Abstract

This dissertation enlights on the characteristics of electromagnetic waves in cylindrical and spherical media. In cylindrical media, for the dielectric rod, impedance cylinder coated with dielectric and uniaxial dielectric cylinder, the integration along the real k_z -axis has been deformed into the complex k_z -plane using Cauchy's residue theorem to avoid the branch point singularities of the real k_z -axis. The complex k_z -plane consists of pole singularities and depending on the location of the poles, poles can be classified as leaky and creeping-wave poles. The characteristics of the space-wave radiation pattern that is due to the branch point singularities are also analyzed. Pattern characteristics corresponding to space and leaky-waves are investigated for all source-polarizations with variation in cylinder parameters. The phase and attenuation characteristics of the axially propagating leaky-waves are also investigated, delineating the radiating and guided-wave regions of the cylinder.

Thereafter, a full-wave Green's function approach for the rigorous investigation of a probe-coupled dielectric resonator antenna configuration with an imperfect inner conductor is presented. The impedance boundary condition is applied over the imperfect conductor in the formulation to derive the fields in and outside the dielectric region. The technique enhances the applicability of the full-wave Green's function in the evaluation of input impedance and radiation characteristics for an antenna structure with imperfectly conducting spherical surface. The role of the surface impedance on the antenna resonance and quality factor is thoroughly characterized.

Next, the formulation for the scattered field due to the linearly polarized plane wave incident on the impedance sphere coated with multiple layers of dielectric is presented. Detailed numerical results for electromagnetic scattering from an impedance sphere coated with two layers of lossy dielectric are presented. Thereafter, an asymptotic solution for the field in the shadow region exterior to an impedance sphere coated with two layers of the lossy dielectric is presented. The creeping-wave modes are computed and plotted with respect to parametric variations for both the TM and TE cases.