

2009.2



Pictures above : H-radical distribution in a turbulent premixed 60% CH₄ 40% H₂-air flame with equivalence ratio 0.7 2D DNS computations using detailed (GRI-mech) chemistry (a), 1D FGM (b) and 2D FGM (c)

Picture below : afsluitdijk monument



J.M. Burgerscentrum

Research School for Fluid Mechanics
TUD, TUE, UT, RUG, RUN, UL, WUR, UU

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NEWSFLASH

News from the JM Burgerscentrum

It is with great sadness that I heard about the passing away of prof.dr. J Mellema on September 5, 2009. I have had the honour and the privilege of knowing Jorrit Mellema for a long time. I will always remember him as a man of values and character, whose work over the years has been of great importance for the JM Burgerscentrum. On behalf of our researchschool I express my most heartfelt condolences to the family, friends and colleagues of Jorrit Mellema. In the next Newsletter we will have a special in memoriam of him.

Professor Henk Tijdeman has stopped as chairman of the JMBC. He was involved in many activities of our research school. I had good and pleasant contacts with him, during the meetings of the JMBC-Board and during our visits to industries and institutes. The JMBC is very grateful to Henk for his excellent work for our research school and we wish him all the best in the future. As soon as his successor has been appointed by the Board of the TUD (coordinating university for the JMBC) an announcement about the appointment will be published.

Professor Detlef Lohse has been appointed by the Dutch Foundation of Applied Sciences to Simon Stevin Meester 2009. On behalf of the JMBC I have congratulated Detlef with this appointment. It is a great honor for him and for our research school.

The new course program of the JMBC for the coming academic year is ready. For a PhD-student it is essential to deepen his/her knowledge in fluid mechanics to a level significantly higher than that of person with a MSc-degree in fluid mechanics. The PhD-degree courses of the JMBC fulfill this purpose. The deepening of knowledge is not restricted to the area of fluid mechanics, to which the research project of the PhD-student belongs. The idea of the PhD-degree courses is to continue the formal training of the PhD-student in a number of areas in the field of fluid mechanics, but on a post-graduate level. After the PhD-degree the PhD-student must be able to quickly acquaint him(her)self with a new area of fluid mechanics and solve problems in that area. So participation in the JMBC-courses is necessary and strongly recommended.

The JMBC and FOM organized a successful workshop on 19 June 2009. Representatives from industry, institutes, academia and from research funding organizations discussed new challenges in fluid mechanics during this workshop. The goal was to learn about each other's problems, research questions and state-of-the-art knowledge, and to pinpoint options for collaboration. In the morning focused 10-minute presentations were given by representatives from industries, TNO and research institutes about problems they encounter on the topic of fluid mechanics. In the afternoon, parallel workshops were organized by academic groups to present themselves and their expertise and discuss ideas for new research programs with the participants. The outcome of this day will be a 'landscape report' dealing with existing problems and ideas for potential new research collaborations and programs.

The website of the JMBC has been improved. The lay-out has been changed and hopefully it is easier to find relevant information.



G Ooms, Scientific director of the JMBC

NEWSFLASH continued

Premixed turbulent combustion modelling with FGM including preferential diffusion effects

Prof. dr. LPH de Goey, dr. JA van Oijen and dr. RJM Bastiaans (TUE)

1. Introduction

Detailed numerical modelling of reacting flows has gained a continuous growth of interest in the last few decades. However, the numerical modelling of combustion systems is a very challenging task. The interaction of the fluid flow, turbulence, chemical reactions and thermodynamics in reacting flows is of exceptional complexity. At the moment it has become within reach to model the most important physical aspects in detail, but this is still limited to small academic combustion problems. The modelling of the full detail of practical combustion equipment is still prohibited in the next few decades, because of current and future limitations in computing power. This problem asks for special treatments in the modelling of flames. In the last decades two main routes have been followed in combustion science to model the detailed dynamics and structure of chemically reacting flows: chemical reduction techniques [1,2] and laminar flamelet models [3]. We recently developed the Flamelet Generated Manifold (FGM) technique, which combines advantages of chemistry reduction and flamelet models [4,5]. Current state of the art of this technique is highlighted and extension to include preferential diffusion is reviewed in this contribution.

