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Portfolio

Azimuthal Flow Patterns Produced by Annular Swirling Jets

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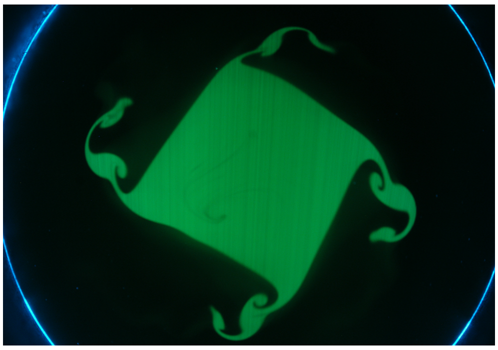
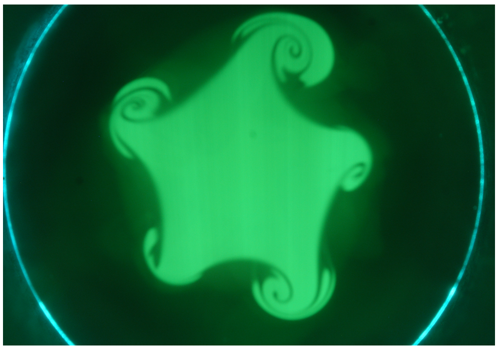
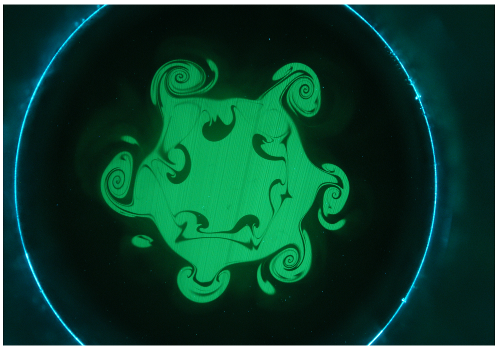


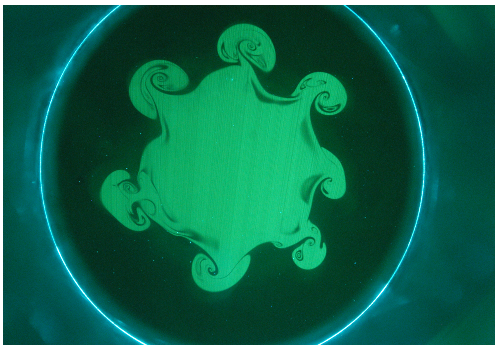
***m* = 4**, $\xi = 2.5$, $x/D_i = 4$, $S = 0.6$ and $Re = 2460$.



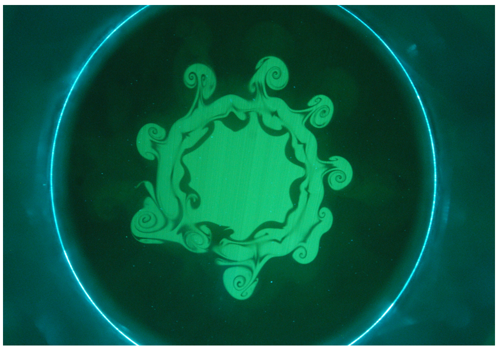
***m* = 5**, $\xi = 3.75$, $x/D_i = 4$, $S = 0.2$ and $Re = 3000$.



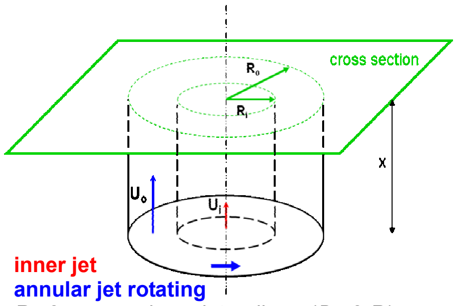
***m* = 6**, $\xi = 4.3$, $x/D_i = 3$, $S = 0.38$ and $Re = 2460$.



