Calculation of dyadic kernel of diffraction operator used for open problems modeling

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1 Introduction

An integral method called WCIP (Wave Concept Iterative Process) [1] [2] is used in this work. The principle of this method consists in iterative resolution of internal and external equations based on diffraction operators $\hat{\Gamma}$ and $\hat{S}$ linking two transverse outgoing and incoming waves **A** and **B**. These waves are linearly dependent on the tangential electromagnetic fields **E** and **H**. The $\hat{\Gamma}$ and $\hat{S}$ operators have the major advantage to be bounded and free of singularities. Also, the WCIP algorithm is always convergent [1].
The diffracted wave on the observation point (x,y) can be written as the sum of the excited waves contributions by the source points (x',y') following the relation:

$$\mathbf{B}(x,y) = \sum_{x'} \sum_{y'} \Gamma(x,y,x',y')\mathbf{A}(x',y') \tag{1}$$

The aim of this work is to derive analytically, in the spatial domain, the dyadic kernel $\Gamma(x,y,x',y')$ of the diffraction operator $\hat{\Gamma}$. The derivation procedure starts by the separation between higher and lower modes contributions in the modal expansion of the dyadic kernel . Afterwards, the latter is converted from the modal domain to closed form in the spatial domain thanks to some mathematical tools. In order to handle the diffraction matrix Γ into diagonal form, a forward-to-circular polarization transform is applied on the wave relation(1).

2 Results

- The closed form of the dyadic kernel $\Gamma(x,y,x',y')$ is successfully derived and fully expressed in the spatial domain. Its expression is varying versus $\frac{1}{R^2}$ unlike the classic Green's function which varies versus $\frac{1}{R}$(R is the distance between source and observation points).
- This variation is very useful for the truncation procedure while implementing the WCIP algorithm (due to the sparse behavior of the diffraction matrix Γ).This feature reduces the number of operations needed by the WCIP process as compared to the MoM algorithm.
- Fig. 1 depicts a comparative study between the two methods complexities. It can be seen that, for complex problems requiring an important number of meshing cells (greater than 1000), the WCIP process is drastically faster than the MoM algorithm even for the worst scenario when the iterations number N_{it} equals to 150.
- The proposed formalism has been validated successfully on scattering by complex structures.

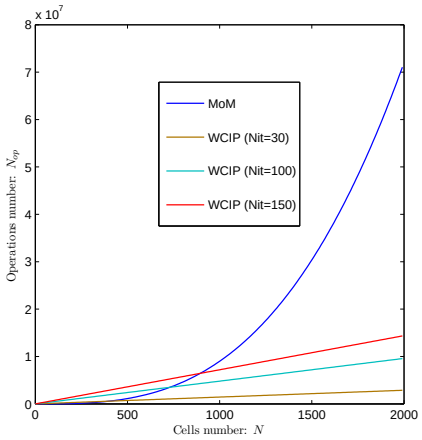

Figure 1: Computational cost for the WCIP and MOM methods versus cells number

References

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