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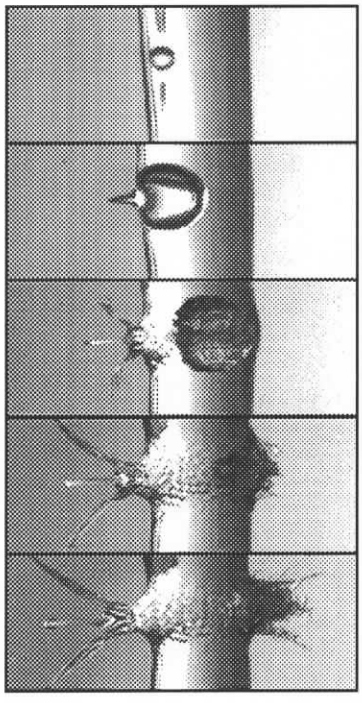

ERCOFTAC bulletin

64
March 2005

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ADDRESS:
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ERCOFTAC C.C.
EPFL STI ISE ERCOFTAC
ME B2 495, Station 9
CH-1015 Lausanne
Tel: +41.21.693.5305
Fax: +41.21.693.5307
E-Mail: ercoftac@epfl.ch
http://www.ercoftac.org

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FRONT COVER PICTURE:
Frame sequence illustrating the dynamic of a laser generated bubble inside a water jet and its interaction with the free surface. The governing parameters are the bubble excentricity and the ratio of its maximum radius over the jet diameter. Courtesy E. Robert, M. Farhat, F. Avellan, Laboratory of Hydraulic Machines, EPFL, Lausanne, Switzerland.

Call for contributions

Deadline for submission of papers, announcements, letter to the editor

July 20, 2005

Next issue scheduled for September 2005

ERCOFTAC Workshop

Direct and Large-Eddy Simulation 6

- DLES 6 -

September 12-14, 2005, Poitiers - Futuroscope, France

General information:

After Surrey in 1994, Grenoble in 1996, Cambridge in 1999, Enschede in 2001 and Munich in 2003, the 6th Workshop, DLES6, will be held in Poitiers, again under the auspices of ERCOFTAC. Following the spirit of the series, the goal of this latest workshop is to establish a state-of-the-art of DNS and LES techniques for the computation and modeling of transitional/turbulent flows covering a broad scope of topics such as aerodynamics, acoustics, combustion and geophysics. This gathering of specialists in the field should once again be a unique opportunity for discussions about the more recent advances in the prediction, understanding and control of turbulent flows in academic or industrial situations.

In order to guarantee your accommodation during this three-day workshop you should register before June 1st, 2005 and make your hotel reservation. Further details about deadlines, registration, hotel reservation, abstract/paper submission and travel information can be found on the web site.

ORGANIZING COMMITTEE:

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Bernard J. Geurts (University of Twente, QMW)
Olivier Métais (University of Grenoble)
Eric Lamballais (University of Poitiers)
Jean-Paul Bonnet (University of Poitiers)

INVITED SPEAKERS:

Vicenzo Armenio (University of Trieste, Italy)
Christophe Bailly (ECL, France)
Sanjoy Banerjee (UCSB, USA)
John Kim (UCLA, USA)
Petros Koumoutsakos (ETH Zurich, Switzerland)
Dominique Laurence (EDF/UMIST, France/UK)
Christos Vassilicos (Imperial College, UK)
Luc Vervisch (INSA, France)

DEADLINES:

March 1, 2005: Submission of two-pages abstract
May 2, 2005: Authors notified of acceptance
June 1, 2005: Advance Registration
August 1, 2005: Submission of 8-pages manuscript

PUBLICATION:

Proceedings will appear in the Kluwer ERCOFTAC SERIES

FEES:

EUR 300, EUR 150 (Ph.D. students
After June 1st, 2005 : Higher rates

CONTACT INFORMATION – LOCAL ORGANIZATION:

DLES6-SECRETARY
Laboratoire d'Etudes Aérodynamiques - UMR 6609 CNRS
Boulevard Marie et Pierre Curie
Téléport 2 - BP 30179
F-86962 FUTUROSCOPE CHASSENEUIL Cedex
France.

Fax : +33 5 49 49 69 68
E-Mail: dles6@lea-spi.univ-poitiers.fr
Web : http://www.dles6.ceat.univ-poitiers.fr/

HOMAGE TO

ROLF KARLSSON

1945-2004

Professor Rolf Karlsson of Sweden has passed away, 59 years old.

Rolf got his basic engineering training at Chalmers Institute of Technology in Gothenburg and received his doctoral degree there in 1980 on a thesis on friction effects in turbulent boundary layers. The same year he was appointed to a position at the Vattenfall laboratories at Älvkarleby (later Vattenfall Utveckling AB). His first assignment dealt with friction in hydro power systems but he got soon involved with flow problems in nuclear power plants and other industrial systems. Rolf developed great skills and experience with, in particular, the LDV technique and he became the leading Swedish expert on this methodology. His basic attitude that no problem was too difficult led him to apply the LDV technique, from small electrochemical cells to large hydro power plants. In his research, Rolf combined boldness in approach with a strong ambition to a physical understanding of the involved mechanisms. This, in combination with a strong persistence and thoroughness, made his work of lasting importance, as exemplified by the ERCOFTAC test case on the wall jet.

Rolf's expertise and interests also gave him an international platform. He was scientific advisor for the annual Lisboa conference "Applications of Laser Techniques to Fluid Mechanics", member of ERCOFTAC's scientific program committee and active in several of IAHR's working groups. Of his international commitments his important contributions to "Best Practice Guidelines" for CFD simulations will have a lasting impact.

In Sweden, Rolf was heavily involved with academic research as adjoint professor, first at KTH and thereafter at Chalmers. At KTH he was for almost ten years chairman of the Faxén laboratory, a strong research centre on fluid mechanics of industrial processes, financed by industry and government. He was also active in the formation of a national Swedish program on energy-related flows and crucial in the initiation of the successful Turbine-99 workshops.

With Rolf Karlsson's decease, the fluids community has lost one of its most experienced and skilled members. We, who had the privilege to know and work with Rolf, have lost an esteemed colleague and a true friend.

Håkan Gustavsson
Luleå University of Technology, Sweden

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An International Journal Published in Association with ERCOFTAC

Board of Editors: J.C.R. Hunt, F.T.M. Nieuwstadt, L. Vervisch & W. Rodi

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REPORT ON THE J.M. BURGERS CENTRE/ ERCOFTAC SUMMERSCHOOL ON MATHEMATICAL TECHNIQUES AND TOOLS FOR DATA ANALYSIS AND MODELLING OF INTERMITTENT STRUCTURES

23 - 27 JUNE 2003, LORENTZ CENTRE, LEIDEN, THE NETHERLANDS

B. Hof and F.T.M. Nieuwstadt

Laboratory of Aero and Hydrodynamics, Delft University of Technology, The Netherlands

The workshop brought together 35 scientists from 7 different countries. The program consisted of 8 three hour presentations (one in the morning and one in the afternoon) introducing the participants to mathematical techniques to extract structural information from complex fluid flows. The lectures and lecturers were

- Proper Orthogonal Decomposition (J. Delville)
- Linear Stochastic estimation (S. Balachandar)
- Continuous Wavelets and Data Analysis (J. Lewalle)
- Flow topology (J.C.R. Hunt)
- Wavelet Methods for Coherent Vortex Extraction (M. Farge)
- Localized structures in laminar and turbulent flows (T. Bohr)
- The Fractal Structure of Turbulent Diffusion (C. Vassilicos)
- Intermittency and Similarity in Turbulence (W. van de Water

These analysis techniques discussed included proper orthogonal decomposition, linear stochastic estimation, wavelet transforms, correlation and structure functions. The talks stimulated lively discussions about the applications and limitations of the particular techniques. One of the main merits of the workshop was to bring together scientists from engineering, physics and mathematical backgrounds to encourage interdisciplinary exchanges and promote new research collaborations.

The talks were followed by practical sessions, where the participants could apply the techniques to experimental and numerical data sets using the computer facilities of the Lorentz centre. These exercise were particularly beneficial for the younger and less experienced participants and gave them an opportunity to familiarize themselves with the techniques while being helped and supervised by some of the leading experts in the field. We found that the facilities and the open and friendly atmosphere of the Lorentz centre are particularly suited for this kind of work.

We would like to acknowledge the funding by the Lorentz Centre, Ercoftac and the J.M. Burgers Centre. Last but not least we would like to thank the members of the Lorentz centre for their help and hospitality.

FIRST ANNOUNCEMENT

6TH EUROPEAN FLUID MECHANICS CONFERENCE – EFMC 6
MONDAY 26 JUNE - FRIDAY 30 JUNE, 2006
KTH, STOCKHOLM, SWEDEN

HTTP://WWW2.MECH.KTH.SE/EFMC6/

The 6th European Fluid Mechanics Conference, organized by EUROMECH (the European Mechanics Society), will take place at KTH, Royal Institute of Technology, Stockholm 26–30 June 2006.

The conference aims to provide an international forum for exchange of information of all aspects of fluid mechanics, including instability and transition, turbulence, multiphase and non-Newtonian flows, bio-fluid mechanics, reacting and compressible flows, numerical and experimental methods, geophysical flows etc, as well as all types of fluid mechanics applications.

Eight prominent scientists have already accepted the invitation to give keynote lectures in their respective fields of expertise. These are (in alphabetical order):

- Gustav Amberg (Sweden) – Fluid mechanics of phase change
- Stephan Fauve (France) – Generation of magnetic fields by turbulent flows of liquid metals
- Sascha Hilgenfeldt (USA) – The power of bubbles: Unconventional microfluidics
- Rich Kerswell (UK) – Progress in Reynolds' problem: transition to turbulence in pipe flow
- Hilary Ockendon (UK) – Continuum models in industrial applications
- Norbert Peters (Germany) – Combustion
- Jens Sørensen (Denmark) – Wind turbine wake structures
- Sandra M. Troian (USA) – Microfluidic actuation and sensing for open architecture systems: Fundamentals to applications.

In addition to these 8 invited lectures and one lecture by the EUROMECH Fluid Mechanics Prize winner (not yet selected), contributions are solicited from the worldwide fluid mechanics research community. The paper selection will be made by EUROMECH Fluid Mechanics Conference Committee on the basis on extended abstracts submitted at the end of 2005 (details on the submission process will be given on the conference home-page during spring 2005). For further information please visit the website:

http://www2.mech.kth.se/efmc6/

Enquiries should be sent to efmc6@mech.kth.se

SUMMARY OF FIRST EUROPEAN FORUM ON FLOW CONTROL (EFFC-1) POITIERS, FRANCE, SEPTEMBER-NOVEMBER, 2004 AND EUROPEAN WORKSHOP ON FLOW CONTROL

POITIERS, FRANCE, OCTOBER 11-14, 2004

J. Delville, J.-P. Bonnet and F. Alvi(+)

Laboratoire d'Etudes Aérodynamiques, CEAT, Université de Poitiers/ENSMA/CNRS

43 rue de l'aérodrome F-86036 Poitiers cedex, France

(+) Permanent address: department of Mechanical Engineering, FAMU-FSU College of Engineering 2525 Pottsdamer Street Tallahassee, FL 32310, USA

MOTIVATION

The First European Forum on Flow Control was convened under the auspices of AIRBUS and CNRS in Poitiers (France) from September through November 2004. Although Flow Control is not a new field of study in fluid mechanics, it is however an area that is presently going through rapid growth and evolution where significant changes are occurring over relatively short periods. The aim of this forum is to provide an opportunity for researchers from within and outside Europe to collaborate and exchange ideas in a more comprehensive manner during long (3 months) stays sponsored by the CAFEDA-AIRBUS programme. During this period, a n European Workshop was organized in order to disseminate the results and promote scientific exchanges on Flow Control in Europe. A session of a more industrially oriented meeting, the KATnet Workshop devoted to Flow Control, was hosted during the same period in such a way that the academic and industrial communities can exchange on this topic.

THE LONG TERM FORUM

The main thrust of this Forum was towards aeronautical applications, however it was exclusively not so, since flow control has many uses in other fields. Although, as the name suggests, the focus of this meeting is on flow control research being conducted in Europe, we were fortunate to have a large number of participants from many other countries. Researchers from Australia, France, Germany, Netherlands, Spain and the United States participated in the workshop with periods of stay ranging from a few weeks up to three months. The EWFC will be similarly organized and conducted every year.

The areas of focus for the first EFFC session were:

1) "Post processing and closed-loop methods for turbulent flow control" and 2) "Flow Separation control".

Post processing is often crucial for the reduction in complexity of the system to be controlled (particularly when the flow is turbulent); for the extraction of the relevant physics and for the design of closed loop strategies, among others. Attention was focused on the low order description of complex flows, including process identification procedures. POD approaches were especially addressed in this framework. The groups involved in this topic of the Workshop were mainly: LIMSI (France), LEA (France), LEMTA (France) and TU Berlin (Germany). During this Workshop, discussions and interactions between researchers working in these two areas was particularly productive. For example, as a consequence of such exchanges, researchers dealing with separation control had an opportunity to interact with and to provide data bases to be analysed in this low order description framework by members of the first group.

