1. Volume visualisation of the VISIBLE MAN

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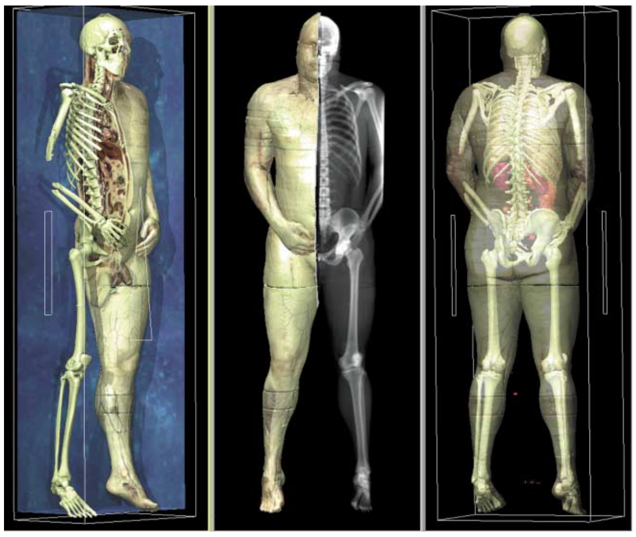
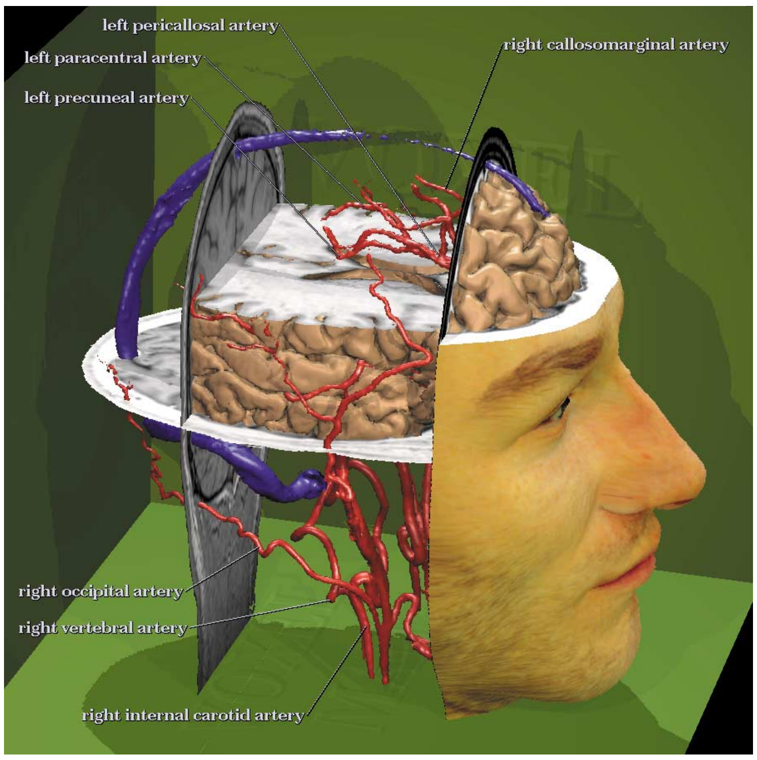


Three-bodies

1871 photographic cross-sectional images with a slice distance of 1 mm and a spatial resolution of 0.3 mm were taken from a cadaver by Victor Spitzer, University of Colorado. Computer tomograms were taken as well. A volume model was created from these data. The VOXEL-MAN Volume visualization environment allows its exploration by dissection, look-through projections or artificial X-ray imaging. Because of the huge amount of data to be handeled, for the whole body (upper figure) only a resolution of 3 mm was used. For the head (lower figure) a resolution of 1 mm was chosen. More information: http://www.uke.uni-hamburg. de/idv



