

Consideration of Non-Constant Viscosity in the Analysis of the Navier-Stokes Equations

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In this paper, we study the question of asymptotic degrees of freedom in a viscous flow. Particularly, we create a bound on the dimension N of the determining node set $\mathbf{x}_i$ of a fluid with time-dependent viscosity $\nu(t)$. If the fluid velocity is calculated at these N points, the fluid velocity can be determined asymptotically over the entire domain Ω . To support the proof of this bound on N , we are required to develop some new norm inequalities. We also illustrate how the Navier-Stokes equations, the most accepted model for the flow of a viscous fluid, arrive from physical conservation laws and properties of norms and normed spaces. For the construction of the problem, we consider a domain of Ω in $\mathbb{R}^d$, $d = 2$ or $d = 3$, a polyhedral domain which has been exactly tessellated with a quasi-uniform, shape-regular set of simplices. The main novelty of this paper is the creation of a bound on N that considers a non-constant viscosity (ν is replaced by the real-valued function $\nu(t)$).

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