COHERENT AND INCOHERENT WAVES IN A TRUNK DOMINATED FOREST

R. Lang[1*], C. Utku[2] and S. Seker[3]

[1]Dept. of Electrical and Computer Eng., George Washington University, Washington, DC, 20052

[2]Instrumentation Sciences Branch, NASA ,GSFC, Greenbelt, MD 20771

[3]Dept of Electrical and Electronic Eng., Bogazici University, 80815, Istanbul, Turkey

The problem of propagation of electromagnetic waves in a trunk dominated forest is examined. The actual problem is simplified by considering an unbounded medium of vertical dielectric cylinders. The cylinders are randomly distributed and have small fractional volume. An electric line source, placed at the origin, is used to excite vertically polarized waves. The analysis of the problem is further simplified by assuming that the frequency is low enough so that the cylinders can be replaced by two dimensional Rayleigh scatterers. The behavior of the coherent and incoherent waves will be examined as a function of distance from the source.

The problem is first examined analytically. Using the assumed small fractional volume, a Foldy equation for the mean and an equation for the correlation function can be obtained. By using the Rayleigh assumption, a simple wave equation for the mean is obtained and solved in terms of a Hankel function with an equivalent propagation constant. The Rayleigh assumption reduces the correlation to an equation for the intensity. This intensity equation is in the form of a convolution which can be solved explicitly by means of a Fourier transform. The results show, as expected that as the distance increases, the coherent intensity decreases while a relative increase is observed in the incoherent intensity.

To check the accuracy of these results, a Monte-Carlo simulation of infinite length vertical cylinders is used. The cylinders are distributed randomly in a rectangular region with the line source placed about 1/3 from the end. Many realizations are computed and averaged to obtain estimates of the coherent and incoherent intensity. These results will be compared with the analytic results for different size rectangular forests.