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Prof. Shoou-Jinn Chang
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Message from the Editor-in-Chief

The unique journal *Inventions* is different from all other journals. Many scholars spend their lives publishing research papers in many different journals, but most of these journals do not help scholars collate and analyze their results or assist in promoting them to a relevant industry. However, *Inventions* will help authors not only to publish their papers in the journal, but also to promote their research results to industry and assist them in realizing the purpose of technology transfer. In the future, *Inventions* will help authors to evaluate their technology license fees based on the valuation theory and approaches and also help authors to show their patents and technologies on a network transaction platform.

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- **Possibly Evaluate Technology License Fees of Published Papers for Authors**
- **Possibly Show Their Published Technologies on a Network Transaction Platform for Authors**

Aims and Scope

Inventions is an international, peer-reviewed journal that publishes original scientific research of significance concerning innovation/invention, or patent-based/extended/reviewed research papers in all fields of science, engineering and product development processes. We encourage authors to give special attention to patent-based/extended researches and short techni¬cal reports regarding transferring technology.

The scope of *Inventions* includes:

- Patent-based/extended/reviewed inventions in engineering
- Innovation/inventions in systems
- Innovation/inventions in devices
- Innovation/inventions in methods
- Innovation/inventions in composition
- Innovation/inventions in processes
- Innovation/inventions in products
- Innovation/inventions in design
- Innovation/inventions in advanced technologies

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Basel, July 2017

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Editor-in-Chief

Prof. Dr. Takayoshi Kobayashi

Message from the Editor-in-Chief

As the world of science becomes ever more specialized, researchers may lose themselves in the deep forest of the ever increasing number of subfields being created. This open access journal *Applied Sciences* has been started to link these subfields, so researchers can cut through the forest and see the surrounding, or quite distant fields and subfields to help develop his/her own research even further with the aid of this multi-dimensional network.

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Aims and Scope

Applied Sciences (ISSN 2076-3417; *Applied Sciences-Basel* recorded in Web of Science) is an international, peer-reviewed, open access journal, published monthly by MDPI AG, Basel, Switzerland.

According to the Journal Citation Reports®, published by Clarivate Analytics in June 2017, the new Impact Factor is 1.679. *Applied Sciences* now ranks 150/275 (Q3) in the category 'Materials Science, Multidisciplinary', 91/166 (Q3) in 'Chemistry, Multidisciplinary', and 75/147 (Q3) in the category 'Physics, Applied'.

The journal covers all aspects of applied biology, applied chemistry, applied physics, and applied engineering. It has eight Sections:

- Nanotechnology and Applied Nanoscience
- Optics and Lasers
- Acoustics
- Chemistry
- Materials
- Energy
- Mechanical Engineering
- Computer Science and Electrical Engineering

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1 登錄系統

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3 出具報告

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簡單

人性化介面設計

本系統以友善的用戶介面、簡易問答規則與點選式設計，協助用戶輕鬆快速上手。

科學

國際評價理論

依據美國最具代表性評估協會-NACVA評價理論及評價準則公報為基礎。

實惠

降低企業成本

大幅節省企業專利、技術評估的時間、金錢等成本。

專業

提供市場參考數據

整合大量產業數據及評價技術參數，協助用戶評價技術價值更專業、具高度參考性。

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營運計畫

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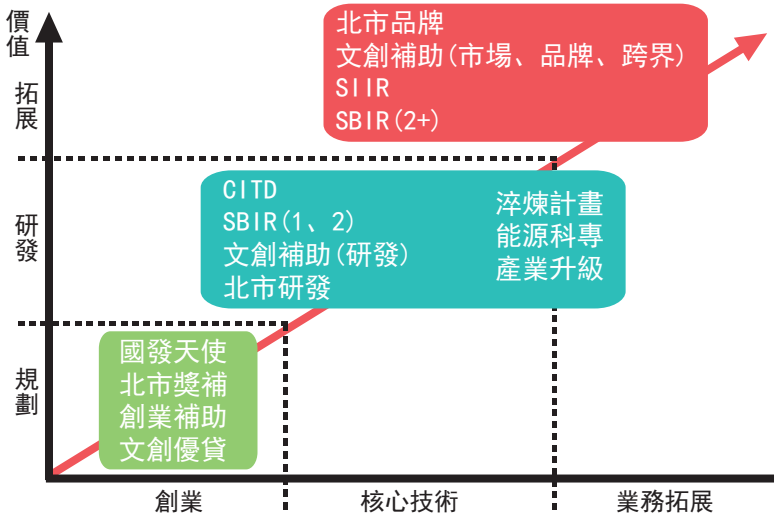

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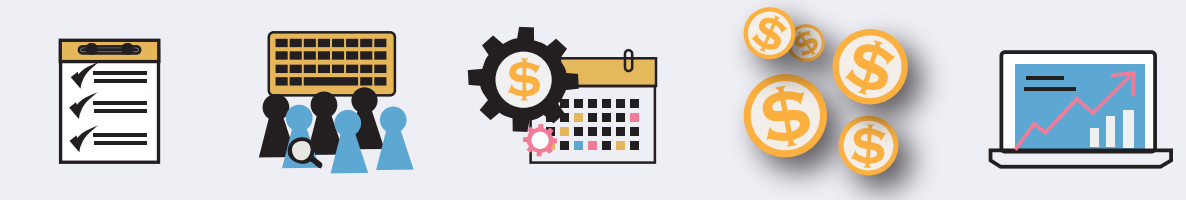

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Agenda

ICI For All SPINTECH MNHTE

Day 1: Friday, September 29th , 2017

15:00 – 17:30	AMMT(Alliance of Machining and Measuring Techniques) Speech & Exhibition Teachers' Hostel –2F RoomC/ 1F Recreation Center Square
15:00 – 18:00	Registration-Members Teachers' Hostel – Ying-Bin Building 1F Lobby
17:30 – 20:00	AMMT(Alliance of Machining and Measuring Techniques) Welcome Reception Teachers' Hostel – The Tao Li Yuan Chinese Restaurant

Day 2: Saturday, September 30th , 2017

09:00 – 10:00	Registration –ICI / SPINTECH Teachers' Hostel – Ying-Bin Building 1F Lobby
10:00 – 10:30	Opening Ceremony Teachers' Hostel – Conference Building 3F Assembly Hall
10:40 – 10:55	**MDPI Speech I** Title: Introduction of Open Access and MDPI Journals Speaker: Lucy Lu Chairman: Prof. Chien-Hung Liu Teachers' Hostel – Conference Building 3F Assembly Hall
10:55 – 11:10	**MDPI Speech II** Title: MDPI Editorial Procedure and Publication Ethics Speaker: Yurong Zhang Chairman: Prof. Chien-Hung Liu Teachers' Hostel – Conference Building 3F Assembly Hall
11:10 – 11:50	**Keynote Speech I** Title: Femtosecond ionization mass spectrometry Speaker: Prof. Totaro Imasaka Chairman: Prof. Cheng-Chi Wang Teachers' Hostel – Conference Building 3F Assembly Hall

