Multiplicatively Regularized Source Reconstruction Method for Phaseless Planar Near-Field Antenna Measurements

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The source reconstruction method (SRM), as an antenna measurement technique, often operates on data collected in the near-field of the antenna under test (AUT) to reconstruct an equivalent current distribution of the AUT. In general, the SRM computes equivalent electric and magnetic currents on a virtual surface enclosing the AUT that radiate the same electromagnetic fields as the AUT. These currents can be used to compute the far-field pattern of the AUT, as well as provide valuable antenna diagnostic information. Most SRM research considers measured near-field data that has both amplitude and phase information, but an increasing trend towards antenna operation at higher frequencies makes collecting accurate phase information more challenging and expensive [1]. To this end, we investigate the application of the SRM to phaseless (amplitude-only) near-field measurement data.

In past applications of the SRM to phaseless near-field measurements, two planes of collected data were utilized to improve the accuracy of the reconstruction. One such method finds an equivalent magnetic current distribution by minimizing multiple cost-functionals that represent the misfit between the measured field amplitude and the field amplitude produced by the equivalent currents [2]. The method that we propose allows for *simultaneous* use of measurement data from two planes by employing a multiplicative regularization scheme similar to that originally developed for the inverse scattering problem [3]. The proposed method also supports the reconstruction of equivalent electric *and* magnetic currents, allowing for more complex reconstruction surface geometries.

Initially we will describe the mathematical formulation of the non-linear ill-posed inverse problem associated with the proposed phaseless SRM. We will then discuss the advantages of using a multiplicative regularization scheme and explain how the derivative-based conjugate gradient method is used to minimize the resulting non-linear cost-functional. Finally, we will give an overview of the numerical implementation of the proposed method for the case of planar near-field measurements, and present reconstruction results using synthetic near-field data, with and without additive noise.

[1] R. G. Yaccarino and Y. Rahmat-Samii, “Progress in phaseless near-field antenna measurement research at the University of California, Los Angeles,” *IEEE International Sym. on Antennas and Propag.*, vol. 4, pp. 416–419, 2001.

[2] F. Las-Heras and T. K. Sarkar, “A direct optimization approach for source reconstruction and NF-FF transformation using amplitude-only data,” *Antennas and Propagation, IEEE Transactions on*, vol. 50, no. 4, pp. 500–510, 2002.

[3] A. Abubakar and P. M. van den Berg, “Iterative forward and inverse algorithms based on domain integral equations for three-dimensional electric and magnetic objects,” *Journal of Computational Physics*, vol. 195, no. 1, pp. 236 – 262, 2004.

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