***m* = 7**, $\xi = 6.8$, $x/D_i = 3$, $S = 0.36$ and $Re = 3600$.



***m* = 8**, $\xi = 8.18$, $x/D_i = 2$, $S = 0.36$ and $Re = 4000$.



R_i=2 cm : inner jet radius (D_i=2 R_i)
R_o=5 cm : annular jet radius
U_o axial velocity of annular jet
U_i axial velocity of inner jet
x axial position

Visualizations of azimuthal flow patterns of annular swirling jets by laser tomography at cross-sections of different axial positions x/D_i are shown here. There are two cylindrical coaxial jets where only the annular jet is rotating. This configuration commonly occurs in industrial burners. Slight modifications of the flow parameters ($\xi = \dfrac{\overline{U_i}}{\overline{U_o}}$, $S = \max\left(\dfrac{U_\theta(r)}{U_x(r)}\right)$ and $\mathrm{Re} = \dfrac{U_x D_i}{\nu}$ with U_x the axial mean velocity and D_i the inner jet diameter) give different vortex modes m $\in$ {4, 5, 6, 7, 8}.

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Effect of a Neighboring Sonic Jet on the Shock Structure of a Sonic Jet

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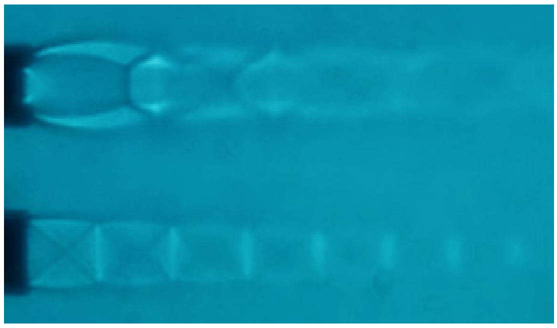
(a) Top nozzle NPR 0, bottom nozzle NPR 3

(b) Top nozzle NPR 1.89, bottom nozzle NPR 3

(c) Top nozzle NPR 3, bottom nozzle NPR 3

(d) Top nozzle NPR 4, bottom nozzle NPR 3

(e) Top nozzle NPR 5, bottom nozzle NPR 3



(f) Top nozzle NPR 6, bottom nozzle NPR 3

The shadowgraph pictures show the changes in the shock-cell structure of a sonic jet of a fixed nozzle pressure ratio (NPR) due to a near by sonic jet at different NPR. Two identical axi-symmteric convergent nozzles of exit diameter (D) 10 mm, placed with centre-to-centre distance of 2.4D, were used in the experiments. The nozzles were connected to individual stagnation chambers so as to maintain different NPR for each nozzle. The NPR of the bottom nozzle was kept constant at 3. The top nozzle NPR was varied from 0 to 6.

The bottom jet shock-cells are influenced for top jet NPR 1.89, 3, and 4. For the top jet NPR 5 and 6 the bottom jet shock-cells are almost identical to the no flow condition in top nozzle. There is almost no change in the first 3 shock-cells for all the combinations tested. The maximum influence is observed for top jet NPR 3. The change in the shock-cells in the bottom jet is due to interaction of acoustic fields which depends on the expansion level of the jet, resulting in the modification of the acoustic feedback loop.

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Visualizing Wifi Using the Wifi Camera

