

Preface

On the Regular Publication of the Journal



Mizuno, A.

The Journal of visualization has been distributed for five years since its start in July 1998. Since then, the regular quarterly distribution has been the major target to be attained for the editorial board, as well as maintaining its quality and expanding international circulation. One of the important characteristics of this journal is that all papers are published in full color in order to promote better understanding of complex phenomena.

We are happy to report that this journal enjoys a very favorable reputation, and the numbers of contributors and subscribers are increasing.

Editorial Board consists of 17 Regional Editors, 17 Managing Editors and 33 Advisory Editors from all over the world in variety of fields related to Visualization. These Editors cooperate together to publish this outstanding Journal periodically.

It is a great honor for me to have an opportunity of acting as the managing editor of the current issue, which is published and distributed in October 2002, and to carry out the spirit of the Journal, even though I am rather new to have joined in the editorial board.

I called for papers through the regional editors worldwide, and saw two notable outcomes. One is the contribution of the invited paper from Prof. R. A. Robb, which appears at the top of this issue. The other is a group of papers by Russian authors organized by Prof. Chashechkin (Moscow University). For the latter, I owe much to Prof. Ryuji Kimura (Tokyo University) who has a close relationship with Prof. Chashechkin. But to my regret, due to the delay in the review process, none of these papers could be included in this issue. I hope they will appear in the following issues.

We are happy that the journal is now published periodically. On the other hand, we still have to undertake some challenges, in particular to boost circulation. On behalf of the editorial board, I would sincerely like to ask the readers to help raise the number of subscription including that from libraries. It would be of great appreciation if the readers would solicit their colleagues and acquaintances interested in the field to subscribe to the Journal of Visualization.

Managing Editor
Akisato Mizuno

Cover Photo

Visualization of Two-dimensional Flows by a Liquid (Soap) Film Tunnel

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This image represents a two-dimensional jet produced in a soap film tunnel (Gharib and Derango, *Physica D*, Vol.37 pp.406-416, 1989). The small variation of the film thickness results in interference patterns, thus, providing an excellent means for flow visualization. The figure shows a laminar jet (Re number = 25), but the jet fluid has a lower surface tension than the ambient fluid, which results in a large growth rate for the jet.

Visualization of Flow Structure in a Channel with Corrugated Walls by Liquid Crystals