10:40 – 12:10	SPINTECH – Thesis Competition 1F Room A	SPINTECH – Thesis Competition 1F Room B	SPINTECH – Thesis Competition 2F Room C	
12:10 – 13:30	Lunch The Lalu Hotel – B1 The Oriental Brasseries			
13:30 – 14:10	**MNHTE-Keynote Speech I** Title: Laser induced nanoparticle melting and its application Speaker: Prof. Seung Hwan Ko Chairman: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall			
14:10 – 14:40	**MNHTE-Invited Speech I** Title: Heat conduction of polycrystallined diamond films, crystallined diamond substrates, and SiGeSn thin films studied by ultrafast spectroscopy Speaker: Dr. Kung-Hsuan Lin Chairman: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall			
14:40 – 15:10	**MNHTE-Invited Speech II** Title: Mass Transfer in the Solid Oxide Fuel Cell Speaker: Prof. Hironori Nakajima Chairman: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall			
15:10 – 15:40	**MNHTE-Invited Speech III** Title: Drops, bubbles on nanostructured surfaces and their applications Speaker: Prof. Yen-Wen Lu Chairman: Prof. Ming-Chang Lu Teachers' Hostel – Conference Building 3F Assembly Hall			
15:40 – 16:10	**MNHTE-Invited Speech IV** Title: Exploring new fundamentals and applications of nanoporous membranes: A nanofluidic approach Speaker: Prof. Chuanhua Duan Chairman: Prof. Ming-Chang Lu Teachers' Hostel – Conference Building 3F Assembly Hall			
13:30 – 15:45	SPINTECH – Thesis Competition 1F Room A	SPINTECH – Thesis Competition 1F Room B	SPINTECH – Thesis Competition 2F Room C	SPINTECH – Thesis Competition 1F Recreation Center

15:45 – 16:00	Tea Break Teachers' Hostel – 1F Recreation Center Square			
16:20 – 17:00	**Keynote Speech II** Title: Cooling hot spots with functionnalized graphene Speaker: Dr. Sebastian Volz Chairman: Prof. Chih-Wei Chang Teachers' Hostel – Conference Building 3F Assembly Hall			
17:00 – 17:40	**Keynote Speech III** Title: Classifications of Research and Development Patents Speaker: Prof. Gou-Chung Chi Chairman: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall			
16:00 – 17:00	SPINTECH – Thesis Competition 1F Room A	SPINTECH – Thesis Competition 1F Room B	SPINTECH – Thesis Competition 2F Room C	SPINTECH – Thesis Competition 1F Recreation Center
17:50 – 18:10	Group Photo Teachers' Hostel – Conference Building 3F Assembly Hall			
18:30 – 20:30	Banquet & SPINTECH Award Ceremony The Lalu Hotel – 1F Lalu Garden			

Day 3: Sunday, October 1st, 2017

08:30 – 09:00	**MNHTE-Invited Speech V** Title: Active thermal conductivity control of magnetic nanofluids Speaker: Prof. Yuhiro Iwamoto Chairman: Prof. Huei-Chu Weng 2F Room C			
09:00 – 12:00	Session A1 1F Room A	Session B1 1F Room B	Poster 1 1F Recreation Center	**MNHTE-Invited Speech VI** Title: Heat transfer and thermoelectric properties of 2D materials Speaker: Dr. Wen-Pin Hsieh Chairman: Prof. Huei-Chu Weng 2F Room C **MNHTE-Invited Speech VII** Title: Ultralow thermal conductivity and thermal diffusivity in graphene/metal heterostructures Speaker: Prof. Koh Yee Kan Chairman: Prof. Huei-Chu Weng 2F Room C **MNHTE-Invited Speech VIII** Title: Laser-induced plasma drilling of silica glass Speaker: Prof. Hirofumi Hidai Chairman: Prof. Huei Chu Weng 2F Room C **Session C1- MNHTE Oral & Poster** Chairman: Prof. Yu-Bin Chen 2F Room C
12:00 – 13:30	Lunch The Lalu Hotel – B1 The Oriental Brasseries			**MNHTE- General Assembly** 2F Room C
13:30 – 16:30	Session A2 1F Room A	Session B2 1F Room B	Poster 2 1F Recreation Center	

Day 4: Monday, October 2nd, 2017

09:00 – 18:00	Technical Visit & Communication

MNHTE2017 Program

Friday, September 29th, 2017

18:00 – 20:00	Welcome Reception Teachers' Hostel –The Tao Li Yuan Chinese Restaurant

Day 1: Saturday, September 30th, 2017

09:00 – 10:00	Registration Teachers' Hostel – Ying-Bin Building 1F Lobby
10:00 – 10:30	Opening Ceremony Teachers' Hostel – Conference Building 3F Assembly Hall
10:40 – 11:10	**MDPI Speeches** Teachers' Hostel – Conference Building 3F Assembly Hall
11:10 – 11:50	**ICI & MNHTE Keynote Speech I** Title: Femtosecond ionization mass spectrometry Speaker: Prof. **Totaro Imasaka** Chair: Prof. Cheng-Chi Wang Teachers' Hostel – Conference Building 3F Assembly Hall
12:10 – 13:30	Lunch The Lalu Hotel-B1 The Oriental Brasseries
13:30 – 14:10	**Keynote Speech I** Title: Laser induced nanoparticle melting and its application Speaker: Prof. **Seung Hwan Ko** Chair: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall
14:10 – 14:40	**Invited Speech I** Title: Heat conduction of polycrystallined diamond films, crystallined diamond substrates, and SiGeSn thin films studied by ultrafast spectroscopy Speaker: Dr. **Kung-Hsuan Lin** Chair: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall
14:40 – 15:10	**Invited Speech II** Title: Mass transfer in the solid oxide fuel cell Speaker: Prof. **Hironori Nakajima** Chair: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall

15:10 – 15:40	**Invited Speech III** Title: Drops, bubbles on nanostructured surfaces and their applications Speaker: Prof. **Yen-Wen Lu** Chair: Prof. Ming-Chang Lu Teachers' Hostel – Conference Building 3F Assembly Hall
15:40 – 16:10	**Invited Speech IV** Title: Exploring new fundamentals and applications of nanoporous membranes: A nanofluidic approach Speaker: Prof. **Chuanhua Duan** Chair: Prof. Ming-Chang Lu Teachers' Hostel – Conference Building 3F Assembly Hall
16:10 – 16:20	Tea Break Teachers' Hostel –3F Corridor
16:20 – 17:00	**ICI & MNHTE Keynote Speech II** Title: Cooling hot spots with functionnalized graphene Speaker: Dr. **Sebastian VOLZ** Chair: Dr. Chih-Wei Chang Teachers' Hostel – Conference Building 3F Assembly Hall
17:00 – 17:40	**ICI & MNHTE Keynote Speech III** Title: Classifications of Research and Development Patents Speaker: Prof. **Gou-Chung Chi** Chair: Prof. Ming-Tsang Lee Teachers' Hostel – Conference Building 3F Assembly Hall
17:50 – 18:10	Group Photo Teachers' Hostel – Conference Building 3F Assembly Hall
18:30 – 20:30	Banquet The Lalu Hotel – 1F Lalu Garden

