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Scattering of a Uniform Complex-Source Beam by a Finite Plane Angular Sector

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A rigorous analytical solution is derived for the electromagnetic scattering of a uniform complex-source beam (CSB) by an electrically perfectly conducting (PEC) finite sector. Via the Babinet principle this problem is closely related to that of a sector-like aperture in an infinitely extended plane screen. The geometry is sketched in Figure 1.

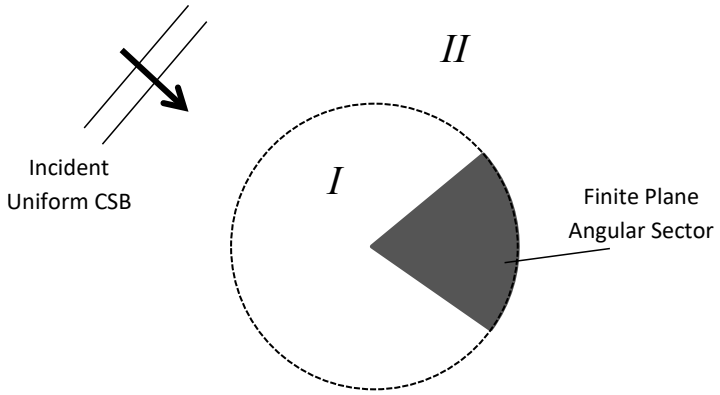

Figure 1. A uniform complex-source beam is illuminating a finite sector.

Following [1] the corresponding electromagnetic boundary-value problem is formulated as a two-domain problem as also seen in Figure 1. Note that the semi-infinite sector is a limiting case of a the semi-infinite elliptic cone and thus belongs to the coordinate surfaces of the sphero-conal coordinate system. Consequently in domain *I* the total electromagnetic field is expressed by using the vector multipole functions in sphero-conal coordinates satisfying the boundary conditions on the sector. In domain *II* the total electromagnetic field is split into a known incident part and an unknown scattered part. Both parts are each expanded by a free-space type multipole expansion in sphero-conal coordinates. The unknown multipole amplitudes are found from the continuity-condition of the tangential electric and magnetic field at the transition from domain *I* to domain *II*.

We will focus on the case that the incident field is a uniform complex-source beam (CSB). Such a beam can be obtained by adding a converging and a diverging CSB with the same location of the waists and the same value for the Rayleigh lengths. In contrast to a standard CSB [2] the uniform CSB is analytic everywhere - particularly also in the waist where the uniform CSB represents a local plane wave.

An analytical solution for this structure with its corners and edges is also of particular interest as a reference for asymptotic and numerical methods.

References

[1] L. Klinkenbusch, "Scattering of an arbitrary plane electromagnetic wave by a finite elliptic cone," *Arch. Elektrotech.*, **76**, pp. 181–193, 1993.

[2] L.B. Felsen,"Complex-source-point solutions of the field equations and their relation to the propagation and scattering of Gaussian beams," in: *Symposia Mathematica, Istituto Nazionale di Alta Matematica.* London, U.K.: Academic, vol. XVIII, pp. 40-56, 1976.