Analysis of electromagnetic scattering by cylinders with edges using a hybrid moment method

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Abstract: The paper presents a method to improve the applicability of the fictitious source-model technique to metallic cylinders with sharp edges. Previous approaches have required that some of the fictitious currents be located in the proximity of the edges, so as to span the rapidly varying field in these regions. While success has been reported, the accuracy of these solutions has often been dependent on a judicious choice of source location. In the paper, the fields in the vicinity of the edges are expanded in terms of analytical solutions of the infinite-wedge problem, while the field beyond these near-edge regions is expanded using fictitious current filaments. The operator equations, for the equivalent problem obtained in this manner, are imposed at the boundary between these regions. As the fields on this boundary are inherently slowly varying, the solution is less sensitive to the location of the fictitious current sources. Moreover, higher accuracy in calculating near-field quantities such as the induced surface current can be attained with a smaller number of expansion functions.

dimensional, electromagnetic wave interaction problems [1–3]. In this method, one uses current sources, whose fields are known analytically for simulating the actual fields in the regions of interest. As in the method of moments, a set of equations is obtained by imposing the required conditions at the physical boundaries of the scatterer. This method has been proved to be efficient for scatterers with smooth surfaces. When sharp edges are involved, a number of sources have to be concentrated in the region of the edge to simulate the singularity in the fields and in the physical surface currents [4]. This inherently generates ill-conditioning and hence potentially unstable results.

A way to overcome the difficulties which are due to the presence of edges is to incorporate into the solution procedure any *a priori* available knowledge about the behaviour of the fields near edges. The enforcement of the edge condition has proved to offer improvement to method-of-moments solutions [5, 6], but has not been pursued in conjunction with the source-model technique. Furthermore, to the best of our knowledge, the idea of incorporating the edge behaviour in the hybrid manner advocated in this paper is also new.

In this paper, the scattering of time-harmonic waves by cylinders with sharp edges is analysed by separating the problem into two parts. In regions far from the