Day 2: Sunday, October 1st, 2017

08:20 – 08:50	**Invited Speech V** Title: Active thermal conductivity control of magnetic nanofluids Speaker: Prof. **Yuhiro Iwamoto** Chair: Prof. Huei Chu Weng 2F Room C
08:50 – 09:20	**Invited Speech VI** Title: Heat transfer and thermoelectric properties of 2D materials Speaker: Dr. **Wen-Pin Hsieh** Chair: Prof. Huei Chu Weng 2F Room C

09:20 – 09:50	**Invited Speech VII** Title: Ultralow thermal conductivity and thermal diffusivity in graphene/metal heterostructures Speaker: Prof. **Koh Yee Kan** Chair: Prof. Huei Chu Weng 2F Room C
09:50 – 10:20	**Invited Speech VIII** Title: Laser-induced plasma drilling of silica glass Speaker: Prof. **Hirofumi Hidai** Chair: Prof. Huei Chu Weng 2F Room C
10:30 – 11:45	**MNHTE2017 Session** **Poster Presentations** 012649; 012804; 012843; 012852; 012809; 012793 1F Corridor **Oral Presentations** 10:30 – 012692; 10:45 – 012687; 11:00 – 012704; 11:15 – 012782; 11:30 – 013326 Chair: Prof. Yu-Bin Chen 2F Room C
12:00 – 13:30	**The 2017 General Assembly of Heat and Mass Transfer Society of Taiwan** 2F Room C
12:00 – 13:30	Lunch The Lalu Hotel-B1 The Oriental Brasseries
13:30 – 18:00	**Free Afternoon**

Monday, October 2nd, 2017

09:00 – 18:00	**Technical Visit & Communication** (see the 'Free Tour' arranged by ICI2017)

Forewords

First of all, I would like to express my sincere thanks to all of you for participating in the 3rd International Conference on Inventions (ICI 2017), taking place at Sun Moon Lake from September 29 to October 2, 2017. ICI 2017 is also collocated with SPINTECH Thesis award and the 4th Micro & Nanoscale Heat Transfer and Energy Workshop (MNHTE2017).

ICI continues a tradition of bringing together researchers, academics and professionals from all over the world, experts in inventions and innovation for engineering sciences.

As an established academic community, the conference particularly encourages the interaction among research students and developing academics to present and discuss their new current work. All the participants' contributions have helped to make the Conference as outstanding as it is now. The papers comprise the most recent scientific knowledge known in the field of Advanced Manufacturing, Applied Optics and Lasers, Smart System, Electro/Opto/Mechatronic Systems, Energy and Thermal/Fluid Science, Biotechnology, Nanotechnology, Information and Communication, Computing Technology, and Key Industrial Technologies.

In addition to the contributed papers, three invited keynote speeches will be given during the conference. Prof. Volz Sebastian of National Center from Scientific Research of France, who spoke about cooling hot spots with functionnalized graphene; by Prof. Totaro Imasaka of Kyushu University of Japan, who spoke about femtosecond ionization mass spectrometry; by Prof. Gou-Chung Chi of National Chiao Tung University of Taiwan, who spoke about classifications of research and development patents.

These Proceedings will furnish the scientists of the world with an excellent reference book. I trust also that this will be an impetus to stimulate further study and research in all these areas.

We thank all authors and participants for their contributions.

Cheng-Chi Wang
Program Chairman of ICI 2017

Forewords

On behalf of the organizing committees, it's a pleasure to welcome all of you to attend The 3rd International Conference on Inventions collocated with 2017 SPINTECH Technology Thesis Awards, held at Sun Moon Lake, Taiwan, on Sep.29-Oct.2, 2017. The series of ICI conference are cooperated with Multidisciplinary Digital Publishing Institute (MDPI), publisher of our journal Inventions. This year, our organizing team includes TAIWAN SOCIETY of INTELLEGENT INSTRUMENT INVENTIONS, SPINTECH PRECISION MACHINERY CO. LTD., NATIONAL CHIN-YI UNIVERSITY of TECHNOLOGY, NATIONAL CHUNG HSING UNIVERSITY. We would like to express our sincere appreciation for their generous supports who contributed to making it all happen.

The aims and scope of the 3rd international conference on Inventions is to make researchers focus on patent based researches. We expect the conference to be a platform for successful patented inventors to share their experiences with all participants.

We believe this International Conference on Inventions is beneficial to inventors from many aspects:

1. Help authors to evaluate their technology license fees with the valuation theory and the approaches by using Qcount: Intangible Asset Valuation System.
2. Serve as a platform for successful patented inventors to share their experiences with other inventors who might be going through similar difficulties.
3. Provide participants with series of lectures and planning tutorship on innovation, invention and start-up given by professional consultants and consultation.
4. Help authors to showcase their patents and technologies on a network transaction platform.

In record for the Spintech thesis awards, we proudly present as following:

1. College Student Research Scholarship Competition
   First stage: Groups 32; Finalist: 23 Groups
2. Technology Thesis Competition
   First stage: Groups 69; Finalist: 57 Groups
3. High Speed Spindle Innovation-Related Application Implementation
   Finalist: 5 Groups

The ICI2017 conference and Spintech Thesis Awards will be attended by more than 300 people from Asia. We're optimistic that all participants will acquire new skills and knowledge from the keynote speeches, invited speeches and technical sessions, and we do hope all of you will enjoy the special banquet and relaxing tours. We look forward to having a successful conference and we are grateful for all of your participation. Have a fascinating stay in Taiwan.

Chien-Hung Liu
Program Chairman of ICI2017 &
Spintech Thesis Awards 2017

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- Hongying Meng, Brunel University, UK
- Liang Pan, Purdue University, USA
- David T.W. Lin, National University of Tainan, Taiwan

ICI & MNHTE & SPINTECH 2017 Speakers

Keynote speech I

Saturday, 30th September

"Femtosecond Ionization Mass Spectrometry"

Prof. Totaro Imasaka

Graduate School of Engineering Department of Applied Chemistry, Kyushu University, Japan

Mass spectrometry has been successfully used in the trace analysis of organic compounds in environmental and forensic sciences. Especially, mass spectrometry using a femtosecond laser as the ionization source has excellent performance for sensitive as well as selective analysis of trace species. In fact, more than several hundreds of environmental pollutants can be determined simultaneously at femtogram levels on the two-dimensional display of gas chromatography and mass spectrometry (GC/MS). This new technique has been utilized for the trace analysis of toxic polychlorinated dioxins/biphenyls in soil [1], carcinogenic nitro polycyclic aromatic hydrocarbons in particulate matter 2.5 (PM2.5) [2], and allergy compounds in fragrances [3]. More recently, a technique of measuring explosives and nerve agent metabolites have been developed for homeland security [4]. This method provides a molecular ion in the mass spectrum, which is an distinct advantage for more reliable analysis of trace species. An ultraviolet femtosecond laser, e.g., the third harmonic emission (267 nm) of a Ti:sapphire laser, has been employed for efficient two-photon ionization in the ultraviolet region. On the other hand, a near-infrared femtosecond laser, e.g., the fundamental beam of the Ti:sapphire laser or the optical parametric amplifier is useful for observing a molecular ion when it has no absorption band in the near-infrared region. A small-frame low-cost mass spectrometer consisting of a compact femtosecond laser is an attractive device for commercialization, which will be promising in a variety of applications in science and technology in the future.

