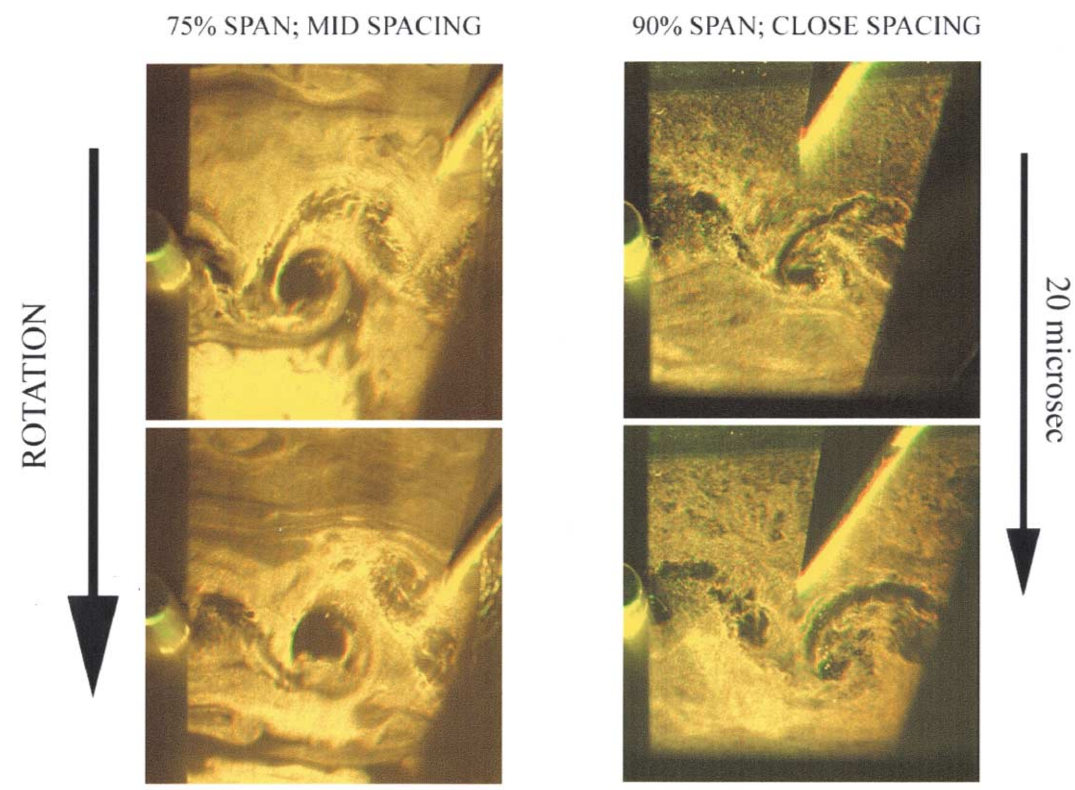
1. Visualization of Vortex-Shedding and Blade Synchronization in a Transonic Compressor

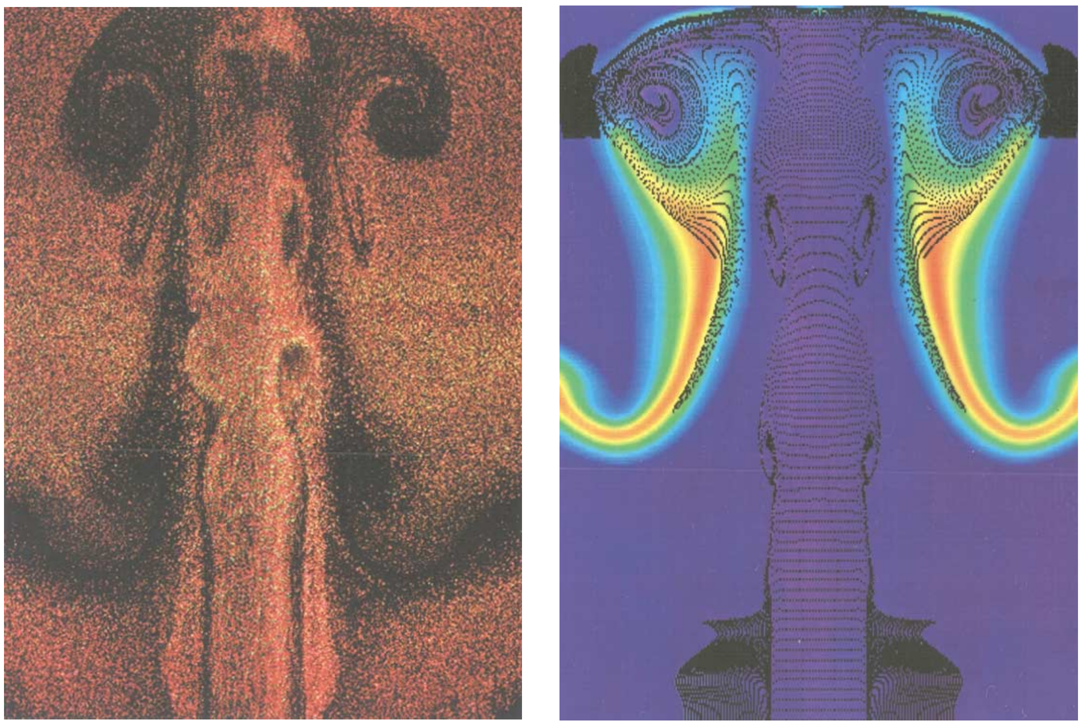
Estevadeordal, J.[1], Gogineni, S.[1], Goss, L.[1], Copenhaver, W.[2] and Gorrell, S.[2]
1) *Innovative Scientific Solutions, Inc. 2766 Indian Ripple Road Dayton, OH 45440 USA*
2) *Air Force Research Laboratory Wright-Patterson Air Force Base, OH 45433 USA*



