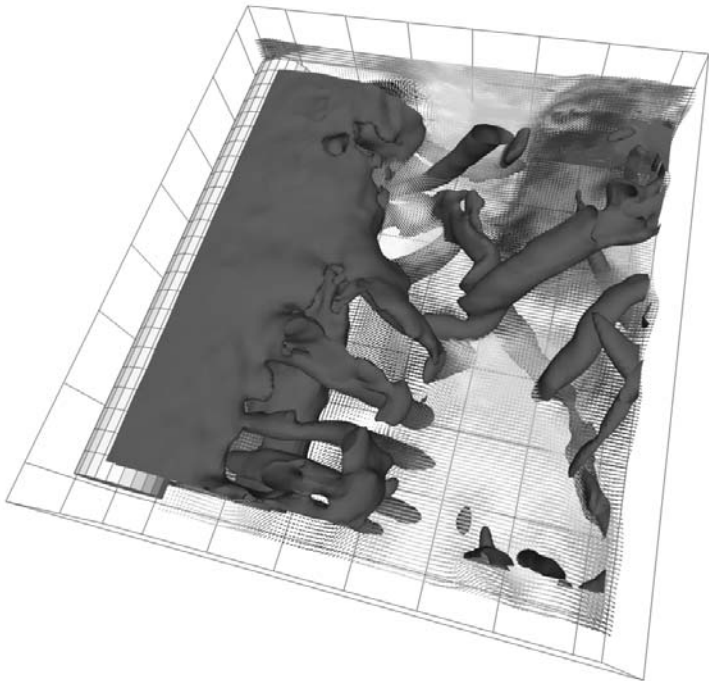




**von KARMAN INSTITUTE
FOR FLUID DYNAMICS**

RECENT ADVANCES IN PARTICLE IMAGE VELOCIMETRY



January 26-30, 2009

	von Karman Institute for Fluid Dynamics 72, Chaussée de Waterloo 1640 Rhode-Saint-Genèse, Belgium
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INTRODUCTION

Particle Image Velocimetry (PIV) has appeared 25 years ago and since the beginning it has drastically improved in all fields. At the same time this technique becomes more and more utilized in fluid dynamic laboratories from research institutes and industry and it is used in a very large range of applications. After its first appearance in the laboratories, the PIV technique has benefited of the progress in the LASER technologies as well as electronic image recording, which considerably enhanced its potential. PIV has also taken advantage of several developments made in the processing algorithms in these two decades. This spectacular evolution has been largely supported through European collaborative projects such as EuroPIV and PivNet.

This Lecture Series aims at presenting the most recent advances and the current state-of-the-art of PIV as well as the perspectives for further developments from the current work of the teams involved.

The Lecture Series is organized into several sections.

The first one will be an introductory course presenting, as a reminder, the fundamental concepts of Particle Image Velocimetry with information on flow seeding, illumination techniques and planar measurements of 3 velocity components.

Then, a large emphasis will be given to novel processing algorithms for time-resolved and 3D methods such as Tomographic PIV and special algorithms for robust analysis such as the ensemble correlation or the adaptive interrogation technique. The state-of-the-art of specific PIV techniques such as micro-PIV and high-resolution PIV measurements at large distance will be discussed along with the presentation of typical applications. Specific courses devoted to the application of PIV in industrial wind tunnels, in combustion and multiphase flows will give a broad coverage of the current measurement capabilities in these domains of application.

Finally, novel approaches based on the PIV technique to measure the wall flow properties such as pressure and shear stress will be presented.

This course should be a good opportunity for researchers and scientists to have a direct contact with the latest progress of the technique and to be able to discuss with the best specialists of the domain. The Lecture Series should therefore prove fruitful to both newcomers to Particle Image Velocimetry and experienced researchers who will find here a useful update.

The Directors of this Lecture Series are Prof. Fulvio Scarano, TU Delft, and Prof. Michel Riethmuller, von Karman Institute.

TIMETABLE

MONDAY JANUARY 26

- 08:45 **Registration**
09:15 **Welcome and introduction**
09:30 **Fundamental concepts (introduction, tracers, illumination, imaging, 2C, 3C)**
Prof. J. Westerweel, Laboratory for Aero & Hydrodynamics, The Netherlands
- 11:00 **Fundamental concepts (Cont'd)**
Prof. J. Westerweel

- 14:00 **Advanced PIV image analysis (pre-processing, interrogation methods, ensemble correlation)**
Dr C. Willert, DLR, Germany
- 15:45 **Advanced methods (Cont'd)**
Dr C. Willert
- 17:00 **Reception**

