15th International Conference on Domain Decomposition Methods
July 21-25, 2003, Berlin, Germany

Explicit Implicit Non Overlapping Domain Decomposition Method with Splitting up method for Multi Dimensional Parabolic Problem

Daoud S. Daoud

Abstract: The explicit implicit domain decomposition methods are a non iterative types of methods for non overlapping domain decomposition. In comparison with the classical Schwarz algorithm for parabolic problem the former methods are computationally and communicationally more efficient for each time step but due to the use of the explicit step for the interface prediction the methods suffer from the accuracy of the usual explicit scheme. In this article a specific type of splitting up method for the dependent variables is initially considered to solve the two or three dimensional parabolic problem over non overlapped subdomains defined for each spatial variable. This type of splitting up will provide a flexibility to start by any spatial variable to solve over the subdomains, and also a flexibility to choose different mesh spacing for each spatial variable. We also presented the parallel explicit splitting up algorithm to define (predict the interface boundary conditions with respect to each spatial variable and for each nonoverlapping subdomains. The use of the presented explicit scheme will provide an interface boundary conditions to have a square or cubic nonoverlapping subdomains rather than stripes along the specific spatial variable for interface line as in the other techniques. The parallel second order splitting up algorithm is then considered to solve the sub problems defined over each subdomain, the correction step will then be considered for the predicted interface nodal points using the most recent solution values over the subdomains. Finally several model problems are considered to test the efficiency of the presented algorithm.

[1] N. Yanenko, *The method of fractional steps*, Springer-Verlag, Berlin 1971.

[2] G.I. Marchuk, *Method of Numerical mathematics*, Springer-Verlag, Berlin 1975.

[3] Y.A. Kuznetsov, *New algorithms for approximate realization of implicit difference schemes*, Soviert. J. Numer. Anal. Math. Modelling 3(1998), pp.99-114.

[4] C. Dawson, Q. Du, and T. Dupont, *Finite difference domain decomposition algorithm algorithm for numerical solution of heat equation*, Math. Comp., 57 (1991), pp.63-71.

[5] T.P. Mathew, P.L. Ployakov, G. Russo, and J. Wang, *Domain decomposition operator splittings for the solution of parabolic equations*, SIAM J. Sci. Comput., 19 (1998), pp.912-932.

[6] T. Lu, P. Neittaanmaki, and X.-C. Tai, *A parallel splitting up method and its application to Navier Stokes equations*, RAIRO math model and Numerical Anal., 26 (1992), pp.673-708.

[7] T. Lu, P. Neittaanmaki, and X.-C. Tai, *A parallel splitting up method for partial differential equations and its application to Navier Stokes equation*,

[8] W. Hundsdorfer, *Accuracy and stability of splitting with stabilizing correction*, CWI Report MAS - R9935, (1999).

[9] G.I. Marchuk and V.I. Kuzin, *On the combination of finite element and splitting-up methods in the solution of parabolic equations*,J of Com. Physi., 52 (1983), pp.237-272.

[10] M. Dryja, *Substructuring methods for parabolic problems*, Fourth international symposium on domain decomposition methods for partial differential equations, Moscow (1990), pp.264-271. SIAM, Philadelphia, PA, 1991.

[11] R.S. Varga, *Matrix Iterative analysis*, Springer Series in Computational Mathematics, (1991), Springer.

[12] Daoud S. Daoud, A.Q. Khaliq, and B.A. Wade, *A non overlapping implicit predictor- corrector scheme for parabolic equations*, in Proceedings of the international Conference on Parallel and Distributed Processing Techniques and Applications(PDPTA '2000), Vol I, Las Vegas, NV, H.R. Arabnia et al., eds., CSREA Press, 2000, pp 15-19.

Type of contribution: Talk
Location: Room 049, **Time:** Thursday, 24 July, 11:20

Daoud S. Daoud (Speaker)
Eastern Mediterranean University (EMU)
Mathematics
Via Mersin 10
Famagusta
Cyprus
mailto:daoud.daoud@emu.edu.tr