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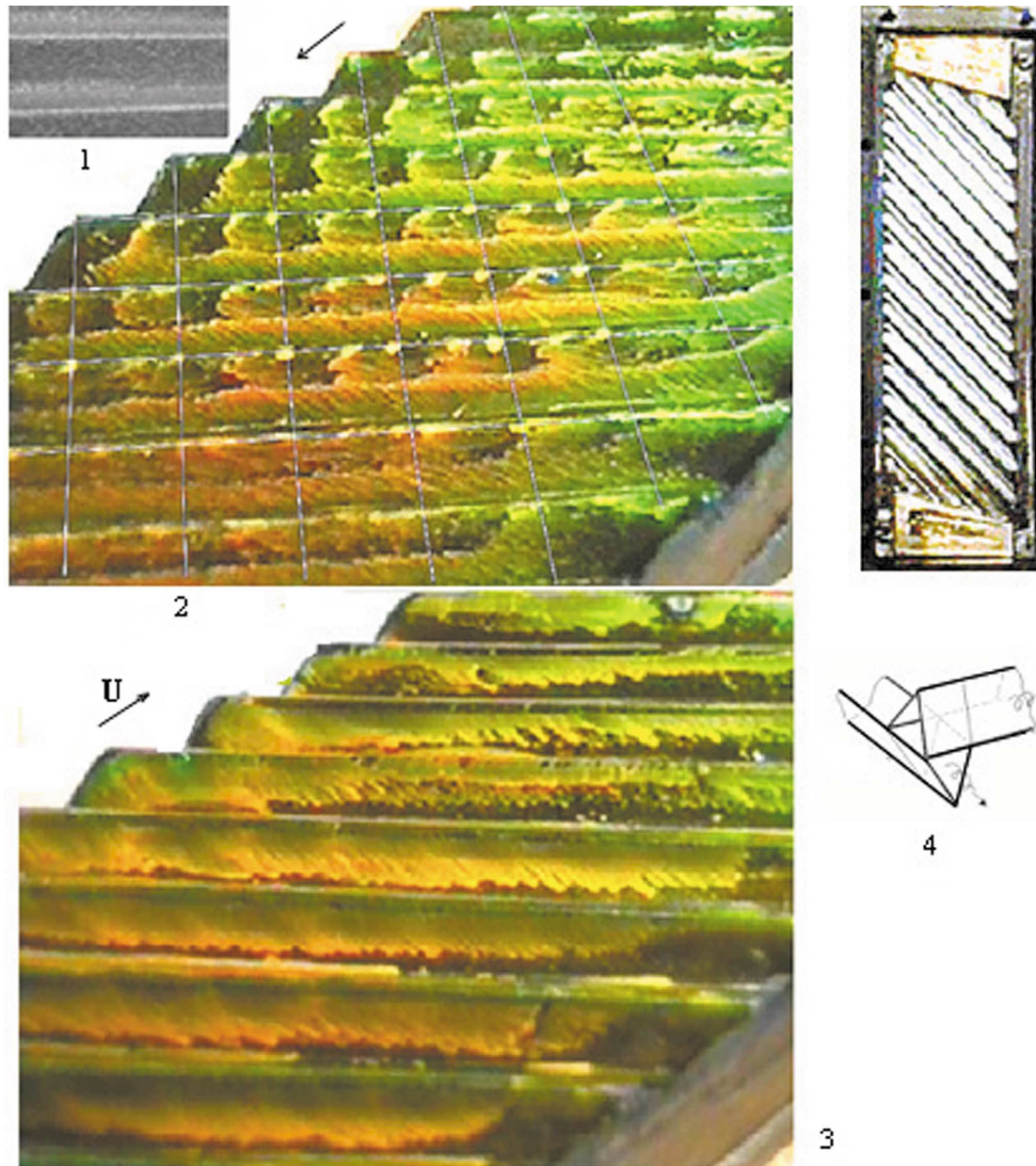


Fig. 1. Test surface with LC without flow

Fig. 2. Shear stress visualization. General view on the corrugated plate on the lee side

Fig. 3. General view on the windward side

Fig. 4. Test model and chart of the channel cell

Visualization of the shear-stress distribution on a wall of the channel formed by two corrugated sheets with opposite directed ribs is presented in figures. For the purpose, the effect of texture transition from the so-called focal-conic texture to planar texture in shear sensitive liquid crystals has been used. Corrugation angle (the twice angle between main flow direction and rib line) $\theta=90^\circ$, crimp angle $\varphi=60^\circ$, hydraulic diameter of the inner channel $d_h=7.6$ mm and Reynolds number $Re_{ch}=1.3 \times 10^4$.

Visualization of Twin & Kármán Vortices on the Ancient Pottery, Jomon-doki, made 4500 Years Ago

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Fig.1. Jomon-doki



Fig.2. Pollen of cedar coming from cedar forest

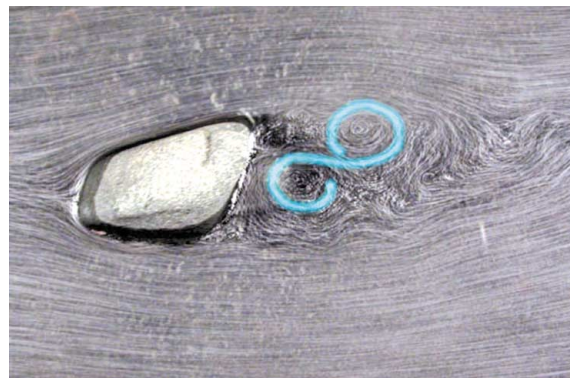


Fig.3. Twin vortex (left) and Kármán vortex (right) behind a rock of river (Surface floating method using pollen of cedar tree and aluminum power)

