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Local multiquadric approximation for solving boundary value problems. (English)

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Summary: This paper presents a truly meshless approximation strategy for solving partial differential equations based on the local multiquadric (LMQ) and the local inverse multiquadric (LIMQ) approximations. It is different from the traditional global multiquadric (GMQ) approximation in such a way that it is a pure local procedure. In constructing the approximation function, the only geometrical data needed is the local configuration of nodes fallen within its influence domain.

Besides this distinct characteristic of localization, in the context of meshless-typed approximation strategies, other major advantages of the present strategy include: (i) the existence of the shape functions is guaranteed provided that all the nodal points within an influence domain are distinct; (ii) the constructed shape functions strictly satisfy the Kronecker delta condition; (iii) the approximation is stable and insensitive to the free parameter embedded in the formulation and; (iv) the computational cost is modest and the matrix operations require only inversion of matrices of small size which is equal to the number of nodes inside the influence domain.

Based on the present LMQ and LIMQ approximations, a collocation procedure is developed for solutions of 1D and 2D boundary value problems. Numerical results indicate that the present LMQ and LIMQ approximations are more stable than their global counterparts. In addition, it demonstrates that both approximation strategies are highly efficient and able to yield accurate solutions regardless of the chosen value for the free parameter.

MSC:

65N35	Spectral, collocation and related methods for boundary value problems involving PDEs	Cited in **87** Documents
35J05	Laplace operator, Helmholtz equation (reduced wave equation), Poisson equation	

Keywords:

Local multiquadric approximation; Local inverse multiquadric approximation; Radical base functions; Meshless method; Collocation procedure; stability; Poisson; numerical results

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