[1] Y-C. Chang, T. Imasaka, Anal. Chem. 85, 349 (2013).
[2] Y. Tang, T. Imasaka, S. Yamamoto, T. Imasaka, Chemosphere 152, 252 (2016).
[3] S. Shibuta, T. Imasaka, T. Imasaka, Anal. Chem. 88, 10693 (2016).
[4] A. Hamachi, T. Okuno, T. Imasaka, Y. Kida, T. Imasaka, Anal. Chem. 87, 3027 (2015).

Experience:

Professional Career

- 2017 – Present : Specially-appointed Professor, Kyushu University
- 2009 – 2017 : Distinguished Professor, Kyushu University
- 1991 – 2009 : Professor, Kyushu University
- 1981 – 1991 : Associate Professor, Kyushu University, Kyushu University
- 1980 – 1981 : Lecturer, Kyushu University
- 1979 – 1980 : Assistant Professor, Kyushu University
- 1978 – 1979 : Postdoctoral Fellow, Stanford University

Awards

- 2002: The Award of The Society for Analytical Chemistry, The Society for Analytical Chemistry Developments of Supersonic Jet Spectrometry and Near-Infrared Laser Spectrometry and Their Applications
- 1994: The Divisional Award of The Chemical Society of Japan, The Chemical Society of Japan Studies on Two-Color Stimulated Raman Effect
- 1984: The Chemical Society of Japan Award for Young Chemists, The Chemical Society of Japan Study on Laser-Induced Spectrometry for Ultratrace Analysis•

Main Research Activities:

- Analytical Chemistry
- Analytical Instrumentation
- Analytical Science
- Trace Analysis, Lasers
- Non-linear Optics
- Spectrometry

Keynote speech II

Saturday, 30th September

"Cooling Hot Spots with Functionnalized Graphene"

Dr. Sebastian Volz

National Center for Scientific Research, France

Thermal management of nano/microelectronic chips now includes heat spreader elements that allow for cooling local hot spots. Graphite films are already in use in commercial products. We will show how few layer graphene films can be used to enhance heat dissipation especially using chemical functionalization based both on demonstrators and on theoretical investigations. The direct contact of graphene with the silica substrate is avoided thus recovering the high intrinsic lateral thermal conductivity of graphene. We show that the interplay between in-plane and cross-plane thermal transport in graphene mediated by functional molecules could lead to substantially improved thermal management of a micro heater. Hence we propose a significant package-level solution for the thermal management of hotspots in high-power electronics at the micro- and nanometer length scale.

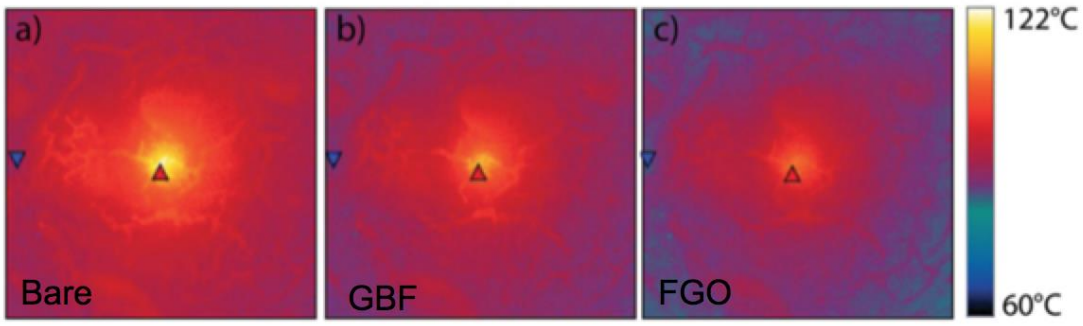


Figure 1: Infrared camera temperature mapping of a local resistive heating of a) the bare surface, b) the surface covered by a graphene based film, c) the surface covered by a functionalized graphene based film.

Reference:

Han, H., Zhang, Y., Wang, N., Samani, M.K., Ni, Y., Mijbil, Z.Y., Edwards, M., Xiong, S., Sääskilahti, K., Murugesan, M. and Fu, Y., Ye, L., Kosevich, Yu. A., Lambert, C., Liu J., & Sebastian Volz. Functionalization mediates heat transport in graphene nanoflakes. *Nature communications*, 7, 11281 (2016)

Experience:

Titles

- Senior Research Fellow of the National Center for Scientific Research (CNRS)
- Head of the European Network 'Thermal Nanosciences and Nanoengineering' (CNRS)
- Head of the Joint Team 'Ecole Centrale Paris/Thales Research&Technology'
- Head of the Thermal Nanosciences Group at Ecole Centrale Paris
- Teaching at Ecole Centrale Paris

Previous Titles

- Senior Research Fellow of the CNRS at IIS-University of Tokyo (2008-10)
- Research Fellow of the CNRS and Head of the CNRS Research Network for Micro and Nanoscale Heat Transfer (2000-08)
- Associate Professor at ENSMA (french Grande Ecole, 1998-2000)
- Postdoc UCLA, Mech. Eng. Dpt. (1997-98)

Cursus

- Full Professor Thesis (2004), Ph.D. ENSMA (1996)
- M.Sc. in Mechanical Engineering ENSMA (1993)

Awards

- Bronze Medal of the CNRS, 2004
- International Thermoelectric Society 2009 Scientific Award

Chair

- Chairman of Workshops Phonons and Fluctuations (Paris, 2010, 2011).
- Chairman of the Workshop Phonon Engineering, Barcelona, May 2010.
- Chairman of Spring School Thermal Nanosystems and Nanomaterials, May 2008.
- Chairman of Symposium Nanoscale Heat Transport –MRS Spring Meeting 2007, April, San Francisco.
- Chairman of the international workshop Nanoscale Energy Conversion, Nice 23-26 Sep. 2006.
- Chairman of Winter School Micro and Nanoscale Heat Transfer, March 2004.

Main Research Activities:

Sebastian VOLZ carries out research in solid state nanoscale thermal transport, including phonon-electron-photon modelling and metrologies for key applications such as thermoelectricity, photovoltaics and IC cooling. He is author of more than 340 scientific communications and has edited two books. He has been leading the CNRS European Network 'Thermal Nanosciences and Nanoengineering' since 2001 and the joint team between Ecole Centrale Paris and Thales since 2009.

