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Computational analysis of scattering by penetrable oblate spheroids using a model of dipoles located in complex space

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Abstract: The recently introduced extension of the current-model technique, which has facilitated a more efficient solution to problems of metallic scatterers whose periphery contains a variety of length-scales features, is applied to analyse scattering by penetrable bodies of similar shape. In the extension of the current-model technique, the coordinates of part of the elemental source centres assume complex values. In this way, the fields radiated by these sources have a beam-shaped pattern and they can better span the field scattered by the smooth parts of the air–body interface. The coordinates of the other source centres retain their conventional real values or have only a relatively small imaginary constituent. The fields radiated by these sources are used to span the field scattered by the rapidly varying parts of the air–body interface. The suggested approach is applied to analyse electromagnetic scattering by a penetrable oblate spheroid. It is found to render the solution computationally more effective at the expense of only a slight increase in its complexity.

approximate boundary field tend to be globally correlated, and an application of the boundary conditions in the simple point-matching sense is sufficient. In the current-model solution presented in Reference 1, the simple sources are Hertzian dipoles located on suitably chosen mathematical surfaces which are displaced from the physical ones, while in the various GMT solutions discussed in Reference 4 these sources are multipoles centred at multiple origins. In some other current-model solutions there have been preferences for other sources. Specifically, in the case of periodic structures, spatially diffused sources with analytically derivable fields have been used [5, 6].

This paper takes a step forward in extending the current-model technique to handle problems of electromagnetic scattering by objects that contain a variety of length-scales ranging from subwavelength to several wavelengths. To solve problems of this kind, one can of course combine the current-model technique with other numerical and asymptotic methods to form a hybrid method which possesses the required flexibility. In such a hybrid method, the effect of the rapidly changing small-scale features can be accounted for by using the current-model technique, while the smoothly varying large-scale features can be analysed by a high-frequency asymptotic