Parallel Algorithm of Solving the Electromagnetic Wave Diffraction Problem on the Spherical Screen

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Abstract— The electromagnetic wave diffraction problem on a thin conducting screen can be formulated as a boundary value problem for the Maxwell set of equations with respect to complex-valued amplitudes of field components (by harmonic dependence on time). In the case of screen being a part of spherical surface it is necessary to construct solutions of the Maxwell set inside and outside of sphere satisfying the boundary conditions and the conjunction conditions.

Any solution in the spherical coordinate system can be represented as a sum of solutions of magnetic and electric types. All components of every individual summand can be represented by potential functions. These functions have the form of the series of radial and spherical function products.

Let the coefficients of expansion into a series of the exterior field be given. It is necessary to find the coefficients of expansion of the field interior sphere and exterior sphere (in view of condition at the infinity).

The field conjunction conditions on a sphere represent by themselves the pair summatorial equation relative to unknown coefficients. This equation can be reduced to a regular infinite set of linear algebraic equations by integral-summatorial identities method. Coefficients of this set contain the integrals over screen of the products of spherical functions.

For all stages of numerical algorithm of solving the problem the parallel calculating processes are possible.

At first, if field traces of outside source at the sphere are decomposed onto magnetic and electric parts then magnetic and electric parts of the unknown field can be found independently. Secondly, if coefficients of field conjunction conditions at the sphere do not depend on longitude coordinate then calculations also can be fulfilled independently for every number of the series coefficients. Thirdly, if by reduction of infinite set the finite set of linear equations of large dimension is obtained, then it can be solved by one of parallel algorithm. But the most effect can be obtained just at the stage of calculating of the integrals over screen.