Books

- Thermal Nanosystems and Nanomaterials, S. Volz, ed., Topics in Applied Physics, Springer, 118, 2010
- Microscale and Nanoscale Heat Transfer, S. Volz ed., Topics in Applied Physics, Springer, 107, 2007

Recent publications

- Among 154 publications including 9 chapters, 62 articles in peer reviewed journals, 18 invited conferences, 36 proceeding papers, 38 communications.
- C. Bera, N. Mingo, and S. Volz, Marked Effects of Alloying on the Thermal Conductivity of Nanoporous Materials, Phys. Rev. Lett. 104, 115502 (2010)
- E. Rousseau, A. Siria, G. Jourdan, S. Volz, F. Comin, J. Chevrier and J.-J. Greffet, 'Radiative heat transfer at the nanoscale, Nature Photonics, 3, 514, (2009)
- M. Bozlar, D. He, J. Bai, Y. Chalopin, N. Mingo and S. Volz, Carbon Nanotube Microarchitectures for Enhanced Thermal Conduction at Ultralow Mass Fraction in Polymer Composites, Advanced Materials, 21, 1, (2009).
- R.S. Prasher, X.J. Hu, Y. Chalopin, N. Mingo, K. Lofgreen, S. Volz, F. Cleri, P. Keblinski , 'Turning Carbon Nanotubes from Exceptional Heat Conductors into Insulators', Physical Review Letters, 102, 105901 (2009)
- G. Domingues, S. Volz, K. Joulain and J.-J. Greffet, 'Heat transfer between two nanoparticles through near-field interaction', Physical Review Letters, 94, 085901 (2005).

Keynote speech III

Saturday, 30th September

"Classifications of Research and Development Patents"

Prof. Gou-Chung Chi

National Chiao Tung University, Taiwan

Research and development works are a key to success in high-tech business, especially in a hard-ware manufacture industry. The output of R&D innovations usually results in patents. This presentation will classify three levels of innovations. There are scientific research, technology applied research and new system applications. Patents in these three categories should be treated differently. But they should be consider together to create synergy effect to bring out a successful commercial product. Time will leave for open discussions on cases such as patents of CD player. We will invite audience to participate.

Experience

- 2016 -Present Consultant to Prime Minister
- 2010 -Present French Atomic Energy High Commissioner's Visiting Committee Member
- 2010-2012 President, Taiwan Smart Grid Industry Association
- 2007.7-2008.7 Chairman, Science and Technology Interchange Committee, Association of East Asian Relations
- 2004.8-2006.8 Executive Secretary, Energy policy and Technology Development Advisory Committee, Executive Yuan
- 2004.5- 2006.8 Deputy Minister, National Science Council, Executive Yuan
- 2000.5- 2004.5 Deputy Minister, Research, Development, and Evalution Commission, Executive Yuan
- Aug.1996-2000 Director, Optical Sciences Center, National Central University.
- Aug.1994-July.2009 Professor, Department of physics, Department of Optics and Photonics, National Central University.
- July.1992-July.1994 Director, Division of Optoelectronics Materials and Devices, OES, ITRI.
- May.1990-June.1992 Director, Division of Semiconductor Materials, MRL, ITRI.
- Jan.1977-Feb.1990 Member of Technical staff AT&T Bell Laboratories.

Main Research Activities:

- Optoelectronic Materials
- Semiconductor Physics
- Solid-state lighting
- Solar cells
- Smart Grid
- Growth and applications of nanowires

Guidelines

1. Official Language

The official language of ICI2017 is English. All presentations including Q&A will be delivered in English.

2. Guideline for Participants

2.1. Conference Venue

Teachers' Hostel(Sun Moon Lake) (http://smlthotel.com.tw/)

2.2. Time of Registration

3:00PM ~6:00PM, Friday, Sep. 29th, 2017 (Ying-Bin Building 1F Lobby)
9:00AM ~ 10:00AM, Saturday, Sep. 30th, 2017 (Ying-Bin Building 1F Lobby)

2.3. Internet Service and International Telephone

Computers with Internet Service at Conference Center are provided by Sun Moon Lake Teachers' Hostel. Wireless is also free to use around the hostel.

2.4. Conference Kit

A conference kit, which contains a conference proceedings, a name badge, tickets for lunches and banquet, a Sun Moon Lake ship ticket, and an official receipt, will be provided to participants during the period from Friday, Sep. 29th to Saturday, Sep. 30th at the Registration/Information Desk.

3. Guideline for Presenters

[1] The presenters and session chairs are asked to keep to the paper sequence as shown in the Final Program. By following this predefined schedule, participants can switch between sessions without missing the particular papers of interest.

[2] The presentation time for each presenter is 15 minutes including Q&A. The session chairs should allow the presenter for a 12minutes presentation and leave 3 minutes for discussions. All presenters are requested to report their attendance to the session chair 10 minutes before the session begins. If there are only 4-5 presenters in a session, then the session chair should allow the presenter for a 15 minutes presentation and leave 3 minutes for discussions.

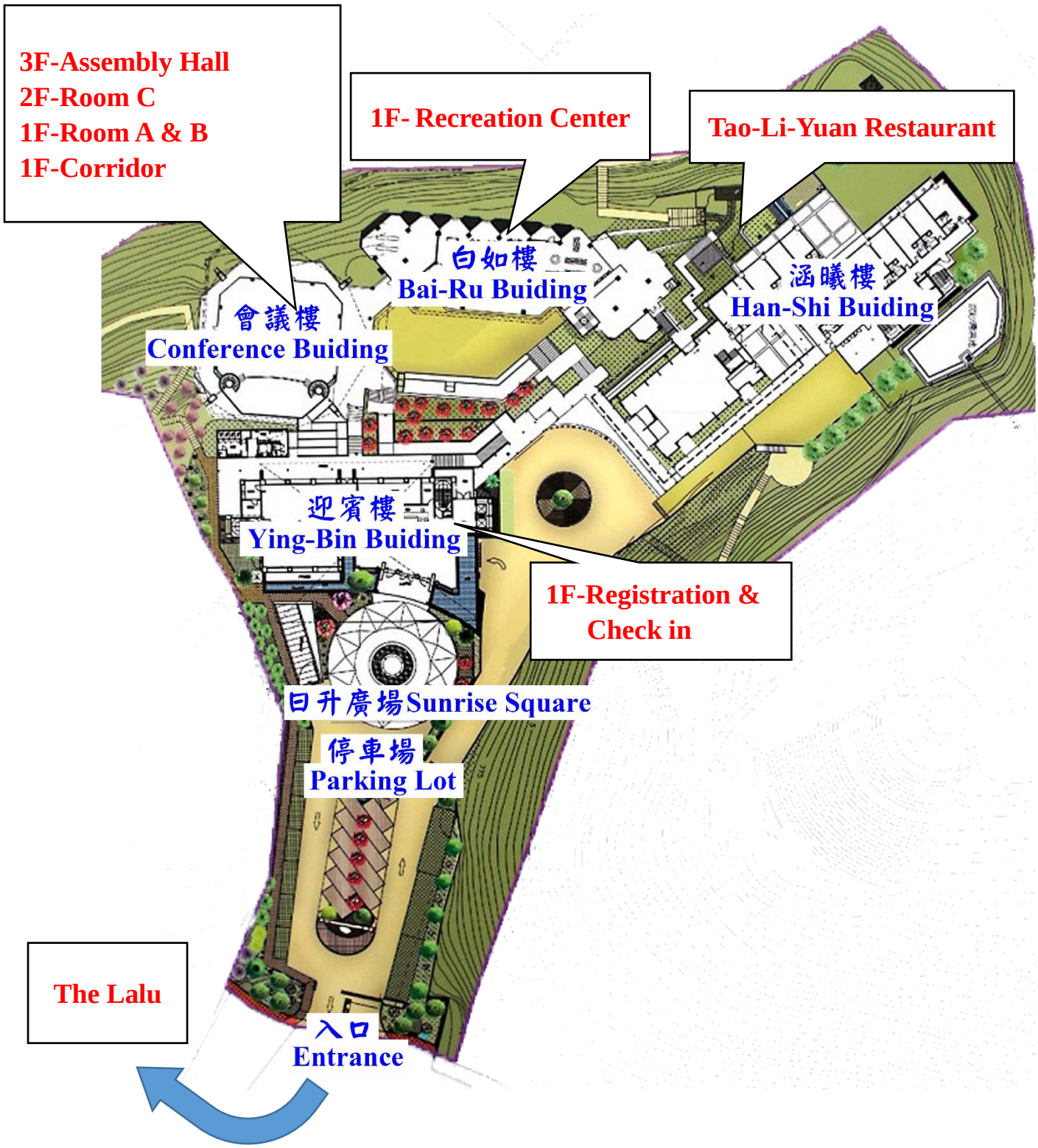
[3] Notebook PCs and LCD projectors will be available in every session room. Presenters are encouraged to prepare their files in MS PowerPoint format on a USB and copy into the PC at session room before the session begins. Our session aids will assist the presenters to copy the file. If you wish to use your own notebook PC, please open the file before your presentation.

