Multiplicatively Regularized Source Reconstruction Method for Phaseless 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 (R. G. Yaccarino and Y. Rahmat-Samii, *IEEE Int. Sym. Antennas Propag.*, 4, 416-419, 2001). 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 (F. Las-Heras and T. K. Sarkar, *IEEE Trans. Antennas Propag.*, 50(4), 500-510, 2002). 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 (A. Abubakar and P. M. van den Berg, *J. Comput. Phys.*, 195, 236-262, 2004). 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 how the multiplicative regularization scheme inherently incorporates adaptive regularization characteristics, and the consequent advantages compared to alternative phaseless methods. To minimize the resulting non-linear cost-functional we use derivative-based optimization. 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.