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Two Dimensional Wavelets Collocation Scheme for Linear and Nonlinear Volterra Weakly Singular Partial Integro-Differential Equations

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Abstract
In this article, we have study a 2D Legendre and Chebyshev wavelets collocation scheme for solving a class of *linear* and *nonlinear* weakly singular Volterra partial integro-differential equations (PIDEs). The scheme is based on wavelets collocation for PIDEs with uniquely designed matrices over the Hilbert space defined on the domain $([0, 1] \times [0, 1])$. Using piecewise approximation associated with 2D Legendre wavelet, 2D Chebyshev wavelet and its operational matrices, the considered PIDEs will be reduced into the corresponding system of *linear* and *nonlinear* algebraic equations. The corresponding *linear* and *nonlinear* system of equations solved by collocation scheme and well-known *Newton–Raphson* scheme at collocation points respectively. In addition, the convergence and error analysis of the numerical scheme is provided under several mild conditions. The numerical results are correlated with the exact solutions and the execution of the proposed scheme is determined by estimating the maximum absolute errors, l_2-*norm* errors and l_∞-*norm* errors. The numerical result shows that the scheme is simply applicable, efficient, powerful and very precisely at small number of basis function. The main important applications of the proposed wavelets collocation scheme is that it can be applied on *linear* as well as *nonlinear* problems and can be applied on higher order partial differential equations too.

Keywords Partial integro-differential equations · Legendre wavelet · Chebyshev wavelet · Collocation scheme · Operational matrices

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