2. The Flamelet Generated Manifold Technique

Most recently developed efficient modelling techniques of combustion processes make use of the multi-scale nature of flames. This idea can be exploited in different smart ways to reduce the number of equations to be solved, leading to an enormous reduction in computing effort. Chemical reduction techniques (such as conventional reduction [1] and ILDM [2]) are based on the idea that most of the chemical time scales in the system are very small. A time-scale analysis can be performed and the fastest time scales are considered to be in steady-state. All variables can be stored in a database as a function of a few controlling variables and during run-time only the few equations for the controlling variables are solved. Laminar flamelet methods [3] are based on the idea that flame structures are much thinner than most of the scales of the distortions in the flow, also implying that the chemical reactions are very fast compared to all other time scales. The reacting flow is modelled by using a kinematic equation for the flame front, the mixture fraction equation for the mixing and a CFD solver for the flow to model these flames [3].

In the last few years our group has proposed some new directions in these fields of combustion science. These are interesting, both because of the improvement in reduction efficiency as well as in the accuracy of the models [4,5]. These new methods are based on a detailed analysis of flames in the so-called laminar flamelet combustion regimes. The approach is based on the idea that the most important aspects of the dynamics of the internal structure of the flame fronts should be taken into account.

NEWSFLASH continued

For this reason, the system of transport equations is split in three parts: 1) a part describing the progress of the flame using a small number of transport equations for so-called progress variables, 2) a part describing the flow and mixing of chemical elements and enthalpy in the system and 3) a so-called set of flamelet equations describing the internal (flame) structure. The progress of the flame is generally described by one (or at most a few) progress variable(s) Y for which a transport equation is solved during run-time. The chemical source term ωY in the transport equation for Y is derived from the flamelet system. The flow and mixing of elements and enthalpy is described by equations for the enthalpy h and elements Z_j , which are independent of the chemical kinetics. The flamelet system is solved in a pre-processing step for each variable Y , h and Z_j . The corresponding solution for the temperature and all species variables $T(Y, h, Z_j)$, $Y_i(Y, h, Z_j)$ and for the source term $\omega Y(Y, h, Z_j)$ depend only on Y , h and Z_j which is stored in a data-base. During run-time, i.e. when a CFD problem of a combustion process is tackled, only equations for Y , h and Z_j are solved using the data-base to retrieve all necessary information to update the solution. In case of LES/RANS models of turbulent flames, it is necessary that transport equations are solved for the filtered/averaged quantities Y , h , Z_j . In this case the database then has to be extended to take into account fluctuations of the quantities mentioned.

The FGM method has been developed and validated in a step-by-step approach in the recent years. At first, we focussed on 1D/2D laminar flames making extensive comparisons possible with computational results using detailed chemistry [4]: burner-stabilized Bunsen flames, partially-premixed triple flames and ceramic burner stabilized flames in a furnace have been investigated with success. We subsequently focused on DNS modeling of strongly stretched (turbulent) flames using unit Lewis number transport models avoiding the influence of preferential diffusion effects [5]. DNS-FGM performs very well in this situation. Furthermore, the approach has proven to be also appropriate for the (RANS and LES) computation of (partially) premixed flames. Recently, we also considered DNS of premixed $\text{CH}_4\text{-H}_2\text{-air}$ flames described by non-unit Lewis numbers. This will be the focus here.

3. Recent results based on non-unit Lewis number DNS computations

Earlier 2D computations of spherically expanding premixed $\text{CH}_4\text{-air}$ flames have shown that a single progress variable Y was sufficient to reproduce results found with detailed chemistry if unit Lewis number are used in the transport model [5]. Enthalpy and element mass fractions are conserved in this case, thereby avoiding fluctuations in flame temperature and equivalence ratio; a single adiabatic premixed flamelet (1D FGM) describing the reaction progress (in terms of Y) is then sufficient, a 2D FGM, taking into account local distortions due to flame stretch and curvature, increases accuracy further but a 1D FGM was already quite accurate. For the case of flames with realistic non-unit Lewis numbers, e.g. necessary to model $\text{CH}_4\text{-H}_2\text{-air}$ flames, the model has to predict fluctuations in enthalpy and element mass fractions as well. These fluctuations may lead to a local enhancement/lowering of the mass burning rate due to rising/decreasing temperature peak values and equivalence ratio fluctuations.

NEWSFLASH continued

It is known that even local flame extinction may appear at highly stretched/curved flame areas and enhanced burning in other flame areas. Cellular and other flame instabilities may appear, depending on the mixture composition.

