Iteration-Free Phase Retrieval for Amplitude-Only Near to Far Field Transformation

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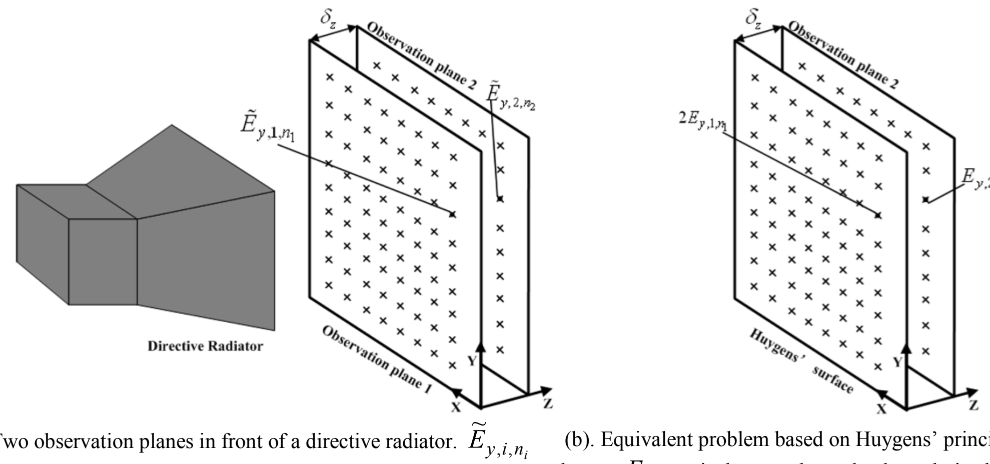
Near to far field transformation is widely used to predict antenna radiation pattern when it is difficult to conduct far-field measurement. Due to the difficulty of phase measurement, near to far field transformation using amplitude-only data attracted much interest. In order to transforming amplitude-only near field to far field, phase retrieval is often needed. Most existing phase retrieval methods iteratively retrieve phase information from field amplitudes on well-separated observation planes, which requires physically large test site for low frequency applications.

This paper proposes an iteration-free phase retrieval method based on field amplitudes on two observation planes with small separation δ_z (see Fig. 1a). Due to the small separation, local optimization suffers from converging to local minima, and global optimization consumes long CPU time. In order to efficiently and accurately retrieve the phase information, Huygens' surface is placed on the first observation plane, as shown in Fig. 1b. According to Huygens' principle and image theory, the equivalent magnetic current is two times the electric field on the first observation plane. Since the equivalent magnetic current on Huygens' surface is the source of fields on the second observation plane, complex-valued field quantities on the two observation planes are related through the integral equation. The integral equation is scaled by field amplitudes on the two observation planes. The scaled integral equation is discretized and a matrix is obtained. It is found that the eigen-vector of the matrix constitutes a solution to the phase retrieval problem (details will be shown in conference presentation). This provides a straightforward way for phase retrieval without iteration. The problem of convergence to local minimums is thus avoided.



(a). Two observation planes in front of a directive radiator. $\tilde{E}_{y,i,n_i}$ is the amplitude of y-polarized electric field at the n-th observation point of the i-th observation plane.

(b). Equivalent problem based on Huygens' principle and image theory. E_{y,i,n_i} is the complex-valued y-polarized electric field at the n-th observation point of the i-th observation plane.

Fig. 1. Configuration of the proposed phase retrieval method.

Compared to existing methods, our proposed method does not require large separation between observation planes. Meanwhile, it avoids the non-convergence problem encountered by local optimization methods. Simulation results will be shown in conference presentation to show the effectiveness of the proposed method.