus in the present case (Figure 6). This antenna can also be seen in figure 6. The In the case of the loss of metamaterials, 8944 V/m and 28.4 A/m are improved in contrast to the dipole antenna in succession.

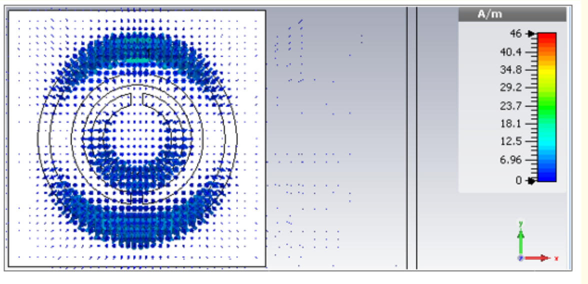


(a) Antenna with metamaterials

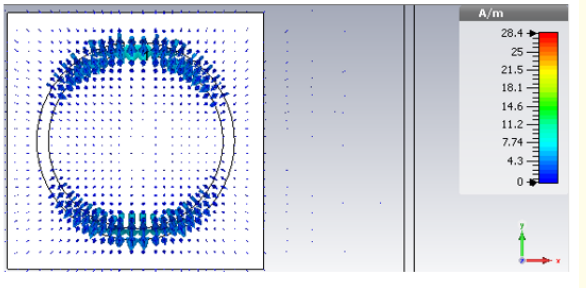


(b) Antenna without metamaterials

Figure 6: Distribution of electric fields.



(a) Antenna with metamaterials.



(b) Antenna without metamaterials

Figure 7: Distribution of magnetic fields.

Conclusion

In this article, a new contribution was made by the use of the split ring resonators to improve and miniaturize the RFID antenna which operates in the UHF range. From the best simulation outcomes we will illustrate the effectiveness of our strategy. Thus, using this technology, we can obtain a very high frequency microstrip antenna with a very small size that can exceed 70%.

Bibliography

1. Veselago Viktor G. "Electrodynamics of substances with simultaneously negative values of and μ". *Soviet Physics Uspekhi* 92 (1967).
2. Cui Tie Jun., *et al*. "Metamaterials". Spring Street, NY: springer (2010).
3. Smith David R., *et al*. "Metamaterials and negative refractive index". *Science* 305.5685 (2004): 788-792.

4. Engheta Nader and Richard W Ziolkowski. “Metamaterials: physics and engineering explorations”. John Wiley and Sons (2006).

5. Pendry John B., *et al*. “Extremely low frequency plasmons in metallic mesostructures”. *Physical Review Letters* 76.25 (1996): 4773.

6. Shelby Richard A., *et al*. “Experimental verification of a negative index of refraction”. *Science* 292.5514 (2001): 77-79.

7. Sanada Atsushi., *et al*. “Characteristics of the composite right/left-handed transmission lines”. *IEEE Microwave and Wireless Components Letters* 14.2 (2004): 68-70.

8. Ferchichi Abdelhak and Ali Gharsallah. “A circuit model to an encoche coplanar antenna for a radio frequency identification TAG”. *International Journal of Electrical and Computer Engineering (IJECE)* 3.3 (2013): 386-391.

9. Best Steven R. “On the performance properties of the Koch fractal and other bent wire monopoles”. *IEEE Transactions on Antennas and Propagation* 51.6 (2003): 1292-1300.

10. Marrocco Gaetano. “Gain-optimized self-resonant meander line antennas for RFID applications”. *IEEE Antennas and Wireless Propagation Letters* 2 (2003): 302-305.

11. Burokur Shah Nawaz., *et al*. “Theoretical investigation of a circular patch antenna in the presence of a left-handed medium”. *IEEE Antennas and Wireless Propagation Letters* 4 (2005): 183-186.

12. Naoui Seif., *et al*. “Nested metamaterials antenna for RFID traceability”. *Microwave and Optical Technology Letters* 56.7 (2014): 1622-1626.

13. Naoui Seif and Ali Gharsallah. “Improved microstrip dipole antenna by using metamaterials for RFID technology”. Proceedings of 2014 Mediterranean Microwave Symposium (MMS2014). IEEE (2014).