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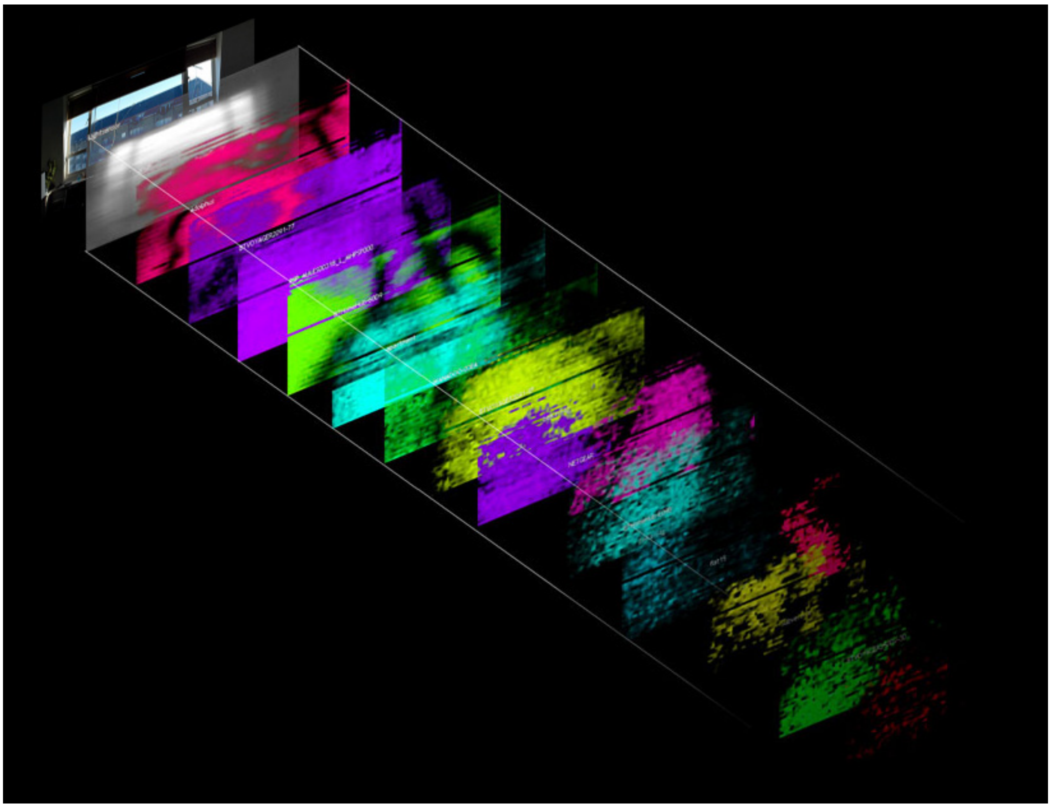

Fig. 1. Image of fifteen Wifi networks (each allocated an arbitrary colour) permeating a domestic living room.

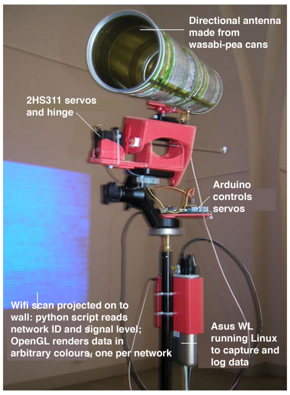

Fig. 2. Equipment.

Fig. 3. View of two Wifi networks coming through a window (arbitrary colours).

These images were created using a “Wifi Camera” custom designed by Somlai-Fischer, Sjölén and Haque (information available at <http://wificamera.propositions.org.uk/>). It makes a use of a directional 2.4GHz wifi antenna mounted on servos scanning an environment at varying resolutions, measuring signal strength of all present networks to generate an image of the wifi “view” of the space. A light sensor is mounted on the antenna in order to generate a visible-light image that confirms precise orientation.

Portfolio

Visualization of Nonpremixed Hydrogen Jet Flame in a Vitiated Coflow by DNS(1)