[4] For unexpected events that cannot be handled on the spot, you may request through session chairs, session aids or make a direct notification to the Conference Secretary Desk.

4. Guideline for Posters

Standard Poster Size: 50 cm (width) X 90 cm (length)

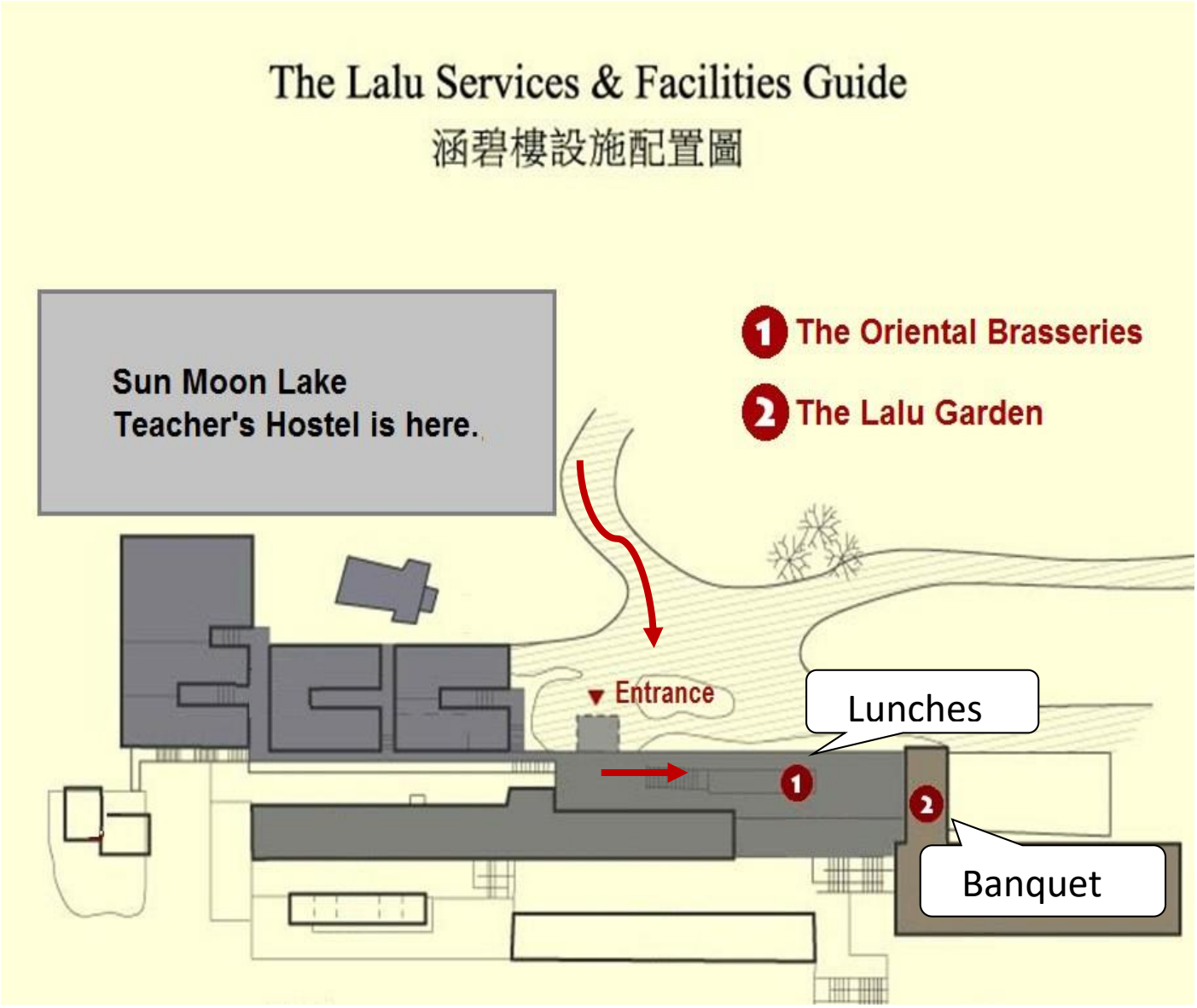
Sun Moon Lake Teachers' Hostel - Symposium Floor Plan



Note: Breakfast (1st Oct.) will be serviced in the **Tao-Li Yuan Restaurant**. Lunch (30th Sep. & 1st Oct.) and banquet (30th Sep.) will be served at **the Lalu**. Please see the next page for the direction.


教師會館與涵碧樓相對位置圖
The relative position map of Sun Moon Lake Teachers' Hostel and The Lalu
水社碼頭
Shuishe Pier
涵碧樓
The Lalu
教師會館
Teachers' Hostel

The Lalu - Symposium Floor Plan



Transportation & Direction

➲ Arrive at Sungshan International Airport

Route 1 Taipei Mass Rapid Transit (MRT) → Kuo-Kuang Motor Transport

1. Please transfer to Taipei Main Station by taking Taipei Mass Rapid Transit (MRT).
   - ✓ MRT ticket: NT$ 25
2. Go to Taipei Bus Station to take Kuo-Kuang Motor Transport No.1833.
   - ✓ Kuo-Kuang Bus single ticket: NT$ 460
   - ✓ The journey by Kuo-Kuang Motor Transport No.1833 from Taipei to Sun Moon Lake takes approximately 4 hours.

