Design of printed antennas based on electrically small resonators for microwave applications

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This paper is focused on the design of printed antennas based on electrically small resonators for microwave applications. Nowadays, low cost radiofrequency devices usually incorporate common planar microstrip antennas, consisting of a rectangular metal patch placed on top of a dielectric substrate mounted over a large ground plane. This type of antennas is supposed to provide a radiation diagram located in the half-space due to the presence of the ground plane. Nevertheless, since this kind of antennas can be viewed as an open circuited transmission line, the electric field at the edges of the conductor patch will spread into the surrounding substrate. This results in the extension of currents over a significant area of the ground plane. For this reason, the ground plane should be maintained electrically large, in order to preserve the radiation diagram and hence minimizing the radiation to the back side of the antenna. However, in some applications, the size of the antenna is a critical issue and should be minimized. To overcome this drawback, the use of an electrically small resonator is proposed, which concentrates the currents around its geometry, as a radiator. Considering that the particle is relatively close to the ground plane (and also its image, located on the opposite side of the ground plane), the induced currents in the ground plane are expected to be concentrated in a relative small region around the resonator. This fact leads to a reduction of the currents at the edges of the ground plane, resulting in the optimization of the FBR when its dimensions are decreased.

The main purpose of this work is to discuss the choice of the resonant particle and its electromagnetic properties, along with the whole antenna structure. As a proof of concept, a printed antenna based on a Non-Bianisotropic Complementary Split Ring Resonator (NB-CSRR) (J. García-García *et al.*, *J. Appl. Phys. 98*, 33103, 2005) has been designed for a presence detector. Its characteristics (also including its Front-to-Back ratio) are simulated and validated experimentally, showing good agreement between them. The performance of the designed antenna is finally compared to that of a conventional patch antenna.