Experimental demonstration of deflection angle tuning in diffraction-inspired unidirectional structures

Rodriguez-Ulibarri, P.; Pacheco-Peña, V.; Falcone, F.; Navarro-Cia, Miguel; Serebryannikov, A. E.; Beruete, M.

DOI:
10.1109/USNC-URSI.2015.7303335

Experimental Demonstration of Deflection Angle Tuning in Diffraction-Inspired Unidirectional Structures

P. Rodríguez-Ulibarri[(1)], V. Pacheco-Peña[(1)], F. Falcone[(1)], M. Navarro-Cía* [(2)], A. E. Serebryannikov[(3)], M. Beruete[(1)]
(1) Universidad Pública de Navarra, Pamplona 31006, Spain
(2) Imperial College London, London SW7 2AZ, United Kingdom
(3) Adam Mickiewicz University, Poznań 61-614, Poland

Direction selective transmission regimes obtainable in the framework of the Lorentz reciprocity have lately attracted scientist community attention. Unlike nonreciprocal structures, reciprocal ones are eminently passive and generally much simpler. Enabling direction selective regimes with reciprocal structures requires breaking the spatial inversion symmetry. With this aim in view, different strategies have been proposed, such as higher diffraction orders excitation, polarization conversion, and bending transmission channels in prism-like configurations. Here, the first approach is implemented for a fishnet metamaterial loaded with a dielectric grating. It is shown that a very compact volumetric device can be designed while maintaining direction selectivity features.

Direction selectivity is experimentally demonstrated here at the V-band of the millimeter-wave range. Beyond this, tuning and eventually sign-switching of the output deflection angle is obtained by varying the frequency and/or angle of incidence. To this end, an ABmm^{TM} vector network analyzer has been used together with a turning platform and a rotating positioner for monitoring both incidence and deflection angle. Forward (grating side illumination) and backward (non-grating side illumination) transmission results at 65 GHz and different output deflection angles (θ_{out} = -10, -5, 0, 5 and 10 deg) are shown in Fig. 1. A clear forward-to-backward transmission contrast can be noticed. At the same time, tuning of the output deflection angle is achieved by sweeping the incidence angle.

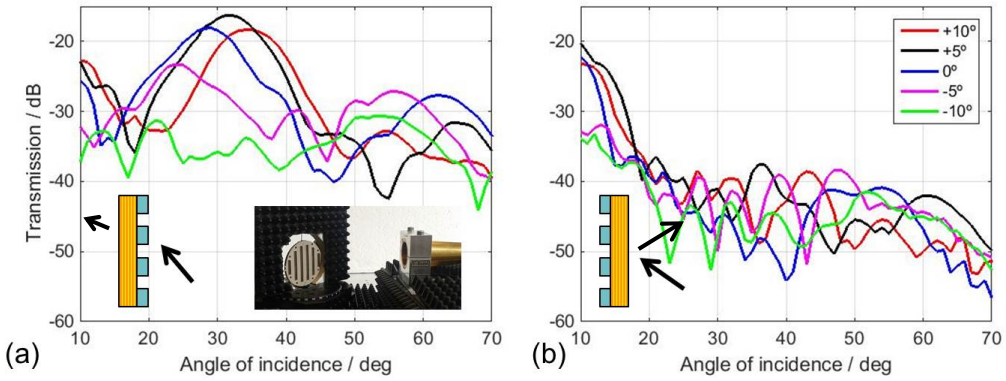

Fig. 1. (a) Forward Transmission at 65 GHz versus angle of incidence. Insets: Schematic of forward transmission scenario and picture of transmitter antenna and sample. (b) Backward Transmission at 65 GHz versus angle of incidence. Insets: Schematic of backward transmission scenario.