The control of separation of the flow over bluff bodies and airfoils is of importance, when dealing with drag, lift or stall control, among others. A specific test case, the ONERA-D profile, was proposed to the contributors for evaluating their control strategy. The groups involved in this topic of the Workshop were mainly: IMFT (France), LEA (France), LTRAC (Australia) and FAMU-FSU (USA). Although a number of strategies are being explored on this geometry, including tangential-slot blowing and zero net- mass flux jets, the main actuator examined to-date were microjet arrays. This is because micro-jets have shown considerable promise in separation control in other adverse pressure-gradient flows.

The long stay Forum EFFC-1, is still on-going; additional work needs to be performed before the final results arising from this forum can be presented and discussed. The next session will be organized jan-march 2006 and will focus on collaborative experiments on flow sepration unsteady controil. Call for participations will be issued in june 2006.

THE ERCOFTAC WORKSHOP

As part of the EFFC-1 Forum, a four-day Workshop was also held in Poitiers (Oct 11 and 14), in conjunction with the Airbus KATnet Flow Control Workshop (Oct 12 and 13). During this Forum, over 32 papers were presented by scientists from around the world; including those participating in the long-term EFFC stays. The attendees at the Workshop (over 70 registered participants) represented more than nine countries in three continents. As a result, over 110 participants were present during the Airbus KATnet Flow Control Workshop. The SIG # 20 "Drag Reduction and Flow Control" was associated to this event. The combination of the academic and industrial (KATnet Workshop) participants ave the opportunity to present the ERCOFTAC activities within SIG 20 to a large audience.

The ERCOFTAC-CAFEDA Workshop was organized in five main sessions as follows:

- The first session was devoted to experimental studies, mainly in shear layers and in separated flows.
- The second session focused on the various concepts for actuators and flow control methods.
- The third session addressed theoretical approaches to Reduced Order Modelling for flow control.
- Since flow control is by essence a multidisciplinary domain, a session was devoted to Miscellaneous Topics in Flow Control.
- The final topic of discussion focused on various Control Strategies, such as Optimal, Robust and Closed-Loop methods

Informal roundtable discussions were scheduled after every formal presentation session to encourage discourse and discussion. The Forum and the Workshop were both very successful in that it led to vigorous discussions and exchange of ideas between the attendees, as we had hoped. Discussions regarding the use of POD-based methods for flow control applications, as well as the comparison of experimental and computational results and the selection of appropriate cases for such comparisons were particularly stimulating and informative. The feedback from the attendees was very positive where the general consensus was that the Workshop produced stimulating discussions and a free-flow and exchange of ideas.

A CD-ROM including the Workshop proceedings (extended abstracts) and corresponding presentations is available and will be widely distributed. Copy of this CD-ROM can be obtain at the France West Pilot Center.

AKNOWLEDGEMENTS

The three-month Forum and the four-day Workshop were mainly sponsored by AIRBUS CAFEDA (Control of AeroDynamic Flows for the Environmentally Driven Aircraft). The Forum was also supported by ERCOFTAC through its Special Interest Group 20 "Drag Reduction and Flow Control". Through its national initiative, GDR "Contrôle des Décollements," the French CNRS was also a sponsor of this workshop. Their support was sincerely appreciated.

COURSE ON

APPLICATION OF PARTICLE IMAGE VELOCIMETRY -THEORY AND PRACTICE-

GÖTTINGEN, GERMANY

MARCH 14 - 18, 2005

Organized by

ERCOFTAC (Germany North Pilot Center, Dutch Pilot Centre, J.M. Burgers Centre)

AG STAB and Measurement Valley

in cooperation with

Laboratoire de Mécanique de Lille

Delft University of Technology

University of Oldenburg, and DLR, Göttingen

Dr. Andrea Schröder, DLR

Institute of Aerodynamics and Flow Technology, Göttingen, Germany

CONTEXT

This was the thirteen's course on application of particle image velocimetry held at DLR Göttingen, Germany, with an accumulated total number of 391 participants from 29 different countries. The course is mainly intended for engineers, scientists and students, who have already some basic knowledge of the PIV technique and have just started to utilize PIV 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 PIV images, especially in using 3C-PIV, time-resolved PIV or combined measurement techniques, have been treated - in theory as well as in practice.

PARTICIPATION

The course was co-organized with the Dutch Pilot Centre - J.M. Burgers Centre. Due to the cooperation with the Burgers center the largest group of participants (11) came from the Netherlands. The second largest group of participants came from Germany (10). The other participants came from France (3 participants) and Sweden (2 participants) and from Slovenia, Brazil, Switzerland, USA and Poland (1 participant each country). In total 31 attendees from outside and four from inside DLR. Nine companies from Germany, Denmark, the U.S., Great Britain, and France manufacturing PIV systems or components such as pulse lasers, cameras or software showed and demonstrated their equipment to the participants of the course during March 17 and 18.

PROGRAM

The main interest of today's research in fluid mechanics is more and more directed to problems where unsteady and separated flows are predominant. For investigations of flow fields with pronounced spatial structures and/or rapid temporal or spatial changes (transition from laminar to turbulent flow, coherent structures, pitching airfoils in transonic flows with shocks, rotors, test facilities with short run time etc.) new experimental techniques, such as particle image velocimetry (PIV) are required which allow to capture the flow velocity of large flow fields instantaneously. An important feature of PIV is, that for the first time a reliable basis of experimental flow field data is provided for direct comparison with numerical calculations and, hence, for validation of computer codes. During the last years a number of different approaches for the recording and evaluation of PIV images has been developed and described in literature. This course mainly concentrated on those aspects of the theory of PIV relevant to applications. Besides giving lectures on the fundamental aspects, special emphasis was placed on the presentation of practical and reliable solutions of problems which are faced during the implementation of this technique in wind tunnels and other test facilities. During practice the participants had the opportunity to carry out the recording and the evaluation of PIV images by themselves in small groups. Recent developments of the PIV technique such as Time-Resolved PIV, 3C-PIV (stereo PIV, multi plane stereo PIV etc.), 3D-PIV (holographic PIV), combined techniques as PIV-LIF and micro PIV have been discussed or demonstrated. Special emphasis was put on the demonstration of the performance of modern high resolution, large format video cameras, which allow the subsequent evaluation of the recordings by means of advanced cross correlation techniques.

LECTURERS

Prof. Michel Stanislas, Laboratoire de Mécanique de Lille, France, has more than 20 years of experience in the field of Flow Visualization, Holography and Particle

Image Velocimetry. His special interest lies in the development of advanced optical measuring techniques for application in fluid mechanics. Prof. Stanislas presented the lectures on the optical aspects of PIV.

Prof. Jerry Westerweel, Delft University of Technology, has considerably contributed to establish a solid theoretical basis of the PIV technique. His main interest is in the development of combined PIV and LIF measurement technique and micro PIV and their application in turbulence research. The main part of the course notes on the theoretical aspects of the PIV technique is based on his work.

Prof. Klaus Hinsch, Carl von Ossietzky Universität, Oldenburg, Germany, who has more than 25 years of experience in the field of Speckle and Particle Image Velocimetry, presented the lectures on the 3C and holographic or 3D-PIV.

Dr. Andreas Schröder, Institute of Aerodynamics and Flow Technology, DLR, Göttingen, is working on the development and application of PIV in large and high speed wind tunnels since 1995 and organized this PIV course. Dr. Jürgen Kompenhans, who founded the PIV course in 1993 and worked on many aspects of the PIV technique and the organization of its Europe-wide Network since 1984. Dr.-Ing. M. Raffel and Dr. C. E. Willert have mainly developed the recent PIV system of DLR for application in large wind tunnels. Together with Dr. Christian Kähler from TU Braunschweig, Dr. Klaus Ehrenfried from DLR, Göttingen, Dipl.-Ing. J. Agocs, Dipl.-phys. H. Frahnert, Dipl.-phys André Heider, Dr.-Ing. F. Klinge, Dr. R. Konrath, Dr. Lars Koop and Dr. B. Stasicki from DLR they presented their knowledge and experience in different areas of the PIV technique such as tracer particles, illumination, recording, evaluation, data presentation, BOS and 3C-PIV.

FURTHER INFORMATION AND NEXT COURSE

More detailed information about the course can be requested from Dr. Andreas Schröder, Institute of Aerodynamics and Flow Technology, DLR, Bunsenstraße 10, D-37073 Göttingen, Tel. + 49 551 709 2190 and Fax + 49 551 709 2830. e-mail: andreas.schroeder@dlr.de. Information about the course may also be found in the World Wide Web at http://www.as.go.dlr.de/EV/PivCourse.

The next course on application of particle image velocimetry will be held from

March 13 to 17, 2006.

THE ERCOFTAC INDUSTRIAL CONSULTATION INITIATIVE

Part of the remit of the ERCOFTAC Industrial Advisory Committee (IAC) is to pose the big flow, turbulence and combustion (FTAC) questions from the industrial point of view and then promote and enable FTAC research programmes which match innovation to industrial need.

In order to strengthen its role in this area, the IAC is initiating a dialogue with industry so as to establish their priority needs. After consultation and analysis, these needs will be translated into targeted research programmes. Researchers will then be encouraged and supported by the IAC to pursue such programmes using funds from the EU and other sources. As a first step, a questionnaire is being circulated to European industrial organisations with interests in flow, turbulence and combustion. This can be found on the ERCOFTAC web page (www.ercoftac.org, under the left side menu window, «Industrial Consultation Initiative»). The response to this questionnaire will be analysed and themes which need further development will be identified. Workshops will then be held in each country to explore these themes with the aim of refining them into key elements of industrial need which can then be readily translated into targeted research programmes.

The IAC welcomes the participation of all industrial organisations in this initiative and we invite key technical personnel to spend a few minutes completing the questionnaire (www.ercoftac.org, under the left side menu window, «Industrial Consultation Initiative»).

Please return to:

A. G. Hutton
Deputy Chairman of the Industrial Advisory Committee
G26/X80
QinetiQ Ltd.
Cody Technology Park
Ively Road
Hants. GU14 0LX
U.K.
Tel.: *+44 1252 395568*
Fax: *+44 1252 395275*
Email: aghutton@qinetiq.com

FINAL REPORT ON THE

ERCOFTAC INTRODUCTORY COURSE TO DESIGN OPTIMISATION

UNIVERSITY OF MANCHESTER, UK

APRIL 6-8, 2005

Prof J.E. Cooper & Prof D. Laurence
University of Manchester, UK

The short course was held at the University of Manchester and was attended by 45 attendees from industry, research establishments and academia from across Europe. The course aimed to give an introduction into design optimisation, some insight as to how this technology is currently used in the Aerospace Industry for aerofoil design, and presentations with hands-on sessions from a number of software vendors. Lectures were given by experts from academia and industry with a wide range of experience in either developing optimisation methods or in their application to industrially related problems.

THE PROGRAMME CONSISTED AS FOLLOWS:

6th April 2005

Opening
J.Cooper – U.Manchester

Introduction to Design Optimisation
A. Morris – Cranfield University

Expectations from a novice user – an aeronautics point of view
W. Haase – EADS-M

Shape optimisation algorithms in aerodynamics: Parameterisation issues
J-A Desideri – INRIA

Coffee

Test Cases: Applications and Real Time Design
V. Toropov, Altair Eng Ltd

Multipoint optimisation of industrial turbomachinery configurations
Ch. Hirsch, NUMECA

Design of Experiments
C. Poloni, U. Trieste

Evolutionary Strategies
T. Back Leiden University

Course Dinner

7th April 2005

Genetic Algorithms
J. Cooper – U.Manchester

Gradient Based Methods
J. Cooper – U.Manchester

Coffee

Adjoint Methods
N. Gauger – DLR

Automatic Differentiation of Programs and its application in Scientific Computing
L. Hascoet - INRIA

Lunch

Meta-Models
K. Giannakoglou – NTUA

Evolutionary tools in Aerodynamics using Game Strategies and Hierarchy: From theory to applications J. Periaux – Pole Scientifique

Coffee

Introduction to Sensitivity Analysis
A. Morris – Cranfield University

Decision Making Tools
P. Sen

Short Presentations by Commercial Software Users

8th April 2005

Hands on Training with Prepared Test Cases

Software vendors who participated were:

NuTech Solutions, ESTECO, Engineous Software Ltd, NUMECA, NAG, SIMTECH, NOESIS Solutions, Applied Computing & Engineering, Advantage CFD, NTUA EASY, ALTAIR.

The general feedback from the attendees was that they found the course very useful, particularly the mix between theory and application. It was thought that the order of the lectures should be changed next time that the course ran so that all of the theory is covered first before moving onto the applications.

STATE OF ART IN THE FIELD

Design Optimisation as a science in its own right has been around for over 30 years and has reached a state of maturity. The application to CFD is still in its infancy however due to the large computation times required to produce a single flow solution for a complex body and few meaningful attempts have been made of aerofoil shape design using a combined CFD / optimisation approach.

ADDED VALUE OF THE COURSE

The course enabled a wide range of researchers and industrialists from a number of different backgrounds (e.g. aerodynamics, ship hull design, MRI Scanner design) as well as software vendors to meet together and discuss their different experiences in the use of design optimisation. A number of the attendees noted how useful they found the hands-on sessions.

POSSIBLE FUTURE DIRECTIONS OF RESEARCH IN THIS FIELD

The application of optimisation technology to CFD and in particular shape design (or ship hulls, aircraft wings for example) is wide open. A great deal of work remains to be done to enable accurate time-efficent solutions to be found.