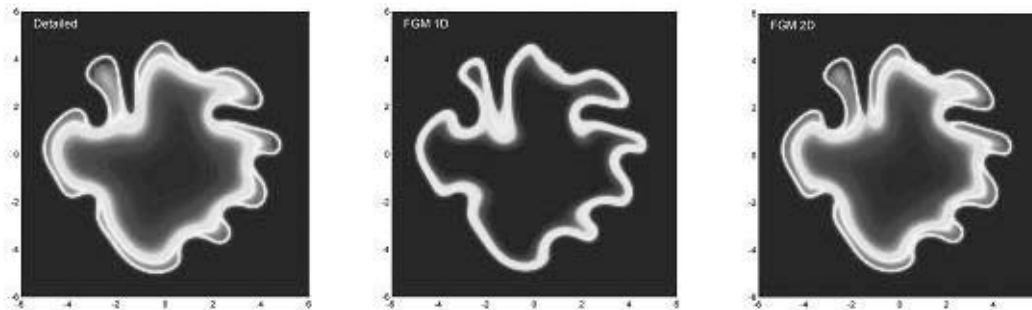


Figure 1 H-radical distribution in a turbulent premixed 60% CH₄- 40% H₂-air flame with equivalence ratio 0.7. 2D DNS computations using detailed (GRI-mech) chemistry (a), 1D FGM (b) and 2D FGM (c).

For the FGM concept, this means that 4 additional equations have to be solved; h , Z_H , Z_O and Z_C need to be taken into account apart from Y . The FGM database would increase to a 5D manifold, which is very large. Earlier computations of stretched flames have shown however, that fluctuations in h , Z_H , Z_O and Z_C are (roughly) linearly related to each other in the curved and stretched laminar flames, so that a single additional progress variable W (taking into account these correlations) may be sufficient. A 2D FGM manifold from flamelets with changes in W is created and stored. This manifold is then used in a series of 2D DNS computations of a circular expanding flame in which Y and W are solved, while all other data are retrieved from the 2D FGM database. Results of the H-radical distribution in this flame with a 1D FGM (without preferential diffusion) and the 2D FGM are presented in Figure 1 and compared with detailed (GRI-mech 3.0) computations using the same non-unit Lewis number transport model. It is clear that the 1D FGM cannot predict the local increase/decrease of the H-radical peak values in positively/negatively curved flamelets, while the 2D FGM can. High values of H-radicals more-or-less coincide with local flame temperature increments leading to fast combustion. The figure shows that the 2D FGM is not perfect, but very well represents the behavior. The computation time is reduced by two orders of magnitude by using FGM instead of the full reaction mechanism.

To investigate the effect of preferential diffusion in practical situations, 3D DNS of lean premixed turbulent Bunsen flames on a slot burner are performed. We again consider a fully premixed fuel with an equivalence ratio of 0.7 and compare a CH₄-air flame with a H₂-CH₄-air flame with a molar fractional distribution of 40% H₂ and 60% CH₄ (referred to as hythane in the following). A 1D FGM is used for the methane flame, but the 2D FGM, introduced above was used for the hythane mixture. Figure 2 shows the chemical source term of the progress variable Y for the hythane case at some time instance.

NEWSFLASH continued

The simulation clearly shows an enhanced reaction rate in regions convex toward the reactants and reduced reaction rate in concave regions, which was not visible in the methane flame. Extinction occurred occasionally in the latter regions. The effect of preferential diffusion was quantified by comparison with a simulation with the 1D FGM. Thus this computation did not incorporate preferential diffusion effects in the 3D transport equations, although the 1D FGM was obviously calculated using the appropriate Lewis numbers in one dimension. The comparison showed that inclusion of a second independent variable W into the manifold was quite important, otherwise effects of preferential diffusion were not captured in the flame. Effects of preferential diffusion were shown to enhance curvature, and thereby to increase the turbulent burning velocity and reduce the mean flame height considerably. Compared to 0% hydrogen, the case of 40% hydrogen increased the burning velocity by approximately 80%. When 3D preferential diffusion was ignored an increase of only 30%, primarily due to the increase of laminar burning velocity, was found.

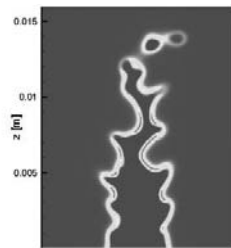


Figure 2 Source term of Y in a turbulent fully premixed 60% CH₄- 40% H₂-air flame with equivalence ratio 0.7. 3D DNS computations using 2D FGM.

4. Conclusions

The FGM technique is one of the most promising techniques to model turbulent combustion accurately using detailed chemistry. In the present contribution, we successfully extended FGM for the modelling of premixed flames with DNS including non-unit Lewis numbers to predict preferential diffusion effects. Local fluctuations in combustion rate due to flame curvature and flow straining along the flame surface are predicted appropriately. Lean CH₄-H₂-air flames with realistic Lewis numbers thereby exhibit a significantly larger flame wrinkling and higher turbulent burning rate than similar flames with unit Lewis numbers.

