Commission B: Novel Challenges with Electromagnetic Bandgap Surfaces

A Uni-Directional Ring-Slot Antenna Achieved By Using An Electromagnetic Bandgap Surface

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Slot antennas offer a number of advantages including low-profile, ease of fabrication, and ease of integration with electronics. Their main drawback, however, is that they are inherently bi-directional radiators. One common technique to redirect the back radiation forward is to place a conducting reflector at a fixed distance away from the antenna. However, in this case the parallel-plate geometry permits the excitation of the dominant TEM mode, which drastically reduces the overall radiation efficiency. Several methods have been shown to successfully reduce the back radiation. One method is to print the slot on a quarter wavelength thick substrate, which gives a gives a front-to-back (F-B) power density ratio at broadside of ε_r. However, slot antennas printed on thick substrates suffer severe surface wave power losses. For an array of slot radiators though, phase cancellation techniques significantly reduce surface wave losses. This is accomplished by properly spacing the array of slot radiators to achieve destructive interference of the surface wave modes (M. Qiu, M. Simcoe, and G.V. Eleftheriades, *IEEE Transactions on Microwave Theory and Techniques*, vol. 50, no. 2, pp. 517-528, Feb. 2002.)

In this abstract we describe how to solve this problem and achieve uni-directional single element slot antennas by using a periodic surface (instead of the uniform conducting reflector) placed behind the slot. The periodic surface is an electromagnetic bandgap (EBG) structure which inhibits the propagation of electromagnetic waves in the region between the slot antenna's ground plane and the periodic surface. An EBG surface which is not prone to radiation leakage and remains compact at low RF frequencies is the mushroom structure described in (D. Sievenpiper, L. Zhang, R.F.J. Broas, N.G. Alexopolous, and E. Yablonovitch, *IEEE Trans. Microwave Theory Tech.*, vol. 47, no. 11, pp. 2059-2074, Nov. 1999.) We will present numerical (FEM) and experimental results which demonstrate the effectiveness of the above described EBG surface in suppressing the back radiation from a CPW-fed ring-slot antenna. The antenna is designed to resonate at 3.7 GHz and is printed on a substrate of dimensions 20 x 20 cm, and the EBG surface is 10 x 10 cm. The gain improvement at broadside in the E and H planes is between 2.5 and 2.9 dB (89-98% efficiency) over a 5% (-10 dB S_{11}) bandwidth.