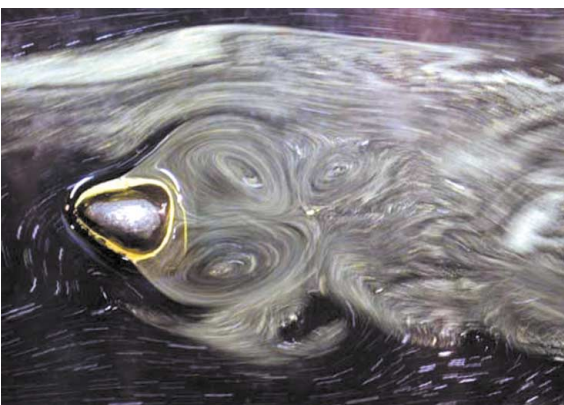


Fig.4. Twin vortex (left) and Kármán vortex (right) behind a rock of river (Surface floating method using pollen of pine tree)

It is said that the Jomon-age in Japan began 16,000 years ago and continued till 2,500 years ago. The earthenware made in this age is called Jomon-doki. Among them, two potteries shown in Fig.1 were discovered in Niigata Prefecture and have very nice pattern. It is said that these potteries were made about 4,500 years ago. The pattern on the side wall consists of two kinds of vortex. One is so-called twin vortex each rotating in the opposite direction and the other that is observed under the twin vortex is the plastic art of Kármán vortex rotating in one direction and presenting reversal S-shaped vortex. It can be easily assumed that Jomon people watched the twin vortex and Kármán vortex created by tracers such as the pollen of the cedar (Fig. 3) and pine (Fig. 4) trees, fallen leaves and petals, and copied the pattern on the earthenware.

Three-dimensional Flow Structure around an Axial Fan

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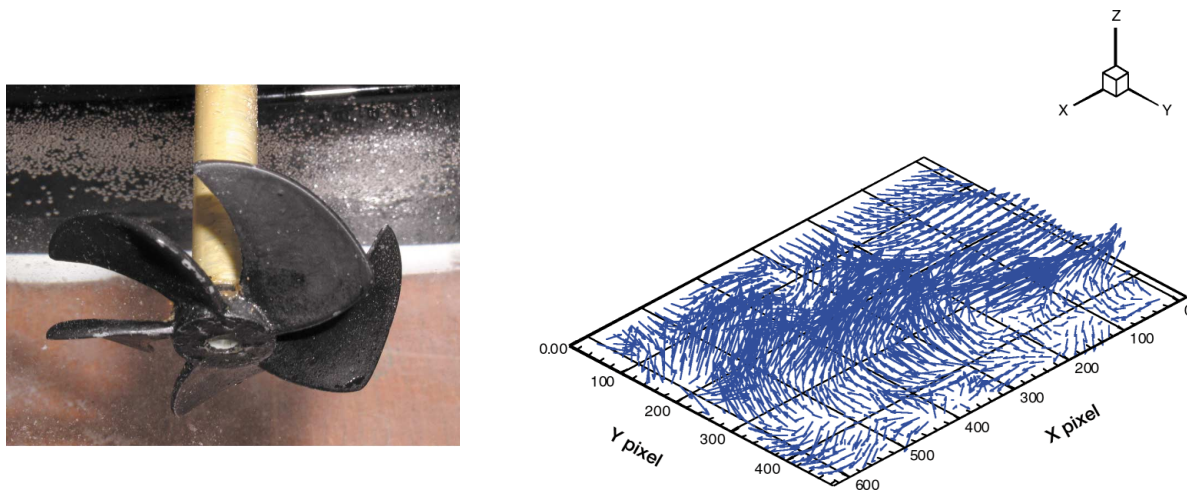