Wake-blade interactions for two configurations of a high-through-flow, axial-flow transonic compressor located in the Compressor Aerodynamic Research Laboratory (CARL) at Wright-Patterson Air Force Base were visualized using Digital Particle Image Velocimetry (DPIV). The synchronization of the vortices with the potential field of the leading edge of the blades and the shock as a function of blade position is evident. Axial distances between the wake generators and the blade leading edge are 12% (close) and 26% (mid) of the chord. The visualizations were performed using a cross-correlation camera, with double exposures of 1 μs. The first frame was colored green and second, red. The images were then superimposed, resulting in the orange DPIV visualization.

2. Modeling and Measurement of the Interaction of Starting Jets and Flames

***Fiechtner, G. J.,**[1,2] **Katta, V. R.,**[1,2] **Carter, C. D.**[1,2] **Gord, J. R.,**[1] **Roquemore, W. M.**[1] **and Rolon, J. C.**[3]*
1) *Air Force Research Laboratory, Propulsion Directorate, Wright-Patterson Air Force Base, OH 45433-7103, USA.*
2) *Innovative Scientific Solutions, Inc., 2766 Indian Ripple Road, Dayton, OH 45440-3638, USA.*
3) *Laboratoire d´Énergetique Moléculaire et Macroscopique, Combustion École Centrale Paris and CNRS Grande Voie des Vignes, 92295 Châtenay-Malabry Cedex, France.*



Explanatory Note: Images of laser-light scattering from particles seeded into an opposed-jet burner were used to develop an improved model of reacting flows. A two-dimensional, time-dependent solution of the Navier-Stokes equations with chemical reactions was implemented to model multiple-vortex interactions produced by starting jets that penetrate a nonpremixed hydrogen-air flame as the lead vortex impacts the upper nozzle. The modeling image of temperature and superimposed instantaneous particle locations (right) and the scattering image (left) reveal multiple vortices. Formation of these vortices and the resulting interactions are important events during the transition to turbulence. The model is being modified to include three-dimensional instabilities that form during this transition in the presence of flames.

3. Development of Counter-Rotating Vortex Pair in a Crossflow Jet

Kim, Kyung Chun[1)]

1) *School of Mechanical Engineering, Pusan National University, Pusan, 609-735, KOREA*