The ERCOFTAC Best Practice Guidelines for Industrial Computational Fluid Dynamics are

Now Available in Electronic Form!

The Best Practice Guidelines can now be provided in electronic form.

- For a one-off payment of 2500 Euro, organisations can provide access to all members of staff by placing the Guidelines on their corporate intranet. (Security of the network must be guaranteed)
- Original, fee-paying members of the Quality and Trust Special Interest Group can receive an electronic copy, without charge, from which they are free to make paper copies.

Please contact:

A.G. Hutton
G26/X80
QinetiQ Ltd.
Cody Technology Park
Ively Road
Hants. GU14 0LX, U.K.

Tel.: +44 1252 395568
Fax: +44 1252 395275
Email: aghutton@qinetiq.com

REPORT ON THE ERCOFTAC, PIVNET 2, EUROPIV 2 WORKSHOP UNIVERSITY OF ZARAGOZA

MARCH 31-APRIL 1, 2003

M. Stanislas

Laboratoire de Mécanique de Lille, Ecole Centrale de Lille

Villeneuve d'Ascq, France

MOTIVATION

The first aim of the workshop was to present the main results of the EUROPIV 2 EC project to the scientific and industrial communities.

The second aim was to favor exchanges and discussions between the EUROPIV 2 consortium and the European PIV community not involved in the project. As this is also the objective of both the Pivnet 2 European thematic network and the ERCOFTAC association through its SIG 32 Special Interest Group, the workshop was co-organized by these three organizations.

The last aim of the workshop was to have some exchanges also with the PIV community outside Europe. This is why two lecturers, well known for their work on PIV, were invited from the USA and Japan.

LECTURE TITLES / CONTENTS

The contributions were the following:

Invited lecture: Application of PIV to AC Electrokinetic Flows, D. Wang, M. Sigurdson, C.D. Meinhart

Invited lecture: Dynamic PIV, a strong tool for transient analysis, K. Okamoto

Session 1: Aeronautics

Detailed characterisation, using PIV, of the flow around an aerofoil in a high-lift configuration.
Arnott, K.P. Neitzke*, J. Agocs, B. Sammler, G. Schneider, A. Schroeder (DLR-Göttingen, *Deutsche Airbus-Bremen)

Comparison of numerical simulations of the flow around an airfoil in high lift configuration with PIV experimental results.
D. Tran

Characterization of the flowfield around a transonic wing by PIV.
Gilliot, J.C. Monnier, A. Arnott*, J. Agocs* and C. Fatien (ONERA Lille, *DLR Gottingen)

Study of the wake vortices of a transport aircraft model with stereoscopic PIV.
H.P. Veerman

Session 2: Advanced algorithms

The local field correction advanced PIV algorithm
A.Lecuona, J. Nogueira

Development and assessment of non isotropic resolution in PIV.
F. Scarano

Advanced PIV algorithms with window deformation. Validation with synthetic images of turbulent flow
B. Lecordier, M. Trinité

Comparison of correlation PIV and hybrid PIV-PTV algorithm in vortical flows.
A.Stitou, M.L. Riethmuller

Session 3: PIV Accuracy

The EUROPIV Synthetic Image Generator.
J. Westerweel, B. Lecordier, J. Nogueira

Characterization of different PIV algorithms using the Europiv SIG and real images from a turbulent boundary layer.
B. Miliat, J.M. Foucaut, N. Pérenne, M. Stanislas

Assessment of vorticity with advanced PIV techniques
A. Lecuona, J. Nogueira

Remarks on the spatial resolution and turbulence measurement with PIV.
P. Saarenrinne

Session 4: Applications

Measurements of Turbulent Flow Transition in a Pipe using Stereo PIV.
J. Westerweel, Petracci, Van Doorne

Investigation of instationary effects in transonic turbomachinery flows using Particle Image Velocimetry.
J. Woisetschläger

Turbulent bubbly flow measurements in a mixing vessel with PIV.
M. Honkanen , P. Saarenrinne

Proposal for Netcdf implementation for planar velocimetry data.
C. Willert

Session 5: Turbulence & PTV

PIV measurements of turbulent decay behind a grid.
De Gregorio F., Avallone G., Romano G.P.

PIV and PTV for the characterization of turbulent channel flow: comparison of experimental and simulation approaches.
M. Moroni, J. Nogueira, G.P. Romano, A. Cenedese, A. Lecuona

Photogrammetric Particle-Image Velocimetry.
A. Schimpf

Application of PIV to characterise the flow-phenomena of a heavy-duty cylinder head on a stationary flowbench.
E. Doosje

Session 6: Holography & ESPI

Advances in light-in-flight HPIV for the study of wind tunnel flows.
S.F. Herrmann, K. D. Hinsch.
Holographic PIV for large scale facilities.
H. Royer, N. Pérenne, M. Stanislas

Comparison between PIV&ESPI and stereo PIV on the measurement of 3-C velocity fields.
J. Lobera, M.P. Arroyo, N. Perenne and M. Stanislas

From ESPI to Digital Image Plane Holography (DIPH): requirements, possibilities and limitations for velocity measurements in a 3-D volume.
J. Lobera, N. Andrés and M.P. Arroyo

Session 7: Stereoscopic PIV

Study of the accuracy of different stereoscopic reconstruction algorithms.
N. Pérenne

Self-calibration of a Stereoscopic PIV system in Scheimpflug condition.
T. Fournel, T. Coudert

3D-PIV measurements near the wall.
D. Calluaud, L.David

Particles generation for PIV in air flows
C. Kähler

SUMMARY

The workshop was fairly successful, showing a wide scope: theory, hardware and software developments, advanced methods, holographic PIV, laboratory and industrial applications, etc. It also showed significant advances in the understanding and practice of the method. For this reason, the proceedings where published in order to make the work presented available to a wider scientific community:

Particle Image Velocimetry: Recent Improvements
M. Stanislas, J. Westerweel, J. Kompenhans (Eds.)
Springer Verlag 2004

This book presents a full paper version of the presentation and is including a CD-ROM which contains:

- all the papers with full color illustrations,
- the new netcdf format (portable binary format) which is proposed in the paper by C. Willert in order to store efficiently the PIV data,
- the Synthetic Image Generator which was developed and tested in the frame of EUROPIV 2 and which is described in detail in the paper by B. Lecordier and J. Westerweel,
- the final summary and main publications of the EUROPIV 2 project which complement the workshop contents.

JOINT INTERNATIONAL PIVNET 2 / ERCOFTAC WORKSHOP ON MICRO PIV AND APPLICATIONS IN MICROSYSTEMS

DELFT, THE NETHERLANDS, APRIL 7-8 2005

Organized by PivNet 2 and ERCOFTAC

Ralph Lindken, Laboratory for Aero- and Hydrodynamics, Delft University of Technology, The Netherlands

CONTEXT

In April 2005 we organized for the first time a workshop on μPIV and applications in Microsystems at the Delft University of Technology. The event was organized as a joint PivNet 2 and ERCOFTAC workshop. PivNet 2 is an EC thematic network - A European collaboration on development, quality assessment, and standardization of Particle Image Velocimetry for industrial applications. The workshop was financially and logistically supported by the Dutch Pilot Centre - J.M. Burgers Centre, the Delft University of Technology and Springer Publishing.

PARTICIPATION

The workshop addressed researchers and developers from industry, research organizations and universities. With 90 participants, 5 keynote lecturers and 25 oral presentations the meeting was one of the most successful PivNet 2 workshops. Most of the participants (35) came from the Netherlands and 23 participants came from Germany. Other participants came from the USA (8), France (6), Denmark (5), United Kingdom (3), Belgium (2) and Japan (2). There was one participant each from Ireland, Israel, Italy, Norway, Poland and Spain.

4 companies from Germany (2) and Denmark (2) manufacturing μPIV systems showed and demonstrated their equipment in live microfluidics experiments.

PROGRAM

Microfluidics is a rather young field in fluid mechanics, but it is one of the fastest growing areas. The large number of participants shows that microfluidics is a "hot topic". This workshop concentrated on the measurement technique micro Particle Image Velocimetry (μPIV) as well as microfluidics applications involving optical flow measurement or visualisation techniques.

Five world-class keynote lecturers made this workshop attractive. The keynote lectures and the title of their talks are as follows:

S. Wereley, Purdue University, USA
Progress and Current Developments in Micro-PIV

M. Yoda, G. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, USA
Nano-Particle Image Velocity (nPIV) measurements Inside the Diffuse Electric Double Layer in Electroosmotic Flow

Y. Garini, Imaging Science and Technology, Delft University of Technology, Delft, the Netherlands
Optical detection and electric manipulation of single molecules in fluidic chips

K.D. Kihm, University of Tennessee, USA
Tracking of nanoparticles in suspension using micro/nano PTV techniques

Prof. C. Meinhart, University of California, UCSB, USA
Optimum particle size and correlation strategy for submicron spatial resolution

Twenty-five oral presentations were given by researchers all over Europe. Some of the presentations dealt with the development of μPIV techniques, e.g. holographic μPIV, stereoscopic μPIV and single-pixel resolution PIV, other talks addressed electroosmosis, mixing, separation, filtration, two-phase flow, and heat transfer at micro scale. The speakers presented applications in the area of life science, pharmaceutical, biological and medical research, DNA analysis, chemical engineering, oil industry and thermodynamics.

Short summaries of the presentations are published in a book of abstracts. The book of abstracts is available in pdf format.

The microfluidics research presented is listed below:

Rafaële Attia, Physical Chemistry, Curie Institute, Paris, France
Imaging Electroosmotic Flow with PIV

Ilja Ausner, TU Berlin, Germany
PIV measurements of film flow on inclined steel plates

Dusan Boskovic, Fraunhofer ICT, Pfinztal, Germany
Characterisation of the flow behaviour in microreactors by means of residence time distribution measurements

Sam Dehaeck, VKI, Brussels, Belgium
Development of a PIV set-up for measuring bubbles

Peter Ehrhard, FZ Karlsruhe, Germany
Measurement of time-dependent flow and concentration fields in an electroosmotically-excited micromixer

Peter Geelhoed, TU Delft, the Netherlands
Thermophoretic Separation in Microfluidics

Thomas Henkel, IPHT, Jena, Germany
Measurement of phase internal flow of liquid/liquid two phase flow in microchannels - approaches for control of mixing efficiency in microdroplets

Koh Ikeda, Ibaraki National College of Technology, Japan
Feasibility Study on Microscopic Digital Holographic PIV

Angela Jianu, FZ Karlsruhe, Germany
Experimental and numerical analysis of liquid flow in the rectangular microchannels of a miniature heat exchanger

Lars-Gunar Klasen, University of Rostock, Germany
Design and development of a stereo Micro PIV - system

Oliver Kuhn, Dantec, Denmark
Out of focus? Precision aspects of Micro-PIV

Ralph Lindken, Aero- and Hydrodynamics, Delft University of Technology, the Netherlands
Stereoscopic Micro PIV applied to the three-dimensional flow in a T-mixer

Ellen Longmire, University of Minnesota, USA
Bubbly flow around microcantilevers

Michal M. Mielnik, NTNU, Norway
Comparison of Micro-PIV and CFD flowfield analysis of a crossflow microfiltration device - measurement depth considerations.

Christian Perrin, Schlumberger Reearch, Cambridge, UK
Micro-PIV in the Oil Industry: a new technology for characterizing flow of complex fluids in porous media.

Hannes Petermeier, ITW - Informationstechnologie Weihenstephan, Germany
Biocompatible PIV-analysis of microorganismic induced convection on the basis of a neurohybrid

Cor Rops,TNO/TPD, Delft, The Netherlands
Experiments on two phase air-water flow pattern characterisation in horizontal micro-channels

Enrico Segre, Weizmann Institute, Israel
Elastic turbulence and mixing enhancement in microchannels

Michael Schlueter, University of Bremen, Germany
Investigations on micromixing in T-shaped micromixers using μ-LIF and μ-PIV

Patrick Tabeling, ESPCI, Paris, France
PIV at nanometric distances from a wall

Volkert van Steijn, Kramers Lab, Delft University of Technology, the Netherlands
Micro-PIV measurements of liquid velocities in single and two-phase flow in capillaries of square cross section

Peter Vennemann, Aero- and Hydrodynamics, Delft University of Technology, the Netherlands
In vivo Micro PIV in the embryonic avian heart

Michel Versluis, University of Twente, the Netherlands
Resolved megahertz observation of the acoustic streaming by a bubble with the high fast framing camera Brandaris 128

Christian Wagner, University of Saarland, Saarbrücken, Germany
DNA flow and analysis in microchannels

Jerry Westerweel, Aero- and Hydrodynamics, Delft University of Technology, the Netherlands
Single-pixel resolution ensemble correlation for micro-PIV applications

FURTHER INFORMATION

More detailed information about the workshop can be requested from Dr. Ralph Lindken, Laboratory for Aero- and Hydrodynamics, Delft University of Technology, Leeghwaterstraat 21, The Netherlands , Tel +31-15-278 29 91, Fax +31-15-278 29 47 r.lindken@wbmt.tudelft.nl Information about the workshop may also be found in the World Wide Web at http://www.ahd.tudelft.nl/~mpiv/

5TH WORKSHOP ON

MODELING OF MULTIPHASE FLOWS IN THERMO-CHEMICAL SYSTEMS. ADVANCED MEASUREMENT TECHNIQUES

SEPTEMBER 2-4, 2005

STAWISKA, K. KOSCIERZYNY/POLAND

The 5th Workshop is a cyclic, annual event of interdisciplinary character. People dealing with fluid mechanics, thermodynamics and chemical engineering are encouraged to present recent problems regarding modelling of multi-phase flows. Multi-phase flows comprise: tow-phase one-component flows (of vapour and liquid), two-phase two-component flows (of gas and liquid, or of gas and solid particles, for instance), multi-phase flows (mixtures of liquid, vapour, gas, and solid particles, for instance, or fluidised beds), flows with chemical reactions. These flows are accompanied by the following characteristic processes: mixing and separation, boiling and condensation, chemical reactions, heat, mass, and momentum transfer on the phase separation surface, as well as wave phenomena and critical flows. In this year special attention will be put on advanced experimental methods utilized in multi-phase flow investigation.
The audience foreseen is mainly the young scientists and PhD students from Polish universities and research centres but participants from all over Europe are invited.
The organising institution are three working groups of the Fluid Mechanics Section of the Polish Academy of Sciences, namely: Subsection of Multiphase Flows and Non-Newtonian Fluids, Subsection of Turbulence and Subsection of Internal Flows.
The School was approved as the official ERCOFTAC event. The school will be held in Stawiska - a village 50 km south from Gdansk in the period 2-4 September 2005. All the organisational matters will be handled by the Gdansk University of Technology and Institute of Fluid Flow Machinery, Gdansk.

