

Abstract Submitted  
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**Dual-plane stereoscopic PIV measurements of turbulence statistics in drag-reducing pipe flows with surfactant additive** YOSHITSUGU NAKA, SHUHEI NUKA, MASAYASU SHIMURA, NAOYA FUKUSHIMA, MAMORU TANAHASHI, TOSHIO MIYAUCHI, Tokyo Institute of Technology — Drag-reducing turbulent pipe flows with surfactant additive are investigated by dual-plane stereoscopic PIV (DPSPIV). The DPSPIV system gives two parallel planes of three component velocity with a good spatial resolution. Measurements are undertaken in a fully developed pipe flow for 21 different conditions, i.e., the combinations of 3 concentrations of the surfactant additive and 7 Reynolds numbers. Two stereo PIV planes are settled at  $50D$  downstream from the pipe inlet and are arranged perpendicular to the mean flow with a small spacing in the streamwise direction. Within the present  $Re$  range, the drag-reduction ratio takes its maximum value 63% at  $Re_D=56\ 000$ . Noticeable differences between drag-reducing and water flows are observed on their statistics. The peaks of the rms values of the velocity fluctuations are shifted away from the wall since the thicknesses of the viscous sub-layer and the buffer region increase compared to the water flow case. In the shear stress profile, the Reynolds shear stress is much reduced in the near wall region, and the viscous shear stress contributes more. Velocity gradient characteristics such as profiles of vorticity components and the balance of the transport equation of the turbulent kinetic energy are also described.

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