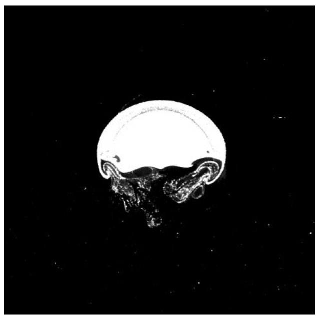


Figure 1(a) α=10˚

Figure 1(b) α=30˚

Figure 1(c) α=50˚

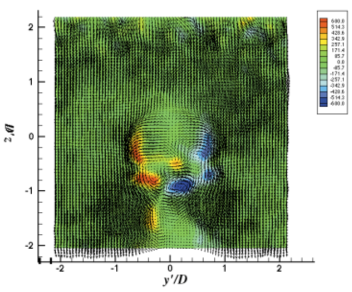


Figure 2(a) α=10˚

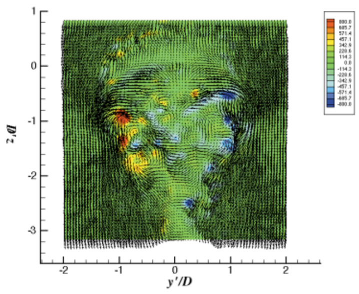


Figure 2(b) α=30˚

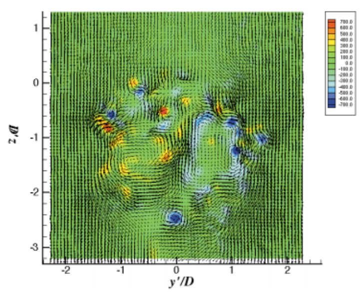


Figure 2(c) α=50˚

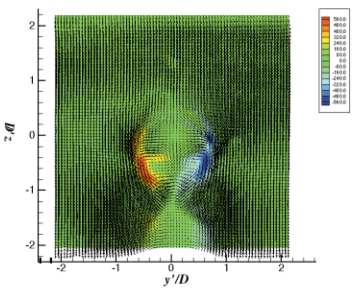


Figure 3(a) α=10˚

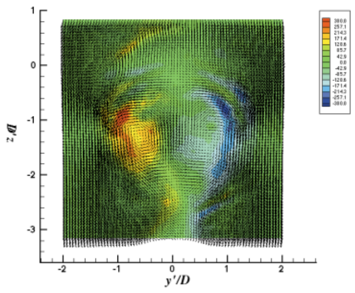


Figure 3(b) α=30˚

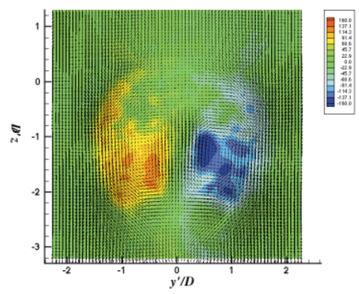


Figure 3(c) α=50˚

The development of counter-rotating vortex pair (CVP) in a crossflow jet was studied experimentally. The jet-to-crossflow velocity ratio was set to be 3.3 and the Reynolds number based on the crossflow velocity and jet diameter was 1,050. The instantaneous laser tomographic images (Figure 1) and velocity fields (Figure 2) were obtained along the crossflow jet at various transverse planes with the angle α between the trajectory coordinate and the wind tunnel bottom plate. Ensemble averaged velocity fields depicted in Figure 3 clearly show the development of the CVP. It is found that the CVP was initiated from the hanging vortices appeared at both lateral sides of the jet column. Note that there are many streamwise vortical streaks in the instantaneous fields which might be created by vortex breakdown process and the rotation of shear layer vortices.

(Acknowledgments: This work was supported by BK21 project.)

4. Simultaneous Velocity and Concentration Fields in a Turbulent Round Jet

***Chang, K.-A.*[1], *Cowen, E. A.*[2], *Liao, Q.*[2] *and Zarruk, G. A.*[2]**
1) *Department of Civil Engineering, Texas A&M University, College Station, Texas 77843, USA*
2) *School of Civil and Environmental Engineering, Cornell University, Ithaca, New York 14853, USA*

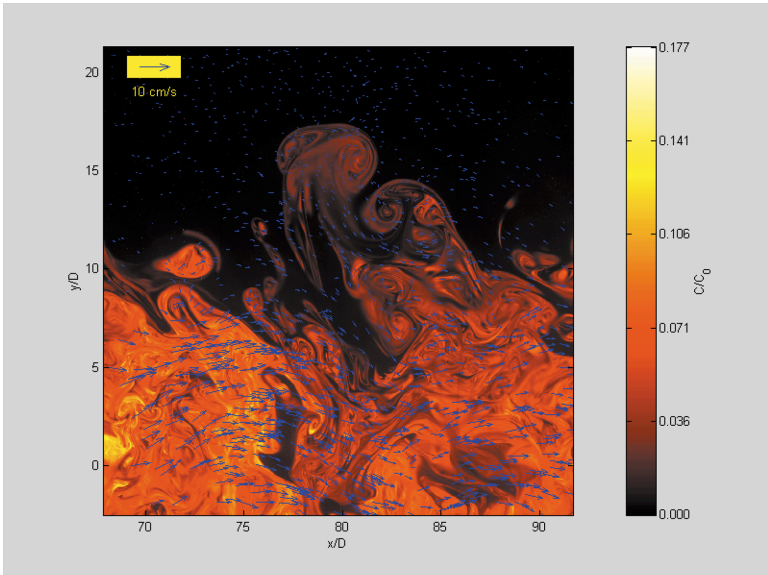


Fig. 1(a)

