Hybrid Chebyshev Polynomial Scheme for Solving Elliptic Partial Differential Equations

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We propose hybrid Chebyshev polynomial scheme (HCPS), which couples the Chebyshev polynomial scheme and the method of fundamental solutions into a single matrix system. This hybrid formulation requires solving only one system of equations and opens up the possibilities for solving a large class of partial differential equations. In this work, we consider various boundary value problems and, in particular, the challenging Cauchy-Navier equation. The solution is approximated by the sum of the particular solution and the homogeneous solution. Chebyshev polynomials are used to approximate a particular solution of the given partial differential equation and the method of fundamental solutions is used to approximate the homogeneous solution. Numerical results show that our proposed approach is efficient, accurate, and stable.

Keywords: Chebyshev polynomials, The method of fundamental solutions, Collocation Trefftz method, Radial basis functions, Poisson equation, Cauchy-Navier equation.