2. Look! Vortices are merging

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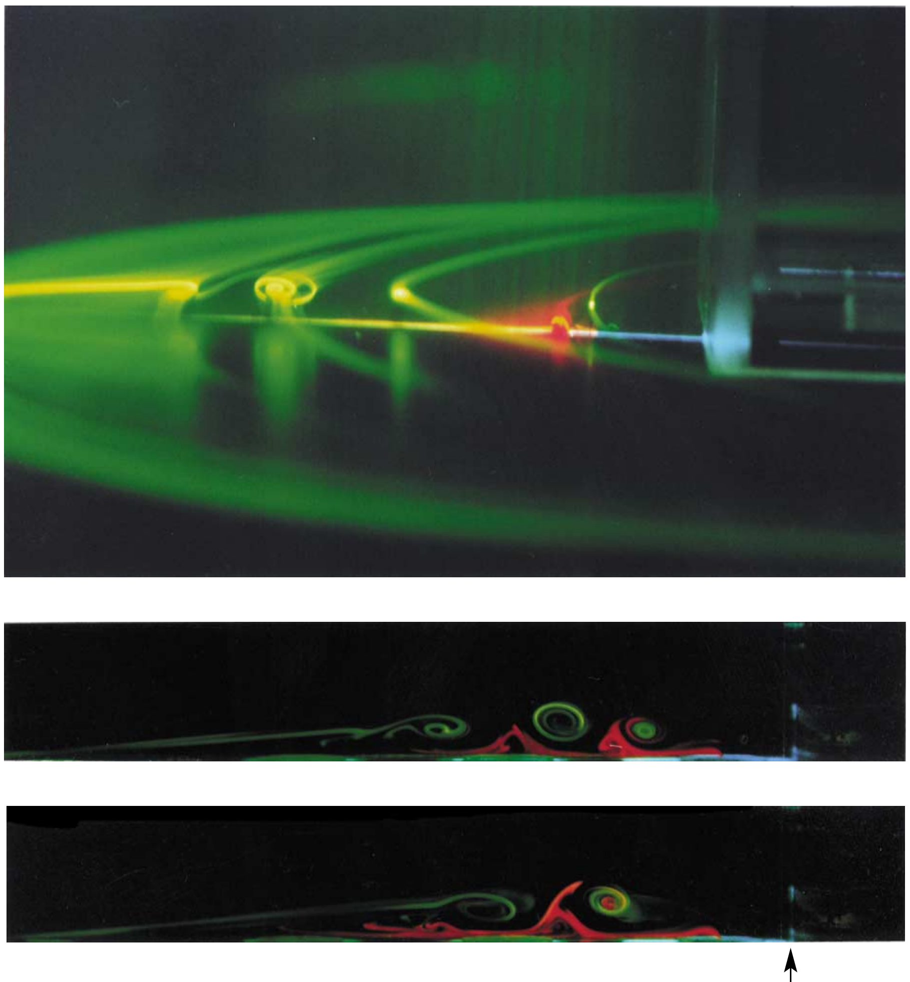
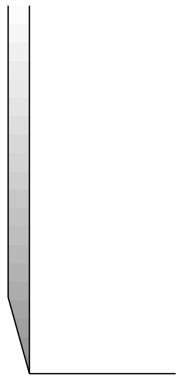


a

b

c

Leading edge of the cylinder



Square cylinder

2.a shows the pattern of a juncture flow in the front of a square cylinder mounted on a flat plate. The horse-shoe vortices shed from the separated shear layer consecutively, and lastly merge each other then form a main horse-shoe vortex that is closest to the cylinder.

2.b and 2.c show the vortex structure at the vertical symmetry section. There are horse-shoe vortices and induced second vortices near the flat plate.

Experimental condition: The experiment was conducted at a water tunnel with low turbulence intensity less than 0.3% and with a test section 0.4m*0.4m*4m at Peking University. The Reynolds number based on the side length of the cylinder is about 3000. A Laser-light-Sheet was used for visualizing the flow structures in the vertical symmetry section.

