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Abstract

Objective:
Reliable flow rate measurement is critical for production optimization and reservoir management. Most watercut and three phase metering technologies cannot provide adequate accuracy over the full range of multiphase flow rates. Many require frequent calibration and have high capital and operational cost (CAPEX and OPEX). Some may perform well at the surface but are not suitable for permanent downhole deployment. This work describes the theory, design and field trial results of a new flow meter based on ultrasound tomography. This new technology has the potential to overcome many limitations of existing metering solutions.

Methods and Procedures:
A new meter has been developed which measures multiphase flow fractions using an array of ultrasound transmitters and receivers positioned around the circumference of the pipe. This technique provides a direct way of interrogating the physical properties of oil, water and gas with minimal calibration requirements. The meter takes an array of acoustic measurements across the flow cross section and generates a speed of sound map of the flow using a technique very similar to a computed tomography (CT) scan. This can be used to identify the various phase fractions and, combined with a total flow measurement, creates a full multiphase flowmeter capability.

Results and Conclusions:
A series of tests have been performed in both horizontal and vertical oil-water flows ranging in water cut from 0 to 100%. Field trials of the first generation system have been conducted in Saudi Aramco fields. In each testing campaign, results from ultrasound tomographic flow meter were compared with other commercial systems and a test separator. The lab and field results suggest that the technology can provide reliable watercut measurement with the additional capability of ultrasound flow imaging. The flow visualization capability can provide valuable information about flow regime for production and reservoir engineers.