Acoustic Streaming of a Sharp Edge

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Abstract

Anomalous acoustic streaming is observed from sharp edges of vibrating solid bodies in fluids. The streaming velocities can be orders of magnitude higher than expected from the Rayleigh streaming at similar amplitudes of vibrations. Acoustic velocity of a fluid relative to a solid body diverges at a sharp edge giving rise to a localized time-independent body force acting on the fluid. The force results in a formation of a localized jet produced by the sharp edge. Perturbation theory together with COMSOL Multiphysics® equation based modeling is used to calculate and understand this unique mechanism of acoustic streaming. The theory agrees with experimental results and with a direct time resolved CFD analysis. The origin of the presented streaming can be interpreted to be due to a centrifugal force of the acoustic fluid flow around a sharp edge.