VOLUMETRIC MEASUREMENTS OF A TURBULENT SWIRLING FLOW

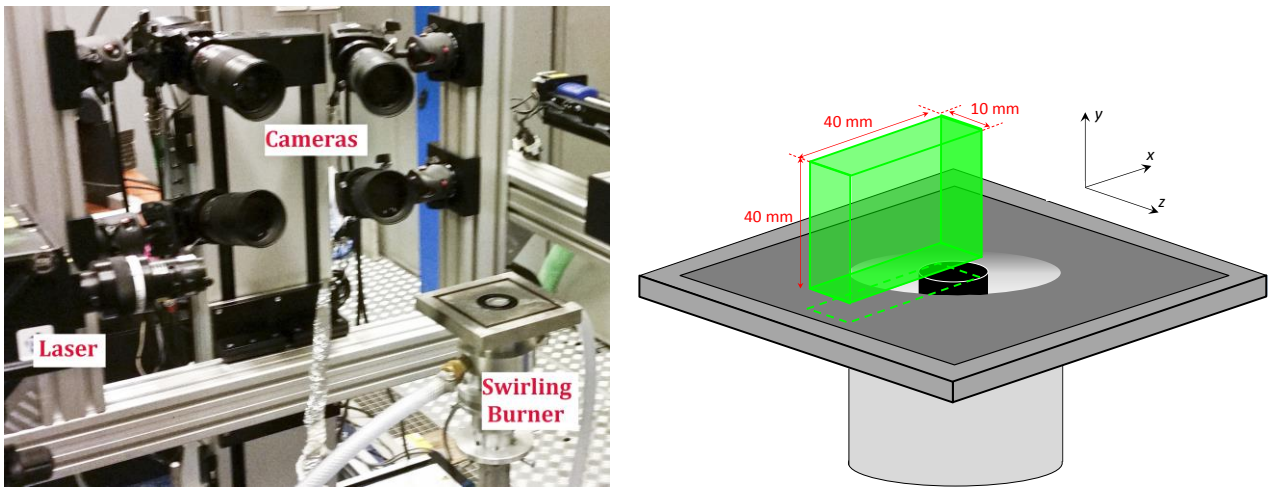
APPLICATION NOTE V3V-FLEX-002 (A4)

The Turbulent Swirling Flow

Swirl flows are used in combustion application to enhance mixing and improve flame stabilization in a variety of practical situations. Strongly swirling reacting flow contributes to stabilize the flames and improve the turbulent mixing. The helical fluid flow creates a recirculation zone, allowing dilution with combustion products, and the decrease of the flame temperature limiting the NOx production. This application note describes a volumetric study of the flow out of the burner.

Experimental Setup

Measurements were conducted at the University College of London, Faculty of Mechanical Engineering using V3V-Flex system. The isothermal case was considered with air flow seeded with solid dry expanded microspheres of 20 µm of diameter and a density of 70 kg/m^3. The particles were suspended using a fluidized bed chamber. Four 8MP cameras fitted with Scheimpflug mounts were mounted in front of the burner aimed toward the output region of the burner. The measurement region was illuminated with a dual-head Nd:YAG laser operating at 2 Hz, with nominally 200 mJ per pulse. The size of the measurement volume is 40 × 40 × 10 mm^3 and is located at the top of the burner as shown below:

