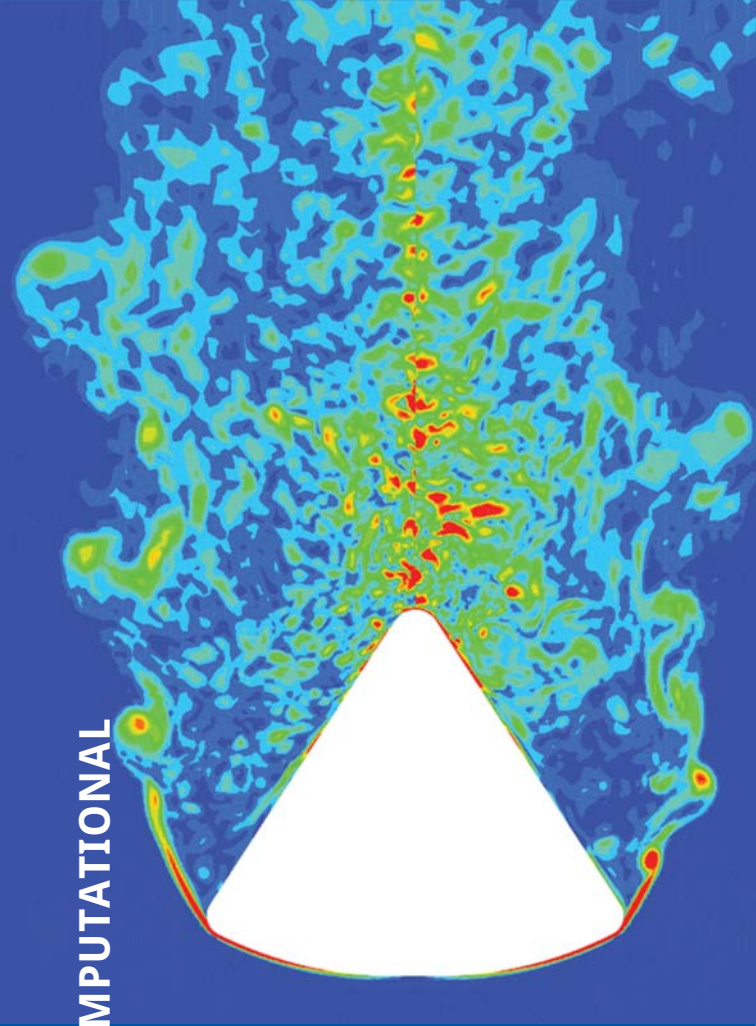




- INTRODUCTION TO MEASUREMENT TECHNIQUES  
OCTOBER 8-12, 2012
- INTRODUCTION TO CFD  
JANUARY 21-25, 2013
- CUBESAT TECHNOLOGY AND APPLICATIONS  
JANUARY 29 - FEBRUARY 1, 2013
- CFD FOR ATMOSPHERIC FLOW AND WIND  
ENGINEERING  
MARCH 11-13, 2013
- RADIAL COMPRESSOR DESIGN  
MARCH 11-15, 2013
- ACCURATE AND EFFICIENT AEROACOUSTIC  
PREDICTION APPROACHES FOR AIRFRAME NOISE  
MARCH 25-28, 2013
- AEROENGINE DESIGN: FROM STATE OF THE ART  
TURBOFANS TOWARDS INNOVATIVE  
ARCHITECTURES  
APRIL 8-12, 2013
- FLUID DYNAMICS ASSOCIATED TO LAUNCHER  
DEVELOPERS (STO-AVT-VKI)  
APRIL 15-19, 2013
- RADIATION AND GAS-SURFACE INTERACTION  
PHENOMENA IN HIGH SPEED RE-ENTRY  
(STO-AVT-VKI)  
MAY 6-8, 2013
- TURBULENT COMBUSTION  
MAY 13-17, 2013
- SOURCE TERM CHARACTERIZATION OF THE  
CONSEQUENCES OF STORAGE TANK  
AGGRESSIONS (STO-AVT-VKI)  
JUNE 3-5, 2013
- TRANSITION AND TURBULENCE IN HIGH-SPEED  
FLOW  
JUNE 10-14, 2013
- FLOW CHARACTERISTICS AND PERFORMANCE OF  
SAFETY VALVES  
SEPTEMBER 9-11, 2013
- ACCURATE TEMPERATURE MEASUREMENTS  
SEPTEMBER 16-20, 2013
- 37<sup>TH</sup> COMPUTATIONAL FLUID DYNAMICS:  
ADJOINT METHODS IN CFD  
TO BE DETERMINED

(Please correct your address if necessary)

Lecture Series Secretary  
von Karman Institute for Fluid Dynamics  
72 Chaussée de Waterloo  
B-1640 Rhode-St-Genèse  
Belgium



# INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS

January 21-25, 2013

VON KARMAN  
INSTITUTE  
FOR FLUID  
DYNAMICS



## INTRODUCTION

The objective of this course is to provide an elementary tutorial presentation on computational fluid dynamics (CFD), emphasizing the fundamentals and surveying a variety of solution techniques whose applications range from low speed incompressible flow to hypersonic flow. The course is aimed at persons who have had little or no experience in this field, both recent graduates as well as professional engineers, and will provide

- an insight into the philosophy and power of CFD
- an understanding of the mathematical nature of the fluid dynamics equations
- a familiarity with various solution techniques

At the conclusion of the course, an attendee will be well prepared to understand the literature in this field, to follow more sophisticated state-of-the-art lecture series, and to begin the application of CFD to his or her special areas of concern. While the techniques to be discussed will be applicable to all fields of fluid dynamics, the lecturers and the majority of examples presented will carry a strong flavor of aeronautics.

