Subgrid-Scale Modeling of Added Mass for Filtered Eulerian-Eulerian Modeling of Fluidized Beds through Data-Driven Framework

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Case	ρ_g [kg m^{-3}]	ρ_s [kg m^{-3}]	$\mu_g \times 10^{-5}$ [Pa s]	d_p [µm]	u_t [m s^{-1}]	Re$_p$ [-]	St_p [-]
SG1	1.3	1600	2.89	145	0.48	3.12	213
SG2	2.28	1600	2.5	145	0.48	6.30	246
SG3	1.3	1500	1.84	210	1.00	14.77	950

Table 1: Flow configurations spanning a range of particle Reynolds and Stokes numbers used to assess the performance of the predictive framework developed in this work.

(i) the particle Reynolds number,

$$\mathrm{Re}_p = \frac{\rho_g d_p u_t}{\mu_g}, \tag{1}$$

(ii) the inverse scaled filter size,

$$(\Delta^*)^{-1} = \left(\frac{\Delta_f}{\mathrm{Fr}_p^{1/3} d_p} \right)^{-1}, \tag{2}$$

with the particle Froude number, $\mathrm{Fr}_p = \dfrac{u_t^2}{d_p ||\mathbf{g}||}$,

(iii) the scaled particle volume fraction,

$$\phi^* = \frac{\bar{\phi}_s}{\phi_{s,max}}, \tag{3}$$

(iv) the vertical component of the scaled gas pressure gradient,

$$\nabla p^*|_z = \frac{\nabla \bar{p}|_z}{\rho_s ||\mathbf{g}||}, \tag{4}$$

(v) the vertical component of the scaled slip velocity,

$$u^*_{slip,z} = \frac{\tilde{u}_{slip,z}}{u_t}, \tag{5}$$

and the vertical component of the scaled drift flux,

$$Y = \frac{\phi^* \tilde{v}_{d,z}}{u_t}, \tag{6}$$

as the output.