Preface

Importance of Visualization in Science and Technology

Oshima, M.

The 21st century has just started. Science and technology were dramatically advanced in the past century, probably far more advanced than anybody could have imagined. New discoveries were made and technologies were developed, which brought us rich and convenient life styles. There is no doubt that science and technology will continue to play an important role in the future. However, orientation of basic science in technology has changed and become more diversified. Industries based on technologies such as information or biology were rapidly developed around the turn of the century. These emerging technologies represent a paradigm shift from physics oriented technology to inter-disciplinary fields.

Due to advancement of new technologies, the way researchers tackle a problem is becoming different. Yet visualization is still a key to successful research in order to obtain real insights of phenomena. Journal of Visualization covers a wide range of research fields, and it has published prominent papers in the field of visualization over the years.

I am happy to present 9 papers and 6 frontispieces in this issue. This issue was organized with submitted papers in various aspects such as development of visualization techniques, visualization for better understanding of flow physics, and applications of visualization techniques in aeronautics, meteorology and combustion.

As a managing editor of this issue, I would like to extend my sincere appreciation to all the authors, reviewers and other people who helped organizing the journal. I hope the journal provides an opportunity to expand the horizon of research and contributes to future advancement of researches in visualization.

Managing Editor
Marie Oshima

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.

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Velocity Vectors and Vorticity Contours behind a Hatchback Car in a Plane Normal to the Mean Flow/Car Motion Vector

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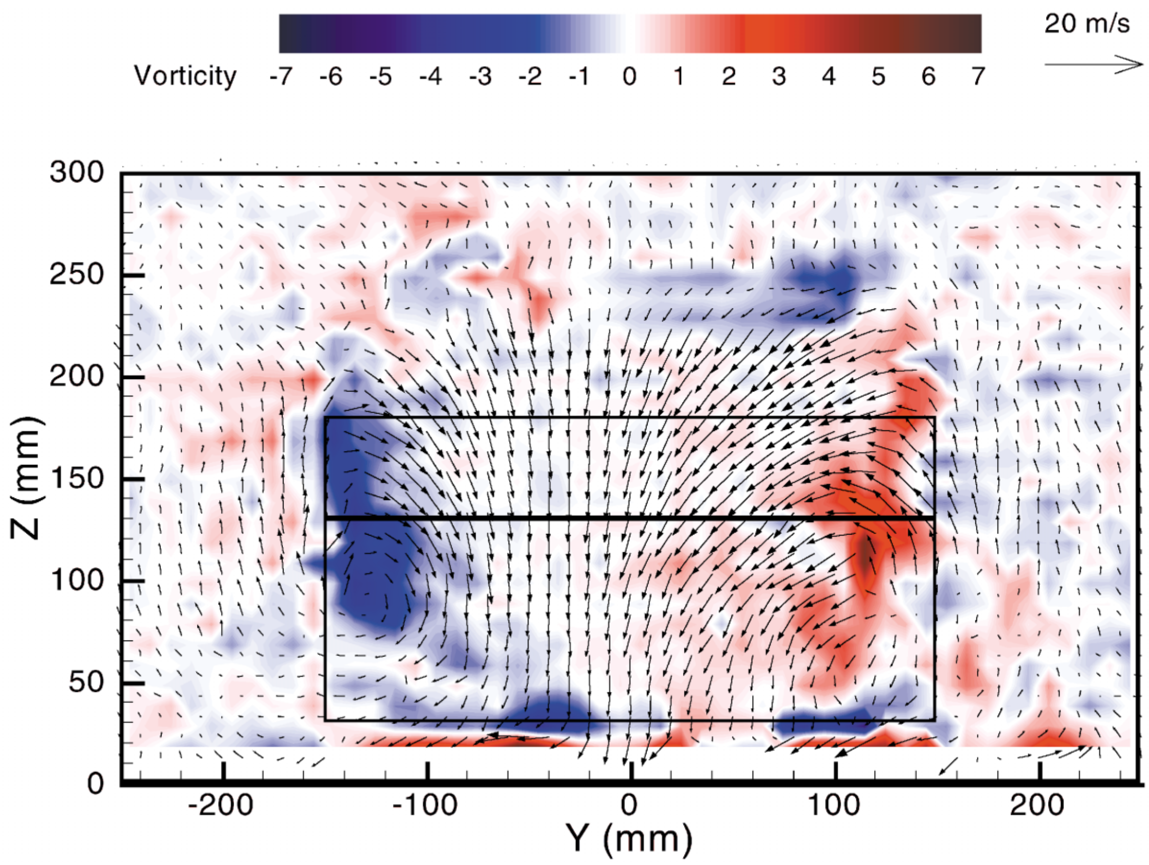

