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MULTI-FLUIDS FLOWS SOLVED WITH LARGE TIME-STEPS

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Abstract. A new generation of the Particle Finite Element Method [1] (PFEM) will be developed and applied for solving the incompressible Navier-Stokes equations for heterogeneous fluid flows. In a previous version of PFEM, the authors showed the ability of Lagrangian frames to deal with problems ranging from simple fluids with a single interface to multi-fluid with multiple interfaces [2].

Multi-fluid flows differ from simple fluids in two thinks: the possibility to have evolving discontinuities on the pressure field or the possibility to have evolving discontinuities on the pressure gradients. The first case appears when there are surface tensions at the internal interfaces or there is an internal jump in the viscosity. The second case is typical of problems with internal jumps in the density. The use of evolving discontinuous pressure or pressure gradient fields is fundamental to achieve acceptable results in multi-fluid fluid flows.

In this lecture a new strategy to be used with PFEM will be presented. The new algorithm, named PFEM-2, allows solving the same problems in a very efficient way concerning computer time. In fact, in all the cases tested, the computer times were smaller than for similar problems solved with classical Eulerian frames.

[1] S.R. Idelsohn, E. Oñate, F. Del Pin, The particle finite element method a powerful tool to solve incompressible flows with free-surfaces and breaking waves, International Journal for Numerical Methods in Engineering 61 (2004) 964-89
[2] S.R. Idelsohn, M. Mier-Torrecilla, E. Oñate, Multi-fluid flows with the Particle Finite Element Method, Computer Methods in Applied Mechanics and Engineering 198 (2009) 2750-2767