INCREASING EFFICIENCY OF USING ARTIFICIAL BOUNDARY CONDITIONS FOR 1D NONLINEAR SCHRÖDINGER EQUATION DESCRIBING LASER PULSE IN PHOTONIC CRYSTAL

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As it well known, the artificial boundary conditions is widely used for computer modelling of various problems (see, for example [1,2]). To increase efficiency of artificial boundary conditions we propose a new method, which consists in the introduction of a number of additional functions related with the equation under consideration (in our case 1D nonlinear Schrödinger equation). These functions describe the propagation of reflected waves from the photonic crystal layers and used for decreasing their influence on solution in photonic crystal. Using proposed method also leads to essential computer simulation time decreasing.

We consider 1D nonlinear Schrödinger equation, describing a femtosecond laser pulse interaction with optical periodic structure (photonic crystal) in following form

$$\varepsilon(z) \frac{\partial A}{\partial t} + iD \frac{\partial^2 A}{\partial z^2} + i\beta(\varepsilon(z) + \gamma(z)|A|^2)A = 0, \quad t > 0, \quad 0 < z < L,$$

(1)

with initial condition

$$A|_{t=0} = e^{-(z-L_c)^2+2\pi\chi(z-L_c)},$$

(2)

which corresponds to wave propagating in a positive direction of z-axis if a parameter $\chi$ is positive and with artificial boundary conditions proposed in [3].

Above, a function $A = A(z,t)$ is a complex amplitude slowly varying in time; $t$ is a time; $z$ denotes a spatial coordinate along which a laser pulse propagates; $L$, $L_c$ are maximal values of time and space coordinate, $L_c$ is a coordinate of the laser beam center at initial time. $D, \beta, \chi$ are real coefficients, which satisfy the conditions $D = \frac{1}{4\pi\chi}, \beta = \pi\chi$.

We have also shown the effect of energy localization in a one-dimensional photonic crystal and the formation of solitons in some layers in case of non-instantaneous medium response.

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REFERENCES