The figure shows vorticity contours and corresponding interpolated velocity vectors for a hatchback car measured in a plane normal to the mean flow. The data was collected at a wake survey plane 2.5 car heights behind the 'hatch'. The measurements show the instantaneous wake is not symmetric and is dominated by two time-dependent, counter rotating, primary, trailing vortices. The data was processed using custom software designed to compensate for through sheet motion and viewing angle.

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Visual Information in Accelerating Taylor-Couette Flow

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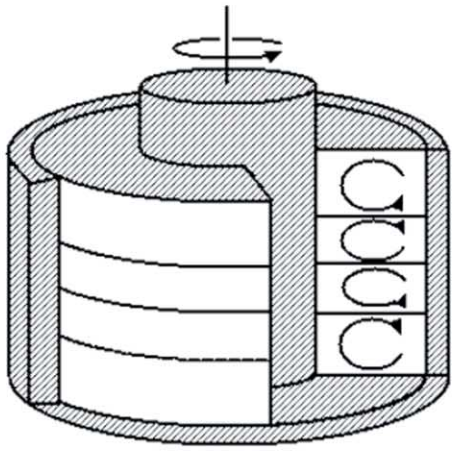
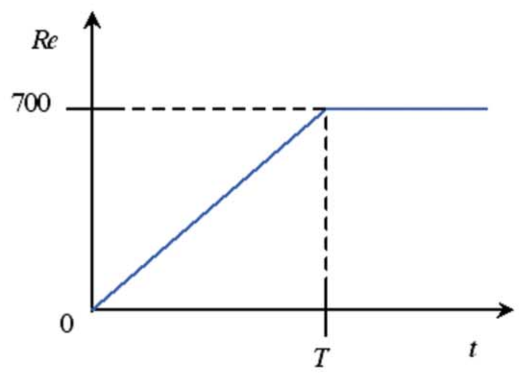
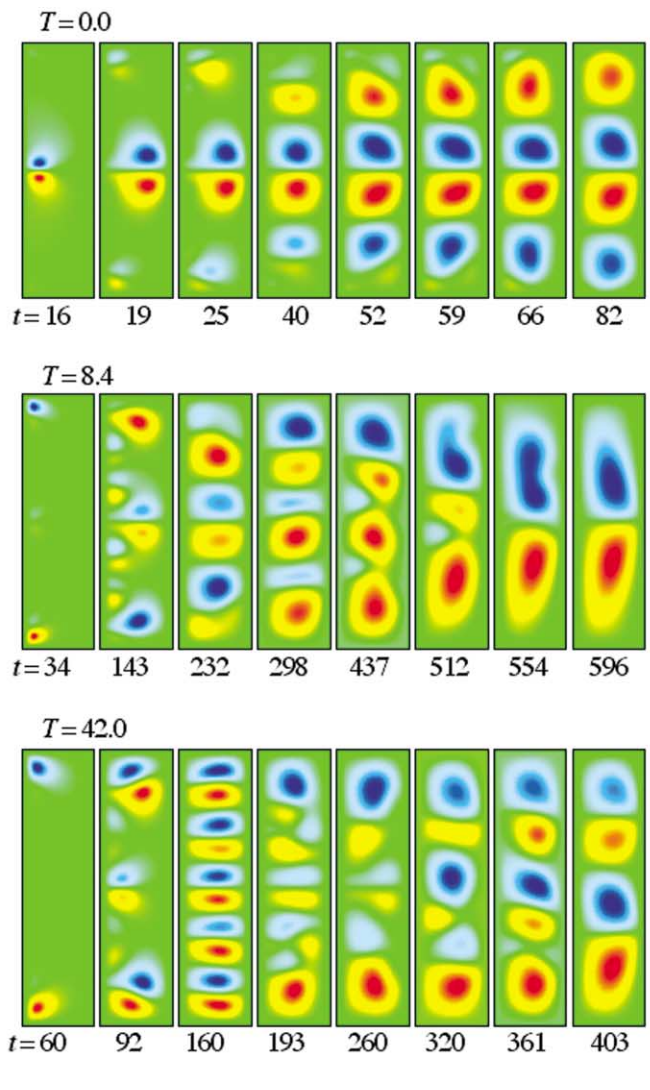


