Abstract Submitted
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Lagrangian Analysis of Intermittent Sound Sources in a Flow-through Square Duct Containing Two Circular Orifice Plates[1] VINEETH NAIR, C.P. PREMCHAND, Indian Institute of Technology Bombay, Mumbai - 400076, K.V. REEJA, P.R. MIDHUN, MANIKANDAN RAGHUNATHAN, RAMAN I. SUJITH, Indian Institute of Technology Madras, Chennai - 600036 — Tonal sound production in pipe flow through orifices is a manifestation of self-sustained pressure oscillations that occur when positive feedback is established between an acoustic mode of the pipe and vortex shedding. These oscillations, which can be established in segmented solid rocket motors, gas-transport pipelines, and automobile exhaust systems are undesirable as they result in structural damage due to fatigue failure. The onset of such oscillations (instability) in turbulent flows for changes in operating conditions from stable operation happens via an intermittent regime comprising bursts of pressure oscillations that are governed by slow (hydrodynamic) and fast (acoustic) time scales. In this study, we focus on the establishment of self-sustained oscillations in the flow through a square pipe containing two circular orifice plates by varying the mass flow rate through the pipe. We extract the coherent structures responsible for sound production at the acoustic time scale from measured time-resolved velocity fields using dynamic mode decomposition (DMD) and the framework of Lagrangian Coherent Structures (LCS). We find that there are noticeable similarities in the sound-producing coherent structures obtained during the bursting stage of intermittency and instability.

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