3. Quasi-coherent Turbulent Structures in a Channel with an Oscillatory Deformed Wall*

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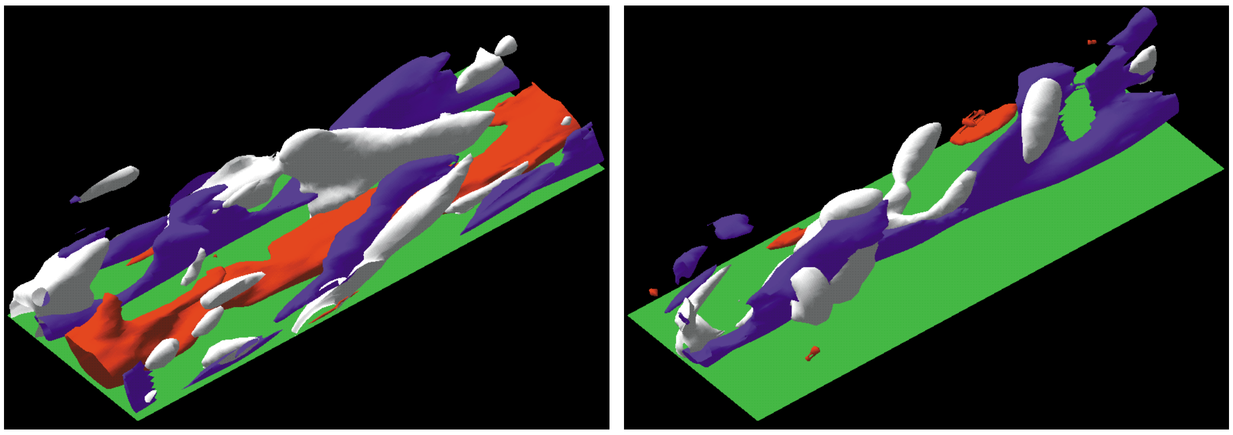
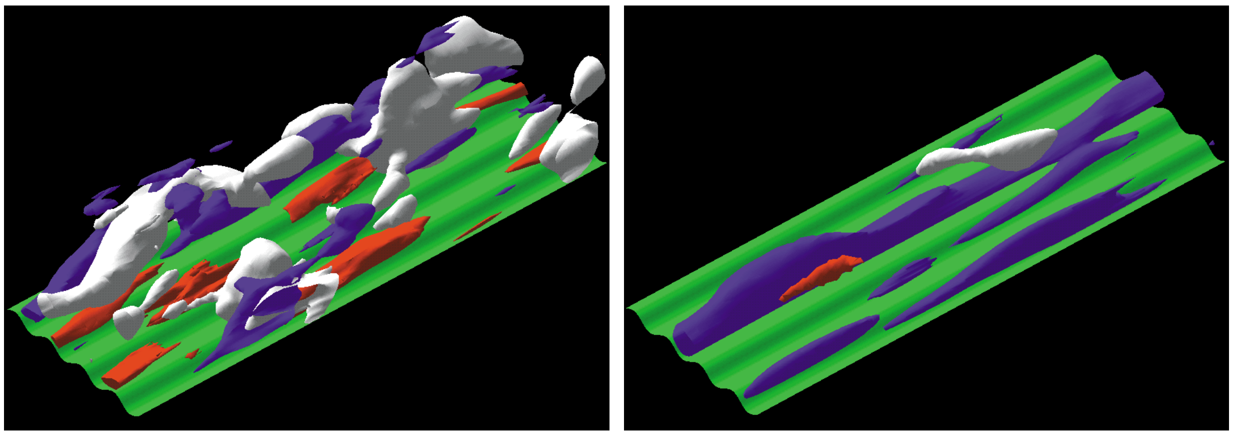


(a) At a large skin friction instant. (b) At a small skin friction instant.

3.1 Turbulent coherent structures in the plane channel at large and small skin friction instants. White: vortical structures, blue: low-speed streaks, red: high-speed regions, flow direction: left to right.



(a) At a large skin friction instant. (b) At a small skin friction instant.

