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A New Insight into the Differential Quadrature Method in Solving 2-D Elliptic PDEs

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Summary

When the local differential quadrature (LDQ) has been successfully applied to solve two-dimensional problems, the global method of DQ still has a problem by requiring to solve the inversions of ill-posed matrices. Previously, when one uses (n-1)th order polynomial test functions to determine the weighting coefficients with n grid points, the resultant nxn Vandermonde matrix is highly ill-conditioned and its inversion is hard to solve. Now we use (m-1)th order polynomial test functions by n grid points that the size of Vandermonde matrix is mxn, of which m is much less than n. We find that the (m-1)th order polynomial test functions are accurate enough to express the solutions, and the novel method significantly improves the ill-condition of algebraic equations. Such a new DQ as being combined with FTIM (Fictitious Time Integration Method) can solve 2-D elliptic type PDEs successfully. There are some examples tested in this paper and the numerical errors are found to be very small.