

Novel Ultra-Wide Band Left-Handed Metamaterial for Microwave Applications

Rachid Rian⁽¹⁾, and Mohamed Essaaidi^(1,2)

(1) Abdelmalek Essaadi University, Tetuan, Morocco

(2) Mohammed V University, Rabat, Morocco

In this paper, we demonstrate experimentally Ultra-wideband left-handed metamaterials ($\epsilon < 0$, $\mu < 0$) transmission band of a one-dimensional metamaterial structure under normal-to-plane propagation in the microwave regime. A typical left handed material (LHM) rectangular cross section rod sample composed of coplanar thin wires and Split Ring Resonator unit cells was fabricated, investigated and tested. The experimental results show that the tested sample has a left-handed behavior across an ultra wide frequency band ranging from 10.3 and 12.5 GHz. This sample is composed of periodic arrangements of wires and split ring resonators (SRRs). Detailed analysis of the complex dispersive wave impedance, refractive index, permittivity and permeability of this sample were carried out. A waveguide-based retrieval method is applied to typical metamaterials and shows its efficiency for the effective parameters extraction. The S-parameters behavior versus frequency is simulated using ANSYS High Frequency Structure Simulator (HFSS). A rectangular cross section rod of the proposed metamaterial was fabricated and filled into a rectangular waveguide. The S parameters measurement of the resulting metamaterial filled rectangular waveguide shows a very good agreement with simulation results and that the proposed meramaterial has an Ultra Wide Band performances. This UWB metamaterial can be very useful in the design of several microwave circuits and devices such as high gain UWB directive antennas and filters.