ABSTRACT

Fundamental physical limitations restrict antenna performance based on its electrical size alone. These fundamental limitations are of the utmost importance since the minimum size needed to achieve a particular figure of merit can be determined from them. In this dissertation, the physical limitations on the size reduction of a broadband antenna is examined theoretically and experimentally. This is in contrast to previous research that focused on narrowband antennas. Specifically, size reduction using antenna miniaturization techniques is considered and explored through the application of high-contrast material and reactive loading. A particular example is the miniaturization of a broadband spiral using readily available high-contrast dielectrics and a novel inductive loading technique. Using either dielectric or inductive loading, it is shown that the size can be reduced by more than a factor of two which is close to the observed theoretical limit.

To enable the realization of a conformal antenna without the loss of the antenna's broadband characteristics, a novel ground plane is introduced. The proposed ground plane consists of a traditional metallic ground plane coated with a layer of ferrite material. It is shown that the ferrite coated ground plane minimizes the negative effects that occur when the spacing between a traditional metallic ground plane and antenna becomes electrically small.