On the Use of SVD-Improved Point Matching in the Current-Model Method

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Abstract— **Fictitious-current models have been applied extensively in recent years to a variety of scattering problems in computational electromagnetics. This paper introduces an approach which uses the singular value decomposition (SVD) to improve the accuracy of the numerical solution. In this approach, the SVD is essentially facilitating a systematic way to optimally reduce the generalized inverse matrix used in the solution to a submatrix of smaller rank. This reduction strikes a balance between the fulfillment of the boundary conditions at the matching points and that between them. Clearly, the boundary condition errors at the matching points are no longer strictly zero. However, the previously discernible errors between the matching points are markedly suppressed. The suggested approach is efficacious not only when the impedance matrix is inherently singular or highly ill conditioned, but also when this matrix is entirely well conditioned. It can be generalized and implemented in any method of moments code which uses point matching for testing. The approach has been incorporated into an existing solution based on the current-model method for the problem of scattering from periodic sinusoidal surfaces, and is shown to render the solution more accurate.**

squares sense was proposed by [8]. Later, a similar procedure, involving a solution of an overdetermined system of equations, was also incorporated in the GMT [9]. Recently, a number of researchers employed the singular value decomposition (SVD) to solve ill-conditioned systems of linear equations [10]–[14]. However, these attempts were only aimed at stabilizing the numerical solution. They did not address the fundamental question related to the point-matching procedure: How well are the boundary conditions satisfied between the matching points? Studies have shown that even when it is possible to solve the system of equations without taking extra measures, the high oscillations of the fields between the matching points might degrade the accuracy of the results.

While the problem of high oscillations of the fields between the matching points is shared by all the solution methods that use point matching for testing, this problem may be even more severe in the current-model method. This can be readily understood by interpreting the fictitious current sources