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Vortex structures and heat transfer in acoustic streaming flows IN MEI SOU, JOHN ALLEN, CHRISTOPHER LAYMAN, CHITTARANJAN RAY, University of Hawaii at Manoa — The velocity and heating in an acoustically induced streaming flow are investigated using simultaneous particle image velocimetry (PIV) and infrared thermography. This study is motivated by the increasing applications of ultrasound-based processing of substances in various fields such as wastewater treatment and biotechnology. The characterization of the acoustic streaming field is an important step in the overall design for sonochemical reactors used in these treatment processes. Results of the coherent structures and heating are obtained from an experimental study of acoustic streaming in a clear acrylic tank. The PIV resolved velocity fields show a jet-like flow along the centerline of the horn and a main vortex pair propagating in the direction of the flow. The coherent vortex structures are examined in terms of the swirling strength and Lagrangian coherent structures (LCS). The swirling strength is used to visualize the vortices in the Eulerian reference frame while the LCS approach is used to reveal the underlying flow structures for the unsteady case. The swirling strength is defined as the imaginary part of the complex eigenvalue of the local velocity gradient tensor. The LCS is defined as the local maxima of the finite-time Lyapunov exponent (FTLE). We present the evolution of the temperature fields together with the corresponding swirling strength and the LCS calculations.

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