TUESDAY JANUARY 27

- 09:00 **Time resolved PIV: systems, interrogation algorithms and applications**
Prof. C. Kaehler, Universität der Bundeswehr München, Germany
- 10:45 **Error analysis: sub-pixel precision, spatial resolution**
Dr B. Lecordier, Université et INSA de Rouen, France
- 14:00 **3D PIV techniques: scanning light sheet, tomography**
Prof. F. Scarano, Delft University of Technology, The Netherlands
- 15:45 **3D PIV techniques: scanning light sheet, tomography (Cont'd)**
Prof. F. Scarano

WEDNESDAY JANUARY 28

- 09:00 **PIV techniques for micro-fluidics**
Prof. J. Westerweel
- 10:45 **High-resolution measurements by long-range microPIV**
Prof. C. Kaehler
- 14:00 **PIV in combustion and multiphase flows**
Dr B. Lecordier
- 15:45 **Visit of the VKI laboratories**

THURSDAY JANUARY 29

- 09:00 **PIV-based forces and pressure measurements**
Dr B. van Oudheusden, Delft University of Technology, The Netherlands
- 10:45 **PIV applications in industrial wind tunnels**
Prof. M. Raffel, DLR, Germany
- 14:00 **PIV-based wall-shear stress measurements (micro-pillars, mirror-images)**
Prof. C. Bruecker, TU-Bergakademie Freiberg
- 15:45 **PIV-based wall-shear stress measurements (micro-pillars, mirror-images) (Cont'd)**
Prof. C. Bruecker

FRIDAY JANUARY 30

- 9:00 **Adaptive-resolution interrogation algorithms**
Mr R. Theunissen, von Karman Institute, Belgium
- 10:45 **Treatment of fluid-solid interfaces**
Mr R. Theunissen
- 14:00 **Departure of VKI bus**

PRACTICAL INFORMATION

Lunch will be taken from 12h30 to 14h00. Coffee breaks are scheduled each morning and afternoon.

APPLICATION FOR ADMISSION TO VKI LECTURE SERIES

Lecture Series Title: RECENT ADVANCES IN PARTICLE IMAGE VELOCIMETRY

☐ Mr ☐ Mrs

Family name: Firstname: Nationality:

Name & full address of organisation, institution or university:
Phone n°: Fax n°:
Position or title: E-mail:

☐ Asking a reduced fee and joining a recommendation letter as: ☐ undergraduate student ☐ Ph.D. candidate or University assistant
Company / University VAT number:
VAT of the von Karman Institute: BE 0407 185 709

HOTEL RESERVATION (if applicable)

I require accommodation at Hotel for person(s)
Single: Double:
I shall require transport to and from the Institute
I do not require transport to and from the Institute ☐
Please indicate any special needs (e.g. vegetarian, ...):
Date: Signature:

ACCOMMODATION & TRANSPORT

Participants are advised to make their reservations as early as possible. VKI secretariat (secretariat@vki.ac.be) can book rooms upon request in the recommended hotels listed below. Daily rates include all charges and continental breakfast. These prices could be subject to changes. **However, participants could occasionally find special offers on hotel websites.**

Hôtel des Colonies http://www.hotel-des-colonies.com	Single: 120 € / Double: 140 €
Hôtel Vendôme http://www.hotel-vendome.be	see the website
Hôtel Marivaux http://www.marivaux.be	see the website
Thon Hotel Brussels City Centre http://www.thonhotels.be/	Single: 142 € / Double: 174 €
Hôtel Le Dôme http://www.hotel-le-dome.be	Single: 125 € / Double: 145 €
Progress Hôtel http://www.progresshotel.be	Single: 200 € / Double: 220 €

A youth hostel, the Sleepwell, is within walking distance of the recommended hotels. We invite you to make your own reservation through their website: http://www.sleepwell.be.

The hotels situated in Brussels are all within walking distance from the Place Rogier. A train service links the airport with the Gare du Midi. Complete your journey to the hotel/youth hostel by taxi. Each morning and evening, bus transport will be provided between the Place Rogier and the von Karman Institute, located in Rhode-Saint-Genèse, a suburb south of Brussels.

The following hotels are also recommended, particularly for those who travel by private car.

Auberge de Waterloo****
Chaussée de Waterloo 212 - 1640 Rhode-Saint-Genèse
Tel: +32 (0)2 358 35 80 - Fax : +32 (0)2 358 38 06
http://www.aubergedewaterloo.be
(1single room: +/- 106€)

Gravenhof Hotel
Alsebergsesteenweg 616 - B-1653 Dworp
Tel: +32 2 380 44 99 - Fax: +32 2 380 40 60
http://www.gravenhof.be
(1 single room: +/- 105 €, breakfast not included)

For more information about the location of the Institute and the hotels, please visit our website on http://www.vki.ac.be.

