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Electromagnetic Scattering by Impenetrable Polygons

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The Generalized Wiener-Hopf technique (GWHT) [1] combined with Fredholm factorization method [2] constitute an effective quasi-analytical spectral method to study electromagnetic diffraction problems by complex structures with edges. One of the peculiarities of the method is the capability to break down the complexity of the diffraction problem allowing the description of the problem in terms WH functional equations derived for different homogeneous canonical sub-regions. The combination of the WH functional equations constitute a comprehensive formulation of the problem that allows spectral interpretation. In order to solve the matrix Generalized Wiener-Hopf equations we resort to Fredholm factorization method that reduces the factorization problem to Fredholm integral equations (FIEs) of second kind.
In this work we consider a diffraction by a polygon with three impenetrable faces [3]. We observe that the GWHEs model is an exact model that take into account the whole physics of the problem without resorting to full local numerical techniques or iterative techniques based on PO/PTD/GTD for the presence of multiple centers of scattering an diffraction. In this work we assume sources constituted of plane waves.

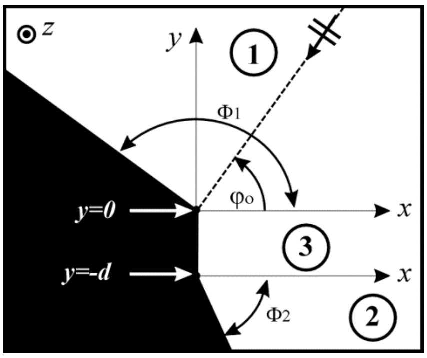

Figure 1. Diffraction by a polygon

The solution procedure is based on the following steps:1) split the complex geometry into homogenous canonical sub-region where WH equation models hold, 2) apply Fredholm factorization, 3) simple discretization of FIEs and reconstruction of the approximate spectra of WH unknowns, 4) asymptotics to get field components.
The WH equation models formulate the wave scattering problem in terms functional equations whose unknowns are Laplace transform of field components. In the present problem we have two kind of sub-region: two angular sub-regions (labelled 1 and 2) and one rectangular sub-region (labelled 3). The functional equations in this case contain spectral components defined at the interfaces of the sub regions and at the boundary of the regions on the impenetrable structure. First we analyze the case with perfect boundary condition (pec and pmc) thus we extend the method to impedance faces.
This problem enlarges the library of canonical scattering problems and its solution has a great impact in propagation community where ray techniques may integrate this structure in the database. The structure complete the case of complex problems constituted by two wedges: separated [4] and connected (the present work).

References

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