A Mapping for Spectral Filtering in Planar Near-Field Aperture Antenna Measurement

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A very popular approach to reduction of artifacts in the results of spherical near-field measurements of antennas is low pass filtering of the expansion of the fields in spherical modes. The number of retained low order modes is related to the electrical size of the antenna. [F. Jensen and A. Frandsen, AMTA Proceedings 489-494, Stone Mountain Park, GA, 2004] An analogous spectral approach may of course be used in planar near-field measurement of aperture antennas wherein one filters the aperture plane fields to the physical size of the aperture thus low pass filtering the angular dependence of the far zone radiation fields. Because the aperture is assumed to be of infinitesimal thickness, such filtering always results in a radiation pattern having zero slope versus polar angle when the polar angle is 90 degrees. This is a property of the mapping between wave number space and polar angle space. One may understand this by noting that the projected aperture of the antenna viewed from polar angle equal to 90 degrees has zero size and can therefore support only radiation that is constant versus angle (neglecting polarization effects).

In the work reported here, the mapping between wave number space and polar angle space is generalized for applicability when the aperture has finite thickness. That is, the mapping is formulated in terms of the projected aperture as a function of polar angle. The resulting mapping renders the frequency of pattern oscillation in the far zone approximately constant versus polar angle so that low pass filtering is equally effective at all angles rather than being heavily focused on the regions near 90 degrees as is usually the case. This mapping has an adjustable parameter, the ratio of the projected aperture at a polar angle of 90 degrees to that at boresight; that is, the ratio of aperture thickness to aperture size. When this parameter is set to zero, the mapping reduces to the usual one relating the pattern in wave number space to the pattern in polar angle space. An attractive property of this mapping is that it is analytically invertible.