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Homogenization of hydrodynamics problems

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Turbulent regimes are arisen under a small viscosity and are associated with rapidly oscillating fluid dynamics. Moreover, in numerical modeling it is known that rapidly oscillation effects arise under computer simulations of solutions to Navier-Stokes equations with a vanishing viscosity. But reasons of the effects are not clear, since the effects may be turbulent regimes or the numerical simulations may be incorrect. Some theoretical results in the direction will be presented in the report.

Homogenization of nonstationary Navier-Stokes equations with periodic rapidly oscillating initial data and the vanishing viscosity will be discussed. We give homogenized (limit) equations whose solutions determine approximations (asymptotic leading terms) of solutions to the equations under consideration and estimate the accuracy of the approximations. These approximations and estimates shed light on the following interesting property of the solutions of the equations. When the viscosity is not too small, the approximations contain no rapidly oscillating terms, and the equations under consideration asymptotically smooth the rapid oscillations of the data; thus, the equations are asymptotically parabolic. If the viscosity is very small, the approximations can contain rapidly oscillating terms with zero means, and the equations are hyperbolic.

Asymptotic and homogenizing methods are used for the consideration according to [1]. The results are applicable to some Kolmogorov flows.

[1] G. V. Sandrakov *Izvestiya: Math.* **71**, (2007), p. 97.