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Characterization of Printed Reflectarray Elements on Variable Substrate Thicknesses

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Abstract : Narrow bandwidth and high loss performance limits the use of reflectarray antennas in some applications. This article reports on the feasibility of employing strategic reflectarray resonant elements to characterize the reflectivity performance of reflectarrays in X-band frequency range. Strategic reflectarray resonant elements incorporating variable substrate thicknesses ranging from 0.016λ to 0.052λ have been analyzed in terms of reflection loss and reflection phase performance. The effect of substrate thickness has been validated by using waveguide scattering parameter technique. It has been demonstrated that as the substrate thickness is increased from 0.508mm to 1.57mm the measured reflection loss of dipole element decreased from 5.66dB to 3.70dB with increment in 10% bandwidth of 39MHz to 64MHz. Similarly the measured reflection loss of triangular loop element is decreased from 20.25dB to 7.02dB with an increment in 10% bandwidth of 12MHz to 23MHz. The results also show a significant decrease in the slope of reflection phase curve as well. A Figure of Merit (FoM) has also been defined for the comparison of static phase range of resonant elements under consideration. Moreover, a novel numerical model based on analytical equations has been established incorporating the material properties of dielectric substrate and electrical properties of different reflectarray resonant elements to obtain the progressive phase distribution for each individual reflectarray resonant element.

Keywords : numerical model, reflectarray resonant elements, scattering parameter measurements, variable substrate thickness
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