Comments on Disperse Phase Interaction

In the last section the relation between the force interaction term, $\mathcal{F}_{Dk}$, and the force, F_k, acting on an individual particle of the disperse phase was established. In sections (Ne) we include extensive discussions of the forces acting on a single particle moving in a infinite fluid. Various forms of the fluid force, F_k, acting *on* the particle are presented (for example, equations (Neg18), (Neg20), (Neg21), (Neh17), (Neh21), (Nff2)) in terms of (a) the particle velocity, $V_k = u_{Dk}$, (b) the fluid velocity $U_k = u_{Ck}$ that would have existed at the center of the particle in the latter's absence and (c) the relative velocity $W_k = V_k - U_k$.

Downstream of some disturbance that creates a relative velocity, W_k, the drag will tend to reduce that difference. It is useful to characterize the rate of equalization of the particle (mass, m_p, and radius, R) and fluid velocities by defining a velocity *relaxation* time, t_u. For example, it is common in dealing with gas flows laden with small droplets or particles to assume that the equation of motion can be approximated by just two terms, namely the particle inertia and a Stokes drag, which for a spherical particle is $6\pi\mu_C R W_k$ (see section (Nec)). It follows that the relative velocity decays exponentially with a time constant, t_u, given by

$$t_u = m_p / 6\pi R \mu_C \tag{Nbg1}$$

This is known as the velocity relaxation time. A more complete treatment that includes other parametric cases and other fluid mechanical effects is contained in sections (Nei) and (Nej).

There are many issues with the equation of motion for the disperse phase that have yet to be addressed. Many of these are delayed until section (Nd) and others are addressed later in the book, for example in sections (Nef), (Nek) and (Nel).