Route 2 Taipei Mass Rapid Transit (MRT) → Taiwan High Speed Rail (THSR) → Nantou Bus or Sun Moon Lake Route Taiwan Tourist Shuttle Bus

1. Take Taiwan High Speed Rail (THSR) from Taipei Station to Taichung Station
2. Go from THSR Taichung Station Hall No.5 or No.6 Exit Escalator to 1F Bus Station
3. Go to No. 5 Exit, No. 3 Bus Platform and take Nantou Bus No. 6670 or The Taiwan Tourist Shuttle Service: Sun Moon Lake Route.
   - ✓ Nantou Bus single ticket: NT$ 189
   - ✓ The Taiwan Tourist Shuttle Service ticket: NT$ 189/ one way, NT$ 340 / round trip
   - ✓ The journey from Taichung to Sun Moon Lake takes approximately 90 minutes.

➲ Arrive at Taoyuan International Airport

Route Ubus → Taiwan High Speed Rail (THSR) → Nantou Bus or Sun Moon Lake Route Taiwan Tourist Shuttle Bus

1. Please transfer to THSR Taoyuan Station by taking Ubus
   - ✓ Ubus ticket: NT$ 30
   - ✓ Intervals: 5 - 10 minutes intervals during peak times
   - ✓ Trip length: 25 minutes
2. Take Taiwan High Speed Rail (THSR) from Taoyuan Station to Taichung Station
3. Take Nantou Bus No. 6670 or Taiwan Tourist Shuttle Service: Sun Moon Lake Route.

➲ Arrive at Kaohsiung International Airport

Route Kaohsiung Mass Rapid Transit (MRT) → Taiwan High Speed Rail (THSR) → Nantou Bus or Sun Moon Lake Route Taiwan Tourist Shuttle Bus

1. Please transfer to THSR Zuoying Station by taking Kaohsiung Mass Rapid Transit (MRT)
   - ✓ MRT ticket: NT$ 50
2. Take Nantou Bus No. 6670 or Taiwan Tourist Shuttle Service: Sun Moon Lake Route.

Schedule-at-a-Glance

September 29th (Fri.)	
15:00 ~ 18:00	Registration
18:00 ~	Welcome Reception

September 30th (Sat.)			
9:00 ~ 10:00	Registration		
10:00 ~ 10:30	Opening		
10:40 ~ 10:55	MDPI Speech I	10:40 ~ 12:10	SPINTECH Technology - Thesis Award
10:55 ~ 11:10	MDPI Speech II		
11:10 ~ 11:50	Keynote Speech I		
12:10 ~ 13:30	Lunch		
13:30 ~ 14:10	MNHTE Keynote Speech I	13:30 ~ 15:45	SPINTECH Technology - Thesis Award
14:10 ~ 14:40	MNHTE Invited Speech I		
14:40 ~ 15:10	MNHTE Invited Speech II		
15:10 ~ 15:40	MNHTE Invited Speech III		
15:40 ~ 16:10	MNHTE Invited Speech IV	15:45 ~ 16:00	Tea Break
16:20 ~ 17:00	Keynote Speech II	16:00 ~ 17:00	SPINTECH Technology - Thesis Award
17:00 ~ 17:40	Keynote Speech III		
17:50 ~ 18:10	Group Photo		
18:30 ~ 20:30	Banquet & SPINTECH Award Ceremony		

October 1st (Sun.)					
08:20 ~ 08:50	MNHTE Invited Speech V				
09:00 ~ 12:00	Session A1	Session B1	Poster 1	08:50 ~ 09:20	MNHTE Invited Speech VI
				09:20 ~ 09:50	MNHTE Invited Speech VII
				09:50 ~ 10:20	MNHTE Invited Speech VIII
				10:30 ~ 11:45	MNHTE Session C1
12:00 ~ 13:30	Lunch			12:00 ~ 13:30	MHNTE General Assembly
13:30 ~ 16:30	Session A2			Session B2	Poster 2

October 2nd (Mon.)	
09:00 ~ 18:00	Technical Visit & Communication

- **Time for each presentation** (Including the question-and-answer period)
  - ✓ Keynote Speech: 40 mins
  - ✓ Presentation: 15 mins

Sunday, October 1st, 2017

Oral Session A1 1F RoomA
09:00-12:00

B. Inventions and innovation in advanced manufacturing

E. Inventions/innovation in smart system

Chairman: Ching-Hung Lee

- National Chung Hsing University

Chairman: Hau-Wei Lee

- National Chung Hsing University

A1-0. 09:00

Invited Speech

Prof. Takayoshi Kobayashi

A1-1. 09:30

012690 Innovative RFID Based Product Portfolio Automatic Management System

Shang-Liang Chen and Meng-Han Feng

A1-2. 09:45

012747 The Effect of Ball Grooves Configuration on the Dynamic Characteristics of Linear Rolling Guides

Jui-Pin Hung, Made Rama Arya, Yu-Jhang Chen

A1-3. 10:00

012748 Investigation of the Correlation between Cutting Parameters and Surface Roughness

Jui-Pin Hung, Kung-Da Wu, Yung-Chih Lin

A1-4. 10:15

013640 BIM Applied to the Light Gauge Steel Structure Modular Design and Automated manufacturing

Shang Yuan Chen, Tai Liu

A1-6. 10:30

012685 Machine Doctor: A Feed Drive Diagnosis System for CNC Machine Tools

Ching-Hung Lee, Chien-Yu Lin, Yu-Jen Chen

Sunday, October 1st, 2017

Oral Session B1 1F RoomB
09:00-12:00

L. Inventions and Innovation in Electrical Engineering/Energy/Communications

X3. Innovation in Smart Sensor Metrology & Intelligent Automation System

Chairman: Chin-Sheng Chen

- National Taipei University of Technology

Chairman: Jui-Hung Liu

- Southern Taiwan University of Science and Technology

Chairman: Chih-Jer Lin

- National Taipei University of Technology

B1-1. 09:00

012808 Combined Adaptive Link-Aware Clustering Algorithm with Optimal Relays in Wireless Sensor Networks

Young-Long Chen, Siao-Jhu Shih, Pin-Lun Huang

B1-2. 09:15

013233 Performance Improvement Evaluation of a Controller Retrofitted Wind Turbine

Jui-Hung Liu, Jien-Chen Chen

B1-3. 09:30

013264 Load Analysis of the Yaw Operation Strategy to a Wind Turbine System

Jui-Hung Liu, Jien-Chen Chen, Chih-Hsun Peng, Chia-Ming Chang

B1-4. 09:45

013363 Analysis of Flux-Switching Permanent Magnet Generator for Hydro-power Systems

Cheng-Tang Pan, Yu-Lung Lin, Shao-Yu Wang, Chung-Kun Yen, Zong-Hsin Liu

B1-5. 10:00

012703 Model Reference Adaptive Control and Fuzzy Neural Network Synchronous Motion Compensator for Gantry Stage

Chin-Sheng Chen

B1-6. 10:15

012721 A Low Cost of IoT Laser Interferometer by Using a Raspberry Pi3

Huay-Chung Liou, Bing-Lin Ho, Jr-Rung Chen, Hau-Wei Lee, Tsung-Han Hsieh

B1-7. 10:30

012781 Calibration of a Robot and Compensation for Stiffness model Using a 3D Camera

Chih-Jer Lin, Yu-Jung Lin

B1-8. 10:45

012787 Geometric Error Measurement of Machine Tool Using an Auto-tracking Laser Interferometer

Jr-Rung Chen, Bing-Lin Ho, Hau-Wei Lee, Shan-Peng Pan, Tsung-Han Hsieh

B1-9. 11:00

013045 Multiple-point Measurement for Mechanical Strain, Raising Temperature and Working Frequency of a High Speed Spindle using One Fiber Bragg Grating Sensor

