Conformal Wideband Antennas with Single and Double-U-Shaped Slot

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Microstrip patch antennas are light weight and low profile antennas that are inherently narrowband with the bandwidth in the order of 1%-2%. In emerging wireless communications and radar systems, however, large bandwidths are necessary to transmit massive amounts of data and to enhance the resolution in radar systems. Some early techniques to increase the bandwidth include adding parasitic patches in single or stacked layers, which in turn increase the lateral and axial dimensions of the antenna, respectively. Hyung and Lee (T. Huynh and K. F. Lee, *Electron. Lett*. 31, 16, 1310-1312, 1995) proposed a novel technique to increase the bandwidth of patch antennas to 30% by cutting a U-shaped slot from the patch. Such wideband antennas are attractive candidates for both military and commercial applications for high speed data communications. Due to their varied applications these wideband antennas may need to be mounted on different curved surfaces, as such their planar structure may prove to be a hindrance.

In this paper, first a single U-slot rectangular patch antenna operating at its fundamental mode with about 40% bandwidth is investigated. The antenna is then placed on a conformal cylindrical structure. Different parameters of this structure including arc length, radius of the cylinder, and the substrate thickness are varied to study their effects on the antenna properties such as gain, cross polarization, input impedance and frequency bandwidth. It is found that the resultant conformal patch antenna further increases the frequency bandwidth to 50%, without degrading radiation properties of the antenna. It is also observed that with the conformal structure, thinner substrates can be used without compromising the frequency bandwidth. The frequency bandwidth of this conformal antenna is widened by a factor of 1.2 and has an enhanced cross polarization performance in the order of -15dB at the diagonal plane, which is 5dB less than its planar wideband antenna counterpart. The radiation patterns of the conformal patch antenna retain their symmetry at the principal planes, however the peak gain drops by about 0.5dB, due to its smaller aperture size than the planar counterpart.

The aforementioned conformal antenna is further investigated by utilizing two symmetrically inverted U-slots along the resonant length of the patch that can now support both dominant and the next higher order mode, i.e. the TM_{10} and TM_{20} modes. To realize symmetric radiation patterns, the differential feeding technique is used to excite the patch. The frequency bandwidth is significantly increased to 74.3%. It is worth mentioning that unlike other reported U-slot antennas, the proposed antenna still retains its effective characteristics in terms of low profile, stable polarization, and symmetric radiation patterns over the operating frequency range. The cross polarization level of this double U-slot conformal antenna is still less than -15 dB at the diagonal plane, which outperforms its planar counterpart, and the maximum gain at the center frequency of 3 GHz is 7.55 dBi. More importantly, it should be noted that the thickness of the substrate is very small (1.57 mm), which is in the order of $0.02\lambda_d$, where λ_d is the dielectric wavelength at the center frequency. In conclusion, two conformal wideband antennas are investigated in this paper and the corresponding results will be presented and discussed in the conference.