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A time-efficient variable shape parameter Kansa-radial basis function method for the solution of nonlinear boundary value problems. (English) Zbl 07427448


Summary: In this study we consider the application of a Kansa-radial basis function (RBF) collocation method for solving two- and three-dimensional nonlinear boundary value problems (BVPs) of second and fourth order. In this variable shape parameter approach, a distinct shape parameter is linked with each RBF in the approximation of the solution and the total set of unknowns in the resulting discretized nonlinear problem comprises the RBF coefficients in the approximation and the set of (distinct) shape parameters. The solution of the system of nonlinear equations is achieved using the MATLAB© optimization toolbox functions or \texttt{fsolve} or \texttt{lsqlin}. Unlike previous applications of these routines to nonlinear BVPs, we exploit the option offered in these functions to provide the analytical expression of the Jacobian of the nonlinear systems in question and show, in several numerical applications, how this leads to spectacular savings in computational time.

MSC:
65N35 Spectral, collocation and related methods for boundary value problems involving PDEs
65H10 Numerical computation of solutions to systems of equations

Keywords:
RBFs; Kansa method; collocation; nonlinear PDEs

Full Text: DOI

References:


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http://www.mas.ucy.ac.cy/~andreask/appendix.pdf

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