References

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- [4] van Oijen, J. and de Goey, L.: Modelling of premixed laminar flames using flamelet-generated manifolds. Combust. Sci. Technol. 161, (2000) 113-131.
- [5] van Oijen, J., Bastiaans, R. and de Goey, L.: Low-Dimensional Manifolds in Direct Numerical Simulations of Premixed Turbulent Flames. Proc. Combust. Inst., 31 (2007) 1377-1384.



LPH de Goey | TUE

NEWSFLASH continued

Time for a change !

H Tijdeman | UT

Many times, when thinking about the JMBC, the big dike which separates the former Zuiderzee (later called IJsselmeer) from the Waddenzee comes to my mind. Firstly because it was at that time an enormous challenge to design and construct such a dike with all types of complicated flow problems, without computers, advanced measuring techniques and heavy machines.



Secondly and especially in relation with our JMBC because of the text in the monument erected at the location where the dike in 1932 has been closed, saying: "Een volk dat leeft bouwt aan zijn toekomst" (a population that lives, builds for its future).

In my opinion the outstanding research conducted by the participants in our research school, the education of the new generation of scientists for research institutes and industry, is exactly what is meant by the aforementioned text.

The JMBC is a very lively research school, very efficiently run by our outstanding scientific director, who is not only a brilliant scientist but also a very good people manager.

Also a compliment has to be made to our secretary, Ilse Hoekstein, who very effectively and creatively runs the administrative side of our institute.

I enjoyed it very much working with you all during the long period in which I had the privilege to be a member and later on chairman of your board.

For me the time has come to leave the board and to make room for the next generation, but not before thanking you all for having a fantastic time with JMBC.

Of course I hope to meet you again on future events of JMBC.



H Tijdeman | UT | Chairman of the JMBC Board of Directors | photo Arjan Reef

ANNOUNCEMENTS

Wim van Saarloos new director of FOM Foundation

Utrecht, 25 August 2009 - The FOM Executive Board has appointed Professor Wim van Saarloos (1955) Director of FOM Foundation, effective 1 November 2009. He succeeds Dr Hans Chang, who stepped down in early July after 24 years with FOM and who continues his career at the Royal Netherlands Academy of Arts and Sciences (KNAW). Van Saarloos is currently Professor of Theoretical Physics at Leiden University and Director of the Lorentz Center, which he also established and for which he received a Royal Award in 2008. He has extensive administrative experience and a good network of contacts within and outside physics. The Director of FOM also acts as Director of the NWO Subfield of Physics. Van Saarloos' combined experience as a scientist and administrator, which gained him the confidence of the Dutch physics community, will serve him well in his new role. He has a clear vision on the balance and necessary interaction between fundamental and applied research. In developing the Lorentz Center, he also demonstrated vision and persuasiveness, and he built up a network outside physics. Van Saarloos explains: "I've been committed to science and physics in the broad sense for quite some time now and I'm really looking forward to continuing my work at this level and so help set the direction of physics research in the Netherlands. I'm very pleased with the road FOM has taken the past few years, with an increased focus on valorisation and industry contacts in addition to fundamental research (under the watchword of 'Physics for Science & Physics for Society'). It's a line that I'll continue to pursue. Fundamental and applied research are not that far apart as people often think."

Career

Van Saarloos graduated cum laude from Delft University of Technology with a degree in Technical Physics. After receiving his doctorate, cum laude, from Leiden University, he went on to live in the USA for eight years, where, after a postdoc, he gained a staff position in the Department for Materials Research at AT&T Bell Laboratories. He returned to Leiden in 1991, where he was appointed Professor of Condensed Matter Theory. In that role, he built up an internationally recognised research group in the field of soft condensed matter and led, among other things, a range of FOM programmes. In 1997, he initiated the Leiden-based Lorentz Center, which, over the past 12 years, under his direction, has grown to become a leading international centre for workshops in the sciences and which serves as an example to other countries and other disciplines. Van Saarloos also contributes to the field of physics in a broad sense, drawing on extensive administrative experience on a range of committees and advisory bodies including the FOM Governing Board, the Mid-Term Review Committee for Technical Physics, and as chair of the Committee who has written the Physics Action Plan, the precursor to the Physics Sector Plan. He continues his involvement with the Sector Plan as a member of the Breimer Committee. Van Saarloos has been a member of the Royal Netherlands Academy of Arts and Sciences (KNAW) since 2004. In 2005, he joined the Royal Holland Society of Sciences and Humanities and in 2007 he became a Fellow of the American Physical Society. He has received a number of awards for his achievements, such as the Physics Prize and a Royal Knighthood in the Order of the Dutch Lion (2008) for his contributions to the Lorentz Center. Van Saarloos is married and has three daughters.



