1023-65-528 **Guy Baruch**, School of Mathematical Sciences, Tel Aviv University, Ramat Aviv, 69978 Tel Aviv, Israel, **Gadi Fibich**, School of Mathematical Sciences, Tel Aviv University, Rama Aviv, 69978 Tel Aviv, Israel, and **Semyon Tsynkov*** (tsynkov@math.ncsu.edu), Department of Mathematics, North Carolina State University, Campus Box 8205, Raleigh, NC 27695. *Numerical Solution of the Nonlinear Helmholtz Equation.*

The nonlinear Helmholtz equation models the propagation of electromagnetic waves in Kerr media and describes important phenomena in optics and other areas. We will discuss the main difficulties that it presents for analysis, and introduce a new fourth-order method for its numerical solution. Its key element is a special nonlocal two-way artificial boundary condition, which facilitates reflectionless propagation of the outgoing waves and fully transmits the incoming field at the boundaries of the computational domain. The method enables direct simulation of nonlinear self-focusing in the nonparaxial regime, and gives a quantitative prediction of backscattering. We will show numerical results for various settings, including critical self-focusing and subcritical propagation of solitons.

Recently, we also added finite volume compact schemes for the analysis of material discontinuities, and a Newton-based nonlinear solver. Newton's linearization is nontrivial since the Kerr nonlinearity contains absolute values of the field and is Frechet non-differentiable for complex-valued solutions. Thus, the NLH has to be recast as a system of two real equations, in which case Newton's method converges rapidly and enables computations for very high levels of nonlinearity. (Received September 16, 2006)