



Preface

This book is a compilation of 111 papers that were chosen to be presented at the Malaysian International Tribology Conference (MITC) 2013 held at the Sutera Harbour Resort, Kota Kinabalu, Sabah, Malaysia on the 18th-20th of November 2013.

Chief Editor

PROFESSOR DR. MASJUKI HASSAN, CEng FIMechE

Editorial Board

Assoc. Prof. Dr. Salmiah binti Kasolang
Dr. Koay Mei Hyie
Dr. Mohd Fadzli bin Abdollah
Prof Dr. Jaharah binti A. Ghani
Prof. Dr. Ille C. Gebeshuber
Prof. Dr. Kanao Fukuda
Prof. Ir. Dr. Mohamd Nor Berhan
Assoc. Prof. Dr. Talib bin Ria Jaafar
Assoc. Prof. Dr. Md. Abdul Maleque
Assoc. Prof. Dr. Nor Hayati binti Saad
Assoc. Prof Dr Mariyam Jameelah binti Ghazali
Assoc. Prof. Dr. Willey Liew Yun Hsie
Dr. Aidah binti Jumahat
Dr. Mimi Azlina binti Abu Bakar
Dr. Nik Rosli bin Abdullah
Dr. Mohd. Kamel bin Wan Ibrahim
Dr. Nancy Julius Siambun
Dr. Mohd Kamal Bin Mohd Shah
Dr. Syahrullail bin Samion
Dr. Muhammad Hussain bin Ismail
Nik Roselina binti Nik Roseley
Ahmad Khushairy bin Makhtar
Hilmi bin Amiruddin
Abdul Rafeq bin Saleman

**Malaysian International Tribology Conference (MITC) 2013
The Malaysian Tribology Society (MYTRIBOS),
Department of Mechanical Engineering,
Universiti Malaya,
50603 Kuala Lumpur,
Malaysia.**

MESSAGE FROM PRESIDENT OF MYTRIBOS

MALAYSIAN TRIBOLOGY SOCIETY (MYTRIBOS), a professional and non-profit organization, effectively bridges the gap among academia, industry and research organizations in the field of tribology. Over the years, the number of members has slowly and steadily increased, which includes both local Malaysian and expatriates working in Malaysia.

Previously, in 2009, MYTRIBOS first organized a conference for local participants. Following that, a regional conference was organized in 2011 and today for the first time, MYTRIBOS is organizing an international conference - Malaysian International Tribology Conference 2013 (MITC2013); which will help to facilitate exchange of information in tribology amongst tribology practitioners all around the world. The conference will explore every aspect of fundamental and applied tribology research.

MYTRIBOS eventual vision and mission is to help reduce energy consumption by making machineries more energy efficient. As efficient machinery means less greenhouse gas (GHG) emission, thus MYTRIBOS is contributing towards the improvement of the environment and to achieve a better quality of life and more sustainable world. MYTRIBOS too is creating awareness of the importance of practicing proper tribology.

Finally, I would like to thank the organizing committee of MITC2013, keynote speakers, local and overseas participants and the sponsors. Without your contribution, organizing such an international conference would not be possible. I hope that this conference will enable us to have a productive discussion, help us to exchange ideas and views and to form future collaborations. Wish you further success in your future endeavors and enjoy your stay in Malaysia; and especially in Sabah 'Land Below the Wind'.

PROFESSOR DR. MASJUKI HASSAN, CEng FIMechE
President, MYTRIBOS

MESSAGE FROM CHAIRMAN OF MITC 2013

On behalf of the organizing committee of MYTRIBOS, I am proud to welcome everyone to the 1st Malaysian International Tribology Conference MITC2013. In earlier events, MYTRIBOS has successfully conducted two conferences: the National Tribology Conference NTC 2009 in Kuala Lumpur and the Regional Tribology Conference RTC 2011 in Langkawi. This year, MYTRIBOS has made a commitment to, once again, organize a conference but at the higher international level. This international conference, MITC2013 is made possible by the support of the tribology community around the globe. For MITC2013 this year, we have received 111 papers from which 70% are local and 30% international. Based on the first authors, we have participants coming from 13 countries namely Malaysia, Japan, Austria, Netherlands, India, China, Korea, Turkey, Qatar, United Kingdom, Philippines, Singapore and Saudi Arabia.

MITC2013 symbolizes our continuous effort to provide a platform for researchers around the globe to meet and share their expertise and findings specifically on tribology related research areas. This conference also provides a platform for networking not only among academicians from different universities and institutes but also between universities and industries.

