Current-model analysis of electromagnetic scattering from objects containing a variety of length scales

Eitan Erez

Kibbutz Ein Hashofet, 19237, Israel

Yehuda Leviatan

Department of Electrical Engineering, Technion—Israel Institute of Technology, Haifa 32000, Israel

Fictitious-current models have been applied extensively in recent years to a variety of time-harmonic electromagnetic-wave scattering problems. An extension of the current-model technique is introduced that facilitates the solution to problems subsuming scatterers that contain a variety of length scales. This extension is in tune with the current-model technique's philosophy of using simple current sources whose fields are analytically derivable. The approach amounts to letting the coordinates of some of the source centers assume complex values. Positioned in complex space, the simple current sources radiate beam-type fields that are more localized and that are better approximations of the scattering from the smooth expanses of the object. The coordinates of the other source centers retain their conventional real values. These latter current sources are used, of course, to approximate the fields in the vicinity of the more rapidly varying expanses of the object. We use the new approach to analyze electromagnetic scattering by an object comprising two adjacent perfectly conducting spheres of different size. We find that it renders the solution computationally more effective at the expense of only a slight increase in its complexity.