Summary: Fourier spectral method has been widely used to solve Schrödinger equation with constant coefficients. It meets difficulties and loses its efficiency when solving Schrödinger equation with variable coefficients. We show that Fourier collocation method can be applied to efficiently solve Schrödinger equation with variable coefficients. The method is characterized by the expansion of the solution in terms of Fourier series-based functions, while the expansion coefficients are computed so that the equation is satisfied exactly at a set of collocation points. We implement the method to solve the Schrödinger-Poisson (SP) system with perfectly matched layer (PML), which is a Schrödinger-type equation with variable coefficients. We carry out numerical simulation for the SP system by employing splitting method in time and Fourier collocation method in space, respectively. Numerical results show that the Fourier-collocation method coupled with PML technique can absorb well the outgoing waves governed by the Schrödinger equation when the wave goes out of the computational boundary.

MSC:

65N12  Stability and convergence of numerical methods for boundary value problems involving PDEs
65N35  Spectral, collocation and related methods for boundary value problems involving PDEs
65Zxx  Applications to the sciences

Keywords:
Schrödinger-Poisson system; perfectly matched layer; Fourier collocation method; time-splitting method

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