W van Saarloos | New director FOM Foundation

ANNOUNCEMENTS continued

New professor at JMBC : Bruno Eckhardt | TUD

Bruno Eckhardt's interests in fluid mechanics range from low Reynolds number Stokes flows to turbulence transition in shear flows up to fully developed turbulence and its modelling and characterization. Using tools and ideas from dynamical systems theory he has contributed to the study of point vortex motion, chaotic mixing and the turbulence transition in pipe and other shear flows. As an associate editor for Physical Review E he is responsible for its fluid mechanics section. He is a fellow of the American Physical Society, the Institute of Physics (London) and the European Mechanical Society. In 2008 he was elected to the Senate of the German Research Foundation. In spring 2009 he started a three year term at TU Delft. His primary appointment is with the physics department at Philipps-Universitaet Marburg in Germany.



B Eckhardt | TUD

New professor at JMBC : Fulvio Scarano | TUD

Current position: Full Professor in Aerodynamics

Delft University of Technology, Aerospace engineering Department, Section Aerodynamics

Currently active in the development of non-intrusive flow diagnostics techniques for aerodynamics. Investigation of flow turbulence in the supersonic and hypersonic regimes (STW-VIDI grant). Development of three-dimensional time-resolved particle image velocimetry by tomography for the study of aeroacoustic phenomena in aerospace systems (EU-ERC grant). Research on unsteady and turbulent flows for aeronautics and wind energy. Bluff-body aerodynamics, wind-turbines and propellers, boundary layers transition, turbulence and their control.

Collaborations with European Space Agency, von Karman Institute, DNW, NLR, DLR among others. Member of the European Board of Measurement Science and Technology. Organization of international workshops under the framework of PIVNET and EWA (European Windtunnels Association).

JMBC courses on Compressible Flows and Particle Image Velocimetry. Keynote lecture at the International Symposium of Flow Visualization and International Symposium on Particle Image Velocimetry. Author of about 50 publications in English and French among papers and book chapters and more than 100 conference papers with 10 invited lectures.



F Scarano | TUD

ANNOUNCEMENTS continued

Contactgroup Multiphase Flow

Following a recent request, about 100 people have become member (or renewed their membership) of the Contactgroup Multiphase Flow. If you are interested, but did not subscribe yet, please do so through the link www.impact.utwente.nl/links/JMBC.

All members will receive a separate e-mail invitation for Thursday 26th November 2009, when the Contactgroup will organize a day with presentations on the special theme of "Multiphase flow with heat transfer". We have 6 speakers from industry, research institutes, and university. Venue will be the new office of Shell in Amsterdam. At the end of the day there will be a visit to some of the fluid flow & flow assurance experimental facilities.

For more information, you can contact us:

prof. dr ir R.A.W.M. Henkes (Ruud Henkes), R.A.W.M.Henkes@tudelft.nl
dr ir N.G. Deen (Niels Deen), N.G.Deen@tnw.utwente.nl



RAWM Henkes | TUD

Capillarity-driven flows in microfluidics

From April 20-24, the new Burgerscenter course on Capillarity-Driven Flows in Microfluidics was given for the first time. 35 PhD students and Postdocs from Delft, Twente, Eindhoven and Amsterdam came for one week to the Conference Hotel Drienerburgh on the campus of the University of Twente. In a total of 22 lectures, the seven lecturers gave an overview over both basic fluid dynamic aspects of microfluidic and thin film flows as well as current hot topics of microscale flow phenomena involving free interfaces, such as drop generation and emulsification in microfluidics, contact line dynamics, thermo- and solutocapillarity, and electrowetting. The lectures included aspects of basic phenomenology combined with intuitive modelling (everyone will remember the fantastic live experiments on elastocapillarity demonstrated by José Bico), experimental techniques, as well as rigorous theoretical modelling. The program was complemented by an extensive lab tour through the laboratories of the Physics of Complex Fluids and the Physics of Fluids Group, as well as a social dinner early on, which stimulated the discussions and the cohesion between the participants. In the final discussion all participants were enthusiastic and highly recommended to repeat the course in due time. (For all participants and anybody else who may have missed the course, the entire course material including lecture slides is available on the website of the Physics of Complex Fluids group:

http://pcf.tnw.utwente.nl/education/jmbc_course_on_capillarity_dri/)



F Mugele | UT



A Darhuber | TUE



J Snoeijer | UT

CALENDAR

PhD students have to participate in at least three JMBC courses, preferably during their first two years. Information about the contents of the courses can be found in the "Course Programme" of the JM Burgerscentrum, available as downloadable PDF file on <http://www.jmburgerscentrum.org> or as hardcopy by sending an e-mail to the secretariat: jmburgerscentrum@tudelft.nl

