Experimental analysis of the shear layer instabilities in supersonic impinging jets using double PIV technique

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ABSTRACT

Supersonic impinging jets have diverse practical applications like VTOL aircraft exhaust jet noise, ground erosion during rocket launch and surface finish in cold gas spray additive manufacturing processes. The turbulent flow dynamics in this configuration is marked by the presence of an aero-acoustic feedback loop, generating strong resonance tones. An important feature driving the phenomenon is the shear layer instabilities leading to the propagation and growth of vortical structures. Experimental investigation of flow instabilities in supersonic jets using LASER diagnostics can be highly challenging due to the practical limitation of acquiring a time resolved data with large ensembles. An alternate approach using double PIV measurements has been presented in the current study which involves large ensembles of data acquisition by two parallel PIV systems, offset by a very small time-step. The resulting data is not time resolved but gives additional information of the instantaneous time derivatives of velocity field. Using analysis techniques like the dynamic mode decomposition (DMD), valuable information about the dynamics of the shear layer can be obtained. The study focusses on the optical setup and the experimental parameters for such measurements.