ID de Contribution: **50** Type: **Présentation orale**

Reduced order modeling and control of a fluidic pinball wake: An experimental investigation

lundi 23 juin 2025 12:20 (20 minutes)

Over the past decade, fluidic pinball has emerged as a valuable benchmark for studying flow control strategies (Deng(2020)). The cylinder rotation rates serve as the control inputs and the velocity sensors in the wake provide the outputs. Despite its geometric simplicity, the wake behind the fluidic pinball exhibits complex interactions of multiple frequencies and nonlinear dynamics, making it an excellent test case for the development and evaluation of control laws.

While numerous numerical studies have been performed at low Reynolds numbers, experimental literature is limited, mainly due to the associated engineering challenges. This study presents the findings from low-speed wind tunnel experiments conducted on the fluidic pinball in the turbulent regime ($1000 \leq Re \leq 3000$). Planar two-component particle image velocimetry (PIV) captures the velocity field, while hot-wire anemometry provides high-resolution velocity time traces in the wake. Complete characterization of the coherent structures and their dynamics in the wake is proposed for both the stationary pinball and the flow with open-loop control.

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Classification de Session: Présentations