1. Three-dimensional instabilities in a counterrotating vortex pair

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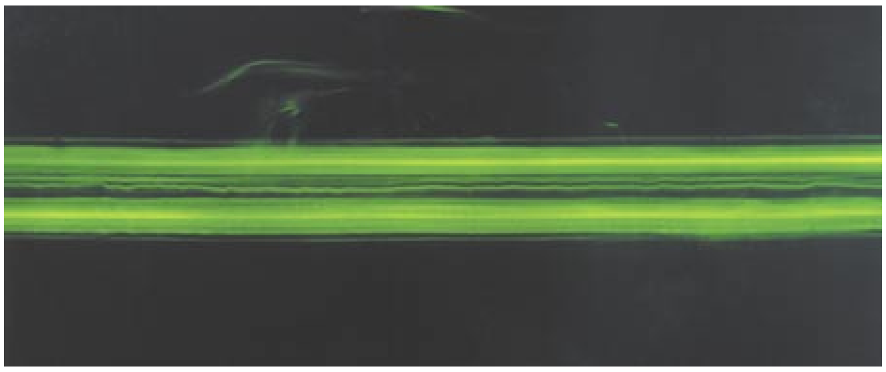
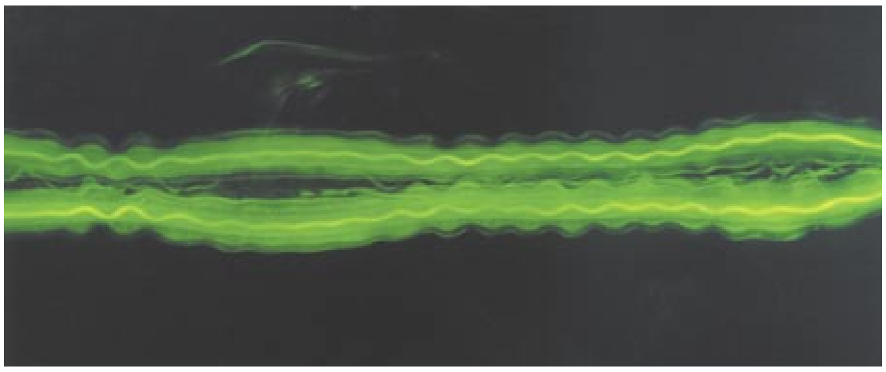
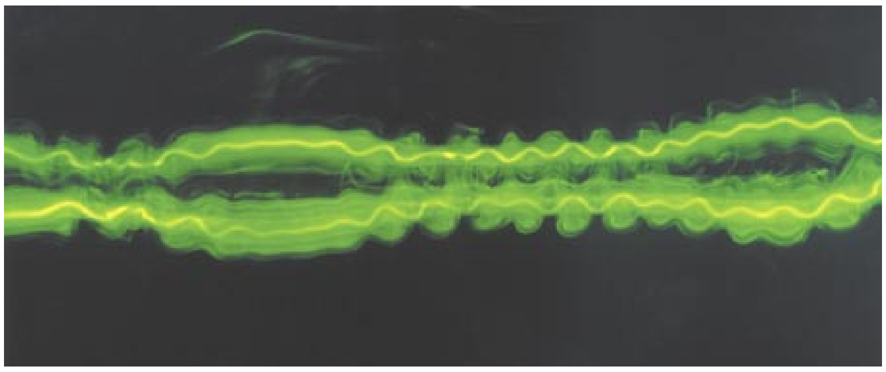


(a)



(b)



(c)

These photographs show visualizations of the simultaneous development of two distinct instabilities in a counterrotating vortex pair at a Reynolds number, based on circulation, of 2750. The evolution of the pair, which is initially straight and parallel (a), is visualized using fluorescent dye and flood illumination with the light from an Argon laser. (b) clearly shows a large-scale symmetric deformation (the well-known Crow instability), as well as an anti-symmetric short-wavelength instability. In (c), the ordered perturbation starts to break up, leading to a rapid destruction of the vortex pair at later times. The short-wave perturbation is due to a so-called elliptic instability of the vortex cores, which is here observed clearly for the first time in an open flow.

Leweke, T., Williamson, C. H. K.; "Cooperalive clliptic instabillity of a vortex pair". J. Fluid Mcch., vol. 360, pp. 85-119 (1998).

