Forces on particles, droplets and bubbles

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For numerical simulations using macro-scale approaches, such as the Euler/Euler and the Euler/Lagrange method, coefficients are needed for the relevant forces acting on the particles, since the particle Reynolds number is mostly larger than unity so that theoretical results do not help. Moreover, the forces and their formulations are different for solid particles and bubbles. Small droplet may be mostly considered as "rigid" droplets.

Starting from the well-known BBO equation all the included forces are summarized with extensions to higher Re_p. This includes slip effects (Brownian motion) on the drag force as well as added mass and Basset force. Then forces like thermophoresis, and Brownian diffusion are introduced which are especially important for very fine particles.

Under special conditions also lateral lift forces are very important such as slip-shear and slip rotation lift. For all the introduced forces best-practice guidelines are provided under which conditions they have to be considered.

Finally the state-of-the-art with respect to forces relevant for mobile and fluid bubbles is presented.

An estimate under which conditions forces like pressure, added mass and Basset force are important will be also presented.

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