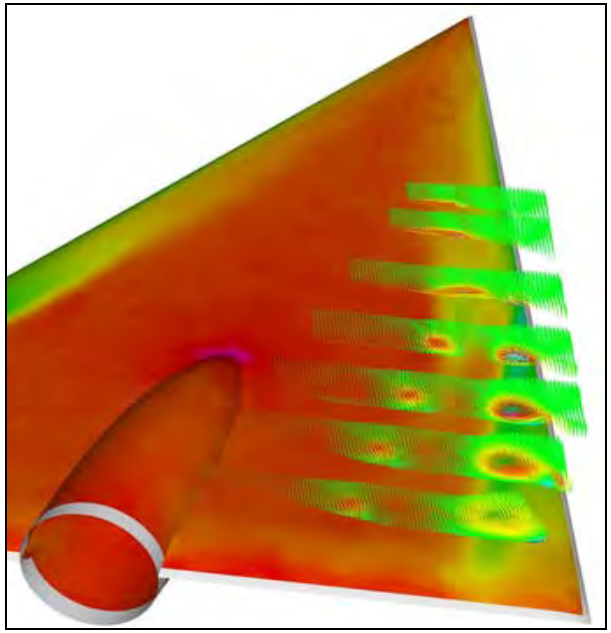
Application of
Pressure Sensitive Paint

- Theory and Practice -



Pressure distribution and velocity field of a 65° delta-wing model with
rounded leading edges at α=13°, Φ=0°, Ma=0.4, Re = 3 Mio,
measured by means of PSP and PIV at DNW-TWG
in the course of the second International Vortex Flow Experiment.

September 7 – 11, 2009

PSP course to be held at

DLR, Göttingen, Germany

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-Theory and Practice-

For investigations of pressure distributions on wind tunnel model surfaces with high spatial resolution new experimental techniques, such as Pressure Sensitive Paint (PSP) are required. Using this non- intrusive optical pressure measurement technique, spatial structures and/or rapid temporal or spatial changes of aerodynamic phenomena (transition from laminar to turbulent flow, coherent structures, pitching airfoils in transonic flows with shocks, rotors, test facilities with short run time and different flow temperature etc.) can be investigated. Recently an increasing number of scientists and engineers have started to utilise the PSP technique to investigate pressure distributions from low speed up to hypersonic and cryogenic wind tunnels as well as in turbo machines. The PSP technique has also expanded from the measurement of steady state pressures to include both periodic and unsteady phenomena to study the instantaneous structure of pressure fields in various areas of fluid mechanics. A number of different approaches for paint development, recording and evaluation of PSP images have been described in the literature. This course, which is the third one on PSP organised by DLR Göttingen, Germany, will mainly concentrate on both industrial measurement techniques as well as aspects of the theory of PSP relevant to applications. In addition to lectures on the fundamental aspects of Pressure Sensitive Paint Systems, special emphasis is placed on the presentation of practical and reliable solutions for problems faced during the implementation of the technique in wind tunnels and other test facilities. During practical sessions on the course, participants will have the opportunity to carry out experiments on paint characterisation, coating technique, and the recording and evaluation of PSP data in small groups. Recent developments of the PSP technique such as PSP for unsteady applications and 360° PSP systems for calculation of forces and moments will be discussed and demonstrated.

Lecturers

Prof. Keisuke Asai or Assistant Prof. Hiroki Nagai, Tohoku University, Sendai, Japan, both having several years of experience in the field of PSP/TSP measurements and paint development, will present lectures on lifetime imaging technique and PSP/TSP for micro devices.
Dr. Vlado Ondrus, Universität Hohenheim, Germany, will discuss chemical aspects and development of the paint in his lecture.
Marie-Claire Merienne from ONERA, Meudon, France, who works for more than 10 years in the field of PSP development, will give detailed information about advanced techniques like corrections for self illumination, temperature etc. and will speak about unsteady PSP.
Alan Davies from BAE Systems, United Kingdom, will present basics and practical aspects of the point-wise lifetime scanning system.
Dr. Youssef Mebarki, National Research Council, Canada, will present a theoretical background on the Pressure Sensitive Paint. He will also present some data fusion for enhanced flow visualizations of PSP results. Dr. Ulrich Henne, Institute of Aerodynamics and Flow Technology, DLR, Göttingen, will organise the PSP course. Dr. Rolf H. Engler, who is performing research and development in PSP for more than 15 years will start the lectures with a general overview of the existing PSP systems and techniques. Together with Dr. Uwe Fey, Dr. Christian Klein, Dr. Robert Konrath, and Dr. Werner Sachs they will present their knowledge and experience in different areas of the PSP technique such as calibration techniques, CCD-cameras, recording, evaluation, data presentation, combination of PSP with other techniques, unsteady PSP, and calculation of loads using PSP.

Course Outline

(Preliminary)

Monday, September 7, 2009

Registration, Welcome by Dr. Jürgen Kompenhans, Head of Department Experimental Methods of the DLR Institute of Aerodynamics and Flow Technology.
Principles of PSP technique: General overview, physical and historical background, existing systems, paint types and properties, intensity system and data evaluation, theoretical basis for PSP, light sources.

Tuesday, September 8, 2009

Principles: Camera systems, lifetime method, advanced techniques (from angular effects, deformation to pixel wise calibration).
Applications: Lifetime imaging and PSP/TSP for microdevices.
Practice I.

Wednesday, September 9, 2009

Principles: Basics of unsteady PSP
Applications: Unsteady PSP measurements at ONERA and DLR, enhanced flow visualisation of PSP results.
Practice II.

Thursday, September 10, 2009

Applications: Combination of PSP and PIV in VFE-2.
Practice III and Practice IV.

Friday, September 11, 2009

Practice V.
Future aspects of PSP technique, final discussion and assessment.

Practice

(Preliminary)

PSP coating procedure, characterisation of paint samples, adjustment and data acquisition, lifetime scanning system, data evaluation.

General Information

The latest information about the course may be found at http://pspcourse.dlr.de.

Course Materials

A complete set of course notes will be distributed to the participants at registration.

Program Schedule

Registration will begin at 8:00 on Monday, September 7, 2009 in the Lecture Room of Building 7. Lectures (4 half days) and experiments and demonstrations in the laboratory (5 half days) will run from 8:30 to 12:00 from Monday to Friday and from 13:30 to 17:00 from Monday to Thursday, respectively. All presentations will be given in English. The course will end on Friday 14:00.

Course Registration

Preregistration is required due to limited number of places in the laboratory. *Online registration at* http://pspcourse.dlr.de *is desired*. The registration fee of 950 EURO includes course notes, lunches and refreshments during the course. For payments received before August 1, 2009, a reduced registration fee of 850 EURO applies. The fee for participation is free of VAT as far as the German Umsatzsteuergesetz (UStG) is concerned. The organisers reserve the right to cancel the course in case of insufficient registration. A cancellation fee of 200€ will be charged from registered persons who cancel their participation after August 15, 2009.

Additional Information

For additional information about the course contact:

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Who should attend?

This course is mainly intended for engineers, scientists and students, who may have already some basic knowledge of the PSP technique and have just started to utilise PSP for their special industrial or scientific applications or plan to do so in near future. During the course many problems arising in the recording and evaluation of PSP images will be treated – in theory as well as in practice.

organised by DLR (German Aerospace Center)

in cooperation with

Tohoku University, University of Hohenheim, ONERA, BAE Systems, and National Research Council Canada