

Metamaterial cell-based superstrate towards bandwidth and gain enhancement of quad-band CPW-fed antenna for wireless applications

Abstract

A multiband coplanar waveguide (CPW)-fed antenna loaded with metamaterial unit cell for GSM900, WLAN, LTE-A, and 5G Wi-Fi applications is presented in this paper. The proposed metamaterial structure is a combination of various symmetric split-ring resonators (SSRR) and its characteristics were investigated for two major axes directions at (x and y-axis) wave propagation through the material. For x-axis wave propagation, it indicates a wide range of negative refractive index in the frequency span of 2–8.5 GHz. For y-axis wave propagation, it shows more than 2 GHz bandwidth of near-zero refractive index (NZRI) property. Two categories of the proposed metamaterial plane were applied to enhance the bandwidth and gain. The measured reflection coefficient (S_{11}) demonstrated significant bandwidths increase at the upper bands by 4.92–6.49 GHz and 3.251–4.324 GHz, considered as a rise of 71.4% and 168%, respectively, against the proposed antenna without using metamaterial. Besides being high bandwidth achieving, the proposed antenna radiates bi-directionally with 95% as the maximum radiation efficiency. Moreover, the maximum measured gain reaches 6.74 dBi by a 92.57% improvement compared with the antenna without using metamaterial. The simulation and measurement results of the proposed antenna show good agreement.

Keywords

Coplanar waveguide (CPW) antenna; DNG metamaterial; Multiband; Near-zero refractive index (NZRI); Wideband