JOURNAL OF INTEGRAL EQUATIONS
AND APPLICATIONS
Volume 23, Number 1, Spring 2011

INTEGRAL EQUATIONS FOR CONICAL DIFFRACTION BY COATED GRATING

G. SCHMIDT

Communicated by Giovanni Monegato

ABSTRACT. The paper is devoted to integral formulations for the scattering of plane waves by diffraction gratings under oblique incidence. For the case of coated gratings Maxwell's equations can be reduced to a system of four singular integral equations on the piecewise smooth interfaces between different materials. We study analytic properties of the integral operators for periodic diffraction problems and obtain existence and uniqueness results for solutions of the systems corresponding to electromagnetic fields with locally finite energy.

1. Introduction. In this paper we study an integral equation formulation for the numerical simulation of diffraction by optical gratings under oblique incidence, the so-called conical diffraction. We extend an approach developed in [**14**] for classical TE and TM diffraction problems which turned out to be very efficient for solving diffraction problems in certain scenarios with unfavorably large ratio period over wavelength, profile curves with corners and gratings with thin coated layers. A description of the method together with numerical tests for complicated situations is given in [**16**].

The electromagnetic formulation of conical diffraction by gratings, which are modeled as infinite periodic structures, can be reduced to a system of two Helmholtz equations in $\mathbf{R}^2$ coupled by transmission conditions at the interfaces between different materials of the diffraction grating. Using integral equation methods this transmission problem can be transformed to a system of integral equations over the interfaces. We consider here the case of coated gratings, where the interfaces between different materials are separated (see Figure 1 in Section 4). The integral equations are derived by a combination of direct and indirect methods. Due to the oblique incidence the approach leads

Received by the editors on May 16, 2008, and in revised form on October 6, 2008.
DOI:10.1216/JIE-2011-23-1-71