the presence of a turning point requires a special technique in asymptotic evaluation of reflected ray fields in terms of Airy functions [5], [6]. Therefore, the findings of this work are very significant.

IV. CONCLUSION

In this communication, results on critical gimbal angles of ogival radomes have been presented as a function of fineness ratios and source point locations. These results are significantly different from previously published values. The difference is attributed to the turning point effect which was overlooked by previous radome researchers. Discrepancies for other concave shapes would depend on surface curvature and source location. For a conical radome, there is no turning point, and hence previous results are valid. Numerically efficient methods of determining specular point locations have been addressed. For a given source point, the reflected ray contribution is to be taken into account for look angles beyond \( \theta_s \). Special techniques are required to determine the contribution of specular points near the turning point. This problem has been addressed for a 2D geometry recently [5]. The techniques proposed in this paper can be applied to rotationally symmetric geometries other than ogives. The results presented in this work are useful in radome analysis techniques like ray tracing and Fresnel zone surface integration technique.

REFERENCES


Analysis of TE Scattering from Dielectric Cylinders Using a Multifilament Magnetic Current Model

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Abstract—A moment solution is presented for the problem of transverse electric TE scattering from homogeneous dielectric cylinders. The moment solution uses fictitious filamentary magnetic currents to simulate both the field scattered by the cylinder and the field inside the cylinder and in turn point-matches the continuity conditions for the tangential components of the electric and magnetic fields across the cylinder surface.

The procedure is simple to execute and is general in that cylinders of arbitrary shape and complex permittivity can be handled effectively. Metallic cylinders are treated as reduced cases of the general procedure. Results are given and compared with available analytic solutions, which demonstrate the very good performance of the procedure.

I. INTRODUCTION

The problem of scattering from dielectric cylinders of arbitrary shape has been a subject of considerable interest to the electromagnetic community for many years. Useful reference to a portion of a large body of work with dielectric cylinders is given in our recent paper [1], which has facilitated a solution for transverse magnetic TM scattering by homogeneous dielectric cylinders of arbitrary smooth cross section and complex permittivity via a multifilament electric current model. In the following, we extend the solution developed in [1] to encompass the problem of transverse electric TE scattering.

The suggested approach is to set up two simulated equivalent situations to the original ones inside and outside the dielectric cylinder, respectively, using two sets of filamentary magnetic sources (as opposed to the electric filament used in the TM case) of yet unknown constant complex currents. Specifically, the field scattered by the cylinder is simulated by the field of a set of fictitious magnetic current filament placed inside the cylinder, and the field penetrated by the cylinder surface is simulated by the field of a set of fictitious magnetic current filament placed outside the cylinder. So constructed, the simulated fields inside and outside the cylinder surface are required to obey the continuity condition for the tangential components of the electric and magnetic fields at a selected set of points on the cylinder boundary surface. The result is a matrix equation in which the filamentary constant complex magnetic currents are the unknowns to be determined. The solution of the matrix equation can then be carried out in the computer by inversion or elimination. Once the unknown magnetic currents are found, the analysis of the scattering problem is completed as the fields and field-related parameters in the various regions can be computed straightforwardly without the need to carry numerical integrations.

Notice that instead of using surface integral equations to solve for conventional electric and magnetic surface currents, we solve for fictitious source currents that lie a distance away from the surface of the scatterer. The general formulations and the question of their existence and uniqueness have been discussed in [2]. The formulation in [2] deals exclusively with electric source currents. A replacement of the electric source currents by equivalent magnetic ones is straightforward and has not been explicit there. It is asserted in [2] that although we cannot, in general, guarantee the existence of exact current distributions that will produce the true fields in the respective regions for arbitrary selected sources inside and outside the scatterer, the technique is well-suited for a method of moments numerical solution. The existence of an exact solution is intimately related to the analytic continuability of the scattered fields toward the exterior region and of the internal diffracted field toward the exterior region. Exact solutions, if they exist, are actually equivalent currents. It is needless to say that being numerical, the solution is never exact whether a mathematically admissible solution exists or not. Our objective is thus to match the boundary condition to some desired computational accuracy. Good results can be obtained using an expansion of filamentary currents that lie a distance away from the surface because the fields these currents generate on the surface constitute a basis of smooth field functions. Being smooth field functions, they are suitable for representing smooth quantities on the boundary and are likely to render the final solution accurate, not only