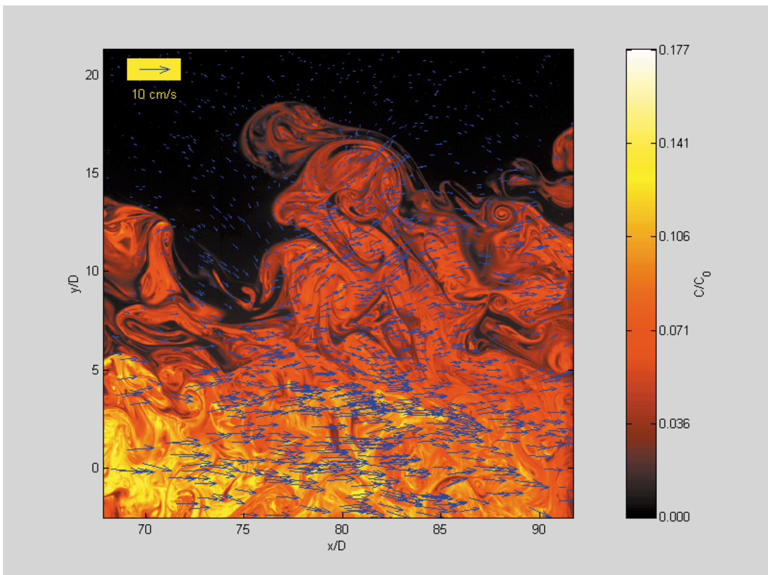


Fig. 1(b)

An experimental technique combining particle tracking velocimetry (PTV) and laser induced fluorescence (LIF) was used to measure velocity and scalar concentration simultaneously. The measurement was taken in a neutrally buoyant turbulent round water jet with an exit diameter of D = 4.4 mm and exit velocity of Uo = 1.06 m/s resulting in a Reynolds number of 4210. Fluorescein dye (initial concentration of Co = 5 ppm, pH = 8.5, temperature = 16.0 C) was seeded with neutrally buoyant hollow glass spheres and used as the jet source. Figures 1 (a) and (b) show two instantaneous measurements. The jet is in the horizontal (x) direction with the jet orifice located at x = 0, y = 0.

5. The Gen Yamaguchi Virtual Museum

***Oki, M.*[1], *Suto, Y.*[1], *Yamamoto, O.*[1], *Shinoda, K.*[1], *Sugiyama, T.*[2] and *Fujii, K.*[2]**
1) *School of High-Technology for Human Welfare, Tokai University, 317 Nishino, Numazu-shi, Shizuoka 410-0395, Japan*
2) *Tokai Dentsu Co., Ltd., 519-1 Matsunaga, Numazu-shi, Shizuoka 410-0874, Japan*

External appearance

The first floor

The second floor

The third floor

The Gen Yamaguchi Virtual Museum is a virtual museum that the works of Gen Yamaguchi (1896-1976), a woodcut printer in Numazu-city in Japan, can be viewed through Internet from any place and at any time[1]. Because of no museum to exhibit these prints, they are kept in the Numazu City Hall, and can be viewed only few times a year. Thus, it is very worthwhile to exhibit the prints to the public through Internet. The three-storied museum is made by using the three-dimensional virtual space modeling language called VRML (Virtual Reality Modeling Language), and the visitors can freely "walk through" each floor. The prints were photographed by digital camera, and pasted as texture images. The explanations of a woodcut print can be shown by clicking the image.