In MITC2013, we have 6 distinguished keynote speakers from various background; PROF. IR. DR. MOHAMAD NOR BIN BERHAN (Universiti Teknologi MARA, MALAYSIA); PROF. DR. SHIGEYUKI MORI (Iwate University, JAPAN); ASSOC. PROF. DR. SUJEET K. SINHA (Indian Institute of Technology Kanpur, INDIA); DR. YOSHIO KUMADA (Taiho Kogyo Co., Ltd., JAPAN); DR. T.C.S.M. GUPTA (LubeWorld Holdings Sdn. Bhd., MALAYSIA); MR. NARENDRA MOHAN DUBE (DUCOM Instruments Pt. Ltd., INDIA). These outstanding speakers are renowned experts in their fields. They are specifically invited to uphold MITC2013.

We are indeed very honored by the support of TAIHO KOGYO Research Tribology Foundation from Japan and other sponsors of MITC2013 as acknowledged in the Program Book. Your kind gestures are highly appreciated. Finally, to all participants, thank you very much for being part of MITC2013. Your presence in Kota Kinabalu this year is most appreciated and valued. My gratitude also goes to all committee members, your commitment and passion has made this conference possible. Well done everyone!

ASSOC. PROF. DR. SALMIAH KASOLANG
Chairman, MITC 2013

ORGANIZING COMMITTEE

PRESIDENT

Prof. Dr. Masjuki bin Haji Hassan - [Universiti Malaya](#)

CHAIRMAN

Assoc. Prof. Dr. Salmiah binti Kasolang - [Universiti Teknologi MARA](#)

SECRETARY

Dr. Aidah binti Jumahat - [Universiti Teknologi MARA](#)

Prof. Ir. Dr. Mohamad Nor bin Berhan - [Universiti Teknologi MARA](#)

Dr. Mimi Azlina binti Abu Bakar - [Universiti Teknologi MARA](#)

Mrs. Nik Roselina binti Nik Roseley - [Universiti Teknologi MARA](#)

TREASURER

Prof. Dr. Jaharah binti A. Ghani - [Universiti Kebangsaan Malaysia](#)

TECHNICAL

Dr. Mohd Fadzli bin Abdollah - [Universiti Teknikal Malaysia Melaka](#)

Mr. Hilmi bin Amiruddin - [Universiti Teknikal Malaysia Melaka](#)

Mr. Abdul Rafeq bin Saleman - [Universiti Teknikal Malaysia Melaka](#)

Mr. Ahmad Khushairy bin Makhtar - [Universiti Teknologi MARA](#)

PUBLICATION

Dr. Koay Mei Hyie - [Universiti Teknologi MARA](#)

Assoc. Prof. Dr. Md. Abdul Maleque - [Universiti Islam Antarabangsa Malaysia](#)

Prof. Dr. Ille C. Gebeshuber - [Universiti Kebangsaan Malaysia](#)

Prof. Dr. Kanao Fukuda - [Malaysia-Japan International Institute of Technology ; JAST](#)

Assoc. Prof. Dr. Nor Hayati binti Saad - [Universiti Teknologi MARA](#)

Dr. Syahrullail bin Samion - [Universiti Teknologi Malaysia](#)

Dr. Muhammad Hussain bin Ismail - [Universiti Teknologi MARA](#)

PUBLICITY AND PROMOTION

Assoc. Prof. Dr. Mariyam Jameelah binti Ghazali - [Universiti Kebangsaan Malaysia](#)

Engr. Muhammad Redzuan bin Umar - [Hakita Engineering Sdn. Bhd.](#)

Miss Suzzana binti Azemi - [Universiti Kebangsaan Malaysia](#)

LOGISTIC

Mr. Mohamad Ali bin Ahmad - [Universiti Teknologi MARA](#)

Assoc. Prof. Dr. Willey Liew Yun Hsie - [Universiti Malaysia Sabah](#)

Dr. Nik Rosli bin Abdullah - [Universiti Teknologi MARA](#)

Dr. Mohd. Kamel bin Wan Ibrahim - [Universiti Malaysia Sabah](#)

Dr. Nancy Julius Siambun - [Universiti Malaysia Sabah](#)

Dr. Mohd Kamal bin Mohd Shah - [Universiti Malaysia Sabah](#)

PROGRAM AND SPONSORSHIP

Dr. Talib bin Ria Jaafar - [Universiti Teknologi MARA](#)

Mr. Mokhtar bin Said - Zeta Scientific Sdn. Bhd.

Mrs. Fazira Suriani binti Mohamed Fadzil - [SIRIM](#)

Mr. Shah Rizal bin Saupi - Zeta Scientific Sdn. Bhd.

