**Far Field Extrapolation in the Boresight Direction from Near Field Samples to Improve the Signal Integrity in Time Domain Measurement**

Sembiam R. Rengarajan
Department of Electrical and Computer Engineering
California State University, Northridge, CA 91330, USA

Antenna pattern measurements in time domain can provide broadband frequency domain pattern data. In some applications there is a need to know the transfer function of an antenna in a certain frequency range of interest in the boresight direction. In this case one transmits a time domain waveform from the antenna under test (AUT) and receives the signal from a known receive antenna. From the received signal and the receive antenna transfer function it is possible to determine the transfer function of the AUT. The radiated far field exhibits spherical wave behavior in the form exp (-jkr)/r, where r is the distance between the two antennas and k is the free space wavenumber. If the spacing r does not satisfy the far field criterion, the radiated field varies with r in the form of a series in inverse powers of r (J. E. Hansen, Spherical Near-Field Antenna Measurements, Institution of Engineering and Technology, 1988), thereby resulting in signal distortion. An extrapolation technique was presented for determining the gain and polarization of an antenna from measured field amplitudes only at reduced distances at a single frequency (A. C. Newell, R. C. Baird, P. F. Wacker, IEEE Transactions on Antennas and Propagation, vol. 21, no. 4, July 1973). A recent study focused on this problem for a monopole antenna using an averaging technique in the intermediate distances (R. D. Tamas, L. Babour, A. Danisor, and G. Caruntu, Proc. IEEE International Workshop in Antenna Technology, 2010). We found that their method is not suited to apertures and other extended antennas.

In this work we investigated the normalized near field amplitude and phase as a function of distance for different types of antennas, such as dipoles, radiation from open ended parallel plate waveguides, and apertures. Based on the knowledge of the asymptotic behavior of the normalized far field we developed a method of extracting far fields from sampled near fields in the boresight direction. The method is based on the minimization of mean square error between the sampled fields and the fields fitted with a power series in 1/r. Computed results will be presented for different parameters such as the aperture size, aperture distribution, frequency, the distance between the transmit and receive aperture, the number of terms in the power series, the number of field samples and sample spacing. We will discuss the method of determining the far field in time domain from the measured near field time domain samples.