The Director of this lecture series is Professor G. Degrez of the von Karman Institute.



VON KARMAN INSTITUTE FOR  
FLUID DYNAMICS

## ONLINE REGISTRATION AVAILABLE

<https://www.vki.ac.be/registration>

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

## COURSE FEE

The fee for the lecture series is 1350 euro, applicable to citizens of NATO countries contributing to the financing of the VKI (Belgium, Czech Republic, France, Germany, Hungary, Iceland, Italy, Luxemburg, Norway, Portugal, Spain and Turkey). For citizens of other NATO countries and of NATO partner countries, the fee is 1760 euro. For non-NATO citizens the fee is 1920 euro. These prices include 21% VAT. The fee includes printed notes, lunches, beverages, and administrative costs. Lectures will be given in English and printed notes will be distributed during registration.

## FELLOWSHIPS

To encourage greater participation in our Lecture Series programme by university members, the Institute has established a limited number of VKI Lecture Series fellowships for citizens of NATO countries contributing to the financing of the VKI, as well as for citizens of other NATO countries and NATO partner countries coming from a university in a VKI financing country. The recipient of such fellowship is entitled to attend the Lecture Series at a reduced fee, which will be 675 euro (VAT included) for assistants not having a Ph.D. degree and for Ph.D. candidates, and 300 euro (VAT included) for undergraduate students. For non-NATO citizens coming from a university in a VKI financing country, the fee is 960 euro (VAT included) for assistants not having a Ph.D. degree and for Ph.D. candidates, and 400 euro (VAT included) for undergraduate students.

The request to be considered for an award must accompany the application to attend the Lecture Series, and the applicant must provide a recommendation letter from his or her professor; if not done so, the request will not be taken into consideration. All possible alternative sources of funding should be investigated before aid is requested under this scheme, so that those most in need will benefit.

## METHODS OF PAYMENT

Payment 2 weeks prior to the beginning of the course (name and course title clearly indicated) by bank transfer to our account Nr 210-0315330-35 at BNP Paribas Fortis Bank, avenue de la Forêt de Soignes 322, 1640 Rhode-Saint-Genève, Belgium, IBAN BE57 2100 3153 3035 (strongly recommended). SWIFT BIC GEBABEBB. *Late registration can be paid in cash (euro), or by VISA or Eurocard at the beginning of the course.*

## TIMETABLE

### Monday 21 January 2013

- 08:45 Registration  
09:15 Welcome, introductory remarks  
09:45 Basic philosophy of CFD  
*Prof. J.D. Anderson, Jr., University of Maryland, USA*
- 11:00 Forms of the governing equations particularly suited for CFD: non-conservative, conservative, flux vectors  
*Prof. J.D. Anderson, Jr.*
- 14:00 Mathematical properties of the fluid dynamic equations : influence on appropriate numerical techniques; stability considerations  
*Prof. J.D. Anderson, Jr.*
- 15:45 Mathematical properties of the fluid dynamic equations (continued)  
*Prof. J.D. Anderson, Jr.*
- 17:00 Reception

### Tuesday 22 January 2013

- 09:00 Discretisation of partial differential equations : finite differences  
*Prof. J.D. Anderson, Jr.*
- 11:00 Discretisation of partial differential equations (continued)  
*Prof. J.D. Anderson, Jr.*
- 14:00 Transformation and grids  
*Prof. J.D. Anderson, Jr.*
- 15:45 Explicit methods for inviscid and viscous compressible flows  
*Prof. J.D. Anderson, Jr.*

### Wednesday 23 January 2013

- 09:00 Explicit methods (continued)  
*Prof. J.D. Anderson, Jr.*
- 11:00 Implicit time dependent methods for inviscid and viscous compressible flows  
*Prof. G. Degrez, von Karman Institute, Belgium*
- 14:00 Implicit methods (continued)  
*Prof. G. Degrez*
- 15:45 Implicit methods (continued)  
*Prof. G. Degrez*

### Thursday 24 January 2013

- 09:00 Implicit methods (continued)  
*Prof. G. Degrez*
- 11:00 Finite volume methods  
*Prof. E. Dick, University of Gent, Belgium*
- 14:00 Finite element methods  
*Prof. E. Dick*
- 15:45 Finite element methods (continued)  
*Prof. E. Dick*

### Friday 25 January 2013

- 09:00 Aspects of CFD computations with commercial packages  
*Prof. J. Vierendeels, University of Gent, Belgium*
- 11:00 A brief introduction to turbulence models  
*Dr.-Ing. F. Menter, Ansys, Germany*
- 13:45 A brief introduction to turbulence models (continued)  
*Dr.-Ing. F. Menter*
- 15:00 Adjourn

Lunch will be taken from 12h30 to 13h45. Coffee breaks are scheduled each morning and afternoon. The afternoon sessions will normally finish at about 17h00.