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# Reform of the drift-flux model of multiphase flow in pipes, wellbores, and reactor vessels

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## Abstract

To aid the understanding of multiphase flows and development of associated computational simulations, we reappraise the drift-flux model to improve accuracy and physical understanding. New insights are supported by careful re-derivation, literature review, and empirical verification. We directly calculate  $C_0$  and  $C_1$  using simultaneous measurements of instantaneous gas fraction and gas-liquid velocities, all obtained from a microscopic measurement volume ( $\sim 1 \text{ mm}^3$ ) inside a macroscopic gas-liquid pipe flow ( $\sim 5000 \text{ cm}^3$ ). A reformulated drift-flux plot is created for this macroscopic flow by using  $\bullet$ -beam densitometry and total flow measurements. The microscopic and macroscopic data both confirm that significant error exists in common methods and assumptions regarding the drift-flux model, namely that the drift-flux parameters  $C_0$  and  $C_1$  are assumed to remain invariant with respect to changes of flow. Our reformulated drift-flux model finds greatly different values of  $C_0$  and  $C_1$  from those predicted by the standard drift flux model, and finds values of  $C_0$  and  $C_1$  to undergo a regime transition due to the bubble dynamics in the multiphase flow, wherein at low gas flow the bubbles seldom interact, as if they are at infinite dilution, while above a critical gas flow the hydrodynamics change due to bubbles interacting significantly with each other. These insights are uncovered only by reformulation of the nominal practices of the drift-flux model.

**Topical Heading:** Transport Phenomena and Fluid Mechanics

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