COURSE FEE

The fee for the lecture series is 1300 euro, applicable to citizens of NATO countries contributing to the financing of the VKI (Belgium, Czech Republic, France, Germany, Hungary, Iceland, Italy, Luxemburg, Norway, Portugal, Spain and Turkey). For citizens of other NATO countries and of NATO partner countries, the fee is 1700 euro. For non-NATO citizens the fee is of 1850 euro. These prices include 21% VAT.

The fee includes printed notes, transport between VKI from and to the recommended hotels in the center of Brussels, lunches, beverages, and administrative costs.

FELLOWSHIPS

To encourage greater participation in our Lecture Series programme by university members, the Institute has established a limited number of VKI Lecture Series fellowships for citizens of NATO countries contributing to the financing of the VKI, as well as for citizens of other NATO countries coming from a university in a VKI financing country. The recipient of such fellowship is entitled to attend the Lecture Series at a reduced fee, which will be of 650 euro (VAT included) for assistants not having a Ph.D. degree and for Ph.D. candidates, or 300 euro (VAT included) for undergraduate students. The request to be considered for an award must accompany the application to attend the Lecture Series, and the applicant must provide a recommendation letter from his or her professor; if not done so, the request will not be taken into consideration. All possible alternative sources of funding should be investigated before aid is requested under this scheme, so that those most in need will benefit.

METHODS OF PAYMENT

Payment 2 weeks prior to the beginning of the course (name and course title clearly indicated) by bank transfer to our account Nr 210-0315330-35 at Fortis Bank, avenue de la Forêt de Soignes 322, 1640 Rhode-Saint-Genèse, Belgium, IBAN BE57 2100 3153 3035 (strongly recommended). SWIFT BIC GEBABEBB.

Late registration can be paid in cash (EURO), or by VISA or Eurocard at the beginning of the course.

PROCEEDINGS

Lectures will be given in English and printed notes will be distributed during registration. Proceedings of other non-RTO lecture series may be purchased at VKI (by e-mail: vanhaelen@vki.ac.be or by fax : 32 2 359 96 00). Information can be found on http://www.vki.ac.be.

HOW TO REGISTER

It is highly recommended that the registration/hotel reservation form is sent at the latest 15 days before the beginning of the course. A letter of acceptance and additional information will be sent on receipt of the application form.



- ☐ INTRODUCTION TO CFD
(12-16 JANUARY 2009)
- ☐ ADVANCES IN LAMINAR-TURBULENT TRANSITION MODELING
(12-15 JANUARY 2009 - AT THE WRIGHT STATE UNIVERSITY, OHIO, USA)
- ☒ RECENT ADVANCES IN PARTICLE IMAGE VELOCIMETRY
(26-30 JANUARY 2009)
- ☐ MODELING AND COMPUTATION OF NANOPARTICLES IN FLUID FLOWS (RTO-AVT-VKI)
(9-12 FEBRUARY 2009)
- ☐ FLOW CONTROL: FUNDAMENTALS, ADVANCES AND APPLICATIONS
(2-6 MARCH 2009)
- ☐ AERODYNAMIC NOISE FROM WALL-BOUNDED FLOWS
(9-13 MARCH 2009)
- ☐ LIQUID FRAGMENTATION IN HIGH-SPEED FLOW
(16-18 MARCH 2009)
- ☐ NUMERICAL INVESTIGATIONS IN TURBOMACHINERY: THE STATE OF THE ART
(20-24 APRIL 2009)
- ☐ HIGH PERFORMANCE COMPUTING OF INDUSTRIAL FLOWS
(5-7 MAY 2009)
- ☐ ADVANCED HIGH TEMPERATURE INSTRUMENTATION FOR GAS TURBINE APPLICATIONS
(11-14 MAY 2009)
- ☐ TURBULENT COMBUSTION
(25-29 MAY 2009)
- ☐ 36TH CFD.ADIGMA COURSE ON VERY HIGH ORDER DISCRETIZATION METHODS
(JUNE 8-12, 2009)

OTHER CONFERENCES:

- ☐ PHYSMOD 2009: INTERNATIONAL WORKSHOP ON PHYSICAL MODELLING OF FLOW AND DISPERSION PHENOMENA
(24-26 AUGUST 2009)
- ☐ 4TH SYMPOSIUM ON INTEGRATION CFD AND EXPERIMENTS IN AERODYNAMICS
(14-16 SEPTEMBER 2009)



Please mail under -cover to VKI