Fig.1. Axial-fan model and instantaneous velocity vectors measured by stereoscopic PIV

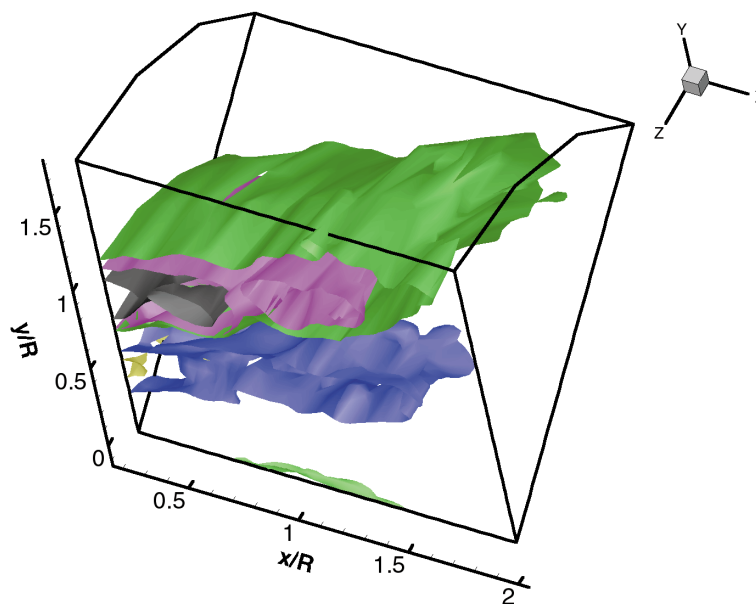


Fig.2. Three-dimensional iso-vorticity structure of spanwise vorticity ω_z

The stereoscopic PIV (particle image velocimetry) measurements were carried for an axial-fan to understand the three-dimensional (3-D) flow structure around the fan. The fan model has five forward-swept blades and its tip diameter is 50 mm. Figure. 1 shows the axial-fan tested and a typical 3-D reconstructed instantaneous velocity field measured in an axial plane just behind the axial-fan. During experiments, the fan is rotating at 180rpm. 500 instantaneous velocity fields were measured and they were ensemble averaged to obtain the phase-averaged mean flow structure.

By combining the vorticity contours measured at four consecutive phases, iso-vorticity contours having the same spanwise vorticity (ω_z) were derived. The contour plot of equi-spanwise vorticity surface is depicted in Fig. 2. It shows the quasi 3-D distribution of positive tip vortices shed from the blade tip, trailing vortices and negative vortices induced from the pressure side of fan blade. The positive tip vortices and negative vortices interact strongly in the region of $0.6 < y/R < 0.8$.

