



☐ INTRODUCTION TO MEASUREMENT TECHNIQUES

OCTOBER 10-14, 2011

☐ UNCERTAINTY QUANTIFICATION IN COMPUTATIONAL FLUID DYNAMICS (RTO-AVT-VKI)

OCTOBER 24-28, 2011

☐ ENGINE INTAKE AEROTHERMAL DESIGN : SUBSONIC TO HIGH SPEED APPLICATIONS (RTO-AVT-VKI)

NOVEMBER 14-16, 2011

☐ INTRODUCTION TO CFD

JANUARY 16-20, 2012

☐ STRUCTURAL DESIGN OF AIRCRAFT ENGINES (RTO-AVT-VKI)

JANUARY 24-27, 2012

☐ LARGE EDDY SIMULATION AND RELATED TECHNIQUES: THEORY AND APPLICATIONS

FEBRUARY 6-10, 2012

☐ AIRCRAFT NOISE

MARCH 12-15, 2012

☐ INTRODUCTION TO OPTIMIZATION AND MULTIDISCIPLINARY DESIGN IN AERONAUTICS AND TURBOMACHINERY

MAY 7-11, 2012

☒ COMBUSTION IN AERO-ENGINES

JUNE 4-8, 2012

☐ FLUID DYNAMICS ASSOCIATED TO LAUNCHER DEVELOPERS (RTO-AVT-VKI)

SEPTEMBER 10-14, 2012

☐ ACCURATE TEMPERATURE MEASUREMENTS

SEPTEMBER 24-28, 2012

OTHER EVENTS

☐ SHORT COURSE ON RADIAL COMPRESSOR

FEBRUARY 6-10, 2012

☐ SYMPOSIUM OF VKI PHD RESEARCH 2012

MARCH 5-7, 2012

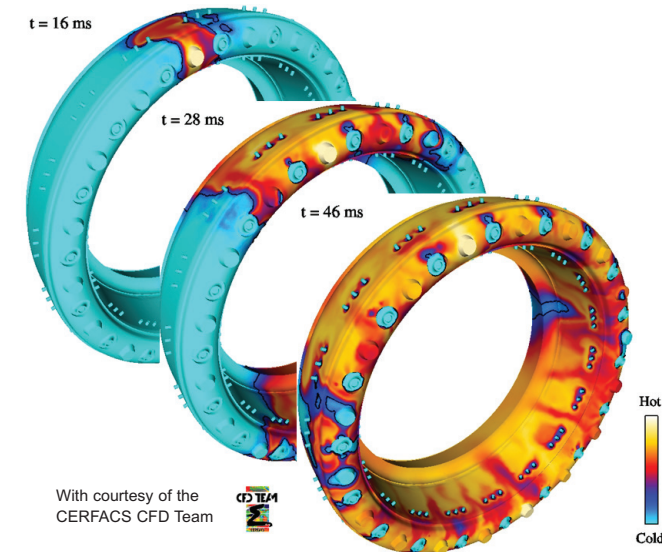
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Lecture Series Secretary
von Karman Institute for Fluid Dynamics
Waterloosesteenweg 72
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von KARMAN INSTITUTE
FOR FLUID DYNAMICS

COMBUSTION IN AERO-ENGINES



June 4-8, 2012

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INTRODUCTION

The flow in an aero-engine combustor is characterized by high levels of turbulence in a high-pressure two-phase air-kerosene reacting flow, with intensive heat transfer. Moreover large-scale structures induced by the swirl stabilizing processes generate strong unsteadiness for mixing and combustion that could couple with acoustics wave propagation and lead to combustion instabilities especially for lean combustors. This Lecture Series will review the aero-engine combustor design requirements, describe the understanding and the tools available for the analysis of fuel injection and spray evaporation, chemistry and physics of combustion, aerodynamics, mixing and unsteadiness, and heat transfer and cooling. The use of Large Eddy Simulation will be the subject of specific lectures. Operability will be addressed in particular with regards to operation under unsteady conditions, ignition and altitude relight. Emphasis will be put on lean combustion that has a low NO_x emission potential, and the experimental demonstration of low NO_x technologies in a representative environment will be presented. As a conclusion, perspectives opened by the use of alternative fuels will be discussed.

The Lecture Series Directors are Prof. M. Cazalens from SNECMA and Prof. J. van Beeck from the von Karman Institute for Fluid Dynamics.



VON KARMAN INSTITUTE
FOR FLUID DYNAMICS

ONLINE REGISTRATION AVAILABLE

<http://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-Genèse, Belgium, IBAN BE57 2100 3153 3035 (strongly recommended). SWIFT BIC GEBABEBB. *Late registration can be paid in cash (euro), or by VISA or Eurocard at the beginning of the course.*

TIMETABLE

Monday 4 June 2012

08:45	Registration
09:00	Welcome address <i>Mr. J. Muylaert, Director, von Karman Institute for Fluid Dynamics, Belgium</i>
09:30	Introduction to aero-engine gas turbine combustion <i>Dr T. Doerr, Rolls-Royce Deutschland, Germany</i>
10:45	Coffee break
11:15	Introduction to aero-engine gas turbine combustion (Cont'd) <i>Dr T. Doerr</i>
12:30	Lunch break
14:00	Chemistry / Physics of turbulent combustion <i>Prof. E. Mastorakos, University of Cambridge, United Kingdom</i>
15:15	Coffee break
15:45	Chemistry / Physics of turbulent combustion (Cont'd) <i>Prof. E. Mastorakos</i>
17:00	Reception

Tuesday 5 June 2012

09:00	Operability: ignition, altitude relight <i>Prof. E. Mastorakos</i>
10:30	Coffee break
11:00	Heat transfer and cooling <i>Prof. A. Schulz, University of Karlsruhe, Germany</i>
12:30	Lunch break
14:00	Heat transfer and cooling (Cont'd) <i>Prof. A. Schulz</i>
15:15	Coffee break
15:45	Aerodynamics, mixing and unsteadiness <i>Prof. J. Carrotte, Loughborough University, United Kingdom</i>

Wednesday 6 June 2012

09:00	Aerodynamics, mixing and unsteadiness (Cont'd) <i>Prof. J. Carrotte</i>
10:30	Coffee break
11:00	Fuel injection and spray evaporation <i>Prof. G. Lavergne, ONERA, Toulouse, France</i>
12:30	Lunch break

14:00	Fuel injection and spray evaporation (Cont'd) <i>Prof. G. Lavergne</i>
15:15	Coffee break
15:45	Visit of the labs

Thursday 7 June 2012

09:00	Innovative combustion technologies <i>Prof. M. Cazalens, Snecma, France</i>
10:30	Coffee break
11:00	Validation of Lean Burn Technologies <i>Dr T. Doerr</i>
12:30	Lunch break
14:00	Analysis of combustor flow using Large Eddy Simulation <i>Prof. T. Poinot, CERFACS, France</i>
15:15	Coffee break
15:45	Analysis of combustor flow using Large Eddy Simulation (Cont'd) <i>Prof. T. Poinot</i>

Friday 8 June 2012

09:00	Operability: combustion instabilities <i>Prof. T. Poinot</i>
10:30	Coffee break
11:00	Alternative Fuels <i>Mr Eric Hermant, Snecma, France</i>
12:30	Lunch break
14:00	End of Lecture Series

Practical Information

Lunch will be taken from 12.30 to 14.00. Coffee breaks are scheduled each morning and afternoon. The afternoon sessions will normally finish at about 17h00.