

GAUSSIAN BEAM DIFFRACTION BY A WEDGE WITH THIN MATERIAL COATINGS

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The 2D problem of Gaussian beam diffraction by a wedge with thin material coatings is examined. Thin coatings are simulated by the generalized impedance boundary conditions (GIBCs) of the third order: $(\alpha_j + \beta_j \partial_{r_2}^2) \left(\frac{\partial U}{\partial \varphi} \right) + (\gamma_j + \delta_j) U \Big|_{\varphi = (-1)^j \Phi} = 0$. To ensure the uniqueness of the solution of diffraction problem, the additional constraints, or so-called contact conditions (CCs), should be posed at points of coatings' junction (that is, at the edge of wedge): $\left[A \left(\frac{\partial U}{\partial \varphi} \right) \right]_{-\Phi}^{\Phi} = 0$, $[B \partial_{r_2}^2 U + C \partial_r U]_{-\Phi}^{\Phi} = 0$. In the formulas above $U(r, \varphi)$ is the total solution of diffraction problem (for example, $U = E_z$ for TM-polarized wave), 2Φ is the opening angle of wedge. The material constants $\alpha_j, \beta_j, \gamma_j, \delta_j$ ($j = 1, 2$ enumerates the wedge' faces) and A, B, C may be expressed in terms of dimensionless thickness $(kh)_j$ of coatings and impedances Z_j of coatings' materials.

The incident Gaussian beam is the high frequency asymptotic solution of the Helmholtz equation which is concentrated around the basis ray l_g depending on the source point $M_0(r_0, \varphi_0)$ and the beam' direction ψ (see Fig.1). Such a solution implies the (asymptotic) plane waves' expansion $U_{in}(r, \varphi) = \sqrt{\frac{k}{2\pi}} \int e^{ikr \cos(\chi - \varphi) - ikr_0 \cos(\chi - \varphi_0) - \frac{ka}{2}(\chi - \psi)^2} d\chi [1 + O(k^{-1})]$ (the parameter a defines beam' width), which is the background for our further numerical analysis of the problem. This analysis is based on the explicit solution of plane wave diffraction problem which is obtained recently [1] by means of the Malyuzhinets' technique.

The most impressive results obtained by means of computations outlined above are as follow. The strong contrast of wedge faces' coating causes: 1) significant increasing of backscattered wave field (both for plane wave and Gaussian beam incidence); 2) amplification and angular displacement of diffracted and reflected beams. The example ($\varphi_0 = \psi = \pi/2$) of scattering pattern for strong contrast of coatings ($re(kh_1) = 5, re(kh_2) = 0$) is shown in the Fig.2 in comparison with the perfect wedge diffraction.

Let us recall that these observations are valid for simulation of coatings by third order GIBC. At the same time, the question of validity of such an approximation for strong coating is still open.

References:

- [1] M.A.Lyalinov, and L.G.Vardapetyan *Zapiski Nauch. Seminarov, St.Petersburg Branch Steklov' Math. Inst. RAS*, **218** (1994), pp.72-95.

