Analysis of Finite Arrays of Circumferentially Oriented Printed Dipoles on Electrically Large Cylinders

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The design and analysis of conformal arrays of printed antennas is of interest in applications ranging from satellite and wireless communications (mobile phone base stations, space division multiple access (SDMA) applications, etc) to military systems (flush-mounted antennas for aircraft and missiles). In these applications, conformality is required either for aerodynamic reasons or to reduce the array's radar cross section. However, the lack of adequate design and analysis tools, in particular for electrically large arrays, is a problem that remains to be solved for conformal printed antenna arrays.

In this paper, several arrays consisting of finite number of circumferentially oriented printed dipoles on electrically large, dielectric coated, circular cylinders are investigated using a hybrid method of moments (MoM)/Green's function technique in the spatial domain. This method is basically an "element by element" approach in which the mutual coupling between dipoles through space wave as well as the surface wave is incorporated. The efficiency of the method comes from the computation of the Green's function, where three types of spatial domain Green's function representations are used interchangeably, based on their computational efficiency and regions where they remain accurate. These representations are (*a*) a steepest descent path (SDP) representation, which is valid everywhere except along the paraxial region and electrically small separations between the source and observation points, (*b*) an asymptotic-based, spatial domain representation which is valid along the paraxial region and complements the SDP representation, and (*c*) an efficient integral representation of the of the planar microstrip dyadic Green's function for the evaluation of self-terms.

Previously, axially oriented printed dipole arrays on electrically large dielectric coated circular cylinders have been investigated, and some of their interesting features have been observed and reported (V. B. Ertürk, K. W. Lee and R. G. Rojas, *IEEE AP-S Int. Symp. and USNC/URSI Meeting*, 23, 2002). However, a full wave analysis for the circumferentially oriented printed dipole arrays has not been reported yet. Therefore, in this paper, our goals are; (*i*) to perform a full wave analysis of large phased arrays of circumferentially oriented printed dipoles on large coated cylinders, and (*ii*) to compare their performances (in the form of current distributions, active reflection coefficient, etc) with axially oriented printed dipoles on the same cylinders, as well as, arrays of printed dipoles on grounded planar slabs.

Several numerical examples, in the form of mutual coupling between two printed dipoles and array current distributions for relatively large arrays, as well as, basic performance metrics for these arrays will be presented. These performance metrics will also be compared with axially oriented printed dipole arrays on similar coated cylinders and printed dipole arrays on grounded planar substrates. Certain similarities and discrepancies will be discussed.