PARALLEL COMPUTING AND DOMAIN DECOMPOSITION

PROJECT AIM

The purpose it to improve efficiency of solution methods in computational fluid dynamics, porous media flow and related applications. The DICCG (deflated preconditioned conjugate gradients) method will be developed further. The method will be generalized such that reliable termination criteria can be applied. Domain subdivision methods will be developed to make DICCG applicable.

PROGRESS

The SEPRAN code is parallelized and works efficiently on parallel platforms. More and more users are simulating with the parallel version. This leads to useful feedback in order to enhance the solver. Theoretically the deflation acceleration is compared with an additive coarse grid correction and a balancing Neumann Neumann preconditioner. It appears that the deflation method leads to the fastest convergence, whereas the work per iteration is less or equal to the other methods. Many (in)compressible Navier-Stokes equation solvers use a splitting method to solve the discretized equation. In many applications, especially in bubbly flows, the pressure equation takes most of the time to be solved. One of the reasons is the jump in the density in gas and water. Multi grid methods can be used but some difficulties remain if the size of the bubbles is very small. In this project the pressure equation is solved by the deflated ICCG method. After optimization it appears that the resulting method is 4-5 times faster than the ICCG method. We plan to make a better choice of the projection vectors and try to combine it with domain decomposition and parallel computing.

PROJECT LEADERS

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RESEARCH THEME

Complex dynamics of fluids

PARTICIPANTS

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COOPERATIONS

TU Eindhoven, Sepra, TNO-Science and Industry, TU Berlin

FUNDED

TUD, TNO-TPD, BRICKS

1st 25% 2nd 25% 3rd 50%

START OF THE PROJECT

1996

INFORMATION

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DISSERTATIONS

1. Tang, J.M. (2008, September 8). Two-Level preconditioned conjugate gradient methods with applications to Bubbly Flow Problems.

SCIENTIFIC PUBLICATIONS

1. S.P. MacLachlan and J.M. Tang and C. Vuik. Fast and Robust Solvers for Pressure Correction in Bubbly Flow Problems. Journal of Computational Physics, 227, pp. 9742-9761, 2008.
2. R. Nabben and C. Vuik. A comparison of abstract versions of deflation, balancing and additive coarse grid correction preconditioners Numer. Linear Algebra Appl., 15, pp. 355-372, 2008.
3. J.M. Tang and C. Vuik. Fast Deflation methods with applications to two-phase flows. International Journal for Multiscale Computational Engineering, 6, pp. 13-24, 2008.
4. J.M. Tang and C. Vuik. Acceleration of preconditioned Krylov solvers for bubbly flow problems. Parallel Processing and Applied Mathematics 7th International Conference, PPAM 2007, Gdansk, Poland, September 9-12, 2007 Editors R. Wyrzykowski and J. Dongarra and K. Karczewski and J. Wasniewski pp. 1323--1332, Lecture Notes in Computer Science , Vol. 4967, Springer, Berlin, 2008.