THE MEMBERS OF THE SCIENTIFIC COMMITTEE OF THE SCHOOL:

- Assoc. Prof. Lubomira Broniarz-Press (Poznan University of Technology)
- Assoc. Prof. Janusz T. Cieslinski (Gdansk University of Technology)
- Prof. Piotr Doerffer (Institute of Fluid Flow Machinery, Gdansk)
- Prof. Stanislaw Drobniak (Technical University of Czestochowa)
- Prof. Jaroslaw Mikielewicz (Institute of Fluid Flow Machinery, Gdansk)
- Prof. Mieczyslaw Poniewski (Kielce University of Technology)
- Prof. Stanislaw Sieniutycz (Warsaw University of Technology)
- Prof. Marian Trela (Institute of Fluid Flow Machinery, Gdansk)
- Prof. Stanisław Wronski (Warsaw University of Technology)

LOCAL ORGANISING COMMITTEE:

- Assoc. Prof. Janusz T. Cieslinski (Gdansk University of Technology)
- Dr. Dariusz Butrymowicz (Institute of Fluid Flow Machinery, Gdansk)

The registration fee, which covers accommodation costs and lecture materials, is 200 EURO.

Additional information about the Workshop may be found at the website:

http:// www.imp.gda.pl/inst_zew/ppw/PPW.html

Registrations should be directed to:

Dr. Dariusz Butrymowicz
Institute of Fluid-Flow Machinery
of Polish Academy of Sciences
Gen. Fiszera 14, PL-80-231, Gdansk, Poland
butrym@imp.gda.pl

See programme on the next page

Programme of the 5th Workshop on Modeling of Multiphase Flows

Friday, 2.09.2005

1300-1305 Opening ceremony

1305-1450 **Session I. LIQUID-VAPOR (GAS) SYSTEMS.** *Chairman – Marian Trela*

- Optoelectronic mesurement system for investigation of two-phase annular flow gas-very viscid liquid – Stanisław Witczak
- Application of contactless liquid crystal and infrared thermography in boiling heat transfer experiments – Mieczysław Poniewski
- Flow visualization of gas and vapor bubbles – Janusz T. Cieslinski

1505-1650 **Session II. ONE-PHASE SYSTEMS.** *Chairman – Piotr Doerffer*

- Measurement of density gradients by means of Specle Method (Quantitative Schlieren method) – Ryszard Szwaba
- Application of a pressure sensitive paint in transonic flows - Arutr Szumski
- Application of the electrochemical method for the characteristics of flow and heat transfer in non-newtonian media - Lubomira Broniarz-Press

1700-1800 **Session III. POSTER SESSION.** *Chairman – Lubomira Broniarz-Press*

Saturday, 3.09.2004

900-1045 **Session IV. FUEL CELLS.** *Chairman – Stanisław Drobniak*

- Numerical Model of PEM Fuel Cell - one-domain approach - Andrzej Boguslawski
- Trends in numerical modeling of flows with electrochemical reactions in solid oxide fuel cell (SOFC) – Michal Karcz
- Performance of SOFC in hybrid gas - steam cycles – Janusz Badur

1100-1245 **Session V. FLOWS WITH CHEMICAL REACTIONS.** *Chairman – Janusz Badur*

- Comparative analysis of advanced combustion models in non-premixed flames - Artur Tyliszczak
- Registration of rapid phenomena by CCD camera with synchronous measurements of thermo dynamic parameters – Marek Gawor
- Selected methods in measurements of fast variable parameters in two-phase flows – Piotr Cyklis

1400-1545 **Session VI. SOLID-LIQUID-GAS SYSTEMS.** *Chairman – Mieczysław Poniewski*

- Experimental methods for investigations of the ice slurry - heat transfer and mass flow – Wojciech Zalewski
- Videogrametry as a complex method of pattern recognition and stochastic analysis in application of multiphase flow– Roman Ulbrich
- Measurement techniques applied in experimental investigations of gas-solid flows, particularly in fluidization process – Wojciech Nowak, Pawel Mirek

1600-1700 **Session VII. POSTER SESSION.** *Chairman – Stanisław Witczak*

1700-1810 **Session VIII. DISPERSIVE SYSTEMS.** *Chairman – Roman Ulbrich*

- Dispersive systems in theory and practice – Barbara Tal-Figiel
- Light in multiphase medium – Tadeusz Krol
- The general conception of the experimental stand for the research of the wet steam and moist air transonic condensing flows – Sławomir Dykas

Sunday, 4.09.2004

900-1120 **Session IX. AEROSOLS, MICRO- AND NANOPARTICLES.** *Chairman – Wojciech Zalewski*

- Generation and movement of aerosol in the electric field - Marcin Lackowski, Anatol Jaworek
- Measurement methods of size and charge of charged aerosol particles - Marcin Lackowski
- Advances in two-phase flows at nanoscale - Jan Saczuk
- Modeling of multi-phase flow phenomena in waste paper processing technology - Dariusz Asendrych

1130-1230 **ROUND TABLE DISCUSSION.** *Chairman - Jarosław Mikielewicz*

The Workshop was granted the **2000 EURO** scholarship from ERCOFTAC authorities. The organisers intend to give a certain number of scholarships to PhD students who would like to participate in the Workshop. Requests for the grants should be directed to Prof. J.T. Cieslinski (jcieslin@pg.gda.pl), chairman of the Subsection of Multiphase Flows and Non-Newtonian Fluids until **June 1st 2005.**

REPORT ON THE MANAGING BOARD MEETING PARIS, APRIL 22, 2004

Th. Ursenbacher
ERCOFTAC Coordination Centre

MANAGING BOARD MEETING

ERCOFTAC will continue with the process to implement the industrial strategy. Prof. Hutton presented a first business plan and will define more accurately the targets and action items of the project with the support of a group of experts.

Concerning the EU related activities, a reformulated Network of Excellence proposal has been accepted by EU (FR6) and ERCOFTAC will now be engaged in leading the proposal.

ELECTION OF MANAGING BOARD REPRESENTATIVES

The list of the Managing Board members were reviewed noting in particular the industrial positions of the France South, Germany West and Spanish PC, respectively, which were still vacant. Prof. Braza informed the MB officers on the positive outcome of a meeting held in May 2005 with Liebherr Aerospace. A representative of this company will be invited to attend the ERCOFTAC fall meetings in Vienna. Prof. Rodi confirmed that Prof. N. Peters and Dr. Binninger were still looking for somebody to represent the Germany West PC. Dr. Castilla confirmed that the Spanish PC was also waiting for the answer of two industries, contacted after the departure of Dr. Velazquez from industry to academia. Dr. Ursenbacher will maintain contact with these three PC to clarify the Industrial Representative situation.

Following his nomination as Dean of the School of Engineering in KTH, Prof. Amberg has resigned as coordinator and research representative of the Nordic PC and proposed Dr. Wallin from FOI to take over his duties at least until the next Nordic PC meeting this fall 2005. Prof. Thome informed also the Assembly that the Swiss PC elected, as usual and for two years, a new Chairman, Prof. Poulikakos from ETH Zürich, and proposed to nominate him as Swiss research representative. The Board approved both nominations.

FINANCIAL REPORT

The global reserve of ERCOFTAC as of the end of 2004 is €331,408. Dr. Duursma noticed the amount of € 7'000.00 remaining on the scholarships account, which has still not been requested by the respective organizers. Dr. Cambon, as auditor, will visit the Administrative/ Development Office in Brussels to check the 2004 ERCOFTAC accounts and report on the book-keeping at the Autumn meeting.

The delicate problem of unpaid membership was brought up again. The amount of membership fees, which has not been paid per 31st of March 2005 is €107.000. From this the total non-payments for the years 1998 until 2004 amounts to €75.000. The administration office has recently made an effort to update addresses of members. This has led to some recouping of money. However, it was decided that a further action by personal contact to find out who in which organisation is the current ERCOFTAC focal point would be needed. The PC coordinators are in the best position to do that, since they most likely know who to contact in their region to clarify the situation. They will receive the list of unpaid memberships and will be required to explain the situation and to clarify the problem.

Finally, the 2005 budget and expenditures to date were presented. The MB assembly discussed the amount of scholarships allocated to support ERCOFTAC events. Prof. Leschziner raised the intensive discussion from the previous day's SPC meeting on the problem of the increasing number of WS/SS over the years, requesting scholarships. ERCOFTAC has sufficient reserves to accommodate additional high quality proposals. The 2005 exploitation was approved.

REPORT FROM INDUSTRIAL ADVISORY COMMITTEE

Prof. Hutton presented the business plan for the implementation of the industrial strategy. After having reminded the options exposed at Prague and the decision taken in favour of a 'direct industrial engagement', he exposed the key of the engagement, which mainly aims to expand the industrial membership and ensure that high value, in terms of products, services and marketing approach, is delivered. To achieve that, four activities have been chosen, i.e. organisation of an annual industrial fluids congress, of CFD workshops and CFD courses, and sales of the 2nd edition of the Best Practice Guideline. The annual costs of an industrial executive employment was proposed and balanced with the potential income of an engagement strategy delivering the products and services specified above. It came out from a three year financial projection that a maximal investment of k€134.2 would be required from ERCOFTAC. On the basis of the plan of Prof. Hutton, Dr. Sick presented then a projected cash flow, by analyzing over the time the activities creating cash flow. It appeared that the liquidity would become positive only after 3 years, but would remain irremediably negative without the contribution from the conference.

The MB assembly discussed the business plan and judged the project very risky. It was suggested going more in details in the targets for the three first years, especially to estimate the costs for organising the courses and conferences, to clearly appreciate the profile of the coordinator and to disconnect his role from the chairmanship of the IAC. Prof. Oliemans proposed to form a committee to define more accurately the targets and action items of the project, to contact some current industrial members for analysing and giving appreciations on the aims and the way to reach them. The group will be required to report at the next ERCOFTAC meeting where a final decision should be taken. The proposal was approved and the assembly invited Profs. Hirsch and Thome as well as Drs. Carey, Duursma and Sick to be involved in the group as experts under chairmanship of Prof. Hutton.

In parallel, the Industrial Advisory Committee proposes to grant a subsidy of €10,000 to Prof. Laurence for the preparation of the 2nd edition of the BPG. This was approved by the MB.

REPORT FROM ADMINISTRATION AND DEVELOPMENT OFFICE

Prof. Hirsch reviewed the A/D Office activities over the last 6 months. The main task has been the transfer of accounts from VUB to Numeca. An information form has been sent to all the members in order to update the database and a new form has been sent with the invoice of 2005 asking to provide a delivery address and a separating invoicing address. A procedure of automatic reminders for the late payments has also been created. With the invoices 2005, it appears that some members still on the list were not member any more for some years. Also some participants considered as members never subscribed until now for a membership. Some persons having requested funds for holding an ERCOFTAC turned out not to be members. Prof. Leschziner will check with Prof. Hirsch whether the organizers of ERCOFTAC meetings requesting funds are members and pay their membership. On the basis of this report, Prof. Hirsch and Dr. Duursma recommended to the MB to:

- exclude the unpaid invoices for the years 1998 to 2002 from the balance sheet 2004 (total amount €22,000). No more reminders will be sent;
- exclude the unpaid invoices for the former membership from the balance sheet (total amount €11,500);
- introduce a 6-month expiry term to any summer school or workshop grant, starting at the beginning of the event;
- change the legal address of A/D Office according to the ERCOFTAC By-Laws article 1 to: ERCOFTAC Administration and Development Office, avenue Franklin Roosevelt 5, 1050 Bruxelles, Belgium;
- specify the financial power for ERCOFTAC payments according to the ERCOFTAC By-Laws, article 14 as: empowerment of Prof. Ch. Hirsch for amounts to € 10,000, and otherwise joint empowerment of Prof. Ch. Hirsch and Dr. R.P.J. Duursma.

