Title: Symmetrically structured epsilon negative metamaterial for antenna gain enhancement.

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Abstract: An epsilon negative metamaterial (MTM) is presented in this article that bears a symmetrical structure and shows a transmission coefficient (S21) resonance at 2.78 GHz. The proposed MTM unit cell comprises an outer square ring with horizontally oriented splits, connected along the vertical axis to a circular inner ring featuring vertically oriented splits, forming an interconnected structure. The electrical dimension of the MTM cell is 0.08λ × 0.084λ, and here wavelength, λ is determined at 2.4 GHz. The MTM shows negative permittivity, near zero permeability as well as refractive index. The electric field, Magnetic field, and current distribution have been analyzed to realize resonance behavior. The compactness of the MTM is identified through an effective medium ratio (EMR) of 12.2. Moreover, an equivalent circuit is modeled and Advanced Design Systems (ADS) is utilized to confirm its performance. The prototype of the metamaterial is developed and a measured result is taken that exhibits a well-matching with the simulation result. Application of this metamaterial is checked through designing and developing an antenna and MTM is used as a superstrate over the antenna. Both the simulation and measured results reveal that as a superstrate, MTM helps to increase the antenna gain by more than 100% with less effect on the bandwidth. Thus, this new metamaterial can be a good candidate as an antenna element for increasing performance. Moreover, the proposed antenna-MTM system can be utilized for wireless power transmission as it provides an adequate gain in a compact 3D structure.

Keyword: Metamaterial, Antenna, Epsilon Negative, Effective Medium Ratio (EMR).

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