Bernoulli collocation method for solving linear multi-dimensional diusion and wave equations with Dirichlet boundary conditions

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Abstract

In this paper, a numerical approach is proposed for solving multi-dimensional parabolic diusion and hyperbolic wave equations subject to the appropriate initial and boundary conditions. The considered numerical solutions of these equations are considered as linear combinations of the shifted Bernoulli polynomials with unknown coecients. By collocating the main equations together with the initial and boundary conditions at some special points, equations will be transformed into the associated systems of linear algebraic equations which can be solved by robust Krylov subspace iterative methods such as GMRES. Operational matrices of dierentiation are implemented for speeding up the operations. In both of the one-dimensional and two-dimensional diffusion and wave equations, the geometrical distributions of the collocation points are depicted for clarity of presentation. Several numerical examples are provided to show the eciency and spectral (exponential) accuracy of the proposed method.