Reflector-based Broadband Antennas offering low profile

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Abstract

Broadband antennas offering low profile are becoming increasingly important as they provide devices with improved support for multiple frequency bands. A broadband antenna has a large bandwidth (one octave or higher), making them ideal for various technologies such as cellular, Wi-Fi, Bluetooth and navigation. Broadband antennas also reduce the number of antennas required in a single housing, ,by replacing multiple narrowband antennas with a single broadband antenna. Our work focuses on a subset of FR-1 frequency range [**1**] which goes from 600 MHz to 5 GHz, which covers cellular bands as well as Wi-Fi, Bluetooth and GPS.

Many broadband structures like the spiral antenna radiate in front and back of the antenna [**2**]. This is known as bi-directional radiation. One objective of the antenna design is uni-directional radiation. One reason for this is to have Electromagnetic Compatibility or follow EMC compliance with the electronics that are usually present near the antenna. Moreover, bi-directional radiation is a waste of power from the antenna's perspective and constitutes an efficiency hit– since transmitter is powering a radiation pattern that is not useful in terms of link budget. Finally, the antenna also falls short of any SAR compliance requirements.

There are multiple methods to achieve uni-directional radiation. One method to suppress the back radiation is to use a metal reflector or approximate Perfect Electric Conductor (PEC). An example of this is the ground plane used in microstrip antenna design. This antenna type consists of a radiating patch with an electrically large ground plane, separated by a dielectric material, as shown in the Figure 1. This ground plane is useful in avoiding any radiation beneath the patch antenna happening beneath the patch antenna. This increases the gain of the antenna in the front. This translates to a high Front to Back Ratio. However, if the antenna is too close to the PEC, the image currents cancel the currents in the antenna, resulting in poor radiation efficiency [**3**]. To address this problem, the ground plane needs to be a certain distance away(lambda/4) from the radiator(patch).. This distance then becomes the limiting factor, since it increases the overall profile of the antenna.

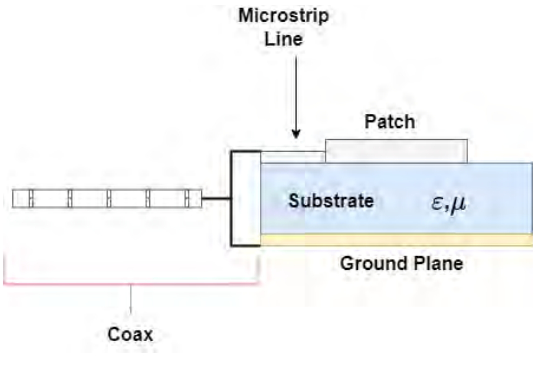

Figure 1. Ground Plane on Microstrip Patch Antenna.

The next technique which does not suffer from this distance limitation is a PMC or Perfect Magnetic Conductor. Since PMC is not found in nature like PEC[**4**] , one needs to design a structure that can mimic the properties of the PMC. Such a structure is known as an AMC or Artificial Magnetic Conductor. There are many AMC implementations in literature such as mushroom EBG(electromagnetic bandgap structures), FSS etc. Many AMC implementations in literature are narrowband or multiband. The requirement for the broadband antenna design is a broadband AMC, which can reflect the frequency bands of interest.

This work intends to present a broadband antenna with a broadband PMC reflector which provides uni-directional radiation pattern throughout the frequency bands of interest(FR-1). In this work, multiple broadband antenna types such as spiral and bowtie have been investigated. The antennas and the PMC reflector are designed separately in CST Microwave Studio. After that, a combined simulation of the system is done. The final antenna is then prototyped, and the simulation and measurement results are presented, comparing the return loss, radiation efficiency and radiation pattern with the presence of PEC vs PMC.

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