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Development of optical and ultrasound methods for the multiphase flows investigation and numerical calculations verification in biotechnological process

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Motivation and Aim: Experimental studies and numerical calculations verification in multiphase flows, including biotechnological processes, is very actual [1]. Both the of optical non disturbance methods development and probe methods development are very important. Institute of optoelectronic information technologies together with the Institute of Thermophysics actively lead the development of such methods for multiphase flows. The aim of this work was to develop methods of laser Doppler anemometry, fiber-optic method for gas fraction diagnosing and ultrasonic methods, as well as probe endoscopic methods for flow investigation in industrial technologies, including biotechnologies.
Methods and Algorithms: The first method is the method of laser Doppler anemometry, which makes it possible to measure velocity fields in two-phase flows. The method measure the frequency of the Doppler shift from tracer particles passing through the measurement volume. The method capabilities allows measurement of three components of the velocity vector with an error not exceeding 0.5 %. The second method is a fiber optic method for local gas fraction measurement. The method allows to register the light reflected from the gaseous medium via the optical fiber. The third method is based on the ultrasonic measurement of the Doppler shift from inhomogeneities in a two-phase flow. The error of the latest two methods does not exceed 10 %.
Results: The results of the methods application for kinematic flow parameters measurement and gas fraction in various process applications are shown. Both the possibilities of remote application of the methods and the implementation in the probe version are shown. The methods application results made it possible to obtain new fundamental mechanisms and to create new experimental databases for numerical calculations verification.
Conclusion: A fundamental scientifically base of new information diagnostic systems for industrial technologies has been created. The results of the work have been implemented at the largest enterprises in the machine-building, nuclear, oil and hydropower industries.
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