Large Eddy Simulation of Turbulent Flame

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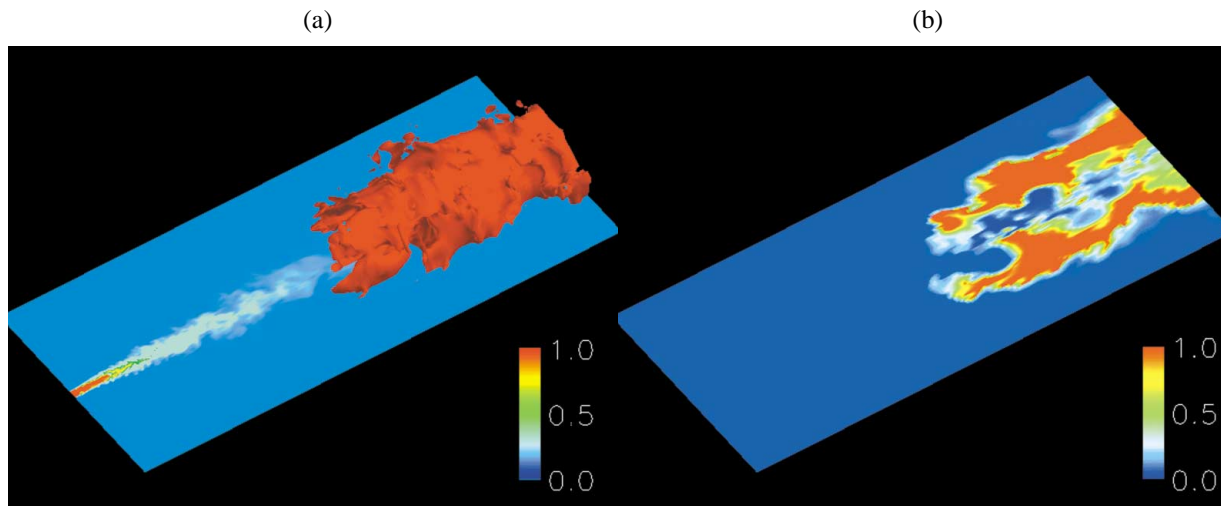


Fig.1. (a) The lifted flame front (red surface) and the mixture fraction distribution (color contour)
(b) The distribution of the scalar G

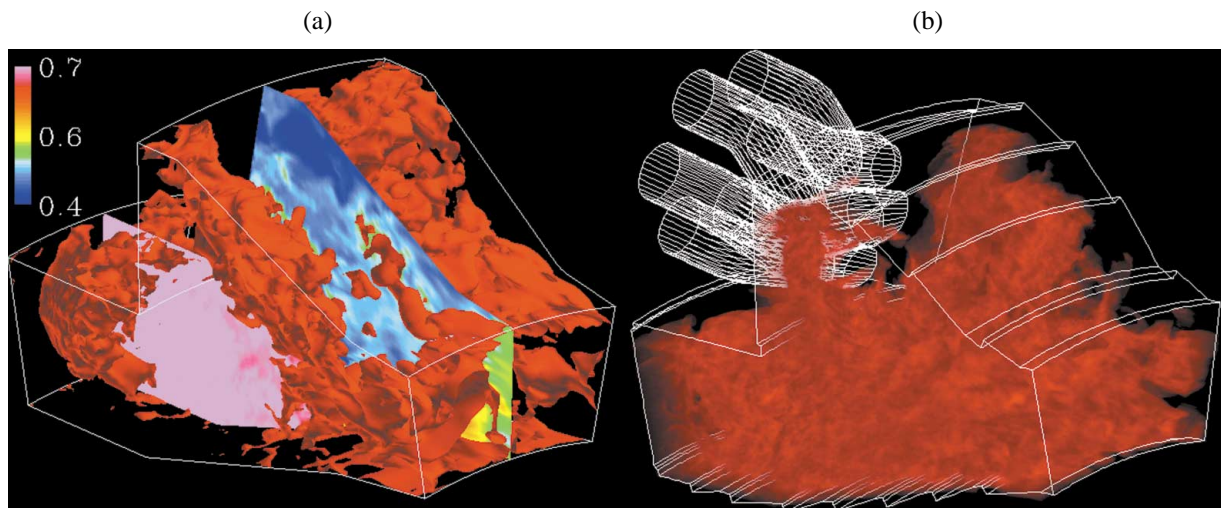


Fig.2. (a) The flame front (red surface) and the distribution of the equivalence ratio (color contour)
(b) The volume rendered flame based on the value of the scalar G

The flame front in a turbulent combustion flow field was numerically simulated using a large eddy simulation and a flamelet model. As a flamelet model, the G-equation model for a premixed combustion and the conserved scalar approach for a diffusion combustion were used respectively. Combining both equations for premixed and diffusion flame, the "2-scalar flamelet approach" was newly introduced to predict the complicated flame, such as the lifted flame and the flame propagation with non-uniform fuel ratio.