3.2 Turbulent coherent structures on the deformed wall at large and small skin friction instants. Structures as in 3.1.

In pursuit of a possible active feedback turbulence control method utilizing a flexible wall, a simple oscillatory mode of wall deformation is tested in a turbulent channel flow using direct numerical simulation. The deformation is uniform in the streamwise direction and spatio-temporally sinusoidal. It is found that both regular and deformed channel flows exhibit a long-period fluctuation of the skin friction coefficient. 3.1 shows typical quasi-coherent turbulent structures observed in the plane channel in large and small skin friction phases, whilst 3.2 shows those on the deformed wall. The activity of turbulent structures becomes highly intermittent with wall deformation.

*Mito, Y. and Kasagi, N. (1998) : DNS study of turbulence modification with streamwise-uniform sinusoidal wall-oscillation, Int. J. Heat & Fluid Flow 19, pp. 470-481.

4. Numerical Simulation of Stably Stratified Flows over Topography

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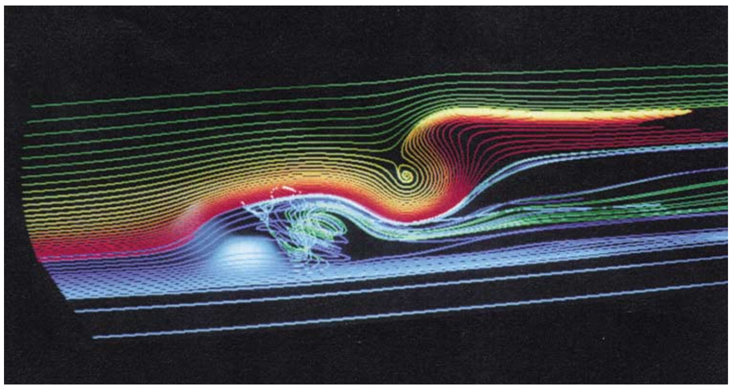
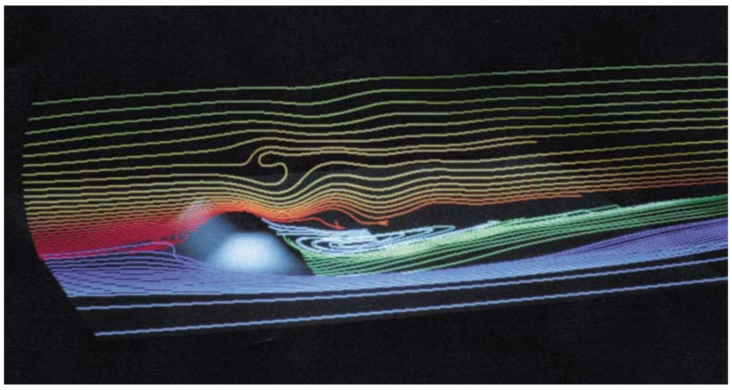
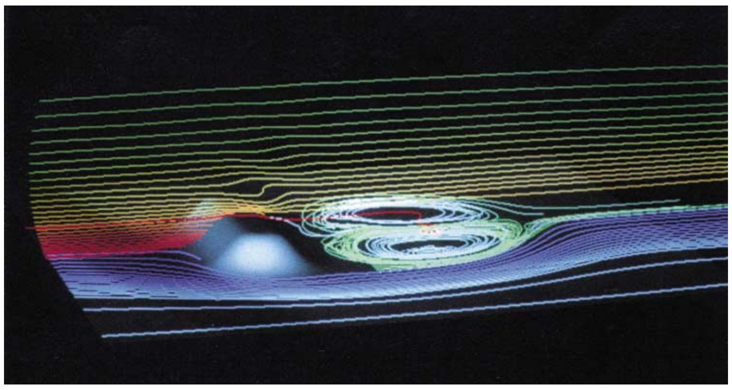


(a) Non-stratified flow (Fr=∞)



(b) Stratified flow (Fr=0.45)



(c) Stably stratified flow (Fr=0.2)
Instaneous streamlines

These figures show the numerical results of stably stratified flows over three-dimensional bell-shaped ridge at a Reynolds number Re=10,000 under various Froude numbers. The numerical model is based on a DNS using a Multi-Directional Finite-Difference Method (MDFDM). A coherent structure of eddies in the lee of the ridge is confirmed at a Froude number Fr=∞ (non-stratified flow). For the cases of Fr=0.45 and 0.2, the flow field around the ridge is dramatically altered by addition of stable stratification. At a Froude number Fr=0.45, a rotor is induced aloft of the ridge. At a Froude number Fr=0.2, most fluids rather go around the sides of the ridge horizontally than go over the top of it.

