Fourier Iteration between Two Measurement Plane Fields of an Antenna with Limited Measured Data

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Recently we investigated a Fourier iteration technique involving the electric fields in a measurement plane in the Fresnel region and the antenna aperture plane (Rengarajan and Pogorzelski, IEEE APS/NARSM, 2015). Only a limited amount of measurement data on a plane that is less than $1/4^{th}$ the antenna aperture size was used in that work. Exploiting the fact that antenna aperture size is limited allowed us to make use of the "band limited signal analogy" of the well-known Gerchberg-Papoulis (GP) algorithm. While the GP algorithm, that iterates between the far field spectrum and the antenna aperture fields, fails to provide the far field value accurately along even the main beam peak direction if the near field scan region size is less than the size of the antenna aperture, our method of iterating between the measurement plane fields and the antenna aperture plane provided accurate results near the main beam peak even with a scan plane size that is significantly less than the antenna aperture size.

In many practical antennas, the aperture plane is not well defined and it may not be known precisely. It is possible to measure fields in two parallel planes by displacing the antenna with respect to the measurement plane. One can then perform Fourier iterations between the two measurement planes, replacing the calculated fields in the measured region by the original measured fields in each iteration. We employ this procedure with limited measured data in the Fresnel region to obtain accurate field data near the main beam peak. A similar iterative technique is used in the well-known phase retrieval algorithms that use amplitude-only measurements in two planes (B. Z. Katsenelenbaum and V. V. Semenov, Radio Eng. Electron. Phys., 12, pp. 223-230, 1967 and A. P. Anderson and S. Sali, IEE Proc., 133, Pt. H, pp. 291-298, Aug. 1985). We will present results of our investigation on accurate evaluation of far field patterns in the main beam region using limited Fresnel region fields. In addition, we will investigate this technique for measurements in the radiative near fields as well.