Facing heat and mass transfer in turbulent flows is the most frequent task that process engineers and applied physicists have to deal with. Due to the complexity of phenomena as well as to the variety of measurement and simulation techniques, the tools available to researchers require in-depth knowledge and specific training that usually fall beyond the MSc programs.
The 15th UIT Summer School is devoted to fill this educational gap by providing engineers, PhD students and post -doc researchers with the theoretical tools and the analytic techniques most effective in modelling such problems. The Course is organised in five coordinate series of lectures on both fundamental and special topics, intended to address questions like: what are the physical phenomena concerned with turbulence? How do turbulent flows behave? How can they be quantitatively described? Which are the mathematical models and the solvers? Which the experimental techniques? Numerous examples from both standard and leading-edge engineering problems of fluid dynamics and heat transfer will help in enlightening and grasping both foundations and applications of this challenging subject.

CONTRIBUTORS

Prof. **Michele Ciofalo**, Università di Palermo;
Prof. **Aldo Coghe**, Politecnico di Milano;
Prof. **Walter Grassi**, Università di Pisa;
Prof. **Adriano M. Lezzi**, Università di Brescia;
Prof. **Alfonso Niro**, Politecnico di Milano;
Prof. **Pietro Poesio**, Università di Brescia;
Prof. **Maurizio Quadrio**, Politecnico di Milano,
Prof. **Sara Rainieri**, Università di Parma

ADDITIONAL INFORMATIONS

Additional info about the Summer Schools can be found on the website:
www.thermalab.polimi.it/news/
For any further questions and requests, please contact:
Prof. Alfonso Niro, Director of 15th UIT Summer School (alfonso.niro@polimi.it)

CREDITS FOR PHD STUDENTS

PhD Students can gain credits according to the regulation of their own PhD School. In addition to the Attendance Certificate, a Proficiency Certificate can be obtained upon submission of a report on one of topics addressed in the program.

APPLICATION AND FEES

The registration fee is 700,00 Euros and includes attendance to the Summer School, coffee breaks during the lessons, and full board treatment from the dinner of Sunday 6th to the lunch of Saturday 12th. The 50% of registration fee (€ 350,00) must be paid before August 14, 2015. The remaining must be paid directly during the check-in at Certosa di Pontignano.
To apply, please download (www.thermalab.polimi.it/news/) and complete the registration form, and kindly send it by e-mail, before August 14, 2015, to:
info@lacertosadipontignano.com

LOCATION

The 15th Summer School will be held in the prestigious Ancient Certosa di Pontignano, a unique place where nature, history and hospitality blend together in a memorable harmony, at a few kilometers from Siena, in the heart of Chianti, on a hill dominating the town. Further information can be gathered directly at Certosa website (www.lacertosadipontignano.com).

UIT Unione Italiana Termofluidodinamica

15th UIT Summer School

6 - 12 September 2015

Starry night , Vincent Van Gogh 1889

Give welcome to chaos, because order hasn't worked.

Karl Kraus

MODELLING AND EXPERIMENTATION ON TURBULENT FLOWS

Director: Prof. Alfonso Niro - Politecnico di Milano

Certosa di Pontignano (Siena)

CARTHUSIA PONTINIANI

	Monday 7 September	Tuesday 8 September	Wednesday 9 September	Thursday 10 September	Friday 11 September
8.30	*A. Niro* *Nature, origin and features of turbulence.*	*W. Grassi* *Plane jets; mixing layer, plane wake, cylinder bundles.*	*M. Quadrio* *Surface roughness effects: how to describe a rough surface.*	*M. Ciofalo* *Special topics 3: Turbulence in transient flows.*	*A. Coghe* *Laser doppler velocimetry (LDV); particle image velocimetry (PIV).*
9.20	*A. Niro* *The scale multiplicity of turbulent motion. Equations of fluid motion.*	*W. Grassi* *Special topics 1: EHD and turbulent jets. Heat Transfer.*	*M. Quadrio* *k-roughness vs d-roughness. Shortcomings of classical description of roughness.*	*M. Ciofalo* *Special topics 4: Turbulent reciprocating channel flow.*	*A. Coghe* *Examples of measurements and data processing in turbulent flows*
10.15	***Coffee break***	***Coffee break***	***Coffee break***	***Coffee break***	***Coffee break***
10.45	*A. Niro* *Fluctuations and Reynolds decomposition: mean-flow equations.*	*P. Poesio* *Homogeneous and isotropic turbulence in real space: structure functions.*	*M. Ciofalo* *Introduction to turbulence modelling: space and time filtering, direct numerical simulation.*	*M. Quadrio* *Turbulent Reynolds stresses and RANS equations. The turbulent viscosity hypothesis.*	*A. Niro* *Standard and advanced techniques for temperature and temperature-field measurements.*
11.40 **12.30**	*A. Lezzi* *Stability and transition to turbulence: linear stability analysis of laminar flows.*	*P. Poesio* *Taylor hypothesis; Kármán-Howarth equation. Isotropic turbulence in Fourier space.*	*M. Ciofalo* *Large Eddy Simulation. Sub-grid-scale (SGS). Filtered conservation equations.*	*M. Quadrio* *Algebraic models of turbulence: mixing length, Cebeci-Smith and Baldwin-Lomax models.*	*A. Niro* *Convective heat transfer measurement by liquid crystal and infrared thermography.*
13.00	***Lunch***	***Lunch***	***Lunch****	***Lunch***	***Lunch***
14.15	*A. Lezzi* *Flow stability between coaxial rotating cylinders. Taylor and Goertler vortices.*	*P. Poesio* *Navier-Stokes equations and turbulent kinetic energy equation in spectral form; energy spectrum.*	*M. Ciofalo** *The Smagorinsky sub-grid model. Further residual-stress models.*	*M. Quadrio* *One-equation models; the Spalart-Allmaras model. Two-equation models: the k-epsilon model.*	*S. Rainieri* *Special topics 5: advanced techniques for thermography filtering.*
15.10	*A. Lezzi* *Orr-Sommerfeld equations; BL stability; Tolmienn-Schlichting waves. Non-linear theory.*	*P. Poesio* *Temperature fluctuations and associated scales; internal energy equation in real and Fourier space.*	*P. Poesio** *Special topics 2: Turbulence in liquid -gas dispersed flow.*	*M. Quadrio* *The k-omega and the k-omega-SST models. RSM models*	*M. Ciofalo* *Special topics 6: Transition to turbulence in curved pipes*
16.00	***Coffee break***	***Coffee break***		***Coffee break***	***Coffee break***
16.30	*P. Poesio* *Introduction to the statistical description of turbulence.*	*M. Quadrio* *Turbulenty wall flows. Multiple layers and length scales; law of the wall and Prandtl's friction law.*		*A. Coghe* *Statistical methods in the experimental description of turbulent flows. Spectral decomposition.*	*M. Quadrio* *Special topics 7: Wall functions for RANS models.*
17.20 **18.15**	*W. Grassi* *Free shear flows: the round jet; BL equations; self-similarity; kinetic energy.*	*M. Quadrio* *Coherent structures and turbulence wall cycle. Super-structures.*		*A. Coghe* *Flow visualization techniques; velocimetry: hot-wire anemometry.*	*M. Quadrio* *Special topics 8: RANS-LES hybrid models. Uncertainty quantification. Super-computing techniques.*
20.00	***Dinner***	***Dinner***	***Dinner***	***Dinner***	***Dinner***

* On Wednesday 9th, the lunch is at 12:45 and the lessons in the afternoon start and stop 15 min in advance with respect to the scheduled time.