5. Visualization of the Turbulent Jet with Two-dimensional Discrete Wavelet Transform

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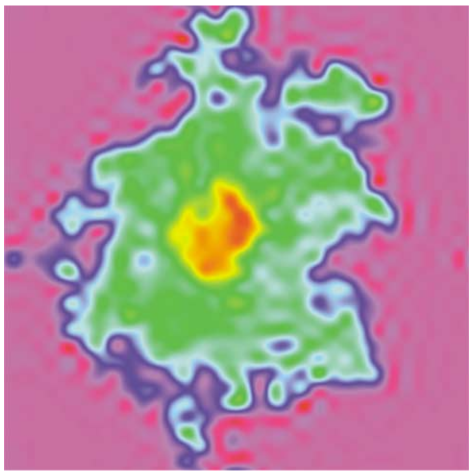
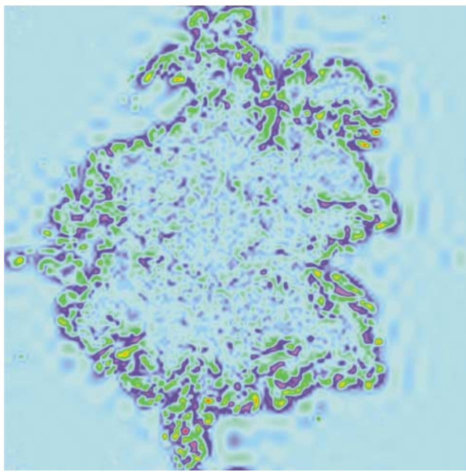
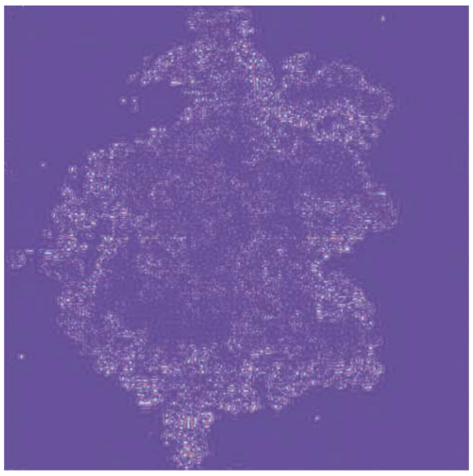


Scale 19~56 mm



Scale 5~19 mm



Scale 1~5 mm

The photographs show the multiresolution structure of a turbulent jet slice in far field (z/d=275) at Re=18×10³, which is obtained by decomposing the experimental image of the jet-fluid concentration with two-dimensional discrete wavelet transform with help of Daubechies' orthonormal wavelet bases of N=20. In these photographs, the highest concentration is displayed as a deep red and the lowest as purple. Blue in each signifies the zero value. These photographs provide further evidences of multi-scale structures in a turbulent jet, and show three ranges of important scales that dominate the energy-containing structure in the range of $\lambda \cong$ 19~56 mm, the turbulent mixing process in the shear layer with $\lambda \cong$ 5~19 mm and the smaller-scale structure at $\lambda \cong$ 1~5 mm, respectively.

