Particle Equation of Motion (BBO-Equation)

The general equation of motion of a small spherical particle suspended in fluid is given as

$$
\begin{aligned}
m_p \frac{dv_i}{dt} = \; & m_f \frac{Du_i}{Dt} - \frac{1}{2} m_f \frac{d}{dt}\left(v_i - u_i - \frac{1}{10} a^2 \nabla^2 u_i\right) \\
& - 6\pi\mu a\left[(v_i - u_i) - \frac{1}{6} a^2 \nabla^2 u_i\right] + (m_p - m_f) g_i(t) \\
& - 6\pi\mu a^2 \int_0^t \frac{\frac{d}{d\tau}[v_i(\tau) - u_i(\tau)]d\tau}{\sqrt{\nu(t-\tau)}} + L_i + F_i
\end{aligned}
\qquad (1)
$$

where $m_p = (\frac{4\pi}{3}) a^3 \rho_p$, $m_F = (\frac{4\pi}{3}) a^3 \rho_f$, a is the radius of the spherical particle, v_i is the particle velocity, $u_i[\underline{y}(t),t]$ is the fluid velocity at the particle location, μ is the viscosity, ν is the kinematic viscosity, ρ_p is the particle density, ρ_f is the fluid density, $g_i(t)$ is the acceleration of gravity and $\underline{y}(t)$ is the location of the particle. Saffman's (1965, 1968) lift force L_i and the acoustical force F_i are added to Equation (1) for completeness