Taylor-Couette Flow and Counter-rotating Vortices.



Time Variation of the Reynolds Number in Accelerating Flows.



Taylor-Couette flow between two-concentric accelerated cylinders with finite length is investigated numerically. These figures give flow patterns in the meridional section. The rotating inner cylinder is on the left and the stationary outer cylinder is on the right. The warm color and cold color represent vortices rotating in a clockwise direction and counter-clockwise direction, respectively. The aspect ratio is 4.0 and the Reynolds number is 700. The non-dimensional time is *t* and the flow at rest is accelerated during time *T*. The differences of the acceleration time cause the non-unique patterns of Taylor-Couette flow.

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Investigation of Flow Separation on a Finite Span Wing by Liquid Crystal Coatings

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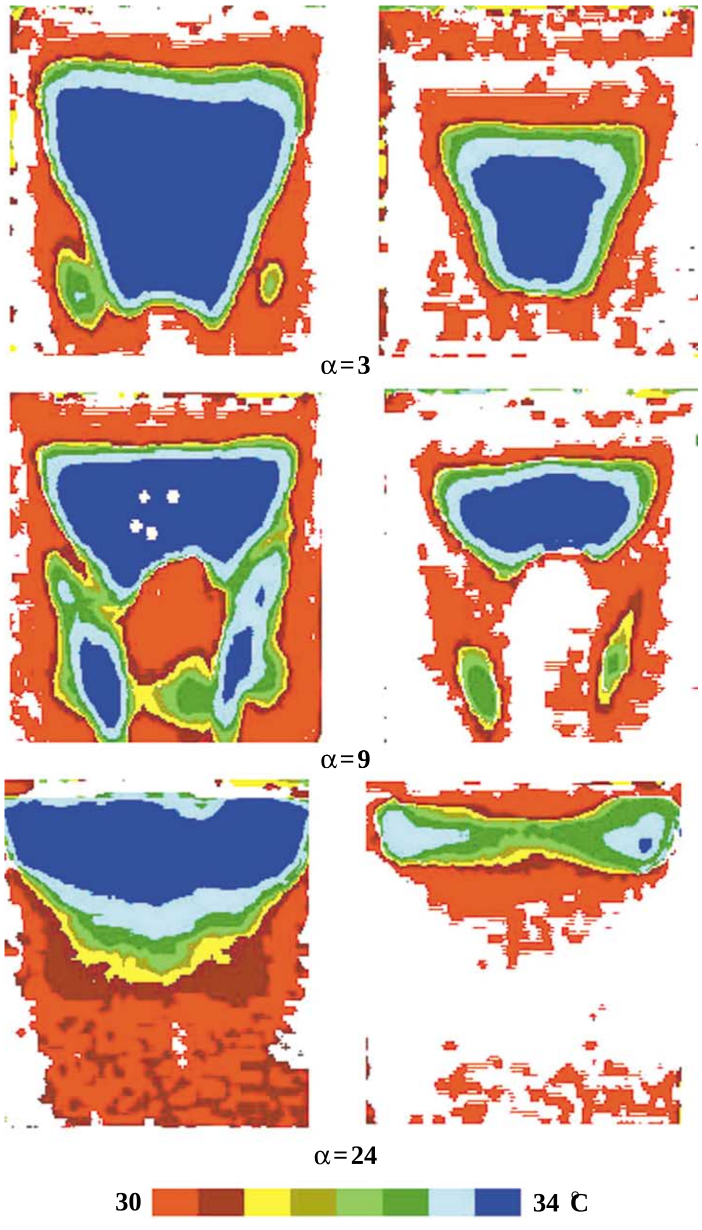

