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**Similarity between particles and bubbles as micro-additives in turbulent channel flow**[1] YOICHI MITO, Kitami Institute of Technology — The acceleration of turbulent fluid flow in a vertical channel by the use of a uniform distribution of microparticles and of microbubbles has been examined by using a direct numerical simulation to calculate the fluid velocities seen by the additives. The flows considered are the downward gas flow to which solid particles of density ratio of $10^3$ are added and the upward liquid flow to which bubbles of density ratio of $10^{-3}$ are added. Both additives, ranging in volume fraction up to $2 \times 10^{-3}$, are represented as solid spheres. The Froude numbers are chosen so as to have similar effects in both flows by the use of the same volume fraction of the additives. The fluid-phase momentum balance, integrated over the domain, is used to examine the changes in drag, wall friction and averaged feedback force of the non-stationary flow models. The feedback force per volume fraction is unchanged in the bubble flow. It decreases with increasing volume fraction and inertia of particles in the particle flow. Similarities between the two disperse flows are seen at small times for small volume fractions. Drag is reduced by both additives. The amount of reduced drag decreases with time at large times in the bubble flow, due to the increases in the accumulation of bubbles above walls.

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