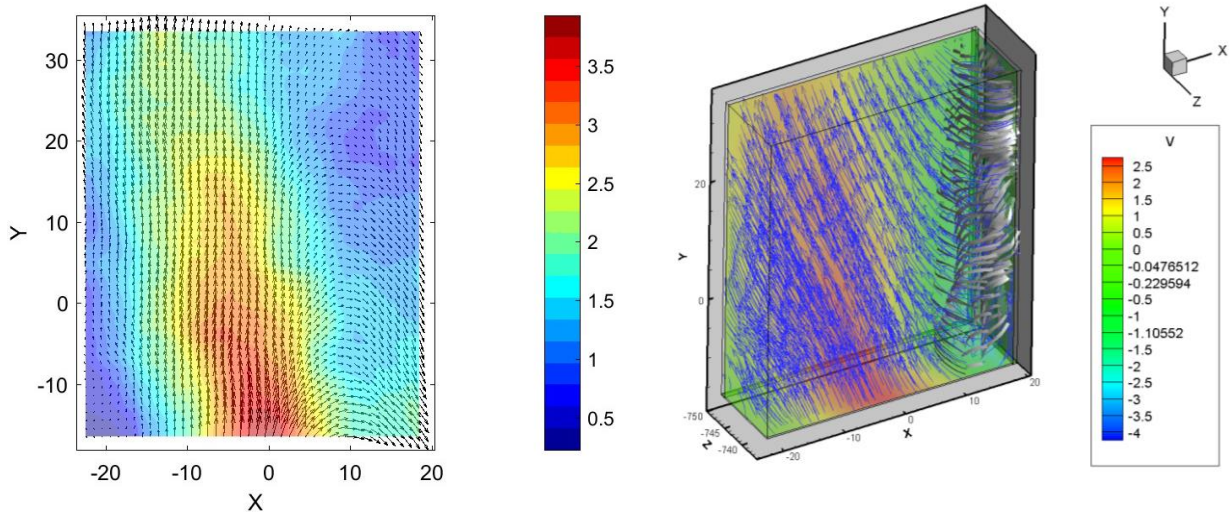


(a) **(b)**

Figure 1 : Experimental setup
a) Cameras and laser arrangement; b) Position and dimensions of the measurement volume

Results

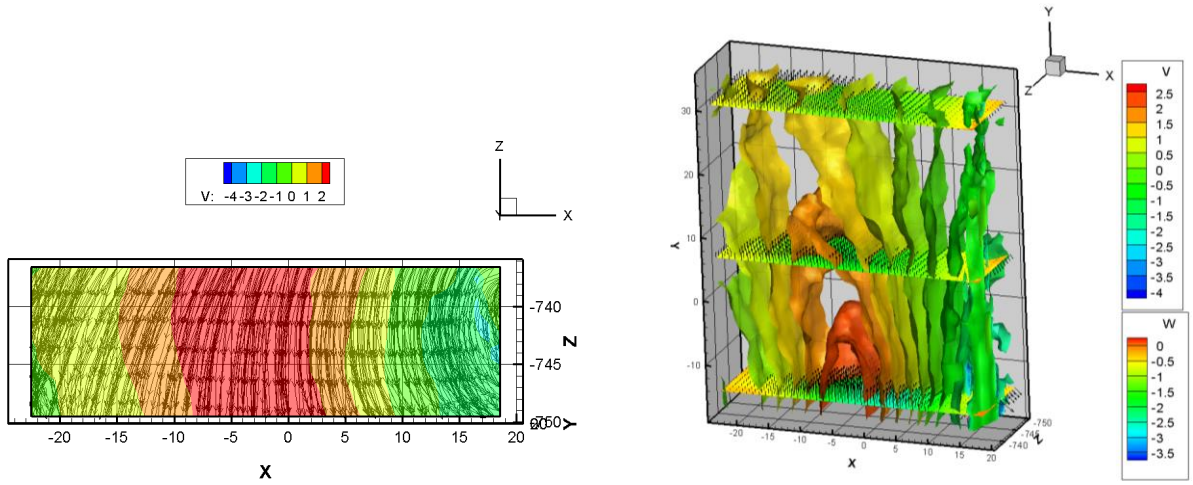
The average velocity magnitude field is shown in Fig 2a. The maximum of the velocity is measured at the annular region of the burner and is found equal to 3.93 m/s. A recirculation region is detected toward the center of the burner as shown by the ribbon streamlines in Fig2b.



(a) **(b)**

Figure 2: Mean velocity field

The top view of the measurement volume, shown in Fig3a, confirmed the helical fluid flow. According to Fig3b the main contributors to the flow are the streamwise velocity component V and the tangential W velocity component as shown in Fig3b.



(a) **(b)**

Figure 3: Detailed flow description: a) Top view of the measurement volume (streamlines superposed to the contours of the vertical velocity component V); b) Iso-surfaces of the vertical velocity component V superposed to the slices of contours of the streamwise velocity component W.