Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XXIX, págs. 7159-7159 (resumen)
Eduardo Dvorkin, Marcela Goldschmit, Mario Storti (Eds.)
Buenos Aires, Argentina, 15-18 Noviembre 2010

CG+FFT POISSON SOLVER FOR CFD PROBLEMS

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Abstract. Graphic Processing Units (GPU's) have received much attention in last years. Compute-intensive algorithms operating on multidimensional arrays that have nearest neighbor dependency and/or exploit data locality can achieve massive speedups. Simulation of problems modeled by time-dependent Partial Differential Equations (PDE's) by using explicit time-stepping methods on structured grids is an instance of such GPU-friendly algorithms. Solvers for transient incompressible fluid flow cannot be developed in a fully explicit manner due to the incompressibility constraint. Fractional step methods require the solution of a Poisson problem for the pressure field at each time level. This stage is usually the most time-consuming one. This work discuss a Poisson solver for the pressure problem on structured grids and fluid+solid domains. This solver is based on standard Conjugate Gradients (CG) iterations and Fast Fourier Transform (FFT) preconditioning. The implementation targets NVIDIA CUDA architecture and takes advantage of freely available software components like *Thrust*, *Cusp*, and *CUFFT* libraries.