Overview of the courses for the academic year 2009-2010

21-24 September 2009	Geophysical fluid dynamics and 2D turbulence
26-30 October 2009	PIV Delft
25-29 January 2010	CFD 1
February 2010	Granular matter
12-14 April 2010	Computational multiphase flow
April 2010	Experimental techniques in fluid mechanics
Spring 2010	Cardiovascular in-vitro and ex-vitro experimental techniques
11-15 October 2010	Particle technology

21 - 24 September 2009

Geophysical fluid dynamics and 2D turbulence

Prof.dr.ir. GJF van Heijst

Place : TUE

This course will concentrate on fundamental aspects of rotating and stratified flows, aiming at a better insight in the dynamics of large-scale flows in seas, oceans and planetary atmospheres. Such insight is also useful for a better understanding of industrial flow configurations in which rotating and/or density effects play a role. Topics that will be discussed include: geostrophic flows, conservation of potential vorticity, Ekman boundary layers, spin-up phenomena, wind-driven ocean circulation, waves in rotating and stratified media, density currents, barotropic and baroclinic instability, sediment transport and bottom morphology, aspects of two-dimensional turbulence and the dynamics of coherent vortex structures. The course includes a number of laboratory and computer sessions, in which the participants can study aspects of the theoretical material presented and discussed during the lectures. Confirmed lecturers : Prof. Herman Clercx (TU/e), Prof. GertJan van Heijst (TU/e), Prof. Hennie Kelder (KNMI & TU/e), Prof. Pieter Levelt (KNMI & TU/e), Prof. Leo Maas (NIOZ & UU), Prof. Huib de Swart (UU), Dr. Ruben Trieling (TU/e).

Registration for this course: m.j.a.m.rodenburg@tue.nl

For more information contact

GJF van Heijst | 040 247 2722 | g.j.f.v.heijst@tue.nl

CALENDAR continued

26 - 30 October 2009

PIV Delft

Prof.dr.ir. J Westerweel

Place : TUD

Particle Image Velocimetry has rapidly become the standard method for measuring fluid velocities in both fundamental and applied research. In October 2009, a one-week course will be taught at the Delft University of Technology. NB: this course does not replace the yearly course at DLR. In this course the fundamentals of the technique will be taught, including applications in particular fields: microfluidics, turbulence, multiphase flows and aerodynamics. Next to lectures, there will be a number of practical sessions where the participants can practice their skills and see some state-of-art facilities (e.g. tomographic PIV, high-speed PIV). The course is primarily targeted at PhD students from the JM Burgerscentrum, who will get priority when registering: due to limitations on the available space in the practical sessions, the maximum number of participants is 25. Others interested (postdocs, faculty, researchers from institutes and industry) are welcome to apply as well, but priority is given to JMBC PhD students. Apart from a basic understanding of fluid mechanics, there is no prerequisite knowledge. Detailed, up-to-date information can be found on the website: www.ahd.tudelft.nl/piv/

Confirmed lecturers: prof. dr. ir. J. Westerweel, prof. dr. F. Scarano, dr. ir. C. Poelma, dr.-ing. R. Lindken; more to follow. Venue: The course is hosted by the Laboratory for Aero & Hydrodynamics, part of the Process & Energy department of the Faculty of Mechanical, Materials and Maritime Engineering (3ME) of the Delft University of Technology.

For more information contact

J Westerweel | 015 278 6887 | j.westerweel@tudelft.nl

25 - 29 January 2010

CFD 1

Prof.dr.ir. AEP Veldman, prof.dr.ir. B Koren, and dr.ir. MI Gerritsma

Place : TUD

The course discusses the basic methods for solving the equations that describe the motion of fluids. It is organized as a series of lectures and computer exercises. The basic model problem is the convection-diffusion equation with dominating convection. A number of spatial discretization methods (nonuniform grids) will be discussed with their pros and cons (upwind/central, lower/higher order, finite-difference/finite-volume). Also the stability and accuracy of time-integration methods is shortly discussed. A next step is to study discontinuous solutions of the Euler equations, with focus on the numerical Riemann problem. Several numerical schemes for calculating shocks and contact discontinuities will be presented; the concept of non-linear limiters is introduced. Also, the incompressible Navier-Stokes equations are discussed. The positioning of the computational grid is assessed (staggered grids), as well as the treatment of boundary conditions. Emphasis is on the role of the pressure. An application is direct numerical simulation of turbulent flow.

