Phaseless Techniques in Antenna Near-Field Measurements: Algorithms, Simulations and Experiments

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During the past century the field of antennas and propagation has matured to an incredible extent. Amazing variations in antenna topologies suggest that each antenna is designed to fulfill special performance needs, such as, gain, frequency of operation, radiation pattern, etc. Upon the construction of an antenna, there is required to ensure its actual performance by performing measurements. Many measurement techniques have been developed as a response to this requirement. This paper focuses on the planar near field measurement technique which allows measuring the near-field of the antenna in indoor facilities at practical distances, and then computes the far-field patterns using post-processing techniques. In particular, advances in near-field "phaseless" measurements will be the central theme of this paper. These types of measurement have particular advantages at higher frequencies. In addition, they are very cost effective. Therefore their implementation has motivated a great deal of research over the past decade.

Previously, the importance of the phaseless techniques in significant reduction of the measurements cost were explored. Although promising, these methods have not been considered capable of dealing with certain antenna issues, such as, scanned beams, polarization construction, uniqueness of the solutions and the impact of probe errors.

This paper describes recent developments and advantages of applying phaseless near-field measurement techniques in constructing antenna radiation patterns. After a brief description of some commonly applied methods, a detailed investigation of the Iterative Fourier Technique (IFT) as a powerful phaseless algorithm for planar near-field measurements is presented. The issues regarding the implementation of this technique are investigated and the modifications necessary to develop a powerful algorithm for phaseless near-field measurements are illustrated. Through a novel customized simulation approach, the effects of probe positioning errors are addressed and it is demonstrated that the phaseless method produce far superior results compared to standard amplitude/phase near field measurements. Representative experimental data, using UCLA's Bi-polar planar near field range, are presented to show the utility of the algorithms developed in this paper.