Near-Field Transformation Utilizing Multilevel Plane Wave Representation Applied to Planar Measurements

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A fully probe-corrected near-field far-field transformation employing plane wave expansion and diagonal translation operators has recently been presented (C.H. Schmidt and M.M. Leibfritz and T.F. Eibert, Trans. Antennas Propagat., 3, 737-746, 2008). Plane waves on the entire Ewald sphere are used as equivalent sources. These are translated to the field probe position by efficient diagonal translation operators, known from fast multipole methods (FMM) to relate the amplitudes of the equivalent sources to the measured probe output voltages. The plane waves are superimposed at the field probe and weighted according to the probe's receiving characteristic. Thus a full probe correction is realized. The unknown amplitudes of the plane waves are determined in an inverse process from the measured probe voltages. In this paper the algorithm is upgraded in a multilevel fashion and applied to planar measurement contours. The measurement points are grouped in a multilevel box structure (see Fig. 1 left) and translations of the plane waves, representing the antenna under test (AUT), are only carried out to the box centers on the highest level. The plane waves are further processed through the different levels towards the measurement points with a decreasing sampling rate using a disaggregation and anterpolation procedure. Disaggregation is a simple phase shift towards the box centers on lower levels and finally the measurement points (see Fig. 1 right). Anterpolation can be thought of as counterpart to interpolation and decreases the sampling rate since the spectral content is proportional to the box size on a given level. This reduces the overall complexity to $\mathcal{O}(N \log N)$, N being the number of measurement points, which is comparable to the classical Fast Fourier Transform based algorithms. So efficient near-field transformations are enabled also for electrically large antennas. The proposed algorithm is able to cope with irregular measurement grids, which might occur from probe positioning errors, or even irregular sample point distributions.

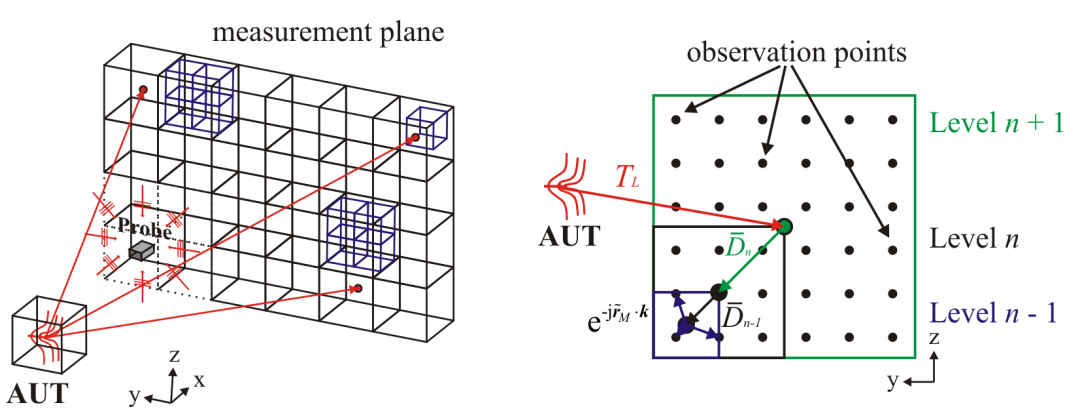

Figure 1: Planar measurement setup and disaggregation operation.