For more information contact

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CALENDAR continued

February 2010

Granular matter

Prof.dr. D Lohse, prof.dr. S Luding, UT

Place : UT

More information will follow.

For more information contact

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12 - 14 April 2010

Computational multiphase flow

“Overview of fundamentals, industrial applications and simulation packages

Coordinator: Prof.dr.ir. RAWM Henkes

Place : TUD

Target audience: PhD students of the JMBC, fluid flow engineers in industry and research institutes, and others interested in the topic. Lecturers: various, incl. Ruud Henkes, Rob Mudde, Hans Kuipers, Luis Portela, Harry Hoeijmakers

Course summary

Multiphase flow denotes the combined transport of gas, liquid, and particles. The aim of this 3-day course is to give a broad overview of the possibilities and limitations of physical-numerical modelling and prediction of Multiphase Flows. This includes (1) fundamentals of physical models and their numerical representation and solvers, (2) application of Computational Fluid Dynamics to a wide range of environmental and industrial processes driven by multiphase flow, (3) assessment of a number of CFD packages widely used to solve industrial problems. At the end of the course the participants will have a good awareness of the types of computational methods, with their specific accuracy, that can be used for multiphase flows occurring in industry. This will help them to build realistic expectations for their own specific practical problems, which might be even more complex than the examples treated in the course. Participants will also be able to acknowledge gaps in our current knowledge, which may help them to define new future research directions.

Day 1: Fundamentals

- Overview of methods, including:
- RANS / LES /DNS
- Euler-Euler (Two-fluid) and Euler-Lagrange (Particle tracking)
- Interface capturing (VOF/Level set) and interface tracking
- Lattice Boltzmann Method
- Best practice guidelines
- Numerical issues: single phase versus multiphase
- Particle transport (bubbles, droplets, solids) in channels and pipelines
- Heat and mass transfer

Day 2 and morning Day 3: Applications

- Fluidized beds
- Gas lift reactors and bubble columns
- Mixing tanks
- Separators
- Pumps (incl. cavitation) and multiphase boosters

CALENDAR continued

- Pipelines
- Evaporators/condensers
- Clouds

Day 3 Afternoon: Industrial simulation packages

We aim at discussing various simulation packages, like CFX/Fluent, TransAT, STAR-CD, OpenFoam, OLGA, LEDA

For more information contact

RAWM Henkes | 020 630 37 83 | r.a.w.m.@shell.com

26 - 29 April 2010

Experimental techniques in fluid mechanics

Dr. M Versluis

Place : UT

The course Experimental Techniques gives a general overview of concepts of experimental methods for flow, pressure, concentration and temperature measurements. The course will discuss various classic techniques (thermocouples, Pitot-tubes, hot-wire anemometry) and optical techniques such as shadow and Schlieren. The course will also focus on modern non-intrusive laser techniques (Laser Doppler and Phase Doppler Anemometry, Particle Imaging and Particle Tracking Velocimetry and Laser-induced Fluorescence). We will discuss methods for flow visualization and high-speed imaging and we have special presentations on experimental methods used in two-phase flows and in micro- and nanofluidics.

For more information contact

M Versluis | 053 489 6824 | m.versluis@utwente.nl

Spring 2010

Cardiovascular in-vitro and ex-vitro experimental techniques

Prof.dr.ir. FN van de Vosse

Place : TUE

More information will follow.

For more information contact

FN van de Vosse | 040 247 4218 | f.n.v.d.vosse@tue.nl

11 - 15 October 2010

Particle technology

Prof.dr. S Luding, Ruud van Ommen, Hans Kuipers

Place : UT

More information will follow.

For more information contact

S Luding | 053 489 4212 | s.luding@ctw.utwente.nl

CALENDAR continued | OSPT - ERCOFTAC - Von Karman Institute Courses

For further information and registration about any of these courses contact the below mentioned organizer.

OSPT courses

Gert Banis
University of Twente
Faculty of Chemical Engineering
OSPT Secretariat
PO Box 217
7500 AE Enschede
Tel : 053 489 3034 / 4626
Fax : 053 489 4738
Email : g.h.banis@utwente.nl
<http://ospt.tnw.utwente.nl>

5 - 9 October 2009

Computational Fluid Dynamics of Multiphase Flow

With this course we intend to provide detailed knowledge on the physical foundation of multiphase flow models and the associated numerical solution methods. Due to its relevance for many industrial applications the emphasis during the course will be on dispersed multiphase flows. The course includes hands-on computer sessions in which several in house simulation tools will be used to solve complex multiphase fluid flow problems. Registration via www.ospt.nl

For more information contact

M Hendrikx | 053 489 4626 | m.v.hendrikx@utwente.nl

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Email : secretariat@vki.ac.be
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VACANCIES

Because of the large number of vacancies we would like you to visit our website www.jmburgerscentrum.org to read the vacancies in detail. Please keep in mind that vacancies can already be fulfilled by the time you got the newsletter.