2. Natural convection flow with longitudinal vortices and transition to turbulence

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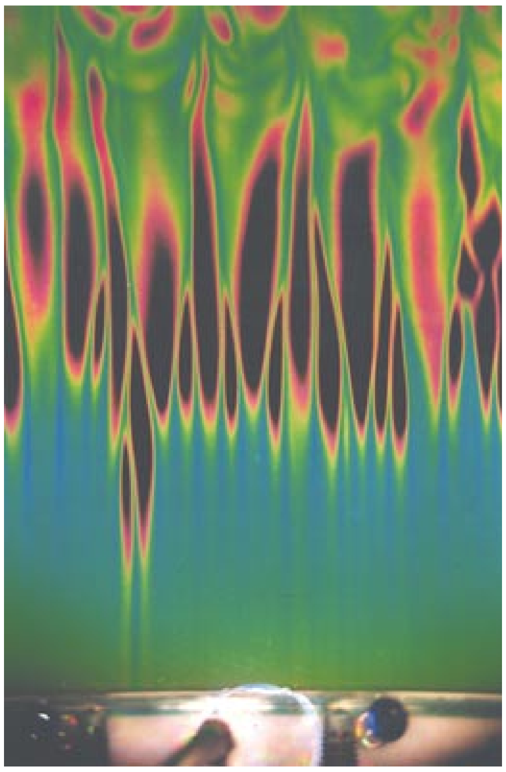
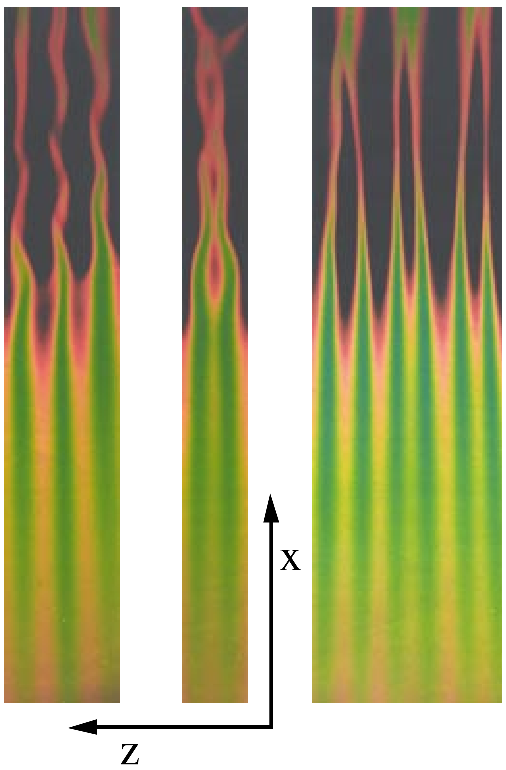


TLC visualization of the surface temperatures of a heated inclined ($\gamma = 40°$ against the vertical) flate plate in natural convection. The x direction is the downflow direction. The laminar and longitudinal vortices produce a regular pattern of the surface temperatures in the down flow direction. Further down stream these vortices become instable and breakdown into turbulence. The colors indicate increasing temperatures with changes from red to yellow, green and blue.



Secondary instabilities of a natural convection longitudinal vortex flow

TLC visualization of the surface temperatures of a heated inclined ($\gamma = 20°$ against the vertical) flate plate in natural convection. The x direction is the downflow direction.
The picture on the left shows a sinuos mode, in the center the varicous mode is visualized and on the right a merging of neighbouring vortices is shown.

3. Flow visualization behind a car rearview mirror

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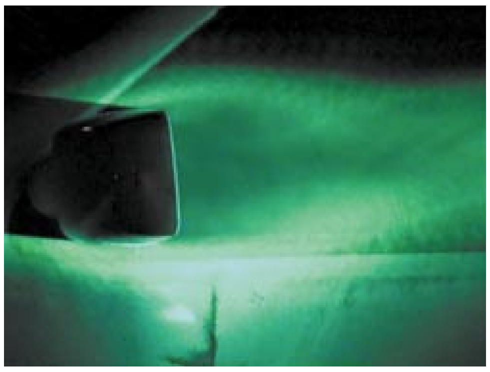

Fig. 1 (a)

