Funaro, Daniele

A multidomain spectral approximation of elliptic equations. (English) Zbl 0622.65104

Numer. Methods Partial Differ. Equations 2, 187-205 (1986).

A spectral approximation for the Poisson equation in one and two dimensions (on a square) is studied. The domain is decomposed into two rectangular regions and the equation is collocated at the Legendre nodes in each domain. On the common boundary of the two subdomains, suitable conditions are imposed so that a unique solution is obtained for the resulting linear system. Different values of the discretization parameters are allowed in each rectangle. The stability of the scheme is established and convergence estimates given. The rate of convergence in a single subdomain depends only on the regularity of the exact solution therein. An efficient preconditioning matrix is proposed. Suggestions for further research are added.

Reviewer: W.Ames

MSC:

65N35 Spectral, collocation and related methods for boundary value problems involving PDEs

65F10 Iterative numerical methods for linear systems

35J05 Laplace operator, Helmholtz equation (reduced wave equation), Poisson equation

65F35 Numerical computation of matrix norms, conditioning, scaling

Keywords:

domain decomposition; collocation; spectral approximation; Poisson equation; Legendre nodes; stability; rate of convergence; preconditioning

Full Text: DOI

References:

[1] Babuska, SIAM J. Num. An. 18 (1981)

[2] Patera, J. Comput. Phys. 54 pp 468– (1984)

[3] Orszag, J. Comput. Phys. 37 pp 70– (1980)

[4] and "Multidomain Spectral Technique for Viscous Flow Calculation," Proceedings of the 4th GAMM Conference of Numerical Methods in Fluid Mechanics (Ed.), Vieweg, 1982, 207-219.

[5] Canuto, SIAM J. Num. An. 19 pp 629– (1982)

[6] Canuto, Math. Comput. 38 pp 67– (1982)

[7] Maday, Numer. Math. 37 pp 321– (1981)

[8] Canuto, Calcolo 18 pp 197– (1981)

[9] These de 3e Cycle, Université Pierre et Marie Curie, Paris 1981.

[10] and "Variational Methods in the Theoretical Analysis of Spectral Approximations," Spectral Methods for Partial Differential Equations. , and , Eds., SIAM, Philadelphia 55-78 (1984).