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Gamma-tomography of the gas fraction distribution inside an axial pump delivering two-phase mixture

Abstract

In the paper a novel non-intrusive tomographic method is presented to visualise the gas fraction distribution inside the rotating impeller of an axial pump delivering a two-phase flow. The device has been developed for an axial pump (inducer), which has an impeller with three helical blades rotating at 1500 rpm. Model fluid is air–water mixture created by a gas distributor upstream the pump inlet nozzle. The developed gamma-tomography set-up consists of a Cs-137 source and an arc of 64 scintillation detectors. Each of the detectors is connected to a number of counters grouped into banks. Each bank is active only during a 100 s long interval of the rotation period, which corresponds to a well-defined angular interval of the impeller rotation. A trigger pulse, generated at the beginning of each revolution, forces the control unit to restart the counting process from the first bank. In this way, the device is able to measure ensemble averaged projections of the gamma absorption density distribution, which are resolved according to the rotating angle of the impeller. An image reconstruction by filtered back-projection provides density distributions inside the impeller. Void fraction distributions are visualised by means of differential tomography, i.e. by subtracting sets of projec tions obtained for two-phase operation and for plain liquid.

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