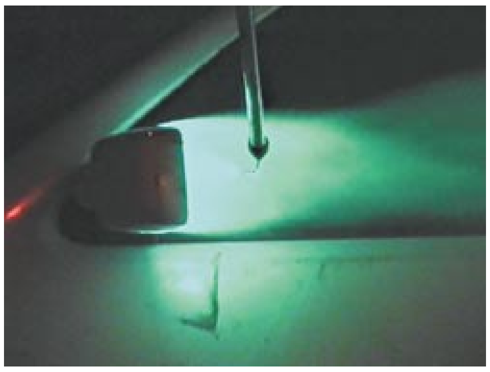

Fig. 1 (b)

Flow visualization of the wake of a rearview mirror made by a light-sheet and smoke. The first image shows mainly the flow out of the wake. The light-sheet comes from the back of the mirror, while the smoke is injected upstream. The second image intends to enhance the view of the inner wake. In this case, the smoke is injected immediately behind the mirror. The light-sheet is made by using an Argon-Ion laser and a multimode fiber 40 m long.

Fig. 2 (a)

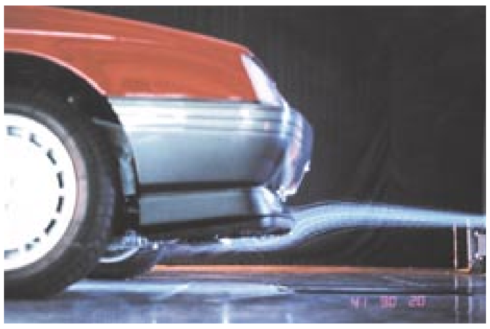

Fig. 2 (b)

Fig. 2 (c)

Flow visualization by helium-filled bubbles

The pictures show details of the flow in front and behind a full-scale passenger car. The first picture shows the complete flow field in front of the car, in particular the stagnation point on the bumper, as well as the flow entering the air inlet in the lower part of the bumber. The second picture shows the flow and its separation under the front spoiler. The third picture shows the flow over the backlight and behind the car rear end. Each picture is made by keeping the camera lens open, while the bubble dispenser is traversing the area of interest.

4. Inner Structure of the Head of Axisymmetric Gravity Currents

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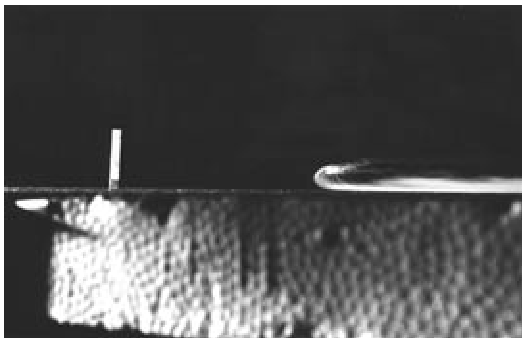

