

## **PARTICLE METHODS: THE MOST EFFICIENT WAY TO SOLVE FLUID MECHANICS PROBLEMS**

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In this lecture a new generation of the Particle Finite Element Method (PFEM) will be developed and applied for solving the incompressible Navier-Stokes equations for both, homogeneous and 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 fluid mixtures with multiple interfaces. Now, a new strategy will be introduced, that 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.

This new strategy may be seen as a different way of linearizing the N-S equations that allows large time-steps with an excellent convergence rate. This particular linearization of the non-linear N-S equations exists only if the equations are written in a Lagrangian frame. In fact, in all the examples tested, only one iteration of the non-linear N-S equations was enough to achieve an excellent result. This conclusion opens a new perspective for the Lagrangian formulation of the N-S equations. To our knowledge, nowadays PFEM is the fastest algorithm for solving multi-fluid flows with non-structured meshes.