

# **Ultrasonic measurement and characterization of liquid-particle flow**

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Research in petroleum sector focuses on continuous development and adaptation of ultrasonic technology to fit the industry's need. One of the challenges is to use the potential of ultrasounds for substantial improvement of knowledge about liquid-particle flows, including slurry systems. The objective of this PhD research project is to approach this challenge by development of experimental methods to measure simultaneously particle concentration and flow speed and subsequently, to characterize liquid-particle flow for control of flow dynamics parameters, especially when a transient situation occurs. There are several approaches to be considered in the project, including analysis of acoustic backscattered signal from suspended particles, analysis of acoustic energy attenuation and sound frequencies. Correlation techniques combined with acoustic techniques will be studied for determination of velocity profile. Other acoustic techniques like ultrasonic imaging may be used, in case it will turn out to be vital for the system description. The experiments will be compared with numerical simulations (FEA software), laser-based techniques (PIV) and high speed video. The study will include both newtonian and non-newtonian fluid systems.

The application in mind is control of production flow parameters, such as monitoring of sand production and other deposits in pipelines, flow regime characterization and detection and characterization of particle fractions. The results and learned knowledge will be beneficial also for research and other industrial applications.

The project is financed by Total E&P Norge and will be carried out at University of Stavanger in cooperation with Production Technology Research in Total E&P Norge.