PIV-LIF techniques for multiphase flows diagnostics. Recent results of Institute of Thermophysics

Dmitriy M. Markovich

Institute of Thermophysics, Siberian Branch of RAS,
1 Lavrentyev ave., Novosibirsk, 630090, Russia.

Abstract.
The present work describes recent experimental studies of two-phase gas-liquid flows performed in Institute of Thermophysics via non-intrusive optical techniques, namely, PIV and LIF.
A turbulent bubbly free jet flow was studied in details by means of PIV for fluorescent tracers and Planar LIF for bubbles imaging. The application of PIV allowed to estimate the spatial distributions of the mean velocity of the liquid and second- and third-order moments of liquid velocity fluctuations in the central plane of the jet. A great influence of bubbles (depending on volumetric gas content) on turbulent structure of the jet was observed near the nozzle exit. The use of PLIF approach for bubbles imaging in the vicinity of the laser sheet and application of a correlation approach for bubble identification and PTV for their velocity estimation, respectively, allowed to obtain the planar distributions the average void fraction, bubbles' mean velocity and the second-order moments of gas-phase velocity pulsations. In particular, a strong correlation of bubble-liquid velocity fluctuations was revealed that indicated that stochastic motions of bubbles were mainly caused by turbulence in the liquid phase.
The work also describes the recent results on LIF application for film thickness measurements in gravitational and gas-sheared liquid film flows. In particular, shape of solitary 3D waves on gravity-driven films and its interactions with stationary waves was investigated.
The LIF technique was also successfully applied for investigation of wavy structure of annular gas-liquid flow in regimes with and without liquid entrainment. It was shown that the wavy structure is quite similar in both cases, providing grounds to develop essentially new models of entrainment phenomenon and transition to entrainment.