This is a map of the temperature distribution on the finite span wing surface during aerodynamic cooling for different angles of attack α. Left and right images are obtained in time by Liquid Crystal Thermography. $Re_c = 97000$. Flow direction is from the top to the bottom.

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Vortex Breakdown Produced in a Cylindrical Rotating End Wall*

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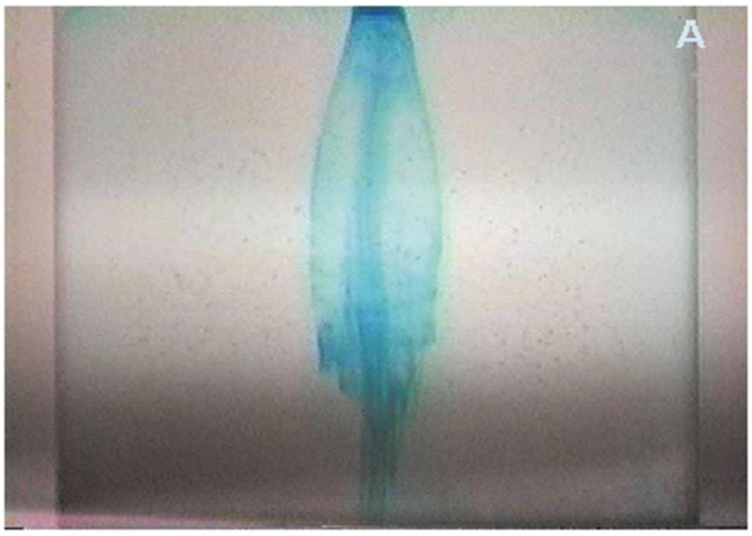

