MESHFREE MODELING USING P-REFINED RADIAL-BASIS FINITE DIFFERENCES

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ABSTRACT

Radial basis functions-generated finite difference methods (RBF-FDs) have been gaining popularity in the numerical modeling community. In particular, the RBF-FD based on polyharmonic splines (PHS) augmented with multivariate polynomials (PHS+poly) has been found effective. Many practical problems, in numerical analysis, do not require a uniform node-distribution. Instead, they would be better suited if specific areas of domain, where complicated physics needs to be resolved, have a relatively higher node-density compared to the rest of the domain. In this work, we propose an adaptive RBF-FD method with a user-defined order of convergence with respect to the total number of (possibly scattered and non-uniform) data points N. Our algorithm outputs a sparse differentiation matrix with a desired approximation order. Numerical examples are provided to show that the proposed adaptive RBF-FD method yields the expected N-convergence even for highly non-uniform node-distributions. The proposed method also reduces the number of non-zero elements in the linear system without sacrificing accuracy.