Axial Scattering from Thin Cones

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Abstract

A recent paper [C. E. Baum, "The Physical-Optics Approximation and Early-Time Scattering", Interaction Note 53, October 2000.] considers the physical-optics (PO) approximation for early-time scattering. For axial backscattering examples of perfectly conducting bodies of revolution (BOR), including paraboloids and circular cones, seem to have good PO results as compared to exact and asymptotic results. However, the perfectly conducting angular sector is not approximated at all by PO (giving zero axial backscattering) for the case of the incident electric field parallel to the plane of the angular sector.

It would then seem useful to understand scattering from cones of various cross sections and compare the results to the PO approximation [T. B. A. Senior, private communication]. The general problem with arbitrary interior cone angle has not been solved. However, we know the exact form the solution must take [C. E. Baum, "The Physical-Optics Approximation and Early-Time Scattering', Interaction Note 563, October 2000; C. E. Baum, "Continuous Dilation Symmetry in Electromagnetic Scattering", Ch. 3, pp. 143-183, in C. E. Baum and H. N. Kritikos (eds.), *Electromagnetic Symmetry*, Taylor & Francis, 1995.] which factors the angular dependence from the temporal/frequency dependence. This applies to various types of cone (e.g., dielectric), but our examples here are for perfectly conducting cones.

A model is developed for axial scattering form thin cones of arbitrary cross section based on the electric- and magnetic-polarizability dyadics per unit length. This is later specialized to perfectly conducting cones for axial backscattering. For circular cones it its shown to agree well with exact and physical-optics results. Applying the model to elliptic cones the disagreement with physical-optics results is clear. In the limit this gives the nonzero results for a thin angular sector.

Noting that the present model is appropriate only for thin cones (small ψ), we still need accurate calculation for fat cones (large ψ, but $<\pi/2$) for further comparison to the PO approximation [T. B. A. Senior, private communication.]. In its own right, however, this small-ψ model can now be applied to various thin structures, including ones that are not conical.