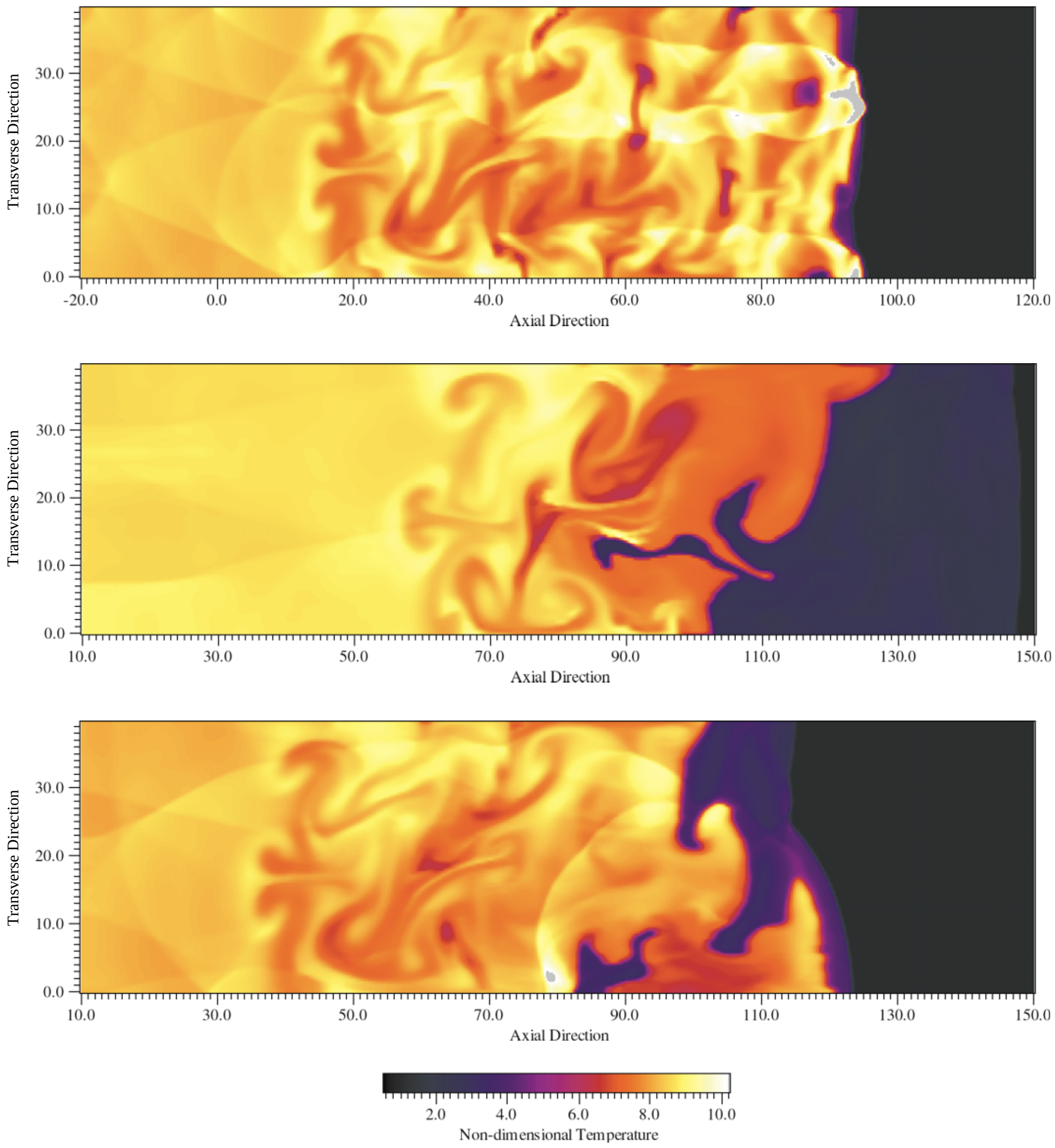
1) http://www.city.numazu.shizuoka.jp/bungaku/yamaguchi.htm

6. Numerical Visualization of Decaying Process of Oxyhydrogen Detonation Waves

***Ohyagi, S.*[1]*, Kobayashi, Y.*[2] *and Obara, T.*[1]**

1) *Saitama University, 225 Shimo-okubo, Urawa, Saitama 338-8570, Japan*

2) *Mitsubishi Heavy Industry Co.Ltd.*



A detonation wave is a supersonic combustion wave. It consists of a shock wave and a reaction wave. A triple shock structure including triple-points of shock waves is a key structure, which defines the detonation wave. In this calculation, a decaying process of the gaseous detonation wave is simulated by the FCT scheme. Figures above show typical results for temperature fields of the waves propagating from left to right. Bright yellow region represents the high temperature burned gas region, dark blue region the shocked unburned gas and black region indicates the non-disturbed region (The gray region indicates that the temperature is higher than the upper limit of color bar). Top figure illustrates the quasi-steady Chapman-Jouguet detonation wave with three triple points on the front. The other two figures show the case in which the detonation waves are decaying due to a change of the mixture properties. In these cases, the flame fronts de-couple with the shock fronts and the triple shock structure disappears.