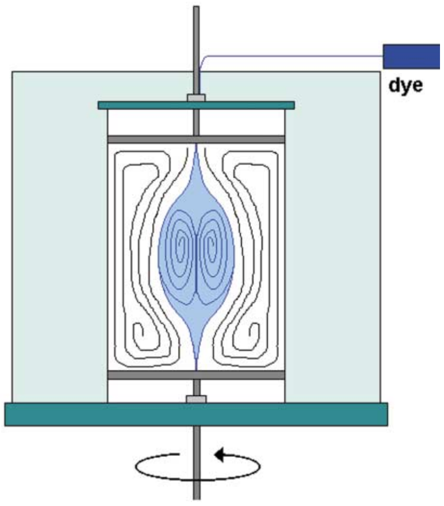

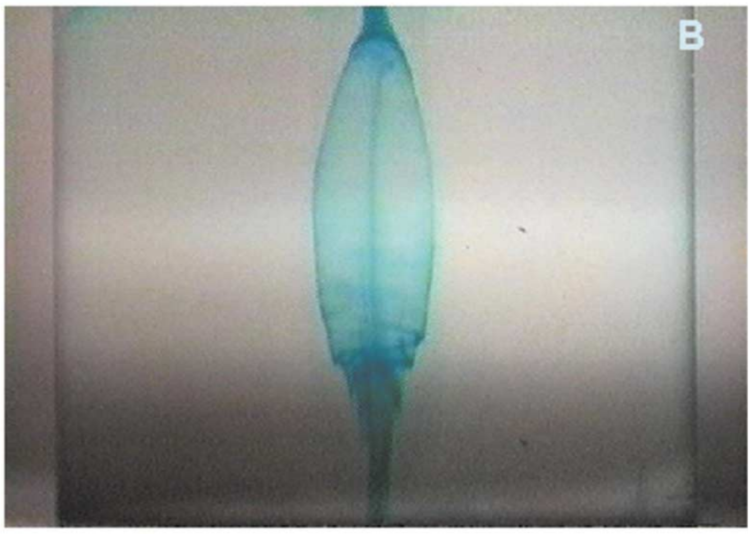

These figures show the flow structure (like a "bubble") produced in a cylindrical container with a rotating end wall. The fluid in the interior of the container is pumped and a vortex breakdown can be produced and revealed using a dye, as schematically represented beside. In this study, a mixture of water and glycerin composes a work fluid. The morphology of the bubble created in the work fluid (A) is highly sensitive to the presence of very small concentration of a polymer dissolved in the work fluid (B).

* More information: 9th International Symposium on Flow Visualization, Edinburgh - 2000 (paper number 258)

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Numerical and Experimental Visualizations of the Flow Inside an Induced Air Ejector

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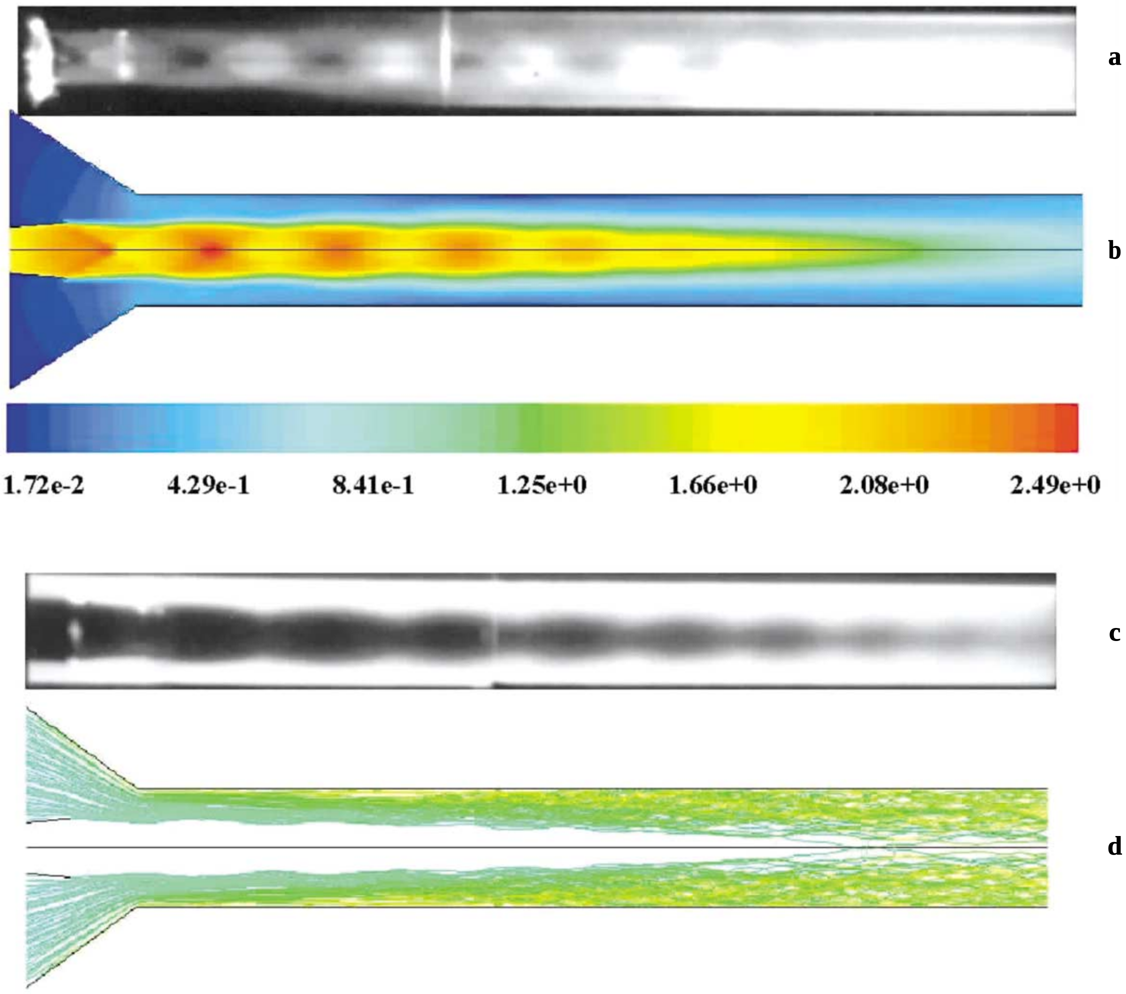

