

## Preface



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## **31st UIT Heat Transfer Conference** Como, Italy, 25–27 June, 2013

The annual Conference of the “Unione Italiana di Termofluidodinamica” (UIT) aims at promoting cooperation in the field of heat transfer and thermal sciences, by bringing together scientists and engineers working in related areas.

The 31st UIT Conference was held in Moltrasio (Como), Italy, 25–27 June, 2013 at the Grand Hotel Imperiale.

The response has been enthusiastic, with more than 70 quality contributions from 224 authors on heat transfer related topics: natural, forced and mixed convection, conduction, radiation, multi-phase fluid dynamics and interface phenomena, computational fluid dynamics, micro- and nano-scales, efficiency in energy systems, environmental technologies and buildings.

To encourage the debate, the Conference Program has scheduled ample poster sessions and invited lectures from the best experts in the field along with a few of the most talented researchers. Keynote Lectures were given by Professor Roberto Mauri (University of Pisa), Professor Lounés Tadrist (Polytech Marseille) and Professor Maurizio Quadrio (Politecnico di Milano).

This special volume collects a selection of the scientific contributions discussed during this conference; these works give a good overview of the state-of-the art Italian research in the field of Heat Transfer related topics.

I would like to thank sincerely the authors for presenting their works at the conference and in this special issue. I would also like to extend my thanks to the Scientific Committee and the authors for their accurate review process of each paper for this special issue. Special thanks go to the organizing committee and to our sponsors.

As a professor of Politecnico di Milano, let me say I am very proud to have been the chair of this conference in the 150th anniversary of my university.

**Professor Alfonso Niro**

## About UIT (Unione Italiana Termofluidodinamica)

The Italian Union of Thermal-Fluid Dynamics (UIT) was founded in Bologna on December 19, 1984, following a proposal by Professor Enrico Lorenzini.

### Mission

The Italian Union of Thermal-Fluid Dynamics (UIT) has the fundamental aim to contribute to the progress of the Italian research and application of thermal-fluid dynamics, by promoting and enhancing the scientific, professional and social values among its members, as well as the formation of new generations of young scientists towards the research work in the field of thermal sciences, heat transfer and their applications.

In order to achieve these objectives UIT undertakes:

- the organization of a heat transfer conference, on yearly basis
- the organization of international Conferences, Seminars, Courses, etc.
- the organization of a summer school, on yearly basis, for PhD students and young researchers
- the institution of a prize, on yearly basis, for the best Italian Masters thesis dealing with thermal-fluid dynamics
- the institution of a prize, on a two-year basis, for the best Italian PhD thesis dealing with thermal-fluid dynamics.

### Governance

The governing bodies of the Italian Union of Thermal-Fluid Dynamics (UIT) are:

- the assembly (Assemblea)
- the steering committee (Comitato Direttivo)
- the president (Presidente)
- the auditors (Revisori dei conti)
- the arbiters (Probiviri)
- the secretary (Segretario).

The assembly of the UIT is made up by all ordinary members (natural persons, institutions and associations), honorary members, distinguished members and meets at least once a year. The assembly establishes the activity of the association, votes its budget and balance, appoints the governing bodies. At present more than 200 members from universities, national laboratories and industries take part in the UIT. The scientific management of the UIT, subject to the limitations of the constitution (Statuto), is handled by a steering committee chosen from its membership. It is made up of seven officers (president, vice-president, secretary, and four members). The steering committee is renewed every three years. President, vice-President and secretary cannot be appointed for the same chair more than twice on end.

## UIT 2013

### Steering committee

Vincenzo Naso, President  
Giuseppe Vella, Vice-President  
Sara Rainieri, Secretary  
Gian Piero Celata  
Davide Del Col  
Paolo Di Marco  
Alfonso Niro

### Auditors

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Marco Spiga  
Luca Tagliafico

### Past-Presidents

Enrico Lorenzini  
(First President and Founder)  
Sergio Faggiani †  
Claudio Pisoni †  
Gian Piero Celata

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Giovanni Del Tin  
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### Honorary members

Arthur E Bergles  
Michael W Collins  
Marino Di Marzo  
Frank P Incropera  
Antonio C M Sousa

**Scientific committee of the 31st UIT heat transfer conference**

Alfonso Niro, <i>Chair</i>	Politecnico di Milano
Giovanni Sebastiano Barozzi	Università degli Studi di Modena e Reggio Emilia
Gian Paolo Beretta	Università degli Studi di Brescia
Gian Piero Celata	ENEA
Giovanni Cesini	Università Politecnica delle Marche
Michele Ciofalo	Università degli Studi di Palermo
Elvio Cossali	Università degli Studi di Bergamo
Paolo Di Marco	Università degli Studi di Pisa
Marino Di Marzo	University of Maryland, USA
Walter Grassi	Università degli Studi di Pisa
Fabio Inzoli	Politecnico di Milano
Enrico Lorenzini	Università degli Studi di Bologna
Oronzio Manca	Seconda Università degli Studi di Napoli
Gian Luca Morini	Università degli Studi di Bologna
Adriano Muzzio	Politecnico di Milano
Vincenzo Naso	Università degli Studi di Napoli
Hisashi Ninokata	Professor Emeritus of the Tokyo Institute of Technology, Japan Visiting Professor at the Politecnico di Milano, Italy
Enrico Nobile	Università degli Studi di Trieste
Bruno Panella	Politecnico di Torino
Stefano Piva	Università degli Studi di Ferrara
Giorgio Sotgia	Politecnico di Milano
Antonio C M Sousa	University of Brunswick, Canada
John Richard Thome	EPFL, Lausanne, Switzerland
Akio Omyama	Kobe University, Japan
Giuseppe Vella	Università degli Studi di Palermo
Evelyn Wang	MIT, Cambridge Mass, USA
Iztok Zun	Slovenian Academy of Engineering, Slovenia

**Keynote lecturers of 31st UIT heat transfer conference**

Roberto Mauri	Università degli Studi di Pisa
Lounés Tadrist	Polytech Marseille
Maurizio Quadrio	Politecnico di Milano

**Organizing committee of 31st UIT heat transfer conference**

Alfonso Niro	Chair
Sergio Arosio	Co-chair
Guido Parissenti	
Luigi Vitali	
Damiano Fustinoni	
Pasqualino Gramazio	
Susanna Ciminà	
Luigi Colombo	
Manfredo Guilizzoni	
Emanuela Colombo	

**UIT conferences**

1	1983	Trieste	16	1998	Siena
2	1984	Bologna	17	1999	Ferrara
3	1985	Palermo	18	2000	Cernobbio (CO)
4	1986	Genova	19	2001	Modena
5	1987	Torino	20	2002	Maratea (PZ)
6	1988	Bari	21	2003	Udine
7	1989	Firenze	22	2004	Genova
8	1990	Ancona	23	2005	Parma
9	1991	Pisa	24	2006	Napoli
10	1992	Genova	25	2007	Trieste
11	1993	Milano	26	2008	Palermo
12	1994	L'Aquila	27	2009	Reggio Emilia
13	1995	Bologna	28	2010	Brescia
14	1996	Roma	29	2011	Torino
15	1997	Torino	30	2012	Bologna

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