Figure 1 shows the result of the simulation for lifted flame. The mixture fraction distribution and predicted flame front are described in Fig.1(a) while the distribution of the scalar G is described in Fig.1(b).

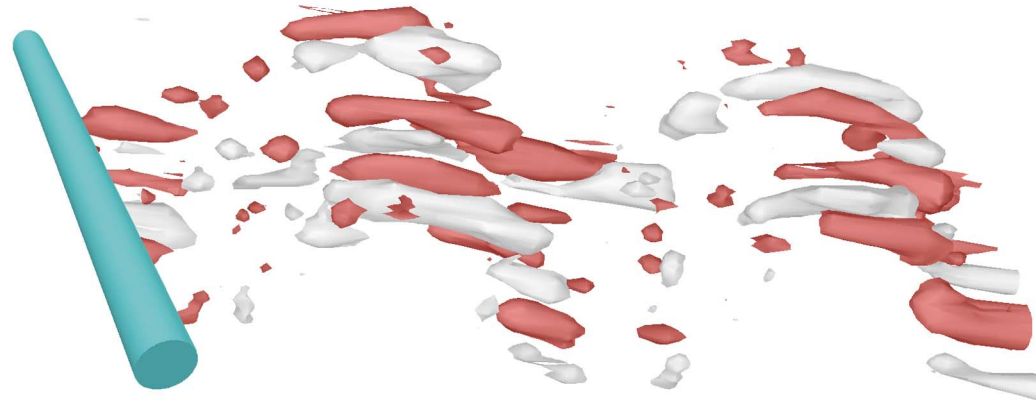
Figure 2 shows the flame in a gas turbine combustor. In this combustor, the fuel ratio is non-uniform. Figure 2(a) shows the distribution of the equivalence ratio calculated by mixture fraction equation and the flame front calculated by the G-equation. Figure 2(b) shows the volume rendered flame based on the value of the scalar G.

Vortex Lock-on and Spatio-temporal Evolutions of Streamwise Vortices

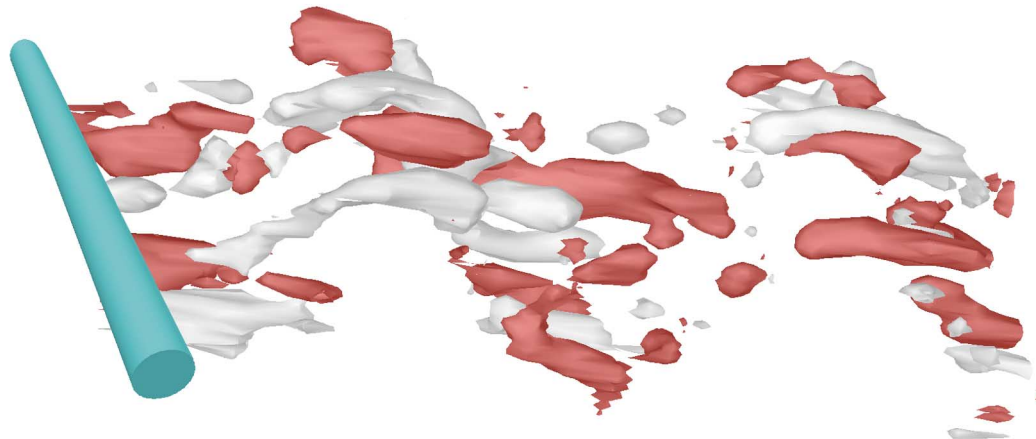
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Natural shedding case, $f_o/f_n = 0$



Lock-on state, $f_o/f_n = 1.92$

These figures show the spatio-temporal representations of iso-vorticity surfaces of the streamwise vortices in the natural shedding and lock-on conditions. Successive PIV images were acquired in the streamwise plane which was located at 2.5 diameters downstream of a circular cylinder, by utilizing an image-reflecting mirror oriented at 45° far downstream. The streamwise coordinate is proportional to time. When a bluff body faces an oscillatory incident flow, a vortex lock-on may occur accompanied with an increase in fluctuating lift and drag forces. Furthermore, the present results strongly manifest the increased strength and spanwise wavelength of the streamwise vortices with lock-on.

