Contribution ID: **306** Type: **Poster presentations**

Numerical solution of diffraction problem on the joint of two open three-layered waveguides

Monday, 10 September 2018 16:00 (1 hour)

This paper describes the algorithm for the numerical solution of the diffraction problem of waveguide modes at the joint point of two open planar waveguides. For the planar structures under consideration, we can formulate a scalar diffraction problem, which is a boundary value problem for the Helmholtz equation with a variable coefficient in two-dimensional space.

The problem on the eigenmodes of an open three-layered waveguide is the Sturm-Liouville problem for a second-order operator with piecewise constant potential on the axis, where the potential is proportional to the refractive index. The described problem is singular and has a mixed spectrum: the discrete part of the spectrum corresponds to the guided waveguide modes, the continuous part of the spectrum to the radiative modes. The presence of a continuous part of the spectrum complicates the numerical solution of the diffraction problem, since the eigenfunctions from the region of the continuous spectrum do not integrate on the axis, and therefore Galerkin's method can not be used in this definition.

One of the ways to adapt the Galerkin method for the problem solution is to limit artificially the area, which is equivalent to placing the open waveguide in question in a hollow closed waveguide whose boundaries are distanced from the real boundaries of the waveguide layer of the open waveguide. As a result of the described approach, we obtain a diffraction problem on a finite interval and with a discrete spectrum, which can be solved by the projection method. The described method is realized in the Maple computer algebra system using CUDA(R) technology to accelerate certain routines.

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Session Classification: Poster Session