A Novel Technique to Simulate Two Dimensional Vortex Flow by the Acoustic Excitation of a Flat Bubble Film

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Two Dimensional vortex flow models are extremely valuable to researchers, as they can be used to predict the formation and evolution of naturally occurring vortices such as Jupiter's Great Red Spot (GRS) and Earth's hurricanes. As a result, it is essential for a setup to properly reproduce and analyze pure two dimensional vortex flow before simulating three dimensional vortices. Currently, thermal convection is used to excite a semi-spherical soap bubble film to simulate two dimensional vortices. However, the setup is complex, and the system is susceptible to producing inconsistent results. The goal of this investigation was to create a more consistent and easily replicable approach to two dimensional vortex modelling. In this setup, a flat soap bubble film was suspended over a box, with a speaker as the excitation source. The speaker's excitation frequency was controlled by a signal generator. At multiple frequencies between 2 and 150 Hz, the vortices that formed on the film (more specifically, doublets) were photographed with a digital camera. The pictures were then analyzed using optical flow code in Matlab. Results showed that the setup was easily controllable by the speaker's excitation frequency, and over a range of frequencies, the system produced results that accurately simulated doublet flow. Furthermore, this setup was far simpler to create than the ones that are currently used, as it contained no moving parts. Thus, by controlling the excitation frequency of the speaker and leaving the setup undisturbed for the duration of the experiment, researchers can utilize and develop this new technique to further the understanding and create better computer models of vortex flow.