Fig. 1

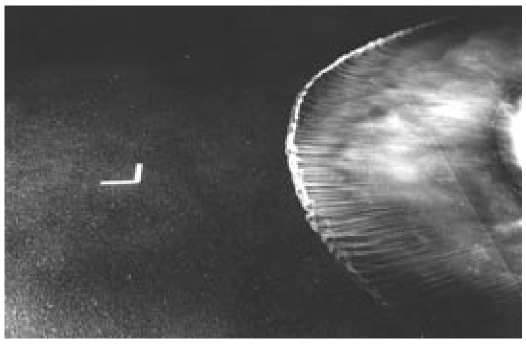

Fig. 2

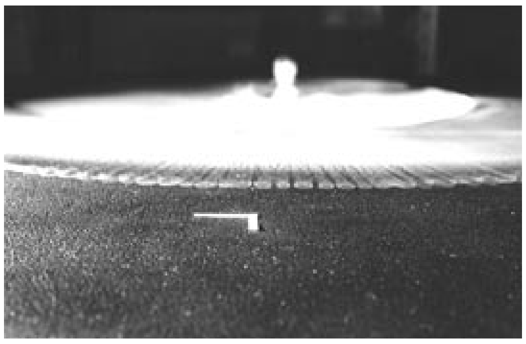

Fig. 3

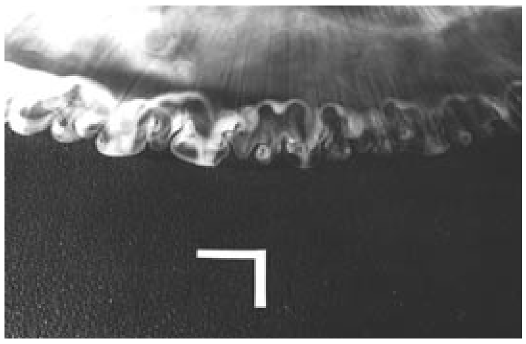

Fig. 4

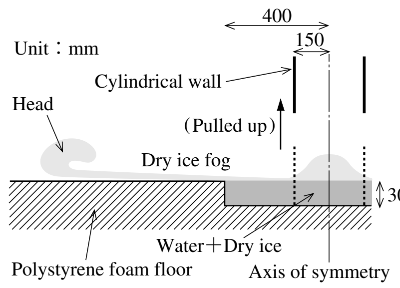

Fig. 5

When a layer of cold air with fog is released from a cylindrical reservoir on a horizontal floor, it spreads nearly axisymmetrically as a gravity current. At the head of the gravity current, the fog layer is rolled up (see Fig.1) and forms a rim when it is looked down from above (Fig.2). Behind the rim, the fog layer is divided into a number of spoke-like structures. Figure 3 shows that each spoke has an elliptical cross section of the nearly equal size. At the head of the gravity current, a thin vortex tube seems to connect two adjacent spokes. A close-up view from above (Fig.4) reveals that each spoke consists of a pair of roll-like convection cells. Fog looks thinner (denser) in the updraft (downdraft) region. Pieces of dry ice are immersed into water to generate dense air with fog. The fog layer accumulates in the cylindrical reservoir and is released by removing the sidewall upward (Fig.5). Figures 1-4 were taken in separate runs.

Fig.1 A side-view of the gravity current. The head advances from right to left at a speed of about 30 cm s^{-1}. The height of the white vertical bar to the left of the head of the gravity current is 5 cm.
Fig.2 The rim-like structure in the fog layer. Each side of the L-shaped scale is 5 cm in length (also in Figs.3 and 4).
Fig.3 A front view of the head. The L-shaped scale is the same as shown in figure 2.
Fig.4 The structure of the head. The L-shaped scale is the same as shown in figure 2.
Fig.5 A vertical cross section of the experimental apparatus.

5. Large Eddy Simulation of Engine In-Cylinder Flow

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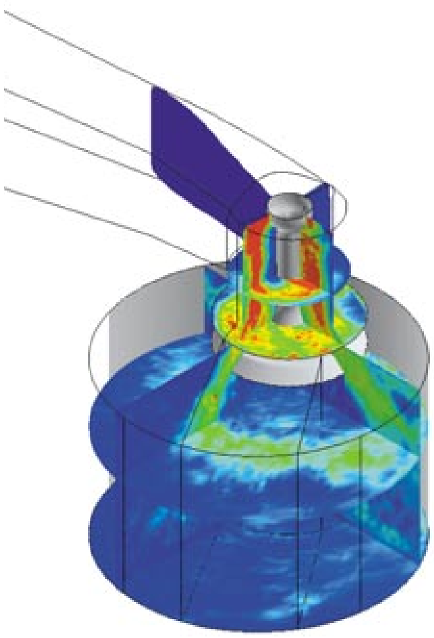
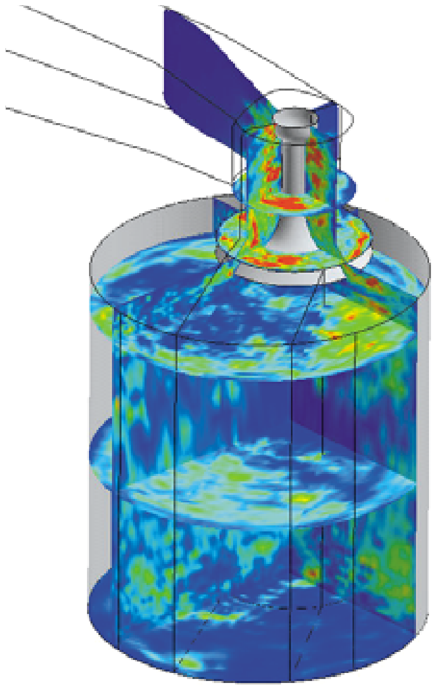
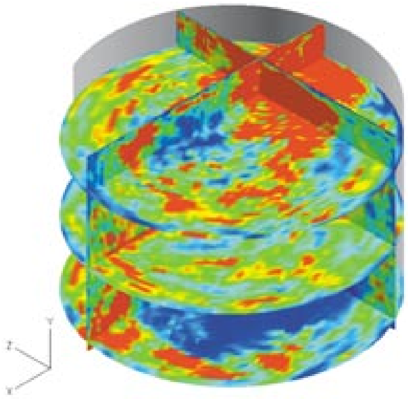


