



SPOD for multi-pulse measurements applied to 3D MP-STB particle tracking data of a high-speed jet in air

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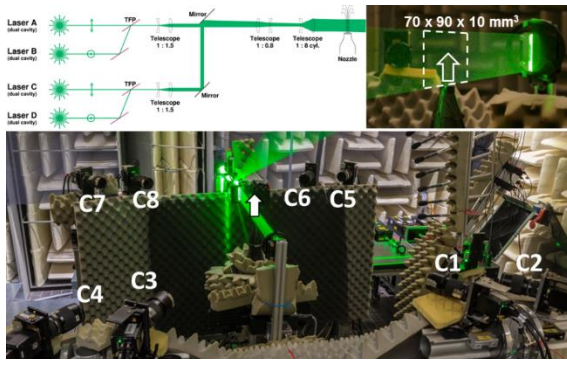


Fig. 1 Experimental setup implementing four-pulse STB using a polarization strategy. Jet data up to Mach 0.84, Diameter Reynolds number 3.1×10^5 is available for round and chevron nozzle types at up to three separate measurement volumes along the jet axis reaching up to 13 diameters from the nozzle [4].

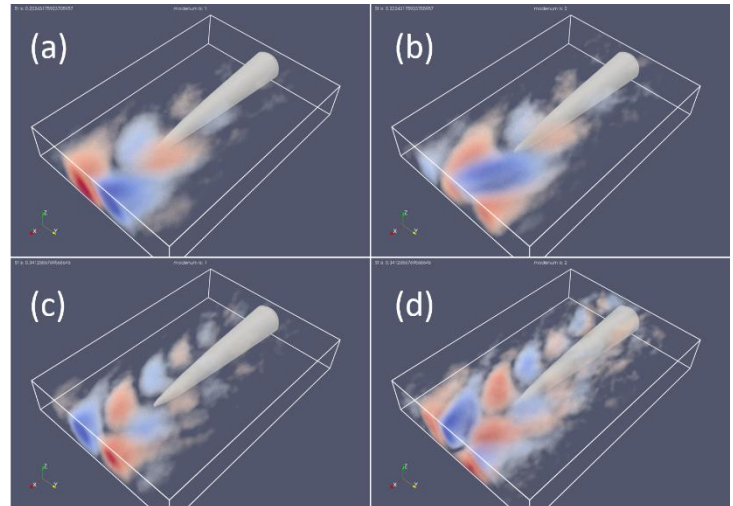


Fig. 2 Axial velocity SPOD modes of the jet near the end of the potential core (grey cone) obtained using the proposed method. First and second mode visualized for St 0.22 (a-b) and St 0.34 (c-d)

Spectral Proper Orthogonal Decomposition (SPOD)[1] can be an important tool in the analysis of the dynamics of fluid flows. However, the computation of SPOD modes generally requires time resolved measurement data which is not always available. Such non-resolved data is used for the computation of flow statistics or spatial modes on stationary flows but generally not available for temporal analysis. In this submission we will present a novel approach to compute modes in such situations for the specific case of multi-pulse Shake-The-Box (MP-STB)[2] measurements. Our approach relies on the fact that a brief amount of temporal dynamics is captured along the short four-pulse tracks obtained via this method. By sampling the tracks at two time-instances we can obtain snapshot pairs separated by a short interval which are sufficient for the computation of DMD modes [3]. We then utilize this in our approach for the computation of SPOD modes by exploiting the similarity between DMD and Fourier modes together with a frequency binning approach. We validate this on synthetic data and then apply the approach to a 3D MP-STB measurement of a subsonic jet in air (fig. 1). The resulting modes (fig. 2) are discussed and compared for different jet nozzle configurations.

References

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