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"Simulation of particle-laden turbulent flow"

Prof. dr. Hans Kuerten
Computational Multiphase Flow Group Multiphase and Reactive Flows
Department of Mechanical Engineering
Eindhoven University of Technology
and
Computational Multiscale Methods
Faculty EEMCS
University of Twente
The Netherlands

Abstract
In many applications in industry and in nature, particle or droplet transport in turbulent flow plays a role. Examples are combustion of fuel particles (biomass or metal) and cloud formation. In our group we study methods and models for accurate simulations of particle- and droplet-laden turbulent flow.
For particle-laden homogeneous isotropic turbulence it is usually assumed that particle collisions are not important if the particle volume fraction is less than 10^{-3}. In inhomogeneous turbulent flow much higher particle volume fractions can occur locally due to turbophoresis and particle clustering. We investigated the effects of particle collisions for this flow and studied the particle collision rate in order to enable stochastic collision modeling.
For particles larger than the smallest scale of turbulence, point-particle methods are inaccurate due to the use of correlations for the drag force which only hold if particles are sufficiently small.
A way to improve these correlations is by particle-resolved DNS. We used this method in turbulent flow in a channel with an array of particles to determine optimal values for the coefficients in a correlation for the drag force. The use of this optimal correlation in point-particle DNS results in better agreement with the results for the particle-resolved simulation.