APPLICATION OF ITERATIVE METHODS FOR PROBLEM OF DIFFRACTION BY PERIODIC STRUCTURES

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Schwarz’s methods and optimal iteration for problem of diffraction by periodic structures are considered. The problem of electromagnetic wave diffraction by a linear waveguide phased antenna array is solved.

The integrated theorems of the diffraction vector theory are applied for electrodynamics problems. Obtained integrated representations for full fields of isolated areas at fixation of observation points lead to the integrated equations. The given equations are solved projection or iterative methods. Projection methods are used most often [1].

The Schwarz’s alternating method has the great value among the iterative approaches used for electrodynamic problems. This method was applied to diffraction problems very seldom. Therefore the decision of diffraction problem by Schwarz’s method is actual.

Let’s consider the general algorithm construction of a diffraction problem by Schwarz’s method. We construct Schwarz’s algorithm in the integrated form and find convergence conditions for waveguide problems. We examine a case, when the complex area (Fig. 1), limited by a surface \( S = S_1 \cup S_2 \), allows splitting into two partial crossed areas with boundary surfaces \( \sigma_1 = S_1 \cup S_{12} \) and \( \sigma_2 = S_2 \cup S_{21} \). We assume, that the problem of field definition in all area can be reduced to search of one scalar function \( U(\vec{r}) \) which satisfies non-uniform Helmholtz equation

\[
\Delta U(\vec{r}) + k^2 U(\vec{r}) = -f(\vec{r})
\]

with zero boundary conditions

\[
U(\vec{r}) = 0, \; \vec{r} \in S = S_1 \cup S_2,
\]

where \( f(\vec{r}) \) is the density of a foreign source. The \( U_1(\vec{r}) \) and \( U_2(\vec{r}) \) values for conditionally isolated areas \( V_1 \) and \( V_2 \) with surfaces \( \sigma_1 \) and \( \sigma_2 \) is connected by the following equations:

\[
U_1(\vec{r}) = U_f(\vec{r}) - \int_{S_{12}} U_2(\vec{r}') \frac{\partial G_1(\vec{r}, \vec{r}')}{\partial n'} dS'_{21},
\]

\[
U_2(\vec{r}) = -\int_{S_{12}} U_1(\vec{r}') \frac{\partial G_2(\vec{r}, \vec{r}')}{\partial n'} dS'_{12} ,
\]

where \( G_1 \) and \( G_2 \) Green’s functions of areas 1 and 2; \( n' \) is an external normal to a surface, and

\[
U_f(\vec{r}) = \int_{V_f} f(\vec{r}) G_1(\vec{r}, \vec{r}') dV'_f.
\]

Consider the decision of equation system (1) by Schwarz’s iterative method. Splitting of a complex range of definition of a field is linked with extraction of the main and zero approximation. Let’s area 1 is the main and area 2 is a small...