

Small Antennas on Electromagnetic BandGap Structures

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One of current constrains on antenna design for small handheld devices such as mobile phones, Personal Digital Assistants (PDAs) and wearable computers is the limitation of space, particularly for some internal types antennas such as printed dipole, meander-line antenna and Planar Inverted F Antenna (PIFA) etc. Among them, PIFA has the features of compactness, moderate range of bandwidth and high gain for both states of polarisation. One of concerns in mobile antenna design is its size reduction. At the moment, there are several methods available for PIFA size reduction, both shorting pins [1] and capacitance-loading [2] is common practices. In theory, antenna size reduction can be achieved when the substrate thickness is reduced. Unfortunately, if the antenna is too close to the conductive ground plane, the phase of impinging field is reversed upon reflection, resulting in destructive interference and hence poor radiation [3]. Another concern here is increased RF power losses in the user's body mainly in the head radiated from edges of the limited ground plane. Electromagnetic Band Gap (EBG) (also referred as Photonic BandGap) [4] offers the opportunity to control and manipulate electromagnetic wave propagation as a result of their being formed from small-scale periodic geometric structures. Its application includes the suppression of surface waves [5], the construction of Perfect Magnetic Conducting (PMC) planes and antenna gain enhancement [6]. More recently, the anisotropic characteristics of PBG structures have been studied and applied to the design of microstrip diplexer antennas [7]. The application of EBG ground in PIFA design has been investigated by Du *et al* using the finite-difference time-domain (FDTD) simulation [8], however no experimental results were presented. In this paper, radiation properties of PIFA on EBG substrate are examined. Specifically, radiation performance degradation from conventional PIFA with reduced air gap between antenna and the ground plane is investigated and compared with that over Uniplanar-Compact (UC) EBGs [9-10] substrate. Such antennas demonstrate the improved radiation properties over the conventional PIFA, and the evidence on surface wave suppression is also demonstrated. Simulation results are presented with experimental verification.

Another application of EBG structures in small antenna design is antenna beam shaping. In this paper, we will discuss the possibilities of designing and implementing an antenna system that is capable of operating in the HiperLAN frequency range with shaped-beam characteristic added to the antenna pattern.

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