REVIEW COMMITTEES

Abdul Rafeq bin Saleman - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Abdul Samad Mohammed - [King Fahd University of Petroleum and Minerals, Saudi Arabia](#)

Ahmad Rivai - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Ahmad Jais bin Alimin - [Universiti Tun Hussein Onn Malaysia, Malaysia](#)

Ahmad Kamal bin Mat Yamin - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Ahmad Khushairy bin Makhtar - [Universiti Teknologi MARA, Malaysia](#)

Aidah binti Jumahat - [Universiti Teknologi MARA, Malaysia](#)

Ajay Bhushan - [Mahamaya Technical University Noida, India](#)

Amir bin Khalid - [Universiti Tun Hussein Onn Malaysia, Malaysia](#)

Anasyida binti Abu Seman - [Universiti Sains Malaysia, Malaysia](#)

Balasubramaniam Vengudusamy - [AC2T Research GmbH, Austria](#)

Bubathi Muruganatham - [Indira Gandhi Centre for Atomic Research, India](#)

Dedi Cupu - [University of Riau, Indonesia](#)

Elmi binti Abu Bakar - [Universiti Sains Malaysia, Malaysia](#)

Hilmi bin Amiruddin - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Hiroyuki Kousaka - [Nagoya University, Japan](#)

Ille Gebeshuber - [Universiti Kebangsaan Malaysia, Malaysia](#)

Jaharah binti A. Ghani - [Universiti Kebangsaan Malaysia, Malaysia](#)

Jariah binti Mohamad Juoi - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Kamarul Ariffin bin Zakaria - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Kanao Fukuda - [Malaysia-Japan International Institute of Technology, Malaysia](#)

Koay Mei Hyie - [Universiti Teknologi MARA, Malaysia](#)

Li Du - [The University of Akron, USA](#)

Low Cheng Yee - [Universiti Teknologi MARA, Malaysia](#)

Mohd. Kamel bin Wan Ibrahim - [Universiti Malaysia Sabah, Malaysia](#)

Mariam Jameelah binti Ghazali - [Universiti Kebangsaan Malaysia, Malaysia](#)

Mimi Azlina binti Abu Bakar - [Universiti Teknologi MARA, Malaysia](#)

Mohd Ahadlin bin Mohd Daud - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Mohd Asyadi 'Azam bin Mohd Abid - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Mohd Azman bin Abdullah - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Mohd Basri bin Ali - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Mohd Fadzli bin Abdollah - [Universiti Teknikal Malaysia Melaka, Malaysia](#)

Mohd Hafis bin Sulaiman - [Universiti Malaysia Perlis, Malaysia](#)
Mohd Juzaila bin Abd Latif - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Mohd Kamal bin Mohd Shah - [Universiti Malaysia Sabah, Malaysia](#)
Mohd Kameil bin Abdul Hamid - [Universiti Teknologi Malaysia, Malaysia](#)
Mohd Rody bin Mohamad Zin - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Narasimhalu Ethiraj - [Dr M G R University, India](#)
Nik Rosli bin Abdullah - [Universiti Teknologi MARA, Malaysia](#)
Nona Merry Merpati Mitan - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Nor Bahiyah binti Baba - [TATI University College, Malaysia](#)
Nor Hayati binti Saad - [Universiti Teknologi MARA, Malaysia](#)
Noraiham binti Mohamad - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Noreffendy bin Tamaldin - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Noritsugu Umehara - [Nagoya University, Japan](#)
Omar bin Bapokutty - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Puvanasvaran A/L A Perumal - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Qumrul Ahsan - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Ramdziah binti Nasir - [Universiti Sains Malaysia, Malaysia](#)
Reduan bin Mat Dan - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Rose Scripa - [University of Alabama at Birmingham, USA](#)
Salmiah binti Kasolang - [Universiti Teknologi MARA, Malaysia](#)
Shahrul Azam Abdullah @ Ab. Aziz - [Universiti Teknologi MARA, Malaysia](#)
Sivakumar A/L Dhar Malingam - [Universiti Teknikal Malaysia Melaka, Malaysia](#)
Subramanian Gopalakannan - [Adhiparasakthi Engineering College, India](#)
Surajit Purkayastha - [University of Cambridge, United Kingdom](#)
Syahrullail bin Samion - [Universiti Teknologi Malaysia, Malaysia](#)
T V V L N Rao - [Universiti Teknologi PETRONAS, Malaysia](#)
Takayuki Tokoroyama - [Nagoya University, Japan](#)
Talib bin Ria Jaafar - [Universiti Teknologi MARA, Malaysia](#)
Tcsm Gupta - [LubeWorld Holdings Sdn Bhd, Malaysia](#)
Tze Chuen Yap - [Multimedia University, Malaysia](#)
Wahyu Kuntjoro - [Universiti Teknologi MARA, Malaysia](#)
Willey Liew Yun Hsie - [Universiti Malaysia Sabah, Malaysia](#)
William Chong - [University of Southampton Malaysia Campus, Malaysia](#)
Zulkifli bin Mohd. Rosli - [Universiti Teknikal Malaysia Melaka, Malaysia](#)