J Appl Mech Eng 2018, Volume 7
DOI: 10.4172/2168-9873-C1-018

Experimental and numerical study on the unsteady flow characteristics of supersonic fluidic oscillator

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Supersonic fluidic oscillator is attracting strong attentions as a more efficient method to control the boundary-layer development and flow separation. However, most previous studies have been focused on the incompressible low-speed flow regimes, and not many studies have been published regarding the highly compressible flows. In the present study, an experimental study has been performed to observe the detailed flow mechanism inside a supersonic fluidic oscillator. High-speed and time-resolved pressure measurements (Kulite, XCQ-062, refer Fig. 1) and synchronized high-speed Schlieren flow visualization are utilized for various nozzle pressures in supersonic regimes. CFD analysis has also been carried out, and the results are compared with the experimental data to draw more accurate flow physics of the oscillator. Observation of the internal fluid dynamics of the oscillator has revealed that the characteristics of the sweeping jet at the oscillator exit is directly related to the evolution mechanism of the separation bubble inside mixing chamber, and that they are very sensitive to a small variation in the internal shape of the oscillator. The discussion is also complemented by the time-resolved CFD examinations applied for various internal features of the oscillator. More details on the unsteady flow characteristics and the correlations for a better design of the supersonic oscillator will be presented.

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