**Velocity reduction of pressure wave propagation through bubble arrays**

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**Abstract**

Pressure waves are capable of being transmitted through optically opaque objects, which have been widely used in biomedical imaging, industrial sensing, and particle manipulation. The transmission speed of the waves in different fluids has always been a hot topic.

In this work, we proposed a new algorithm to measure the pressure field in the pattern with bubble arrays by observing the diameters of bubbles. The algorithm can be divided into three parts. Firstly, use the PTV algorithm to identify and track each bubble. Lagrangian PTV solutions such as four-frame PTV with dynamic threshold identification can be used here to determine the corresponding relationship of bubbles in different images over a series of times. Then, according to the variation of each bubble diameter, calculate the pressure inside each bubble with an integrated Rayleigh–Plesset equation. Lastly, apply an averaging algorithm with Delaunay Triangle for the neighbor relationship determination.

For the experiment setup, we used laser pulses to generate stationary bubbles in fixed positions in gelatin. The bubbles were pressure sensors for the newly-proposed algorithm. A large cavitation bubble is generated later as the source of the pressure wave. The images of bubble arrays were recorded by a high-frequency CMOS. The results show that the bubble arrays decreased the velocity of low-frequency components of the pressure wave. Furthermore, the larger diameters of the bubbles, the more significant effect of the velocity reduction. Additionally, we utilized both Direct Numerical Simulation and simulation by solving Keller-Miksis model to study the wave propagation. The experimental results are in good agreement with the simulations.