Computer Simulation of Artifact Removal in Spherical Near-field Measurements via Probe Calibration

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Recently, Pogorzelski [National Radio Science Meeting, San Diego, July 2008] introduced a method of correcting for general probes in spherical near-field antenna measurement. The approach involves a preliminary calibration measurement of a known antenna yielding a set of calibration coefficients. These coefficients are then used in processing the measurements of an unknown antenna to correct for the deviation of the probe from an ideal Hertzian dipole. It was noted that one might consider all non-moving objects in the measurement chamber, including the walls, to be part of the probe and use this approach to remove the effects of these objects from the measurements. The present paper outlines the correction process in its present state of development and describes a computer model of a spherical near-field measurement system embodying this correction algorithm and including error sources such as rf noise, wall reflection, and incorrect probe positioning. This model is used to assess the performance of the algorithm.

Beginning with the Jensen-Wacker transmission formula it is shown that the sum over the probe azimuthal harmonics can be defined to be a new coefficient which can be obtained from measurements of a known antenna via a least squares solution technique. The full set of these coefficients then contains all the information about the static objects in the chamber that is needed to remove their effects from subsequent measurements. Several example calculations are discussed showing the effects of wall reflection, probe position, and noise at various levels. It is shown that in the absence of noise, wall reflections and probe mis-positioning can be perfectly corrected. A concern has been that the condition numbers of the matrices involved might result in amplification of noise effects rendering the algorithm ineffective in the presence of noise. However, computer simulation has further shown that this is not the case with reasonably achievable noise levels such as -40 dB. Thus, it appears that probe calibration shows promise as a means of removing measurement artifacts from spherical near-field data.