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NUMERICAL SIMULATION OF NONSTANDARD MODELS OF NONLINEAR OPTICS [1]

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We present and analyze different numerical algorithms for solution of the forward Maxwell equations (FME)

$$(\partial_z + \widehat{\beta} V^{-1} \partial_\tau) F + \frac{4n_2}{3c} \partial_t (F^3) = 0 \tag{1}$$

describing a propagation of laser wave packets. A special emphasis is given for applications to nonlinear fiber-optics. Here $E(z,t) = F(z,\tau)$ defines a polarized wave, $\tau = t - z/V$ is so-called retarded time.

Our main goal is to select appropriate numerical solvers for solution of this problem and to compare the efficiency of different strategies when they are used to solve the FME and the generalized nonlinear Schrödinger equations [1]. We investigate the optimality of the following alternatives:

- the finite difference methods versus pseudo-spectral methods;
- full approximation algorithms versus splitting algorithms;
- parallel MPI and OpenMP implementations [2];
- special nonreflecting boundary conditions.

The main numerical challenge deals with construction of robust and accurate numerical solvers for nonlinear terms of (1), which are describing a nonlinear interaction in FME. Special upwind type monotone and TVD approximations are applied and tested. Results of computational experiments are presented and a dynamics of complicated laser wave interactions is simulated. We note that some nonlinear effects can be resolved only by using the new FME model.

REFERENCES

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