Laser tomography and numerical visualizations (CFD) were performed to study the interaction between the primary and secondary flows in a supersonic air ejector. The flow visualizations presented here are relative to the same operating conditions of the ejector (i.e. primary stagnation pressure of 5 bar and entrainment ratio of 0.43). The laser tomography shown on *image a* was achieved by illuminating the flow with a vertically polarized laser sheet. Tracers are sub-micronic water droplets (formed by condensation within the flow) which scatter in the Rayleigh regime. The shock structure which occurs in the supersonic jet downstream of a primary nozzle exit can be examined. The comparison with the iso-Mach number field achieved by CFD (*image b*) is in good accordance, especially for the shock cells locations. The visualization of the nonmixing zone can be obtained by illuminating the flow with a horizontally polarized laser sheet (to extinguish the Rayleigh scattering) and by adding Mie tracers (i.e. 1 μm oil droplets) in the secondary stream. The dark part of *image c* realized in these conditions corresponds to the primary jet portion which is not yet mixed with the secondary flow. A similar visualization of the nonmixing zone can be obtained numerically (*image d*) by plotting the trajectories of virtual particles dispersed in the secondary flow. These methods provide efficient tools for the optimized design of ejectors and mixers.

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Flow Field Investigations in Centrifugal Pumps with Simple Blade Curvature and Constant Impeller Width by Means of Digital Particle Image Velocimetry

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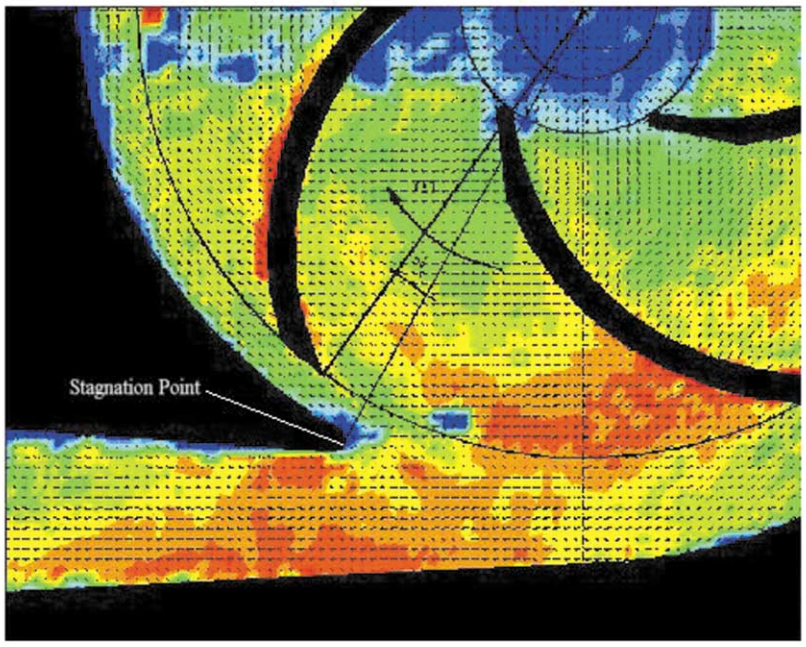


