Bandwidth Enhancement of Iron Slot Antenna with Reactive Impedance layer

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Many planar antennas have been proposed for UWB system. The slot antenna is widely sought of for UWB applications. Various types of slot antennas have been recommended; such as circular, square, elliptical slot and different tuning stubs of rectangular, circular, and tapered shapes have been implemented for enhancing the bandwidth of antennas (Rezaul Azim, Mohammad Tariqul Islam, Norbahiah Misran, IEEE Antennas and Wireless Propagation Letters, Vol. 10, 2011). In addition, adding a surface with reactive impedance could help as well to widen the bandwidth. Compared to the bandwidth of a planar monopole antenna, typically, the bandwidth of a slot antenna is relatively narrower. However, the benefits of slot antenna include stable bi-directional radiation pattern and gain flatness over the band.

Recently, we successfully developed an iron shaped slot antenna with a fork shaped tuning stub with a very wide bandwidth. The design has been developed and fabricated on FR4 substrate ($\varepsilon_r = 4.4$) with a thickness of 1.57 mm and $\tan\delta = 0.02$. The overall dimension of the antenna is 100 × 100 mm^2. The experiment showed that the proposed antenna achieves a good impedance match, a constant gain and stable radiation pattern in the range of 0.85 to 3.0GHz (i.e. 3.5:1).

Further bandwidth enhancement has been achieved using Reactive Impedance Layers (RILs) on top of slots antennas (Hossein Mosallaei, and Kamal Sarabandi, IEEE Transactions of Antennas and Propagation, Vol, 52, No. 9, Sept 2004). These layers are comprised of periodic either spirals, or split ring resonators (SRRs), or squares, etc. Generally, the period of the unit cell of the RILs is relatively small (< 0.5λ) which would degrade the bandwidth, but in our implementation, we utilized a wider period of the RIL to keep the original bandwidth and to enhance the upper frequency range. The newly developed iron slot antenna with RIL with a periodic spiral layer of > 0.9λ spacing, demonstrated a slightly wider bandwidth from 0.81 to 3.29 GHz, which is 4:1 with almost the same gain of 6.5±0.5dB over the band.