The Particle Finite Element Method-Second Generation: an overview

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ABSTRACT

The main idea of the Particle Finite Element Method in both versions: with moving mesh or with fixed mesh, are to have a set of particles that move in a Lagrangian frame convecting all the physical and mathematical variables (for instance, the density, the viscosity or the conductivity, but also the velocity, the pressure or/and the temperature). These physical and mathematical values are projected at the end of each time-step on a moving mesh or on a fixed mesh. The second possibility has been named PFEM-Second Generation or simply PFEM-2.

One of the main drawback of the time integrations using Eulerian formulations are the restricted time-step size that is necessary to use due to the lack of accuracy of the convective terms. Both time integrations, explicit or implicit are, in most cases, limited to small CFL numbers. The cases in which the problem to be solved include free-surfaces or moving internal interfaces, like multi-fluids of fluid-structure interactions this time-step limitation is even worse.

The objective of this presentation is to make an overview of recent examples solved using PFEM-2 and to demonstrate why this method based on particles that move in a Lagrangian frame projecting the results on a fixed mesh is faster than a classical Eulerian Finite Element Method. The authors claim that nowadays, the best way to improve the efficiency of the majority of the CFD problems is the use of a particle-based method like PFEM-2.

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