All the recommendations were approved by the Board. Dr. Ursenbacher will change the rules for holding ERCOFTAC events following the approval of the 6-month expiry term to receive the scholarships and Prof. Oliemans will send to Prof. Hirsch and Dr. Duursma a signed copy of the minutes, to confirm the authorization for signature of Prof. Hirsch and Dr. Duursma to the bank.

REPORT FROM COORDINATION CENTRE

Dr. Ursenbacher reported on the activities of the Coordination Centre. The Coordination Centre had a deficit in 2004 (CHF -6,211.35). This deficit was mainly due to the low Euro exchange rate fixed at the beginning of 2003 by the Federal Administration of Finance, which remained the same for 2004 (and induced a lost of approx. CHF 2,000), and the payment of 5 issues of the Bulletin instead of 4 usually. The Coordination Centre sent the copies of receipts for 2004 to Dr. Cambon who will report in October on the book-keeping.

REPORT FROM SCIENTIFIC PROGRAM COMMITTEE

Prof. Leschziner reviewed the SPC meeting of the day before. He explained his effort to achieve an improvement in the visibility of SIGs, the correctness of the SIG Status Report and the informative value of the SIGs' webpages, which rarely reflect the true status. He summarized the current situation:

- 5 problematic SIGs (especially on reporting on their activities by reporting in the ERCOFTAC bulletin and updating the SIG status report and their website);
- 5 SIGs doing very well active work;
- 1 group, the SIG 25 on "CFD for ship hydrodynamics", will be removed from the SIG list;
- a new group, called SIG 39 on Aeroacoustics, will be chaired by Dr. Boersma and plans a first meeting in July in France.

Prof. Leschziner and Dr. Ursenbacher will stay in contact with each SIG coordinator responsible to update their SIG status report and website. Prof. Laurence should propose for the next SPC/IAC meeting in Vienna a leader for the SIG 102.

Before considering proposals for workshops and summer schools, Prof. Leschziner brought up the general question of how the budget for funding ERCOFTAC events, currently numbering 5 workshops/conferences and 5 summer schools/courses per year. He concluded the discussion by proposing to 'modulate' the fund as a function of the number of requests - i.e., if necessary, to reduce the fund for the well-established meeting, allowing the effective promotion embryonic events. This position was approved by the Committee. He reported then the discussions about the requests for holding ERCOFTAC events and asking for ERCOFTAC label/scholarships. In all, 5 workshops/conferences were considered, of which 4 with a scholarship of €2'000 each and two summer schools with a scholarship of €3'000 each. The MB approved the scholarship expenditure. Thus, in 2005, 7 workshops/conferences and 3 summer schools have been approved, with a collective commitment of €23'000. This is within the notional limit of €25.000.

Concerning Theme Issues, "Micro-Fluids and Bio-Fluids" was proposed to be a topic for the Theme Issue in March 2006. As the following Theme for 2006, Prof. Leschziner proposed "Turbulence and Compressible flow". Prof. Dussauge undertook to coordinate initial steps and to initiate a discussion among relevant colleagues in the SIG on compressible turbulence.

On the PC's statement, Dr. Vassilis confirmed that there was significant progress with the creation of the 2nd Spanish Pilot Centre. He received confirmation of support for the creation of the PC from CIEMAT and Universidad Carlos III, in addition to the previously expressed interest of UNED (Universidad Nacional de Educación a Distan-

cia) and UPM. Dr. Vassilis expressed his wish to attend the next ERCOFTAC meeting where he would be keen to present the formalities of the creation of this new PC.

Finally, Prof. Leschziner presented a proposal to hold the future ETMM7 in Cyprus. He provided some initial logistical information, noting however the lack of documentation in terms of costs. He undertook to progress this to a definitive costed proposal by the end of May and publicise this at ETMM6 in Sardinia.

EC RELATED ACTIVITIES

Prof. Hirsch informed the attendees that a reformulated Network of Excellence proposal for Aeronautics had been accepted by EU (FR6) and that ERCOFTAC would now engage in leading the proposal. A few meetings had been held to prepare the structure of the proposal, with particular attention to the representation and role of the research centres as a link between the academic-research base and industry. Prof. Hirsch noted that the NoE would be an open network, allowing external organisations to be included in the programme. In terms of structure, the coordination of the project would be undertaken by two ERCOFTAC representatives (Prof. Hirsch and Dr. Haase) and further DLR and ONERA representatives. Prof. Hirsch presented the Network Integration Committee structure (composed of 30 people) and described the different areas which would be covered. The objectives of the Network was to foster and co-ordinate relevant research on long-term goals, by gathering the highly-skilled knowledge in flow modelling and simulation from academia and research centres, aiming at transferring fundamental research results into the industrial framework. Industry should be involved to provide guidance on specific objectives and contribute to the assessment of progress towards these objectives.

ERCOFTAC AWARD

The action of Prof. Hirsch to proceed in obtaining the lay-out and costs of the price of a statue for the European ERCOFTAC Award is now clarified. Prof. Hirsch obtained the agreement of an artist who would be willing to make some work for the ERCOFTAC Award for free. This is however subject to final confirmation when the name and conditions of the prize will be finalized.

After a long discussion, the assembly decided to open the competition for young scientist up to 35 years, including PhD students. Prof. Oliemans asked the PC coordinators to inform their members on the competition. Prof. Leschziner suggested preparing a proposal establishing the rules of the competition based on the UK PC's experience with the Osborn Reynolds Award. The proposal will be submitted to the EC members.

NEXT MEETING

The next MB meeting will be held on Friday, November 4, 2005 in Vienna, Prof. Kuhlmann having accepted the organisation. Concerning 2006, Prof. Martelli proposed to organise the next Spring meeting in Florence (Italy) on Thursday May 4 (SPC and IAC) and Friday May 5 2006 (EC).

Warm thanks are due to Drs. Haas and Besnard for their efforts in preparing and hospitality during the meetings in Paris.

ERCOFTAC SIG4 Summer School
Turbulence and Mixing in Compressible Flows
Observatoire de Strasbourg, FRANCE
July 7 - 11, 2005

Scope:

This summer school aims at offering an up-to-date introduction to different aspects of turbulence and mixing in compressible flows as encountered in a wide range of situations and disciplines, including aerodynamics, aeroacoustics, combustion and astrophysics. The different lectures and courses cover theoretical, experimental and numerical aspects. It is expected that the diversity of the themes addressed will be intellectually stimulating and impulse fruitful cross-fertilization.

The course will harmoniously blend extended introduction courses and shorter invited presentations. Each student will be invited to give a seminar on his/her ongoing work and the programme will be scheduled so that enough time will be allocated, not only for interaction between lecturers and students, but also to foster cross fertilization between disciplines. Hopefully some new ideas will emerge and be discussed at a closing round table.

Lecturers:

J.P. Dussauge (IUSTI Marseille):
Supersonic turbulent flows (mixing layers, Shock Wave / Boundary Layer interaction, mixing layers)
L. Jacquin (ONERA Meudon):
Transonic separated and/or noisy turbulent flows (preliminary title)
B. Aupoix (ONERA Toulouse):
One-point closures for compressible flows
J. Sesterhenn (TU Munich):
High-order schemes for DNS and LES of compressible flows
Aeroacoustic noise ; jet noise
E. Collin & J.P. Bonnet (LEA Poitiers):
Experimental studies of supersonic turbulent jet control by pneumatic methods
C. Cambon (LMFA Lyon) & P. Sagaut (LMM Paris):
Spectral approaches to compressible turbulence. Linear and weakly nonlinear theory and modelling
D. Veynante (École Centrale de Paris)
Turbulent combustion (preliminary title)
J.M. Redondo (Univ. Politecnica de Catalunya, Barcelona)
Mixing induced by Richtmyer-Meshkov / Rayleigh-Taylor instabilities
New experiments and simulations on multiscale characteristics and enstrophy cascades in baroclinic driven flows
S. Bouquet (CEA DAM Bruyeres le Chatel)
Non-linear modelling and laser experiments of Rayleigh-Taylor instabilities for supernovae (preliminary title)
R. Walder (Steward Observatory, University of Arizona & Observatoire de Strasbourg) & D. Folini (EMPA Duebendorf)
Driving and Scaling Laws of the Interstellar Medium Turbulence

Information and registration:

More detailed information can be found on the site:
http://cfd.u-strasbg.fr/SIG4/ or via
http://www.ercoftac.org on the SIG 4 page

The final timetable of the school will be posted there. Registration can be done by sending the .doc or .pdf form on the site. On line registration is always appreciated.

A limited number of ERCOFTAC grants covering the registration fee is available for young researchers and engineers. To apply, preregister and e-mail your CV, covering letter and supervisors' reference to the coordinator. Otherwise:

Registration fees:

Non ERCOFTAC:
full registration: 300 €Euro; student registration: 230 €

Member of ERCOFTAC institution:
full registration: 270 €; student registration: 200 €

Registration is only complete once either the ERCOFTAC grant has been allocated or the corresponding payment has been received. In this case, proof of student status and/or ERCOFTAC membership of your institution should be provided to benefit from reduced rates.

Student accommodation:

50 student rooms have been reserved at a preferential rate of 10 €a night for students or 18 €a night for others, internet connection extra. The residence is a 15 minutes bus ride from the Observatory.

Coordinator:

Pierre Comte
Institut de Mécanique des Fluides et des Solides
2 Boussingault
F – 67000 Strasbourg, France
Tel.: +33.3.90.24.28.94
Fax : +33.3.88.61.43.00
E-mail: comte@imfs.u-strasbg.fr

PILOT CENTRE REPORTS

POLISH PILOT CENTRE

S. Drobniak, D. Asendrych
Czestochowa University of Technology, Poland

1. INTRODUCTION

Polish Pilot Centre is one of the most recent ERCOFTAC branches as it was established in 1997 as the first one outside the EU (excluding the Leonard Euler Centre). The strong need of the closer collaboration with European scientific centres has become clearly visible after the transition of Polish economy into market rules. In new circumstances Polish science, in general, turned out not to be sufficiently prepared to respond to the demands of transforming industry and to stimulate its competitive development. In particular it was a common feeling of the Polish scientific society working in the field of flow, turbulence and combustion that computational fluid dynamics, being not sufficiently present in our research, is one of the powerful tools which could significantly contribute to the ongoing transformation. The lack of knowledge about possible CFD applications was especially evident in Polish industry and among others the following industrial branches:

- power industry
- aviation
- automotive industry
- environmental engineering
- chemical engineering
- food processing
- metallurgy

were identified as those which could benefit from solutions provided by CFD. According to the mission statement defined during the inaugurating meeting of Polish PC the main aim of its activities is the transfer of knowledge from the EU countries to Poland in the field of numerical methods in fluid mechanics, heat transfer and combustion.

2. PC ORGANISATIONAL STRUCTURE

Polish Pilot Centre is currently formed by the following members:

- Institute of Turbomachinery, Technical University of Lodz, representative: Dr. A. Smolny
- Department of Theoretical Metallurgy and Metallurgical Engineering, University of Mining and Metallurgy, Cracow, representative: Prof. J. Szmyd
- Institute of Thermal Machinery, Technical University of Czestochowa, representative: Dr. D. Asendrych
- Polish Academy of Sciences, Institute of Fluid-Flow Machinery, Gdansk, representative: Prof. P. Doerffer
- Institute of Aeronautics and Applied Mechanics, Warsaw University of Technology, representative: Dr. P. Sierputowski
- Institute of Power Machinery, Silesian Technical University, Gliwice, representative: Prof. T. Chmielniak
- Divison of Thermodynamics and Fluid Mechanics, Kielce University of Technology, representative: Dr. R. Pastuszko
- Chair of Thermal Engineering, Technical University of Poznan, representative: Prof. E. Tuliszka-Sznitko

No industrial members are associated with Polish PC after withdrawal of Overhaul Company for Energy Industry ZRE, Katowice in 1999.

Polish Pilot Centre is coordinated by Prof. S. Drobniak (Czestochowa University of Technology) since the PC establishment in 1997. The position of the PC secretary is held by Dr. D. Asendrych. The following PC representatives are appointed to the ERCOFTAC managing bodies:

- Managing Board:
  - Prof. Tadeusz Chmielniak, Silesian Technical University, Gliwice,
  - Prof. Piotr Doerffer, Institute of Fluid-Flow Machinery, Polish Academy of Sciences, Gdansk
- Scientific Programme Committee:
  - Prof. Stanislaw Drobniak, Czestochowa University of Technology
  - vacat

3. RESEARCH ACTIVITIES AND EXPERTISE OF THE PC MEMBERS

Institute of Turbomachinery, Technical University of Lodz

The Institute of Turbomachinery specializes since 30 years in aero- and thermodynamics of internal flows. Among others the following topics are undertaken: steady and unsteady effects, rotor-stator interaction, clocking effect, interaction of wakes and boundary layers (high lift airfoils), secondary flow structures, experimental and numerical investigations of the steady and unsteady flows, aero-acoustic. Current performed research projects include the following topics:

- the prediction of rotor-stator, and stator-stator interaction using accurate 3D CFD solver. Basic research is related to provide the most suited approach for accurate study of turbine stage aerodynamics,
- build a new highly-loaded two stage turbine to investigation of the unsteady flow effects and they significant role for the improvement of turbine efficiency,
- turbine rotor/stator and stator/stator interaction, steady and unsteady aerodynamics measurements in stators. End wall flow, blade/vane boundary layers and wake interaction. Flow structure in turbine stator and rotor passages,
- acoustic measurements of the noise emitted by the turbine and its flow phenomena (influence of an acoustic noise upon the turbine clocking effect efficiency variation) in an anechoic chamber where the turbine will be placed.

