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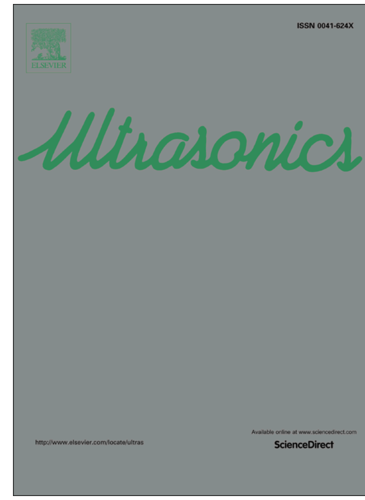


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# Non-contact Method for Analysis of Cavitating Flows

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**Abstract**

This paper presents a novel non-contact method for simultaneous analysis of pressure and velocity conditions in cavitating flows. The method (implemented in our software *ADMflow*) is based on high-speed camera flow visualization and was evaluated in an experiment with ultrasonically induced acoustic cavitation of different intensities. Attached cavitation with clearly visible cavitation structures occurred on the tip of an ultrasonic probe immersed in distilled water. Using the high-speed imaging data, pressure fluctuations were calculated by a computer-aided algorithm based on the Brennen's theory of cavitation cloud kinematics and a modified version of the Rayleigh-Plesset equation. Reference measurements of pressure pulsations were conducted by a hydrophone installed at the bottom of the liquid container. The analysis of cavitation structure dynamics was complemented by calculation of velocity fields from the imaging data, the algorithm for which is based on the advection-diffusion equation. Calculated pressure fluctuations were analyzed in the spatial, temporal and spectral domain. Presented results indicate a strong correlation between the fields of velocity and pressure fluctuations during the growth and collapse of cavitation structures. A comparison of time series and power spectra demonstrates that our cavitation analysis method is in a reasonably good agreement with results of the reference measurement methods and can therefore be used for non-contact analysis of pressure and velocity conditions in cavitating flows.

**Keywords**: Acoustic cavitation, sonotrode, pressure measurement, hydrophone, computer-aided visualization, image velocimetry

# 1 Introduction

Cavitation is a highly complex flow phenomenon in which various vapor structures are formed at low-pressure regions of the liquid, then collapsing violently, causing locally very high values of pressure and velocity, and often resulting in erosion on exposed surfaces [1]. Cavitation can be induced hydrodynamically (i.e. due to the kinetic energy of the flow) or ultrasonically (e.g. on an oscillating ultrasonic probe). Accurate measurements of flow variables such as pressure and velocity are crucial in experimental studies, which remain important in research of complex cavitation phenomena despite the rapid development of numerical cavitation modeling methods. However, due to the harsh operating conditions and the multiphase flow nature, the selection of flow analysis methods is limited. The methods most commonly used for this purpose include local measurements of pressure (e.g. by hydrophones) and temperature, as well as optical (flow visualization-based) which are becoming increasingly popular with the rapid development of high-speed imaging