ADVANCED CFD TECHNIQUES FOR TURBULENT FLOWS: THEORY AND APPLICATIONS

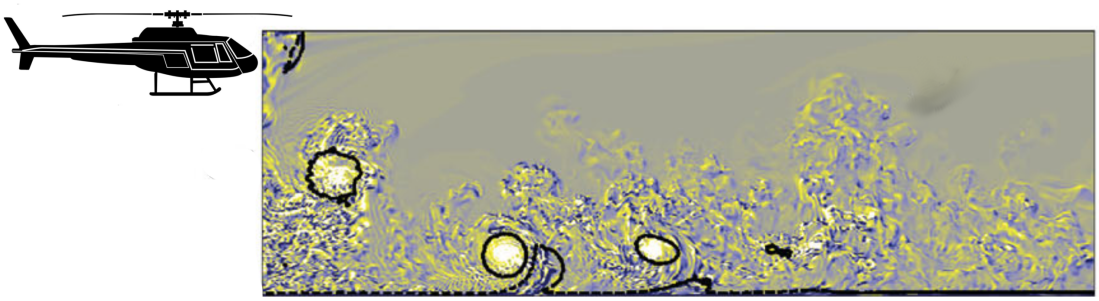
Instructor: Prof. Ugo Piomelli
Queen's University, Canada

Dates: May 19-22, 2015

Venue: Sala riunioni DIEG, University of Udine
(stanza L107NF, primo piano settore sud- ovest)
http://www2.diegm.uniud.it/diegm/cartine/frame_cartine_P1SO.htm

The purpose of this Lecture Series is to offer a full overview of the present development and the potential of Computational Fluid Mechanics for the simulation of turbulent flows. The first part of the course will introduce and discuss fundamental principles, present state-of-the-art applications and possible developments of CFD techniques, with particular focus on Large-Eddy Simulations (LES) and Detached Eddy Simulations (DES) which represents the most promising technique to extend the usefulness of LES for high Reynolds-number flows. The second part will present applications of these approaches to various engineering fields of wide interest.

The course is addressed both to researchers interested in the fundamental simulation of turbulence and engineers wanting to apply the LES technique to perform accurate simulations of turbulent flows.



Instantaneous vorticity field generated by a helicopter hovering near the ground.

Lecture hours: 10:00 – 12:00 and 14:00 – 16:00 from Tuesday May 19, 2015 to Friday May 22, 2015.

Course syllabus

1. **Motivation**
   i. *What is turbulence?*
   ii. *Review of turbulence physics*
   iii. *Why simulations?*
   iv. *Methodologies*
   v. *Resolution requirements*
2. **Governing equations**
   i. *Filtering*
   ii. *Filtered Navier-Stokes equations*
3. **Initial and boundary conditions**
   i. *Initial conditions.*
   ii. *Periodic conditions*
   iii. *Inflow conditions*
   iv. *Outflow conditions*
   v. *Wall conditions*
4. **Subfilter-scale modelling**
   i. *Modelling considerations*
   ii. *Overview of SFS models*
      - Eddy-viscosity models
      - Scale similar and mixed models
      - Dynamic models
      - Deconvolution models
      - Implicit LES
5. **Validation of an LES**
6. **Applications**
   i. *Flow over dunes*
   ii. *Rough-wall boundary layers*
   iii. *Impinging jets*
   iv. *Wall jets*
   v. *Detached Eddy Simulations*
7. **Challenges**
   i. *Commercial codes*
   ii. *Wall-layer modelling*
8. **Conclusions**

Course sponsors

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