A research project on "Experimental and numerical investigations of steady and unsteady 3D flow in a two stage turbine" funded by Polish Grant Agency is performed presently at the Institute of Turbomachinery.

Department of Theoretical Metallurgy and Metallurgical Engineering, University of Mining and Metallurgy, Cracow

The research interests of the Department of Theoretical Metallurgy and Metallurgical Engineering are related to theoretical, numerical and experimental investigations of heat and mass transfer and fluid mechanics related phenomena, i.e.: computational fluid mechanics, turbulence modelling, buoyancy- and rotation- driven instabilities and transition to turbulence; transport phenomena in Czochralski crystal growth processes, convection in Czochralski melt systems, mathematical and numerical modelling of liquid metal turbulent heat transfer, thermo-fluid phenomena in swirling nonisotherrmal flows, turbulent jets, magnetic and gravitational convection, development and application of interactive computational-experimental methodologies (ICEME). The main research topics of the Department concern the following problems:

1. Theoretical metallurgy:

- application of equilibrium and statistical thermodynamics,
- evaluation of thermodynamics properties of metallic alloys, intermetalic compounds and slags,
- kinetics of high temperature metallurgical chemical processes.

2. Heat and mass transfer analysis:

- mathematical modelling heat and mass transfer processes in liquid metals and alloys,
- mathematical modelling and experimental research of turbulent fluid flows,
- modelling of transport phenomena in crystal growth,
- mathematical modelling of solidification processes of liquid metals and alloys (macro and micro models of heat and mass transfer),
- mathematical modelling and computer simulation of metallurgical processes (blast furnaces, flash smelting processes, aluminium electrolysis cells),
- energy and exergy analysis of the metallurgical processes; auditing of energy systems.
- application of least square method in non –linear thermodynamic problems.

3. Energy management and economy in metallurgy:

- energy systems management,
- energy conservation policy,
- economy of thermomodernisation investment

Research project presently being conducted:

- 6FP project "Development of the continuous powder production system (Dev-CPPS)"
- 3 international projects in collaboration with Japanese, Korean and German partners in the field of heat transfer and flow modelling with reference to metallurgical processes
- 1 project sponsored by Polish State Grant Agency
- 1 industrial contract

Institute of Thermal Machinery, Technical University of Czestochowa

The research activity of the Institute of Thermal Machinery (ITM) is focused on numerical and experimental analysis of turbulent flows. The extensive research for more than 25 years has been performed on the laminar-turbulent transition in many flow types including free jets, wakes, wall flows and flows in turbo machinery bladings. The interest of the Institute is also devoted to the boundary layer flows focusing on transitional and turbulent boundary layers. Special attention in the research work performed in the Institute was put also to the dynamics and role of organized, coherent structures in heat and mass transfer in turbulent flows. Some recent research projects have been devoted to the problem of absolute/global instability in variable density and counter-current jets as well as to unsteady aerodynamics and combustion problems in aeroengines. Very recently the research projects have also been launched in the field of CFD application to steel casting and paper recycling.

Another currant of scientific interests of ITM is related to environmental aerodynamics and energy production. The research activities include the following groups of problems: unsteady aerodynamics of bluff bodies with the particular allowance for the modelling (CFD) of unsteady phenomena in built environment, pollutant diffusion processes in the surface layer of the atmosphere technical and organisational solutions for rational, efficient and environmental compatible energy use, local and regional energy planning including: development of software for energy management, integrated plans for energy conservation.

The Institute is very actively involved in the realisation of European projects including Framework Programmes. The projects are related mainly to mathematical modelling of combustion and aerodynamics modelling with special reference to aeroengines. The following projects were/are carried out with ITM participation:

- TRANSPRETURB Thematic Network (4FP) and UTAT (5FP) - unsteady l-t transition on turbine blading
- QNET-CFD Thematic Network for Quality and Trust in the Industrial Applications of Computational Fluid Dynamics (5FP)
- MOLECULES - modelling of low emission combustors sing LES (5FP)
- INTELLECT - integrated lean low emission combustor design methodology (6FP)
- WALLTURB - a European synergy for assessment of wall turbulence (6FP)
- FAR-WAKE - fundamental research on aircraft wake phenomena (6FP)
- ÖKOPROFIT - International-Private-Public-Partnership-Networks for sustainable Development of Policies and Society (INTERREG III C)
- POLONIUM - bilateral French-Polish project related to the optimisation of paper recycling technology

Polish Academy of Sciences, Institute of Fluid-Flow Machinery, Gdansk

The fields of interest of the Institute of Fluid-Flow Machinery (IFFM) related to ERCOFTAC activities:

- Mechanics of liquids - works have been conducted in the frame of 4 topics regarding the problems of exploitation and diagnostics of rotary machinery, design and analysis of the hydraulic properties of water turbines and pumps, numerical modelling and investigations of

three-dimensional flows and as determination of characteristics of propeller pumps, and investigations and modelling of heat transfer in packed beds. A majority of works has been made for the companies from the water power engineering sector.

- Thermomechanics of fluids - the topics of works were concerned with the problems of thermomechanics, exploitation and diagnostics of turbines, transonic flows with strong interactions, modelling of the Processes of pro-ecological combustion in power engineering systems, Investigations of two-phase flows, single and multi-component, mass and heat transfer during phase changes, dynamics of multi-phase media in the electric field, transport of heat in jets and films as well as laminar-turbulent transition in fluid-flow machinery.

IFFM is strongly involved in the international collaboration which takes form of joint research projects. The most important are as follows:

- DEEPSSI - Design and Development of a Steam Generator Emergency Feedwater Passive System for Existing and Future PWRs Using Advanced Steam Injectors (5FP)
- AITEB - Aerothermal Investigation of Turbine Endwalls and Blades (5FP)
- CLEANERPAS - Centre for Renewable Sources and Clean Conversion of Energy (5FP)
- Development of a probabilistic model of thermal fluctuations in wall vicinity (Electricite de France)
- Design and optimisation of microwave sources of atmospheric pressure plasmas (AIR LIQUIDE)

IFFM is also conducting a number of projects sponsored by Polish State Agency for Scientific Research (10) and financed in by industry (13).

Institute of Power Machinery, Silesian Technical University, Gliwice

Scientific interests of the Institute are focused on the design and operational aspects of power generating machinery. Particular research interest in concentrated on:

- The experimental and numerical investigation of the detailed three dimensional unsteady flow structure in the axial flow low speed compressor stage (investigation of the unsteady flow field existing in the low speed axial flow compressor stage and the critical comparison of velocity measurements with three systems)
- Transonic flows with condensation (numerical research in the field of transonic flows giving the 3D viscous turbulent flows of the ideal as well as real gases. research concentrated on a homogeneous/heterogeneous condensation in the moist air and steam flow, turbulence modelling, modelling the external flows of the moist air and internal steam flow through the LP steam turbine stages)
- Optimization of heat exchange within cooled turbine blades (optimization algorithm based on evolutionary approach and FEM, optimization of cooling structure of turbine blades, modernization projects of CHP plants with gas turbines, assessment of the influence of internal cooling on gas turbines performance, modeling of expansion processes in internally cooled gas turbines under various operating conditions, development of simulation modules for off-line and on-line performance control and diagnostics of internally cooled gas turbines)

Research projects carried out at the Institute:

- 6FP - European Reintegration Grant - Numerical research on the 3D compressible flow in turbomachinery channels to estimate losses to increase flow efficiency end to minimize harmful impact on environment
- 8 projects sponsored by Polish State Agency for Scientific Research
- a number of projects financed by Polish power industry

Divison of Thermodynamics and Fluid Mechanics, Kielce University of Technology

The main fields of research interests of the division are:

- flow boiling heat transfer in minichannels focused on the transition from single-phase forced convection to nucleate boiling
- pool boiling heat transfer enhancement on double-extended surfaces - complex experimental investigations (including visualisation) into boiling heat transfer on finned arrays (with tunnelled structure, narrow tunnel structure and capillary-porous structure) covered with extended micro-surfaces
- experimental and theoretical investigations of boiling heat transfer enhancement through the application of porous, metal-fibrous coverings

The above topics are the subject of a number of national research projects (grants from Polish Grant Agency) conducted by the division staff.

Chair of Thermal Engineering, Technical University of Poznan

The fields of research interest of the Chair of Thermal Engineering are as follows:

- mass and heat transfer of impinging jets
- the stability and control of the boundary layers, the flow and heat transfer in rotating geometries, DNS method
- application of the inverse problems to analysis of the thermal flow and thermal fields, thermal polynomials for the problems of fluid mechanics
- investigations of the gas combustion processes
- experimental and theoretical investigations of compressors and centrifugal fans

Research projects currently carried out:

- international - French-Polish bilateral POLONIUM project "Investigation of the laminar-turbulent transition in the rotating cavity" (Université de la Méditerranée, Marseille)
- 8 projects funded by Polish State Committee for Scientific Research
- 1 industrial contract

4. SCIENTIFIC EVENTS ORGANISED BY POLISH PILOT CENTRE

Summerschool on "Recent Developmemnts in Mathematical Modelling of Turbulent Flows", September 24-27, 2001, Olsztyn-Łansk, Poland

The event was intended to be a continuation of a first summer school ("Direct and Large Eddy Simulation" held in 1999) and in addition to DNS and LES modelling it also covered the application of RANS modelling to unsteady flows (TRANS). The main contribution to the school was done by invited speakers: Prof. M. Lesieur, Prof. O. Metais (LEGI, Grenoble) and Prof. K. Hanjalic (TU Delft). Some additional aspects of computational

fluid dynamics were also presented to the audience by Polish speakers. The summer school was attended by almost 60 participants, mainly PhD students and young scientists from Polish universities and research centres. The attendance of a number of them was sponsored from ERCOFTAC grant.

Summerschool on "Recent Developments in Design and Computations of Gas Turbines", September 25-27, 2003, Stare Jablonki, Poland

After two very successful first summer schools held in 1999 and 2001 which were mainly devoted to the fundamental aspects of CFD techniques (DNS, LES and TRANS/VLES) The background given during both meetings have resulted in increased interest in CFD among Polish scientific community, which took the form of two LES research projects carried out in recent time. It was then decided to continue that initiative by organizing the schools dedicated to more specific applicable areas. As the first topic it was proposed by Chairman of Fluid Mechanics Section of Polish Academy of Sciences, Prof. T. Chmielniak to organise the summer school on CFD and combustion modelling with respect to gas turbines, as it is already present in a number of Polish academic centres.

Invited speakers: Prof. W. Dawes (Cambridge University), Prof. N. Peters (RWTH Aachen), Prof. A. Boelcs (EPFL Lausanne) and Dr. R. Howell (Siemens Power Generation).

The summer school was attended by more than 80 participants, among whom PhD students and young scientists from Polish universities and research centers, were in majority. The attendance of a number of them was supported from ERCOFTAC grant.

Workshop on "Size Effects in Microfluidics and Micro Heat Transfer. Fundamental and Practical Aspects", September 16th, 2004, Kielce, Poland

As the result of the discussion held during ERCOFTAC SPC and MB meetings in October 2003 in London, Polish Pilot Centre with the help and assistance of a number of colleagues from different ERCOFTAC member institutions has managed to establish a new Special Interest Group on microfluidics and micro heat transfer (SIG #38). The feedback to that initiative from the community was very strong and several groups were identified as being interested in involvement into activities and willing to collaborate. As the first activity of a newly established SIG the kick-off meeting was proposed to be held in Poland, which could gather together the "micro-community" enabling for exchange of information and planning of future actions. The meeting was attended by the scientists representing several groups from France, the Netherlands, Germany, Norway and Poland working in the field of microfluidics and micro heat transfer with respect to cooling of electronics, biofluidics, metrology in limited room, phase transition (boiling) and related topics.

The meeting was evaluated by the organisers and the participants as a very successful event. In the opinion of SIG coordinators, i.e. Prof. Michel Favre-Marinet (INPG Grenoble) and Prof. Anton van Steenhoven (TU Eindhoven) the links between particular centres were established which should result in future collaboration. It is believed that the newly established SIG on microfluidics and micro heat transfer will support the progress in research and the implementation of its results into industrial practice. The microSIG should also be a platform for transfer of knowledge between outstanding European centres and Polish scientific institutions supporting the ongoing integration of Polish and EU science.

Workshop on "Experimental Techniques in Multiphase Flows", September 2-4, 2005, Stawiska, Poland

The workshops on numerical modelling and experimental techniques in multiphase flows have been organized in Poland since 2001 by Prof. Janusz Cieslinski. The organizers were Institute of Thermal Machinery, Czestochowa University of Technology (Prof. S.Drobniak), Institute of Fluid-Flow Machinery, Polish Academy of Sciences (Prof. P.Doerffer, Prof. M.Trela), Technical University of Gliwice (Prof. T.Chmielniak). Each year the workshop was attended by 30 – 50 participants from Polish research institutions. This-year workshop (organised by ERCOFTAC auspices) will be devoted to the recent developments in experimental techniques in the following areas:

- boiling and condensation,
- sprays,
- fluidised beds and dispersed multiphase flows.

