APPLICATION OF HIGH-REPETITION PIV TO FORCED FLAMES IN A MODEL COMBUSTOR

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The present work is devoted to the experimental study of isothermal and reacting turbulent flows in an atmospheric model combustor. The combustor represented a quartz-glass cylinder (with inner diameter D_0 = 74 mm) mounted on a flat base in which a contraction nozzle was installed. The nozzle exit diameter was d = 15 mm. Propane-air and methane-air flames at Reynolds number $Re_{air} = 4\ 100$ and stoichiometric ratio $\Phi = 1$ were studied by means of high-repetition Particle Image Velocimetry. The system operated in a double-frame mode with the frequency 770 Hz. A periodical forcing with the Strouhal number St = 0.6 (170 Hz) was applied to the inlet velocity in order to promote generation of ring-like vortices.

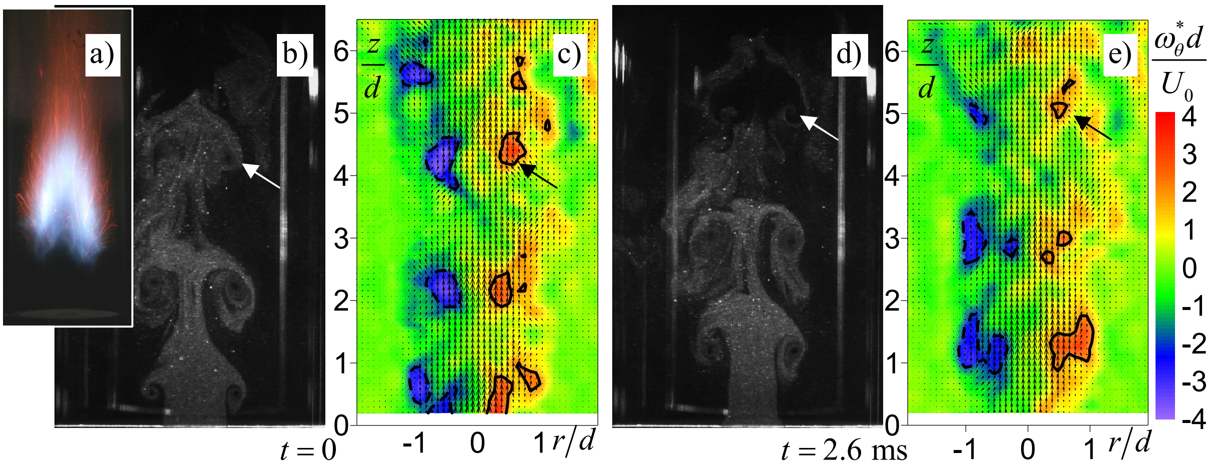

Figure (a) Direct image of a forced propane-air flame ($Re_{air} = 4\ 100$; $\Phi = 1$; $U_0 = 4.7$ m/s; forcing at St = 0.6 and $a_f/U_0 = 20\%$ amplitude); (b, d) PIV images and (c, e) instantaneous velocity and vorticity fields in the axial plane of combustor.

The photograph in Figure (a) shows the combustion regime of the forced propane-air flame. Depicted in the figure examples of PIV images and the corresponding velocity and vorticity fields (normalized by the mean flow rate velocity $U_0 = 4.7$ m/s) demonstrate interaction of the vortex ring (indicated by arrow) with the lifted flame. It can be seen that concentration of tracers (the flow was seeded by 1 μm titanium oxide particles) decreases inside the vortex as the fluid expands after chemical reaction. The poster presentation will describe details of the experimental setup, apparatus and data processing. The poster will present a set of results for the cases unforced and forced propane-air and methane-air flames: the instantaneous and average velocity fields, spatial distributions of the turbulent kinetic energy components.

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