Efficient Measurements and Statistical Analysis of Random Near-Field (NF) Data to Predict Far-Field (FF) Pattern Statistics for Wideband Antennas at In-Band (IB) and Out-of-Band (OB) Frequencies.

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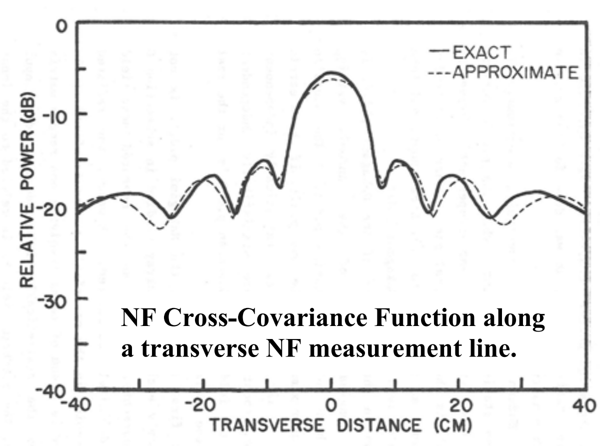
This paper discusses the use of modern NF measurements and statistical analysis techniques for efficient measurement and processing of random NF electric field data to predict the Far-Field (FF) pattern statistics of wideband antennas at IB and OB frequencies. Data collection via conventional single-probe measurement systems and advanced multi-probe arrays is presented and discussed. Randomly-varying fields can be encountered for example in the measurement of reflector and/or phased array antennas containing active devices that affect the phases and amplitudes of the IB and OB modes in the radiating elements. Statistical analysis techniques permit expeditious processing of the huge amounts of IB and OB NF data that are needed in order to succinctly characterize the FF pattern statistics for all combinations of the antenna operational parameters of interest. The key FF pattern statistical parameters such as the statistical average pattern, standard deviation, probability density function (p.d.f.) and the cumulative probability function can be computed directly in terms of a) the statistical average electric field at each NF measurement point, b) the standard deviation of the electric field at each NF measurement point, and c) cross-covariance functions for the electric fields at all different NF measurement points, thereby obviating the need for cumbersome "Monte Carlo" computations (B. J. Cown. "Stochastic Near-Field Theory and Techniques for Wideband Electromagnetic Emitters at In-Band and Out-of-Band Frequencies", Ph. D. Dissertation, School of Physics, Georgia Institute of Technology, 1982.)

The NF cross-covariance functions introduce a new level of complexity in NF measurements and analysis that is absent for deterministic field measurements. In particular, the statistical cross covariance functions can only be directly measured by using 2-d probe arrays spanning the entire NF measurement surface. However, methods for extracting the cross-covariance functions from NF data measured using 1-d probe arrays have been devised. The figure below illustrates the results of one of the methods.



NF Cross-Covariance Function along a transverse NF measurement line.