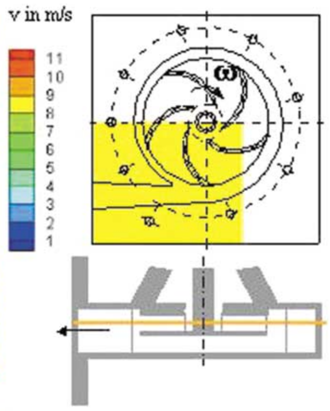
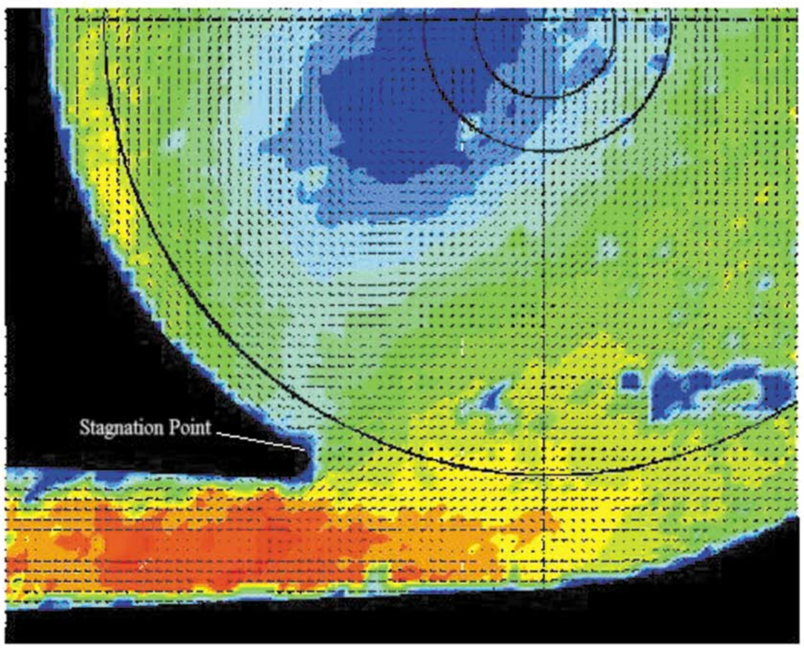


Fig. 1.
Isoplanes and orientation of the absolute velocity in mid section of the impeller of prototype pump SP100/5, operation point $Q/Q_{optn} = 1.43$, rotational speed $n = 2950\ min^{-1}$, rotational angle $\gamma = 9°$



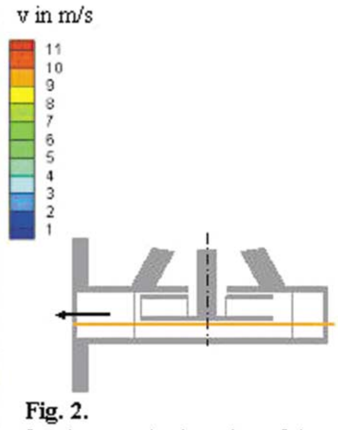


Fig. 2.
Isoplanes and orientation of the absolute velocity in the volute casing of prototype pump SP 100/5, impeller side space, 1 mm underneath the hub disk, operation point $Q/Q_{optn} = 1.43$, rotational speed $n = 2950\ min^{-1}$, rotational angle $\gamma = 9°$

Centrifugal pumps for photovoltaic pumping systems are applied in a wide operating range around their best efficiency point. This leads to different flow fields inside the pump, producing e.g. variations of the position of the stagnation point at the tongue. Moreover, at the same operating point, the flow field in different sections of the pump varies strongly. For increasing the pump efficiency, investigations of the flow inside the impeller and volute casing by means of digital particle image velocimetry are performed.