

Leaky Wave Radiation of a Dipole-Excited Slot Line Printed on an Artificial Plasma

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Leaky wave antennas are characterized by a very narrow bandwidth due to their resonance nature, that also implies a sensitive beam scanning behavior vs frequency. In a recent work (A. Neto and S. Maci, IEEE Trans. Antennas. Propag., vol. 51, no. 7, 1572-1581, 2003) it was shown the possibility to obtain a broad bandwidth leaky wave antenna by using delta-gap fed slot printed between two infinite dielectrics. Expressions for the Green's function and for the leaky-wave wavenumber were derived in the limit for very small slot width. The leaky-wave wavenumber results weakly dispersive being the geometry not dominated by any physical dimension of the structure. Moderately dispersive leaky-wave radiation thus occurs in the denser dielectric medium, that cannot conventionally be the free-space. This implies a not easy applicability of the phenomenon by using homogeneous dielectric. A way to overcome this problem is to cover the slot with a conical dielectric lens with elliptical cross section (A. Neto, S. Bruni, G. Gerini, M. Sabbadini, IEEE Trans. Antennas. Propag., vol. 53, no. 10, 3240-3246, 2005). An alternative way to exploit this phenomenon, investigated here, is the use of an artificial dielectric medium with effective refractive index lesser than unity (artificial plasma) in order to obtain a leaky-type radiation in the free-space on the opposite side of the slot-line. The artificial plasma is constituted by a wire medium, i.e. an array of parallel conducting wires, characterized by a refractive index less than unity and it is therefore dispersive (J. M. A. Brown, Proc. Inst. Elec. Eng., vol. 100IV, p.51, Jan., 1953). In this paper, we first design the refractive index of the artificial plasma in a certain frequency range. Next the artificial medium is employed as substrate for the slot-line antenna etched on a ground plane. The dispersive behavior of the artificial material induces a frequency scanning characteristic in the resulting antenna and reduces its bandwidth. However, the bandwidth remains wider than that obtained from more conventional leaky structures. Alternative solutions for the artificial dielectric that minimize the dispersion and provide even larger operational bandwidth are currently being investigated. Numerical results will be illustrated during the oral presentation, to demonstrate the practical applicability of the phenomenon and the very promising antenna characteristics.