TUD

Vacancy no. 8

Full professor vacancy at Aerospace Engineering

Vacancy no. 6

4 PhD-positions at the Aero and Hydrodynamics lab

Vacancy no. 5

Assistant or associate professor in petroleum engineering

Vacancy no. 4

PD-position on Time Integration Methods

TUE

Vacancy no. 18

Part-time professor in heat storage technology

Vacancy no. 17

PhD Position : Optimisation of heat transfer in micro waves

Vacancy no. 16

UD Position : Mesoscopic Transport Phenomena

Vacancy no. 15

2 PhD Postions at Mesoscopic Transport Phenomena

Vacancy no. 14

PhD Postions : Aeroacoustics of corrugated pipes

Vacancy no. 13

Consultancy position at LIME

Vacancy no. 12

PD position : Second generation of integrated batteries

Vacancy no. 11

PD position : Dynamic capillarity in porous media

Vacancy no. 10

PD position : Shell

Vacancy no. 9

PD position : Thermo-acoustic instabilities expertises

Vacancy no. 7

PhD position : Tracers take the tube

Vacancy no. 6

PhD position : Experimental research on the importance of nucleation on heat transfer

Vacancy no. 2-3

2 PhD positions : Novel gas clean-up technology

VACANCIES continued

UT

Vacancy no. 8

UD position : assistant professor

Vacancy no. 7

PhD position: Clustering phase diagram simulation and theory

Vacancy no. 6

3 PhD positions: computational multi-scale modelling

Vacancy no. 5

1 PD position: Modeling of wave-induced sand transport

Vacancy no. 4

1 PD position: Demonstration air-purifying concrete

Vacancy no. 3

2 PD positions: Multiscale modeling of gas-fluidized beds

Vacancy no. 2

PD position: Extreme surface waves

Vacancy no. 1

PhD position: Thermal convection in rotating flows

Industries & Institutes

Vacancy no. 24

NRG : consultants computational fluid dynamics

Vacancy no. 23

Nantes : PhD-position in thesis on grid adaptation and error evaluation

Vacancy no. 22

ECN + CWI : PhD-position in wind turbine park at ECN and CWI

Vacancy no. 21

ESA : postdoctoral internal research fellowship - ongoing vacancy

Vacancy no. 20

KTH : PhD student in turbulent combustion

Vacancy no. 16

NRG : Consultant Computational Fluid Dynamics

Vacancy no. 15

Flow Motion : CFD Engineer

Vacancy no. 14

Stork : Stromingsdeskundige

Vacancy no. 13

ECN : Group leader wind turbine aerodynamics

Vacancy no. 12

Dupont : Aerodynamist

Vacancy no. 8

TNO : Innovator warmte en stroming

Vacancy no. 3

Nederlands Meetinstituut (NMI) : Wetenschappelijk medewerker Flow

Vacancy no. 1

TNO : Flow & Structural Dynamics Engineers & Innovators gezocht - ongoing vacancy

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NEW JMBC MEMBER

This form must be filled in by the professor who wants to register the new JMBC member. Send with this form a CV. If he/she is accepted by the JM Burgerscentrum, he/she will automatically be registered and receive an information package from the JMBC. Please return this form to the JMBC secretariat, Mekelweg 2 - 2nd Floor, 2628 CD Delft. Registrations can also be done on-line via www.jmburgerscentrum.org.

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Full name :

General

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Name (sub)faculty :

Address university / (sub)faculty :

Street / PO Box :

Postal code / City :

E-mail :

Tel. + Fax work :

Position : AIO, OIO, PD, Other :

Duration of study : from till

Title of the project :

Short description of the project :

Sponsored by :

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Date

JMBC PhD COURSES

Title of the course

Date of the course

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Faculty | Department

Section

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Officially registered PhD students of the JM Burgerscentrum
150 Euro per course, including course material, lunches, diner, travel expenses, and (if necessary) hotel accommodation.
Does the JMBC have to make hotel reservations? Yes No
(Only for officially registered PhD students of the JMBC)

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Name and signature supervisor:

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If it is not possible to attend the course, please cancel/unregister as soon as possible. For cancellations received at least two weeks before the start of the course we will not charge you any costs. After that the full amount will be charged.

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The JMBC Newsletter is an issue of the JM Burgerscentrum, Research School for Fluid Mechanics.

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