On Methods Employing Auxiliary Sources for 2-D Electromagnetic Scattering by Noncircular Shapes

Nikolaos L. Tsitsas, *Member, IEEE*, Grigorios P. Zouros, *Senior Member, IEEE*, George Fikioris, *Senior Member, IEEE*, and Yehuda Leviatan, *Life Fellow, IEEE*

***Abstract*— Methods employing auxiliary sources are applied to electromagnetic scattering problems by 2-D noncircular scatterers. Specific cases are considered for which the singularities of the analytic continuation of the scattered field into the interior of the scatterer can be analytically determined. Then, it is shown that the amplitudes (currents) of the sources diverge and oscillate when the auxiliary curve does not enclose these singularities. Still, the electric fields computed by means of the divergent and oscillatory currents are convergent and correct. The correctness of the computed fields is validated by comparison with the exact solutions (where possible) as well as with the numerical solutions computed via commercial field simulation software.**

***Index Terms*— Analytic continuation, convergence of numerical methods, method of auxiliary sources (MAS), scattering, singularities.**

the usual requirement is that they enclose all singularities of the analytic continuation of the scattered field in the scatterer's interior [10], [11]. However, explicit determination of these singularities is, in general, a difficult matter.

Within the framework of these methods, it was shown in [12] and [13] that two types of convergence are pertinent. The first refers to the convergence of the AS currents and the second to the convergence of the fields. One of the most important conclusions was that it is possible to have a convergent field generated by divergent currents. This was shown analytically and verified numerically for the case of a perfectly conducting circular cylinder subject to a line-source excitation lying in its exterior. The currents diverge when the auxiliary surface does not enclose the singularities