 Combined Complex-Source Beam & Spherical-Multipole Analysis for the Electromagnetic Probing of Conical Structures

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Abstract. Multipole analysis and Complex-Source Beams (CSB) are important techniques in field theory. As examples for applications, multipole expansions are in use to solve and compactly characterize scalar, electrodynamic, and elastodynamic fields in the presence of canonical structures while complex-source beams are perfectly suited to elegantly produce beam-like fields. With a combination of both methods it is possible to analytically investigate the scattering and diffraction of a beam-like electromagnetic wave by semi-infinite circular and elliptic cones. Particularly, the elliptic cone which can be described as a coordinate surface in spherico-conal coordinates consists of several interesting special cases including the half-plane, quarter-plane, and a circular cone. The corresponding electromagnetic boundary-value problem can be solved via a dyadic Green’s function which consists of bilinear products of spherical Bessel functions, periodic and non-periodic Lamé functions. With an incident CSB it is possible to probe any geometrical detail of the structure and thus to isolate the corresponding electromagnetic response. The tip and edge diffraction coefficients are also applied to further complete asymptotic high-frequency methods like the Geometrical Theory of Diffraction (GTD).

References