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A FFT PRECONDITIONING TECHNIQUE FOR THE SOLUTION OF INCOMPRESSIBLE FLOW ON GPU'S

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Abstract. Graphic Processing Units 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 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. Segregated algorithms like the fractional step method 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 solver for the pressure problem in applications using immersed boundary techniques in order to account for moving solid bodies. This solver is based on standard Conjugate Gradients iterations and depends on the availability of a fast Poisson solver on the whole domain to define a preconditioner. We provide a theoretical and numerical evidence on the advantages of our approach versus classical techniques based on fixed point iterations such as the Iterated Orthogonal Projection method.