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Creations of a turbulent puff in a pipe flow with dilute microbubbles KOTARO NAKAMURA, YUJI TASAKA, YUICHI MURAI, Laboratory for Flow Control, Division of Energy and Environmental Systems, Hokkaido University — We examined mutual interactions between a puff and microbubbles in a horizontal pipe flow at Re=1900. Forty trials to investigate flow status were performed at different perturbation amplitudes controlled to create puffs for both of single-phase and flows with dilute microbubbles. The maximum volume fraction of the bubbles is 0.018%. The results indicated that adding microbubbles enhances puff creation, which means intensification of flow transition. It contradicts with the previous experimental findings that milky bubbly liquid provides delay of the flow transition. This difference may be due to local volume fraction; tiny amount of microbubbles accumulate in vortical structures of a puff, and the accumulated bubbles enhances the vortices. To estimate the accumulation numerically, bubble motion in a puff is calculated by Euler-Lagrange simulations. Force balance equation considering buoyancy, pressure gradient, added-mass, drag, and lift is solved by a one-way simulation, which is coupled with velocity fields of a puff obtained by DNS. Estimating the radial pair distribution function and the force balances in a puff, we indicated that microbubbles accumulate in a puff and the pressure gradient originated from the vortical structures is larger than the lift.

Kotaro Nakamura
Lab. for Flow Control, Div. of Energy and Env. Sys., Hokkaido Univ.

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