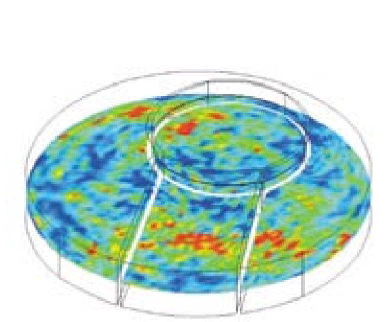
80° CA



180° CA



270° CA



360° CA

These figures show the numerical results of turbulence intensity in cylinder with large eddy simulation method. Engine speed is set on 300rpm. Reynolds number varies from 2100 to $1.4° \times 10^4$ in engine working process. Induction and compression strokes are calculated from 0 to 360 Crankshaft Angle with time interval of 1/200° CA. Four figures show the results of 80, 180, 270 and 360° CA. Very strong turbulence intensity is introduced in induction process and weakened in compression process. On the top dead center of piston, the turbulence is only left at very low level. However, the swirl movement (swirl number) is maintained at high level (not shown here).

6. A model of meandering channel for "Kyokusui-no-En" poetry party

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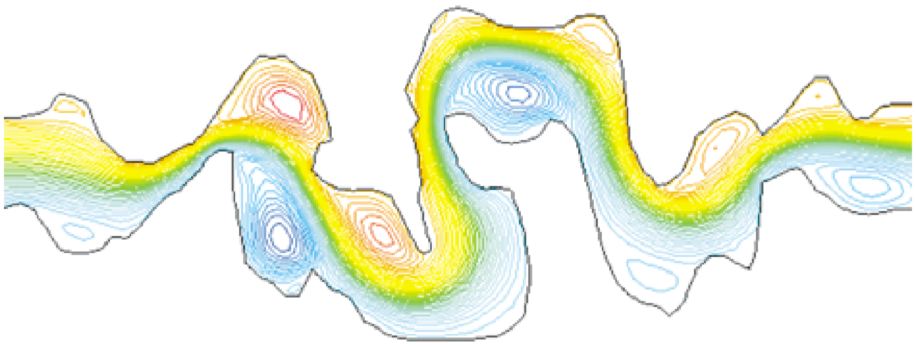
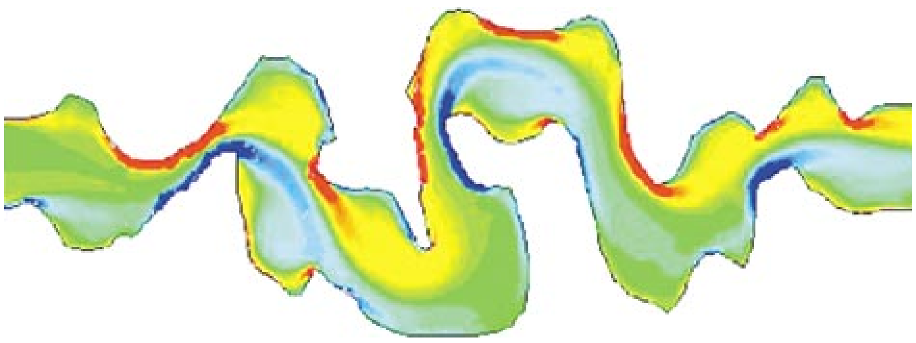


Contours of stream function



Contours of vorticity

Experimental result (Surface floating tracer method)

Poetry party by meandering stream (Kyokusui-no-En) is a ceremony where poets sitting alternately on the both banks of a garden-stream are expected to write a poem before a drink-filled cup coming from upstream passes by. The poets are allowed to pick up the cup to drink only by finishing a poem.

This model of meandering channel must have the characteristics that the cup flowing from upstream passes through a random pass and stagnates at unexpected places. Very interesting flow with vortices, separation and reverse flow occurs through this channel combined with the contracted, enlarged and curved parts. This flow pattern has been checked by numerical simulation and visualization.