Organizers of the workshop would like to treat this event as an opportunity for transfer of knowledge in modern experimental techniques (e.g. PIV, PDA) which are not widely used in Poland.

5. THE INVOLVEMENT OF POLISH PC INTO ACTIVITIES OF ERCOFTAC SIGS

SIG 1 "Large Eddy Simulation"

The collaboration with SIG No 1 was initiated just after the establishment of Polish Pilot Centre in 1998 and resulted in organisation of 2 Summer Schools devoted largely to Large Eddy Simulation (held in Poland 1999 and 2001). Both Summer Schools were organised under the auspices of ERCOFTAC with participation of outstanding representatives of SIG 1, i.e. Prof. M. Lesieur, Prof. O. Metais, Prof. B. Guerts, K. Hanjalic and Prof. P. Voke. The links with LESig are maintained through the bilateral programme POLONIUM (ITM - LEGI Grenoble) and very recent initiative of a new COST Action in the field of LES coordinated by Prof. B. Guerts.

SIG 10 "Transition Modelling"

The links of Polish PC with SIG 10 were initiated by the by the inclusion of the Institute of Thermal Machinery of Czestochowa University of Technology into the consortium of TRANSPRETURB European project. Dr. M. Savill, project coordinator, was acting as the coordinator of SIG 10. Further contacts of ITM resulted from the involvement in the European projects UTAT (5FP) and WALLTURB (6FP).

SIG nr 36 „Swirling Flows"

Prof. E. Tuliszka-Sznitko (Technical University of Posnan) is a member of a steering committee of the SIG.

SIG nr 38 „Microfluidics and micro heat transfer"

The "microSIG" was formed and organised thanks to the initiative of Polish Pilot Centre. The interest of Polish PC in creating of a common European scientific platform in the field of microflows and micro heat transfer resulted from the previous research being carried out by Polish centres. The organisation of a kick-off meeting and hosting the representatives of ERCOFTAC member institutions allowed to contact possible partners and undertake common research. Prof. S. Drobniak (Czestochowa University of Technology) and Prof. M. Poniewski (Kielce

University of Technology) are the members of a steering committee of microSIG.

SIG 101 "Quality & Trust in Industrial CFD"

The participation of Polish PC representatives in the activities of SIG 101 is associated to the involvement of the Institute of Thermal Machinery of Czestochowa University of Technology in the realisation of the QNET project.

SIG 102 "ERCOFTAC Database Interest Group"

The main aim of TRANSPRETURB realisation was the creation of the database with experimental as well as numerical data related to the laminar-turbulent transition for a variety of flow configurations. Institute of Thermal Machinery of Czestochowa University of Technology was involved in the project realisation. The coordination of the database creation process is done by SIG 102 headed by Prof. P. Voke and Prof. D. Laurence.

First Announcement

Quality and Reliability of CFD Simulations II:

Industrial Challenges

Joint NAFEMS – ERCOFTAC Conference

Tuesday 13 September, 2005

University of Nottingham, UK

http://www.nafems.org/events/nafems_events.html

This is the second joint meeting on this theme co-organised by NAFEMS and ERCOFTAC: UK Pilot Centre, SIG 5 (Environmental CFD) and SIG 101 (Quality and Trust in Industrial CFD). It follows the successful first meeting held on 9th March 2004.

The objective is to bring together industrial users of CFD to examine issues of accuracy, reliability and trust in the context of practical applications in the environment, engineering design, and health and safety management. Emphasis will be placed on the useful exploitation of CFD.

Presentations will be made by invited speakers from a number of industrial, academic, commercial and consulting organisations.

Organiser

Dr Chris Lea
Lea CFD Associates Ltd
chris@leacfd.com
Tel: +44 (0) 1298 767552

For further information visit:

http://www.nafems.org/events/nafems_events.html

Blood Flow - Modelling and Diagnostics - BF2005

Advanced Course and Workshop

organized by

ERCOFTAC SIG-37 (Bio-Fluid Mechanics and Heat Transfer)

&

Center of Excellence ABIOMED (Applied Biomedical Modelling and Diagnostics)

June 20-23, 2005, Warsaw, Poland

http://fluid.ippt.gov.pl/bf2005/

Chairmen:

Tomasz Kowalewski, Andrzej Nowicki:

Polish Academy of Sciences, IPPT PAN, Swietokrzyska 21, PL 00-049 Warsaw, E-mail: bf2005@ippt.gov.pl

Anton van Steenhoven:

Mechanical Engineering, P.O. Box 513, 5600 MB Eindhoven, The Netherlands, E-mail: a.a.v.steenhoven@tue.nl

Preliminary subject of lectures:

The main theme of the course is the fluid mechanics of the cardiovascular flow. The following invited lectures are scheduled:

Blood flow measurements: J. Westerweel (Delft)

Mathematical and numerical modelling of cardiovascular flows: J. Szumbarski (Warszawa)

Multiscale modelling of the cardiovascular system: A. Veneziani (Milan)

Heart valves, experimental and modelling: G. Romano (Rome)

Heat transfer in blood circulatory system: G. van Leeuwen & A. van Steenhoven (Eindhoven)

Wave propagation in arteries, coronary circulation or aneurysms: F. van de Vosse (Eindhoven)

Flow in artificial valves and bloodpumps: K. Affeld (Berlin)

Experimental assessment of wall shear flow: U. Kertzscher (Berlin)

Listening blood flow (ultrasound diagnostics): A. Nowicki (Warszawa)

Do Doppler motion detectors colour arteries red? : A. PG Hoeks (Maastricht)

Experimental investigations of blood flow behaviour in large human arteries: Piero Tortoli (Firenze)

Blood flow - soft tissue interactions: J. Telega and M. Stanczyk (Warszawa)

Blood as a complex fluid, flow of suspensions: - TBA

The course is followed by one-day Ercoftac-workshop, inviting contributions on all relevant aspects of blood flow modelling, including flow of suspensions of red blood cells, arterial flow aspects like:

unsteady turbulent flow, curved tubes, flexible walls, wave propagation phenomena, flow around heart valves, bio-heat transfer modelling and measurements.

Participants are encouraged to present they own research in form of short communications (20min). Participants will obtain printed materials including full text of the invited lectures and abstracts of their contributions. It is planned to prepare a post-conference book including selected lectures.

There is no participation fee. Limited support to travel and accommodation costs will be made available for young scientists.

For further details and to register please visit the webpage:
http://fluid.ippt.gov.pl/bf2005/

UK Pilot Centre Osborne Reynolds Award

Chris Carey
Chairman UKPC
Email: chc@fluent.co.uk

On 14th April 2005, the UK PC hosted the third "Osborne Reynolds Day" at the University of Manchester. This annual event is organised in order to recognise and celebrate the quality of young researchers studying applied fluid dynamics in the UK. The competition is open to anyone who is currently studying for a PhD in the UK or has gained a PhD degree from an UK university within the preceding year and whose research topic is in the field of flow, turbulence or combustion.

The event was opened with an invited lecture given by Professor Brian Hoskins of the University of Reading. Professor Hoskins, who is Royal Society Research Fellow and vice Chair of the World Climate Research Programme, spoke about the contribution made by fluid dynamics to the scientific study of climate change, drawing on his experience in meteorological modelling to illustrate some of the important elements of long range predictive methods.

Following Professor Hoskins' lecture, six young researchers presented their work. These six finalists had been selected by consideration of abstracts submitted from universities throughout the UK. The audience included a panel of judges comprising senior academic and industrial members of ERCOFTAC.

After due consideration of the six contributions for the technical value of research and the quality of presentation, Ryan Reynolds of the University of Southampton was selected as the winner of the Osborne Reynolds Award for 2005, for his presentation entitled "Measurements on the Structure of Turbulence over Rough Surfaces". Professor Hoskins congratulated each of the finalists and presented the winner's prize, which was donated by Fluent Europe Limited as part of their sponsorship of the event.

The Osborne Reynolds Day is becoming an established event in the UKPC calendar, and the organisers and judges have been impressed each year by the high quality of the work presented. For further information please contact the author.

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

FACULTY POSITION IN AEROTHERMODYNAMICS OF TURBOMACHINES

AT ECOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE (EPFL)

The EPFL plans a substantial expansion in energy sciences and technologies, in particular through an intensive search for internationally renowned experts.

As part of this, the Institute of Energy Sciences has an opening at the **Assistant Professor (tenure-track)** level. Senior candidates shall nevertheless also be considered. We seek outstanding individuals in the area of aerothermodynamics of turbomachines.

The new professor will be in charge of the Laboratory of Thermal Turbomachines (LTT) and must hence have the capacity to maintain and develop both a fundamental and applied research activity with international visibility. Possible directions of these activities are advanced experimental and/or numerical methods (including reactive flow modeling), linked to high power density machines for advanced energy conversion. The successful candidate will lead important projects and build cooperation with other laboratories as well as with industrial partners, and will contribute to the teaching of thermal sciences within the Mechanical Engineering undergraduate and graduate programs.

Significant start-up resources and research infrastructure will be available. We offer internationally competitive salaries and benefits, as well as a world-class, dynamic research environment.

Applications, including curriculum vitae, publications list, concise statement of research and teaching interests as well as the names and addresses (including e-mail) of at least five referees, should be sent by **August 31st, 2005** to :

Professor Michel Declercq, Dean
EPFL School of Engineering
Station 11
CH-1015 Lausanne
Switzerland

More information about EPFL and its Institute of Energy Sciences are available at :
http://www.epfl.ch or http://ise.epfl.ch

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NEXT ERCOFTAC EXECUTIVE MEETINGS

The ERCOFTAC Executive meetings will be held on the following dates:

SCIENTIFIC PROGRAMME COMMITTEE AND INDUSTRIAL ADVISORY COMMITTEES:

November 3, 2005
Vienna, Austria

May 4, 2006
Florence, Italy

EXECUTIVE COMMITTEE MEETING:

May 5, 2006
Florence, Italy

MANAGING BOARD AND GENERAL ASSEMBLY MEETING:

November 4, 2004
Vienna, Austria

Please note that the meetings in **Paris** are on Thursday and Friday.

For further information contact Dr. Thierry Ursenbacher at the ERCOFTAC Coordination Centre (contact details inside the back page of the Bulletin).

BULLETIN THEMES AND PC REPORTS

PAST AND FUTURE

The ERCOFTAC Bulletin aims to publish news of, and of interest to, the ERCOFTAC Community every 3 months. Every second issue (March and September) is dedicated to a scientific theme. Pilot Centres are supposed to report occasionally on their activities, and the non-theme issues (June and December) since March 1996 should contain two Pilot Centre reports.

We list below the Themes and PC reports of past and planned future issues from 2002 to 2005. PC chairmen are asked to note when their report is due. A complete list of Bulletin themes can be found in the Bulletin section of the ERCOFTAC web server.Those interested in organising a theme issue or in contributing to planned theme issues are invited to contact the Coordination Centre.

2002

March	*Theme:*	Fluid Dynamics Databases (P. Voke)
June	*PC reports:*	Germany West PC UK North (delayed) Portugal (failed to report)
September	*Theme:*	Transition (M. Savill)
December	*PC reports:*	UK PC Portugal (failed to report)

2003

March	*Theme:*	Complex Flow Problems (I. Eames)
June	*PC reports:*	Germany South Nordic Spain (R. Castilla)
September	*Theme:*	Aeroacoustics (B. Boersma)
December	*PC reports:*	France South PC FranceWest PC Germany North PC

2004

March	*Theme:*	Geophysical and Environmental Turbulence Modeling (J. Redondo)
June	*PC reports:*	France PEPIT PC (delayed) Netherlands PC
September	*Theme:*	New Developments in Numerical Methods for CFD (D. Laurence & Ch. Hirsch)
December	*PC reports:*	Belgium PC Switzerland PC France PEPIT PC

2005

March	*Theme:*	Combustion (A. Turan)
June	*PC reports:*	Greek PC (failed to report) Polish PC
September	*Theme:*	Design Optimisation (W. Haase, F. Menter)
December	*PC reports:*	Czech Republic PC Italian PC

SPECIAL INTEREST GROUPS

1. Large Eddy Simulation (LESig)

B.J. Geurts, University of Twente, NL
☎ 31.53.489.4125
Fax 31.53.489.4888
b.j.geurts@math.utwente.nl

2. Turbulent Boundary Layers

J. Morrison, Imperial College London, UK
☎ 44.171.594.5067
Fax 44.171.184.8120
j.morrison@ic.ac.uk

4. Turbulence in Compressible Flows

P. Comte, ULP, Strasbourg, F
IMFS
☎ 33.3.90.242.894
Fax 33.3.88.614.300
comte@imfs.u-strasbg.fr

5. Environmental CFD

H. Morvan, University of Nottingham, UK
☎ 44.115.846.6374
Fax 44.115.951.3898
Herve.Morvan@nottingham.ac.uk

8. Turbomachinery

D.G. Gregory-Smith,
Durham University, UK
☎ 44.191.374.3907
Fax 44.191.374.2550
d.g.gregory-smith@durham.ac.uk