Measurement of Vortex Structure at the Rotor Exit of Turbo-fan

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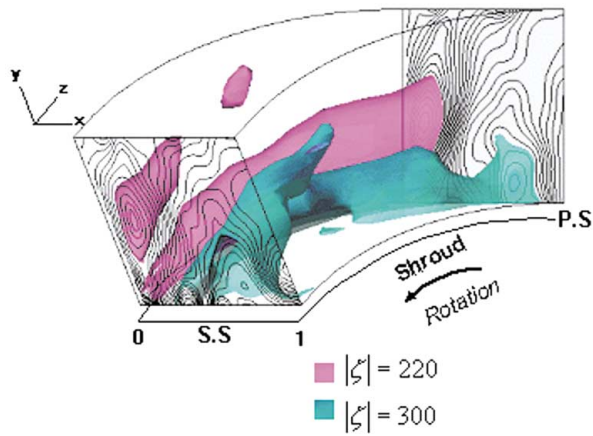
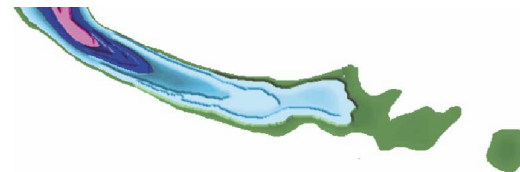
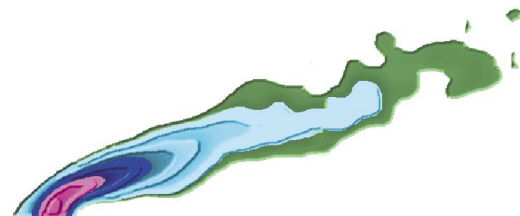


Fig.1. Shear layer vortices



(a) $z/b = 0.2$



(b) $z/b = 0.4$



(c) $z/b = 0.8$

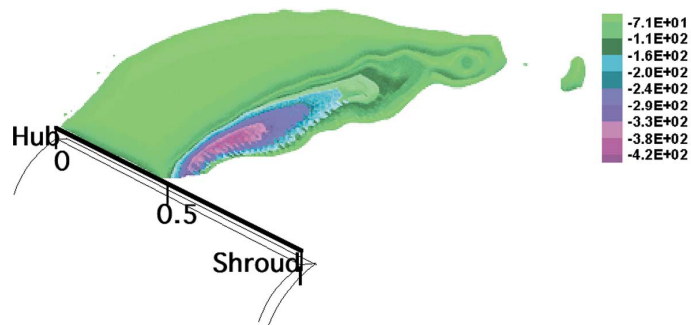


Fig.2. Tip vortices across the span wise

Fig.3. Tip vortices

The tip vortices and shear layer vortices were studied experimentally by using the high resolution PIV technique. The tested turbo-fan having 11 backward-curved blades with a blade outlet angle of 45 degree was rotated at the speed of 900 rpm. The shear layer vortices (Fig. 1) were achieved by averaging 500 stereoscopic PIV measurement data made at 22 circumferential planes, which ranged from 0 degree (blade suction surface) to 32 degree (blade pressure surface). Phase average tip vortices (Fig. 2) were calculated by the 300 instantaneous PIV measurement results at every 20 planes across the span wise. The difference in the magnitude of the velocity speed at these points guarantees that the tip vortex, which is an important factor of noise, is generated around these points. At the location of ($z/b = 0.4$) where a distinctive difference exists in the magnitude of the velocity speed, a large scale of vortex is formed as can be seen in Fig. 3.