Low-Frequency Bandwidth Extension of UWB Monocone Antennas

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There is an ever increasing need for efficient antennas in smaller and smaller packages. This is especially true for the next generation of communication systems, such as JTRS. Some of the joint systems operate in HF/VHF/UHF and L-Bands and require antennas that can operate efficiently from 2-2000 MHz, where current antennas do not perform adequately.

Conical dipoles and monopoles have inherently broadband impedance. In this paper, we first propose a method for computing the antenna bandwidth that takes into account the radiation pattern stability over a specified field of view and impedance matching. The radiation pattern of a resonant quarter-wave thin monopole is used as a benchmark with respect to which the bandwidth is computed. Next, several methods for increasing the bandwidth are considered. A common approach is to make the antenna have a bulbous or spherical surface. A simple modification of a classical monocone antenna is proposed and its bandwidth is optimized. Specifically, the monocone is modified by merging a cone with a circular cylinder at the position referred to as the junction location. It is shown that this modified monocone maintains stable radiation patterns with system gain greater than 0 dBi for 39° over a 20:1 bandwidth, which is a 94% increase in bandwidth compared to the classical monocone.

Finally, several techniques for extending the bandwidth of monocone antennas aimed to reducing the lowest frequency of operation are investigated, individually and in combinations. Among these techniques are: planar and spherical dielectric loading, meandering, top loading including spherical cap, inductive and capacitive loading, just to mention a few. It is shown that the lowest frequency of operation where the antenna constant 0dBi bandwidth, can be extended into the region when the antenna can be classified as small. Numerous tradeoffs will be discussed as well.