

# Preface

The International Meeting on Advances in Thermofluids (IMAT) is an initiative to bring together academicians, research scientists and all interested parties from all over the world in a common platform to foster discussion, exchange ideas for the exploration of future research in the fields of thermal fluids, fluid mechanics, heat transfer, thermodynamics, energy, combustion and all topics related to them.

IMAT is a series of conferences that is held annually on the rotational basis between three universities, namely Universiti Teknologi Malaysia (UTM), National University of Singapore (NUS) and Universitas Indonesia (UI).

Previous IMAT conferences are as follows:

1st IMAT - UTM Johor, Malaysia in 2008

2nd IMAT - Safari Park, Bogor, Indonesia in 2009

3rd IMAT - Furama Hotel, Singapore in 2010

4th IMAT - Avillion Hotel, Melaka, Malaysia in 2011

5th IMAT - Nirwana Resort, Bintan Island, Indonesia in 2012

6th IMAT - NUS, Singapore in 2013

In November 26 - 27th 2014, Universiti Teknologi Malaysia was given the chance to organize the 7th IMAT in Swiss-Garden Hotel & Residences Kuala Lumpur. The objective of the conference are to encourage smart partnership between academic and industry to provide platform for sharing of knowledge among researchers in different field of thermofluids to establish and strengthen worldwide networking.

It is pleasure to present this proceeding of the 7th IMAT, which will be of interest to all concerned in the fields of Thermodynamics, Heat Transfer and Fluid Mechanics. The proceedings contain three keynote lectures given by renowned scholars, Professor Frank K. Lu (Mechanical and Aerospace Engineering Department at the University of Texas at Arlington), Thierry Maré (Institute of Technology of University of Rennes, France) and Professor Hany Al-Ansary (Mechanical Engineering Department at King Saud University).

A record number of 105 papers from various countries were accepted for publication after reviewed by the selected experts.

Special thanks to the members of the Technical and Organising committee for the time their spent on their thoughtful, helpful reviews and planning of the event, and further made this conference became successful.

***The Editors***

November 2014

# Committee

## ORGANISING COMMITTEE

### **Patron:**

Professor Ir. Datuk Dr. Wahid Omar

### **Advisor:**

Professor Ir. Dr. Roslan Abdul Rahman

Professor Dr. Noordin Mohd Yusof

### **Conference Chairman:**

Assoc. Prof. Dr. Mazlan Abdul Wahid

### **Secretary:**

Assoc. Prof. Dr. Syahrullail Samion

### **Technical Committee:**

Assoc. Prof. Dr. Nazri Kamsah

Assoc. Prof. Dr. Kahar Osman

Assoc. Prof. Dr. Nor Azwadi Che Sidik

Assoc. Prof. Dr. Normah Mohd Ghazali

Dr. Haslinda Mohamed Kamar

Dr. Zulkanain Abdul Latiff

Dr. Aminuddin Saat

Dr. Mohd Farid Mohd Said

Dr. Henry Nasution

Dr. Mohd Yusoff Senawi

Dr. Mohd Fairuz Mohd Yasin

Mr. Mohsin Sies

Mrs. Natrah Kamaruzaman

## **The 7th IMAT INTERNATIONAL ADVISORY BOARD**

Professor Ir. Dr. Azhar Abdul Aziz - Universiti Teknologi Malaysia

Professor Dr. Farid Nasir Hj. Ani - Universiti Teknologi Malaysia

Assoc. Prof. Dr. Mazlan Abdul Wahid - Universiti Teknologi Malaysia

Assoc. Prof. Dr. Syahrullail Samion - Universiti Teknologi Malaysia

Assoc. Prof. Dr. Nazri Kamsah - Universiti Teknologi Malaysia

Assoc. Prof. Dr. Nor Azwadi Che Sidik - Universiti Teknologi Malaysia

Assoc. Prof. Dr. Normah Mohd Ghazali - Universiti Teknologi Malaysia

Professor Amer Nordin Darus - Manipal International University, Malaysia

Professor Dr. Bambang Sugiarto - Universitas Indonesia

Professor Dr. Yulianto - Universitas Indonesia

Professor Dr. Harinaldi - Universitas Indonesia

Professor Dr. M. Idrus Alhamid - Universitas Indonesia

Professor Dr. Ing. Nandy Setiadi Djaya Putra - Universitas Indonesia

Assoc. Prof. Dr.-Ing. Ir. Nasruddin, M.Eng - Universitas Indonesia

Dr. Ir. Agus Pamitran - Universitas Indonesia  
Assoc. Prof. Dr. Priyono Sutikno - Institut Teknologi Bandung, Indonesia  
Professor Dr. Kim Choon Ng - National University of Singapore  
Professor Dr. Christopher Yap - National University of Singapore  
Professor Saito Kiyoshi - Waseda University, Japan  
Professor Dr. M.N.A. Hawlader - International Islamic University of Malaysia  
Professor Dr. Nasser Ashgriz - University of Toronto, Canada  
Professor Frank Lu - University of Texas at Arlington, Texas, USA  
Professor Dr. Hwataik Han, Kookmin University, Seoul, South Korea  
Asst. Prof. Dr. Khalid Saqr - Arab Academy for Science, Technology and Maritime  
Transport, Egypt  
Asst. Prof. Dr. Hani Hussain Wali Sait - King Abdul Aziz University, Rabigh, Saudi Arabia  
Assoc. Prof. Engr. Dr Abdul Mutalib Leman - Universiti Tun Hussein Onn Malaysia