10. Transition Modelling

M. Savill,
Cranfield University
Cranfield, UK
☎ 44.1234.754.752
Fax 44.1234.754.601
mark.savill@cranfield.ac.uk

12. Dispersed Turbulent Two Phase Flow

M. Sommerfeld, Martin-Luther Universität, Halle-Wittenberg, D
☎ 49.3461.462.879
Fax 49.3461.462.878
Martin.Sommerfeld@iw.uni-halle.de

14. Stably Stratified and Rotating Turbulence

J.M. Redondo, UPC, Barcelona, E
☎ 34.93.401.7984
Fax 34.93.401.6090
redondo@fa.upc.es

15. Turbulence Modelling

K. Hanjalic, University of Technology, Delft, NL
☎ 31.15.278.1735
Fax 31.15.278.1204
hanjalic@wt.tn.tudelft.nl

20. Drag Reduction and Flow Control

K.S.Choi, Nottingham University, UK
☎ 44.115.9513.792
Fax 44.115.9513.800
Kwing-So.Choi@nottingham.ac.uk

21. Vortex Dynamics

P. Orlandi, Universita di Roma, I
☎ 39.064.445.858.78
Fax 39.064.881.759
orlandi@kolmogorov.ing.uniroma1.it

24. Variable Density Turbulent Flows

F. Anselmet, IMST, Marseille, F
☎ 33.4.91.505.439
Fax 33.4.91.081.637
Fabian.Anselmet@irphe.univ-mrs.fr

28. Reactive Flows

A. Turan
UMIST
P.O. Box 88
Manchester M6O 1QD, UK
☎ 44.161.200.3712
Fax 44.161.200.3723
A.Turan@umist.ac.uk

30. Wind over Waves

G. Stelling, Delft
University of Technology, NL
☎ 31.15.278.5426
Fax 31.15.278.4842
g.s.stelling@citg.tudelft.nl

32. Particle Image Velocimetry

M. Stanislas, Ecole Centrale de Lille, Villeneuve d'Asq, F
☎ 33.3.20.337.170
Fax 33.3.20.337.169
stanislas@ec-lille.fr

33. Transition Mechanisms, Prediction and Control

A. Hanifi, FOI, Stockholm, S
☎ 46.8.5550.4334
Fax 46.8.5550.3481
ardeshir.hanifi@foi.se

34. Design Optimisation

R. Schilling, TU München, D
☎ 49.89.289.16295
Fax 49.89.289.16297
schilling@lhm.mw.tum.de

35. Multipoint Turbulence Structure and Modelling

C. Cambon, ECL Ecully, F
☎ 33.4.72.186.161
Fax 33.4.78.647.145
cambon@mecaflu.ec-lyon.fr

36. Swirling Flows

M. Braza, IMFT, Toulouse, F
☎ 33.5.61.285.839
Fax 33.5.61.285.899
braza@imft.fr

37. Bio-Fluid Mechanics

A.A. van Steenhoven
Eindhoven Univ. of Technology, NL
☎ 31.40.2472.722
Fax: 31.40.2433.445 a.a.v.steen hoven@wtb.tue.nl

38. Microfluids and micro heat transfer (MicroSIG)

M. Favre-Marinet, LEGI, Institut National Polytechnique de Grenoble, Grenoble, F
☎ 33.4.76.825.049
Fax 33.4.76.825.271
michel.favre-marinet@inpg.fr

39. Aeroacoustics

B.J. Boersma, University of Technology, Delft, NL
☎ 31.1.5278.7979
Fax 31.1.5278.2947
b.j.boersma@wbmt.tudelft.nl

101. Quality and Trust in Industrial CFD (IAC SIG)

A.G. Hutton, QinetiQ, Farnborough, UK
☎ 44.1252.395.568
Fax 44.1252.395.322
ahutton@QinetiQ.com

102. ERCOFTAC Database Interest Group (Dbig)

ad interim
D. Laurence, UMIST, Manchester, UK
☎ 44.161.200.3704
dominique.laurence@manchester.ac.uk

The following activities have ceased: 3, 6, 7, 9, 11, 13, 16, 17, 19, 18, 22, 23, 25, 26, 27, 29 and 31.

This page lists the Special Interest Groups currently believed to be active and gives one contact person for each one.

Please notify any corrections to the Coordination Centre in Lausanne.

ERCOFTAC PILOT CENTRES

Belgium
Prof. E. Dick
Universiteit Gent
Department of Machinery
Sint Pietersnieuwstraat 41
B - 9000 Gent
☎ 32.9.264.3301
Fax 32.9.264.3586
erik.dick@ugent.be

Czech Republic
Prof. J. Prihoda
Institute of
Thermomechanics AS CR
5 Dolejskova
CZ - 18200 Praha 8
☎ 420.286.890.383
Fax 420.286.584.695
prihoda@.it.cas.cz

France P.E.P.I.T.
Dr. C. CAMBON
Ecole Centrale de Lyon
L.M.F.A. - B.P. 163
F - 69131 ECULLY Cedex
☎ 33.4.72.18.6161
Fax 33.4.78.64.7145
cambon@ mecaflu.ec-lyon.fr

France South
Dr. M. BRAZA
IMF Toulouse
UMR CNRS/INPT-N° 5502
Av. du Prof. Camille Soula
F - 31400 TOULOUSE
☎ 33.5.61.28.5839
Fax 33.5.61.28.5899
braza@imft.fr

France West
Dr. J.-P. BONNET
LEANP, CNRS
BP 30179
F - 86962 Futuroscope - Chasseneuil
☎ 33.5.49.36.6031
Fax 33.5.49.53.6001
jean-paul.bonnet@univ-poitiers.fr

Germany North
Dr. C. WAGNER
DLR
Inst. für
Strömungsmechanik
Bunsenstrasse 10
D-37073 GÖTTINGEN
☎ 49.551.709.2261
Fax 49.551.709.2404
claus.wagner@dlr.de

Germany South
Dr. F. MENTER
AEA Technology GmbH
Staudenfeldweg 12
D - 83624 OTTERFING
☎ 49.8024.905.415
Fax 49.8024.905.417
florian.menter@otterfing.aeat.com

Germany West
Prof. N. PETERS
RWTH-Aachen
Templergraben 64
D - 52056 AACHEN
☎ 49.241.809.4609
Fax 49.241.809.2923
n.peters@itm.rwth-aachen.de

Greece
Prof. D.D.PAPAILIOU
University of Patras
Mech. Engineering Dept.
Lab. Applied Thermodyn.
GR - 265 00 PATRAS-Rion
☎ 30.61.991.497
Fax 30.61.997.271
papailiu@mech.upatras.gr

Italy
Prof. F. MARTELLI
University of Florence
Dept. of Energy
Via Santa Marta 3
I - 50139 FIRENZE
☎ 39.055.471.925
Fax 39.055.479.6342
martelli@ing.unifi.it

Netherlands
Prof. G. OOMS
J.M. Burgerscentrum
Mekelweg 2
NL - 2628 CD DELFT
☎ 31.15.278.3216
Fax 31.15.278.2979
g.ooms@wbmt.tudelft.nl

Nordic
Dr. S. WALLIN
FOI, Division of Systems Technology
S - 16490 STOCKHOLM
☎ 46.8.5550.3184
Fax 46.8.5550.3062
stefan.wallin@foi.se

Poland
Prof. S. DROBNIAK
Tech. Univ. of Czestochowa
Thermal Machinery Inst.
al. A. Krajowej 21
PL - 42 200
CZESTOCHOWA
☎ 48.34.3250.507
Fax 48.34.3250.555
imc@imc.pcz.czest.pl

Spain
Prof. E. ONATE
Universitat Politecnica de Catalunya - C.I.M.N.E.
Edificio C-1- Campus Norte
Gran Capitan s/n.
E - 08034 BARCELONA
☎ 34.93.205.7016
Fax 34.93.401.6517
onate@cimne.upc.es

Switzerland
Prof. D. POULIKAKOS
ETHZ, LTNT
CH - 8092 Zurich
☎ 41.44.632.27.38
Fax 41.44.632.11.76
dimos.poulikakos@ltnt.iet.mavt.ethz.ch

United Kingdom South
Prof. A.B. CROWLEY
UK South Pilot Centre
Cranfield University (RMCS)
Shrivenham, Swindon
GB - Wilts, SN6 8LA
UK
☎ 44.1793.78.5277
Fax 44.1793.78.5772
crowley@rmcs.cranfield.ac.uk

Chairman

Prof. R.V.A. OLIEMANS
Multiphase Flow B.V.
Noord Houdringelaan 30
NL - 3722 BR Bilthoven, The Netherlands
☎ +31.30.229.1719
Fax +31.15.278.2838
oliemans@globalxs.nl

Seat, Administration and Development Office

Prof. Ch. HIRSCH
ERCOFTAC
Av. Franklin Roosevelt 5
B - 1050 - Brussels / Belgium
☎ +32.2.643.3572
Fax +32.2.647.9398
ado@ercoftac.be

Coordination Centre

Dr. Thierry Ursenbacher
ERCOFTAC - Coordination Centre
EPFL STI ISE ERCOFTAC
ME B2 495, Station 9
CH - 1015 Lausanne / Switzerland
☎ +41.21.693.5305
Fax +41.21.693.5307
ercoftac@epfl.ch

The ERCOFTAC Best Practice Guidelines for Industrial Computational Fluid Dynamics

The Best Practice Guidelines (BPG) were commissioned by ERCOFTAC following an extensive consultation with European industry which revealed an urgent demand for such a document. The first edition was completed in January 2000 and constitutes generic advice on how to carry out quality CFD calculations. The BPG therefore address mesh design; construction of numerical boundary conditions where problem data is uncertain; mesh and model sensitivity checks; distinction between numerical and turbulence model inadequacy; preliminary information regarding the limitations of turbulence models etc. The aim is to encourage a common best practice by virtue of which separate analyses of the same problem, using the same model physics, should produce consistent results. Input and advice was sought from a wide cross-section of CFD specialists, eminent academics, end-users and, (particularly important) the leading commercial code vendors established in Europe. Thus, the final document can be considered to represent the consensus view of the European CFD community.

Inevitably, the Guidelines cannot cover every aspect of CFD in detail. They are intended to offer roughly those 20% of the most important general rules of advice that cover roughly 80% of the problems likely to be encountered. As such, they constitute essential information for the novice user and provide a basis for quality management and regulation of safety submissions which rely on CFD. Experience has also shown that they can often provide useful advice for the more experienced user. The technical content is limited to single-phase, compressible and incompressible, steady and unsteady, turbulent and laminar flow with and without heat transfer. Versions which are customised to other aspects of CFD (the remaining 20% of problems) are planned for the future.

The seven principle chapters of the document address numerical, convergence and round-off errors; turbulence modelling; application uncertainties; user errors; code errors; validation and sensitivity tests for CFD models and finally examples of the BPG applied in practice. In the first six of these each of the different sources of error and uncertainty are examined and discussed, including references to important books, articles and reviews. Following the discussion sections, short simple bullet-point statements of advice are listed which provide clear guidance and are easily understandable without elaborate mathematics. As an illustrative example, an extract dealing with the use of turbulent wall functions is given below:

- Check the lower limit of y^+. In the commonly used applications of wall functions, the meshing should be arranged so that the values of y^+ at all the wall-adjacent integration points is only slightly above the recommended lower limit given by the code developers, typically between 20 and 30 (the form usually assumed for the wall functions is not valid much below these values). This procedure offers the best chances to resolve the turbulent portion of the boundary layer. It should be noted that this criterion is impossible to satisfy close to separation or reattachment zones unless y^+ is based upon y^*.
- Check the upper limit on y^+. In the case of moderate Reynolds number, where the boundary layer only extends to y^+ of 300 to 500, there is no chance of accurately resolving the boundary layer if the first integration point is placed at a location with the value of y^+ of 100.
- Check the resolution of the boundary layer. If boundary layer effects are important, it is recommended that the resolution of the boundary layer is checked after the computation. This can be achieved by a plot of the ratio between the turbulent to the molecular viscosity, which is high inside the boundary layer. Adequate boundary layer resolution requires at least 8-10 points in the layer.
- Exercise care when calculating the flow usingdifferent schemes or different codes with wall functions on the same mesh. Cell centred schemes have their integration points at different locations in a mesh cell than cell vertex schemes. Thus the y^+ value associated with a wall-adjacent cell differs according to which scheme is being used on the mesh.
- Check that the correct form of the wall function is being used to take into account the wall roughness. An equivalent roughness height and a modified multiplier in the law of the wall must be used.

All such statements of advice are gathered together at the end of the document to provide a 'Best Practice Checklist'. The examples chapter provides detailed expositions of eight test cases each one calculated by a code vendor (viz FLUENT, AEA Technology, Computational Dynamics, NUMECA) or code developer (viz Electricité de France, CEA, British Energy) and each of which highlights one or more specific points of advice arising in the BPG. These test cases range from natural convection in a cavity through to flow in a low speed centrifugal compressor and in an internal combustion engine valve.

Copies of the Best Practice Guidelines can be acquired from

Prof. A.G. Hutton
QinetiQ
Building 880
Ively Road
Farnborough GUI401X
UK
☎ 44.1252.395.568
Fax 44.1252.395.322
Email: aghutton@qinetiq.com

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