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This paper addresses the problem of electromagnetic scattering by a bounded object located inside a parallel plate waveguide. The exciting field in the waveguide is either an arbitrary source located at a finite distance from the obstacle or a plane wave generated far from the obstacle. In the latter case, the generating field corresponds to the lowest propagating mode (TEM) in the waveguide.

A strong motivation behind this paper is that the parallel plate waveguide shows a more controlled environment for scattering measurements than free space. Initial investigations show that measurements utilizing this geometry are accessible [1].

The analytic treatment of the problem relies on an extension of the null field approach, or T-matrix method, originally developed by Peter Waterman, and later generalized to deal with object close to an interface. The entire solution employs the integral representation of the solution. This integral representation approach to solve scattering problems has proven to be a very powerful and useful technique to solve a large variety of scattering problems, not only electromagnetic, but also acoustic and elastodynamic problems. The present paper generalizes this approach further to deal with obstacles inside a parallel waveguide. This problem shows features that reflect both the two-dimensional geometry, as well as the three-dimensional scattering characteristics.

The present scattering problem is to some extent equivalent to a scattering problem with infinite number of images of the scatterer distributed periodically in space. The image approach is usually solved by the introduction of an appropriate Green's dyadic. The bookkeeping problems associated with such an approach are, however, an inconceivable task, and the solution of the problem asks for a more systematic approach.

The results presented in this paper are inclined towards microwave applications. There are, however, no such limitations in the results. The technique applies equally well to applications at higher frequencies, e.g. THz and IR, such as the computation of the scattering effects of impurities in thin films etc.

A series of numerical simulation illustrates the results of the paper.

References

[1] Gustafsson, M., Vakili, I., Keskin, S.E.B., Sjöberg, D., and Larsson, C., Optical theorem and forward scattering sum rule for periodic structures, *IEEE Transactions on Antennas and Propagation*, **60(**8), 3818-3826, 2012.