Empirical Investigation of Loaded Microstrip Antenna Performance Parameters

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Much of the prior work on loaded and loading microstrip patch antennas focused upon the net reduction in size achievable through the loading technique(s). For the same nominal footprint, the resonant frequency of a patch can be reduced by modifying its interior geometry, or, for a given frequency the size can be reduced. Alternatively, the basic microstrip antenna shapes can be loaded with lumped elements to achieve a decrease (capacitive edge loading, *C*) or an increase in resonant frequency (inductive edge loading, *L*). The focus of this investigation was on the use of combinations of capacitive and inductive elements to create configurations that had more constant performance in terms of instantaneous impedance bandwidth, pattern shape, polarization characteristics and radiation efficiency as the load values were changed to tune across the desired band. The work here is limited to linearly-polarized, rectangular microstrip antennas. Unlike previous work on loaded patch antennas, this research investigated the limits of tuning both down and up in frequency. Specifically, the use of *L/C* combinations was compared to simply using capacitive element(s) to decrease the resonant frequency of a patch across the same tuning range. Furthermore, the effect of distributing the load along the radiating edge of the linearly-polarized patch is quantified. That is, distributing the lumped elements along the edge of the patch can minimize pattern degradations across the tuning range. Measurements of the radiation efficiency are ongoing, preliminary results indicate that a commensurate tuning range can be achieved with the *L/C* combinations and achieve a somewhat higher radiation efficiency across the same tuning range when compared to capacitive-only loading.

To simply construction of the antennas, a range of frequencies was selected in the UHF band. The presentation includes a complete set of measurements on each configuration and tuning state tested: a) impedance bandwidth, b) radiation patterns, and c) radiation efficiency. Furthermore, the use of varactor elements is compared to tuning with discrete values of capacitance.