ENERGY-PRESERVING TIME INTEGRATION OF NONLINEAR SCHRÖDINGER EQUATIONS

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ABSTRACT

In this talk we consider the numerical treatment of a nonlinear Schrödinger equation which has applications in quantum physics and is used to describe the dynamics of rotating Bose-Einstein condensates. In this context the equation is also known as the Gross-Pitaevskii equation with possible angular momentum. We present energy-preserving time integrators of high order based on a continuous Galerkin ansatz and Gaussian quadrature. We show $L^\infty(L^2)$ and $L^\infty(H^1)$ error estimates when the time integrator is combined with a suitable finite element approximation under mild mesh conditions. Furthermore, we investigate the possibility of using generalized finite element spaces which can lead to an enormous performance boost. Numerical experiments are demonstrated for wave propagating problems in one and two space dimensions.

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