Metamaterial Based Patch Antenna with Broad Bandwidth Designed By COMSOL Multiphysics® Software

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Abstract

A patch antenna based on metamaterials of composite split-ring-resonators (CSRRs) and strip gaps is designed with COMSOL Multiphysics® software. The antenna is constructed by using CSRR structures in forms of circular rings on the patch and employing strip gaps on the ground plane. The signal is fed by a common microstrip line that connects the patch and the input port. The antenna is based on a simple structure of an only one-layer substrate. Roger RO4350 (epsilon_r = 3.66) is preferred as the dielectric material of the substrate. The antenna has a compact footprint that is only 0.357Lambda0 * 0.408Lambda0 at the lowest operating frequency of 1.7GHz. The antenna could operate over two bands that are from 1.70GHz to 2.98GHz and from 3.99GHz to 5.34GHz. The CSRR and strip gaps are combined with the patch and ground to broaden its operating frequencies as well as to enhance its radiation performance via their coupling with the substrate in a different way. The measured impedance of the antenna shows a smooth variation in the vicinity of 50 Ohm over the operating bands. This smooth variation enables the antenna to have broad bandwidth. Additionally, its radiation performance is kept favorable with a peak gain of 6.46dB. The performances of the antenna were characterized computationally and verified experimentally. Simulations are performed employing the mature EM functionality of the COMSOL Multiphysics® software. Good agreements between the simulations and measurements were observed convincing that the antenna could operate over wide bandwidths and radiate effectively with its simple structure and compact size. The presented design is favorable for its broadband as well as good radiation performance with a simple structure that is comprised of only one layer substrate. The antenna is promising for broadband applications that require the operating bands of WCDMA (1920 - 2170 MHz), WiMAX (2500 - 2690 MHz), Bluetooth (2400 - 2480 MHz) or Wibro (2300 - 2390 MHz).

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