6. 3-D simulation of Laser-Induced Cutting Process

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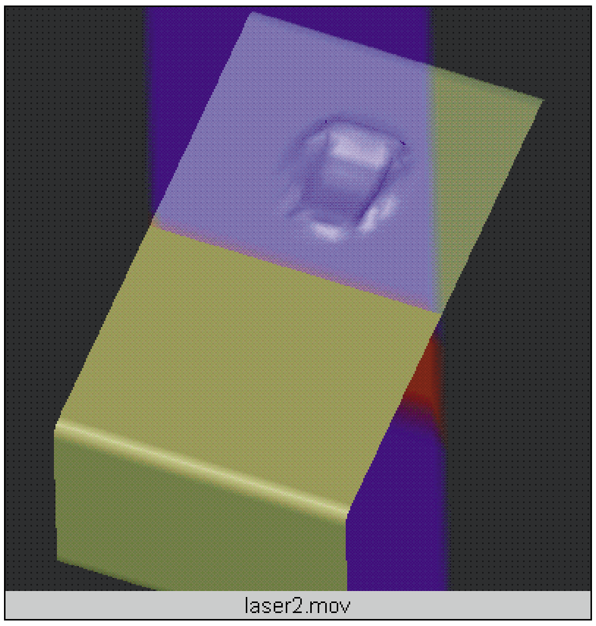

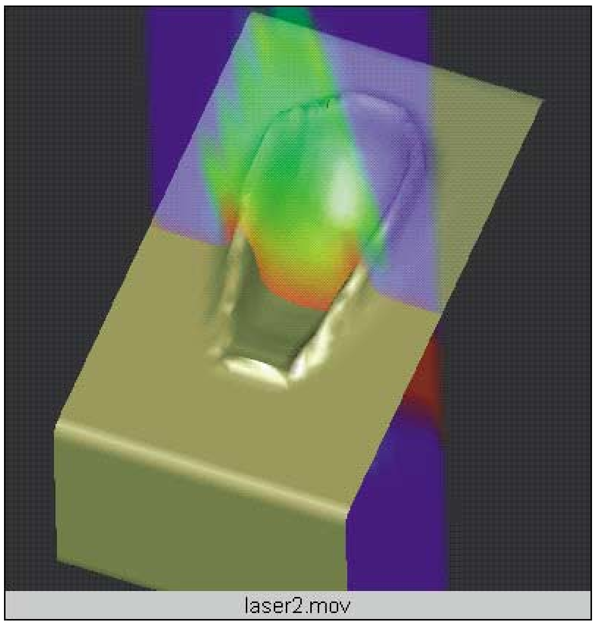

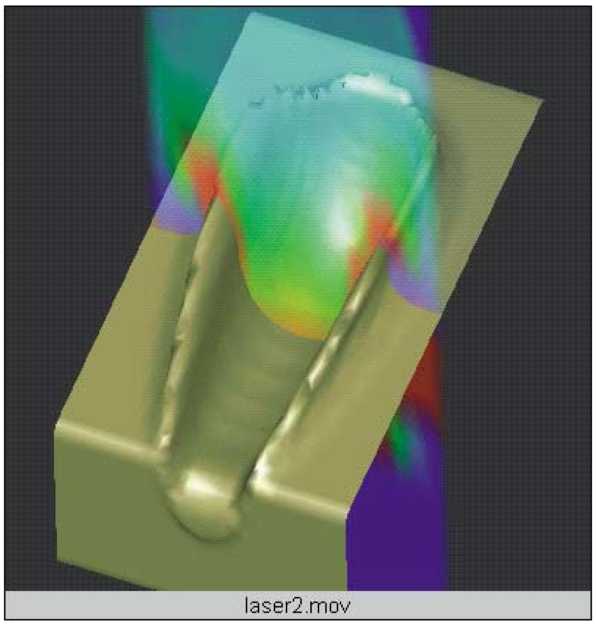

Acrylic block is being melted and evaporated under the illumination of laser light that is scanning over the acrylic surface in time. In the middle of the figure, we have shown a contour map of the evaporating gas. In this process, there exist three different phases like solid, liquid and gas which undergo phase transition. Therefore, these phases must be solved simultaneously by one unified algorithm. The CIP (Cubic-Interpolated Propagation) method has this ability with fixed Cartesian grid system and can treat the sharp interface having density ratio of more than 1000.