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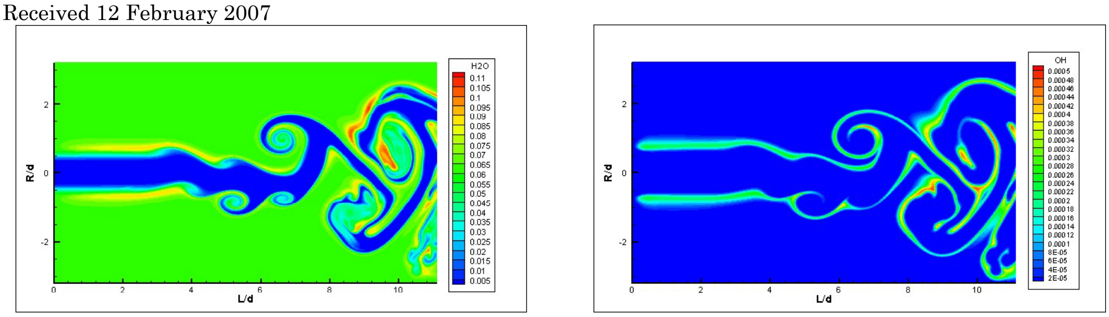
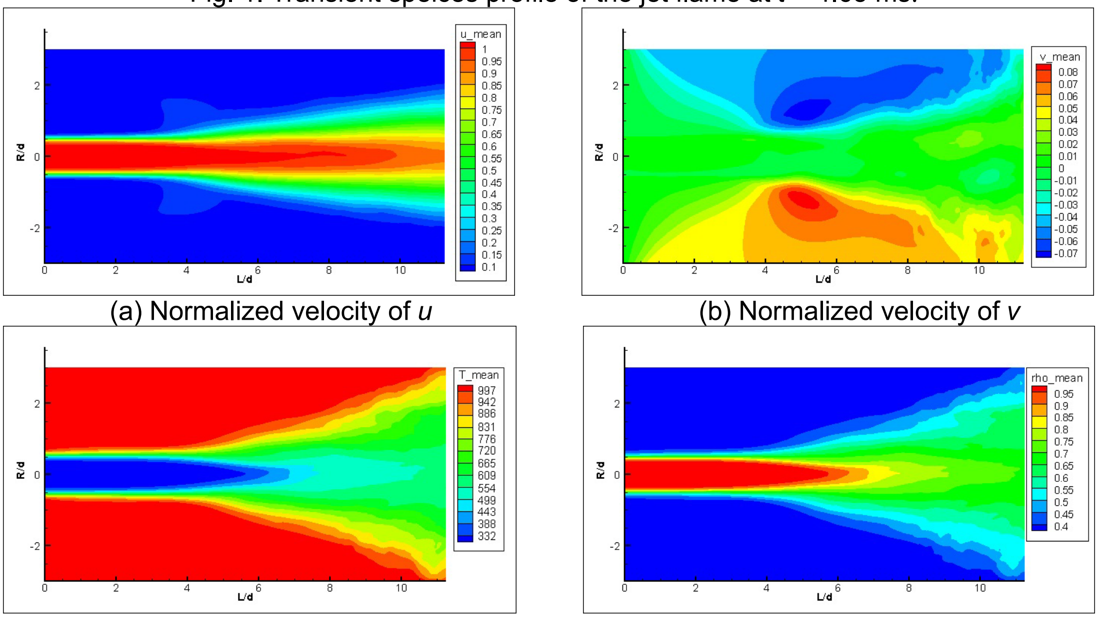


(a) Mass fraction of H_2O (b) Mass fraction of OH

Fig. 1. Transient speices profile of the jet flame at t = 4.65 ms.



(a) Normalized velocity of u (b) Normalized velocity of v

(c) Temperature profile T (K) (d) Normalized density profile ρ

Fig. 2. Faver averaged flow field of the jet flame. The reference values used here are: velocity u_r = 103.5 m/s; density ρ_r = 0.856 kg/m^3

These figures show the simulation results of hydrogen jet flame in a vitiated coflow, which were realized by 2D DNS (Direct Numerical Simulation) method with 9 species and 16 steps chemical kinetic mechanism. The diameter of the jet is d = 4.57 mm. The jet fuel is a mixture of 25 % H_2 and N_2 as dilution, by volume. The velocity of the jet is U_1 = 107 m/s at 305 K. The coflow consisted of products from a lean premixed H_2/air flame with a velocity of U_2= 3.5 m/s at 1045K. The composition is 15 % O_2, 9.9 % H_2O and 75 % N_2, by volume. Based on the velocity of U_1-U_2, jet diameter d and inlet fuel jet properties, the Reynold's number of the jet flame is 23000, Pr = 0.71. The autoignition phenomenon can be well captured and visualized. Figure 1 shows the transient mass fraction profiles of H_2O and OH in the flow field, which were considered as the indicator of reaction as well as the heat release rate. The combustion mainly appears at the edge of the large scale vortex structures. At the end of the noncontinuous flame sheet or the positions with large curve rate, the combustion are always enhanced, as shown in Fig. 1(b). By accumulation of this kind of flame points, the fuel jet will be ignited automatically. Figure 2 shows the Faver-average results of velocity u, v, temperature and density in the flow field.

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