A particle method for the Navier-Stokes equations

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Abstract

The motion of a viscous incompressible fluid flow in bounded domains with a smooth boundary can be described by the nonlinear Navier-Stokes equations. This description corresponds to the so-called Eulerian approach. We develop a new approximation method for the Navier-Stokes equations in both the stationary and the non-stationary case by a suitable coupling of the Eulerian and the Lagrangian representation of the flow, where the latter is defined by the trajectories of the particles of the fluid. The method leads to a sequence of uniquely determined approximate solutions with a high degree of regularity containing a convergent subsequence with limit function v such that v is a weak solution of the Navier-Stokes equations.

Keywords: Navier-Stokes equations, weak solutions, particle methods

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