# Computing the Far Field of an Aperture Antenna in the Plane of the Aperture from its Near Field

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Characterization of the radiation field of an antenna having a planar aperture has commonly been accomplished via planar scanning of the near field of the antenna and calculation of the corresponding far zone field via Fourier transformation. The result is valid over a limited angular range about the boresight direction. The range of validity is determined by two parameters of the measurement geometry, the extent of the scan plane and its distance from the aperture. If angles near 90 degrees are of interest, one must use a large scan extent and a small distance. Of course, when using small measurement distances, one must take care to reduce or eliminate multiple reflections between the antenna and the field probe. Assuming that this has been done, there remains a difficulty with the usual mathematics of the transformation to the far zone when evaluation near or on the aperture plane is desired Previously, this issue has been addressed via the Gerchberg-Papoulis algorithm. [Martini, et al., IEEE Trans. AP-56, 11, 3485-3493, 2008] In that work the fields in the aperture plane are truncated to the aperture and Fourier iteration is used to expand the so-called reliable region to the full front hemisphere. The results are remarkably accurate but issues arise concerning convergence if the iteration is continued indefinitely.

The usual asymptotic evaluation of the transform integral in the far zone is carried out via the method of stationary phase and the result contains a factor of the cosine of the polar angle from boresight. [e.g., Gregson, et al., IET EM Wave Series 53, 2007 Section 4.13] Thus, the result at 90 degrees of polar angle would seem to be identically zero which is clearly incorrect. Theoretically, the apparent zero is in fact canceled by the singular behavior of the spectrum of the measured field. [Cappellin, et al., Radio Sci., 43, RS1012, 2008] However, the singularity is not observed in the measurement because of the finite size of the scan plane. This problem can be mitigated by estimating the nonsingular behavior resulting from the finite scan plane and replacing the cosine factor with this new function. The result provides a reasonably accurate evaluation of the radiation field even in the plane of the aperture.