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Tomographic Methods for Multiphase Flow Measurement

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Measurement of multiphase flow of gas, oil and water is not at all trivial and in spite of considerable achievements over the past two decades, important challenges remain. These are related to reducing measurement uncertainties arising from variations in the flow regime and the fluid properties, improving long term stability and developing new means for calibration, adjustment and verification of the multiphase flow meters.

Tomographic imaging is a powerful tool to unravel the dynamics of the gas liquid distribution in multiphase pipe flow and is regularly applied to provide reference data in the development of multiphase flow meters and for experimental validation and development of flow models. A high-speed γ-ray tomograph developed at the University of Bergen has been developed for this purpose. The image capture rate in the example shown is 100 frames/second, however, the system is capable of identifying the gas-liquid distribution at rates up to 1000 frames/second.

The high-speed imaging systems are designed for use in laboratories and at test facilities and are not suitable for in situ or permanent installations. For this purpose simpler systems with fewer projections are applied. These are referred to as tomographic measurements, tomometry or agile.

An example of a γ-ray system using one source and multiple beams, will be presented. This concept can be applied as a stand-alone meter or to provide accurate measurements of the gas volume fraction for a multiphase flow meter. The pipe flow is split into temporal segments of which the gas volume fraction is measured. One ^{241}Am source with principal emission at 59.5 keV is used because this relatively low energy enables efficient collimation and thereby shaping of the beams, as well as compact detectors. One detector is placed diametrically opposite the source whereas the second and eventually the third are positioned to the sides so that these beams are close to the pipe wall. The principle is then straight forward to compare the measured intensities of these detectors and through that identify the instantaneous cross sectional gas-liquid distribution, i.e., the instantaneous flow pattern. By counting the intensity in short time slots (< 100 ms), rapid variations are revealed.

In conclusion the sensitivity to temporal flow regime variations multiple beams are considerably reduced by this multiple beam principle and is now implemented in commercial meters.

Country/Organization invited to participate

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