Experimental investigation of a spray swirled flame in gas turbine model combustor

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HIGHLIGHTS

- An innovative injection system developed by TURBOMECA, designed to meet future pollutant emission standards have been investigated in a gas turbine model combustor. The burner operates with liquid kerosene under atmospheric pressure to meet more industrial operating conditions.
- Mean flow field is measured in front view and top view using respectively PIV (5 kHz) and stereo PIV (5Hz). Typical aerodynamic of enclosed swirl flame is found.
- Simultaneous PIV and planar laser induced fluorescence of OH (OH-PLIF) is performed on the burner at multi-kHz repetition rates in a complex reactive two-phase flow with high velocities.
- Mechanism of local extinction of the flame by vortices is highlighted with the temporal analysis of instantaneous measurement sequence

ABSTRACT

Dynamical processes in gas turbine combustors play a key role in flame stabilization. Those phenomena are investigated in a gas turbine model combustor for a partially premixed kerosene/air flame at atmospheric pressure (Fig. 1). The large optical accesses of the combustion chamber enable the application of laser diagnostics. Stereo-PIV, Planar laser induced fluorescence (PLIF) of OH at 10 kHz and simultaneous particle image velocimetry (PIV) at 5 kHz have been implemented. The flow field is characterized by PIV in front view and by stereo-PIV in a horizontal plane while the flame structure is visualized by OH-PLIF. Simultaneous OH-PLIF/PIV measurements are used to investigate the interactions between the flow field and the flame (Fig. 2, left). POD and image processing tools are developed to analyze images (Fig. 2, right). Temporal analysis of the results demonstrates the development of a local flame extinction mechanism.

Fig. 1: kerosene/air gas turbine model combustor

Fig. 2: (Left) Simultaneous PIV/OH-PLIF measurement, (Right) associated POD reconstruction colored by vorticity