Chien-Ching Ma, Ruei-Cing Gong, Ching-Yuan Chang

B1-10. 11:15

013330 A self-tuning cross-coupled two degree-of-freedom PID control for positions synchronization of parallel linear motors
Syuan-Yi Chen, Chin-Sheng Chen, Zhen-Wei Yang

B1-11. 11:30

013732 Defect Classification and Evaluation System Based on Deep Learning
Ming Chang, Chia-Sheng Pan, Ruifang Ye

B1-12. 11:45

013797 Displacement measurement simulation of three-axis gantry type structure with auto-tracking ranging principle
Bing-Lin Ho, Hau-Wei Lee, Jr-Rung Chen

Sunday, October 1st, 2017

Poster 1 1F Recreation Center
09:00-12:00

B. Inventions and innovation in advanced manufacturing

D. Inventions/innovation in devices sensors and actuators

E. Inventions/innovation in smart system

G. Inventions/innovation in energy and thermal/fluidic science

J. Design/modeling/computing methods

K. Inventions and Innovation in smart design

X2. Invention/innovation in energy saving technology

X4. Nanomaterials for Renewable and Sustainable Energy

Poster 1-1

012624 Sparse Coding for Manufacturing Quality Prediction

Zheng-An Zhu, Hung-An Kao, Cheng-Hui Chen, Yan-Shou Hsieh, Chen-Kuo Chiang

Poster 1-2

012664 A novel technique for reducing thermal errors associated with thermal bending of machine tools

Ming-Tsang Lee, Zhao-Jin Chen, Ming-Chieh Hung, Chia-An Liu, Chieh-Wen Tseng

Poster 1-3

013293 Flexible four-in-one microsensor for PEMFC interior monitoring

Chi-Yuan Lee, Kuan-Lin Yu

Poster 1-4

012696 An investigation of Vibration Assisted Deep groove EDM of Titanium alloy (Ti-6A-4V)

Chi-Shiang Fang

Poster 1-5

012716 Research on Injection Molding of Bevel Gear

Dyi-Cheng Chen

Poster 1-6

012754 Characteristics of the effect of swirling gas jet assisted electrochemical discharge machining for glass based on machine vision

Chao-Ching Ho

Poster 1-7

011633 Measurement of TCP Errors of the Five-axis Machine Tools by Combining Double Ball-Bar with an Orthogonal Ball Cup Array Plate

Chien-Hung Liu, Hau-Wei Lee, Zhe-Hsin Pong

Poster 1-8

012658 The Invention of Tooling and Manufacturing Process of Curvature Hollow Composite Structure Tube

Kuo-Wei Wu, Chih-Chia Chen, Ming-Jen Ting

Poster 1-9

012739 A novel thermal error control system of machine tool for smart manufacturing

Yu-Chi Liu, Chow-Shih Wang, Yao-Cheng Tsai, Shih-Yu Kao, Hung-Sheng Chiu, Hsiu Fen Lee

Poster 1-10

012961 Prediction of Thermal Displacement of Spindle in Vertical Machining Center by Neural Network

Meng-Ying Lin, Shao-Hsien Chen, Min-Sheng Gao

Poster 1-11

012350 Application of Laplace Adomian Decomposition Method to Nonlinear Fin System Problems
Chin-Chia Liu, Chao-Kuang Chen

Poster 1-12

012424 Flexible three-in-one microsensor embedded in the vanadium redox flow battery stack for in-situ microscopic sensing and diagnosis
Chi-Yuan Lee, Chin-Lung Hsieh, Chia-Hung Chen, Kin-Fu Lin, Chong-An Jiang

Poster 1-13

012425 Study on the internal real-time microscopic diagnosis and aging of proton exchange membrane water electrolyser
Chi-Yuan Lee, Chia-Hung Chen, Shih-Chun Li

Poster 1-14

012823 Simulation analysis of dynamic distribution of the high-temperature furnace with two burner on the furnace temperature
Yen-Liang Yeh, Shao-Wen Tang, Bin-Hao Chen

Poster 1-15

013085 Laser Assisted Material Synthesis and Pattering Technology for Microelectronics Fabrication and Lab-on-a-Chip Applications
Ya-Yu Chiang, Chien-Hung Liu, Seung Hwan Ko Ko, Ming-Tsang Lee

Poster 1-16

012780 Indoor Positioning System Based on BLE Location Fingerprinting
Yu-Chi Pu, Pei-Chiun You

Poster 1-17

012803 Inverse Current Measurement Method for Parameter Estimating of Miniature Loudspeaker
Chih-Wen Chang, Jin-Huang Huang, Chi-Chang Wang

Poster 1-18

013308 Nonlinear Modelling of the Cerebral Blood Flow Responses to Carbon Dioxide for Diabetic Patients and Healthy Subjects
Shyan-Lung Lin, Yu-Kai Hung, Ching-Kun Chen, Shoou-Jeng Yeh

Poster 1-19

012611 Study on the effects of molding parameters on tie bar deformation and part weight
Po-Wei Huang, Hsin-Shu Peng, Cheng-Yue Hung, Kai-Fu Liew, Pei-sheng Pan, Wei-Jie Su

Poster 1-20

013377 An Investigation of Efficiency Improvement and Energy Saving of Waste Heat Source Recovery in the Air Compressor System
Chih-Neng Hsu, Shih-Hui Lu

Poster 1-21

013679 Simulation Study on the Mode of Smart Control on the Comfort of Living Room
Wen-An Wang, Ssu-Wei Tung

Poster 1-22

012736 Internal Resistance of an Anode-Supported Honeycomb Solid Oxide Fuel Cell Depending on the Flow Channel Configurations
Shunzaburo Murakami, Hironori Nakajima, Tatsumi Kitahara

Sunday, October 1st, 2017

Oral & Poster Session C1

2F Room C

10:30-12:00

N. Micro & Nanoscale Heat Transfer & Energy Workshop

X4. Nanomaterials for Renewable and Sustainable Energy

Chairman: Yu-Bin Chen

- National Tsing Hua University

C1-1. 10:30

012692 Microscale transport phenomena in the novel laser direct metal synthesis and pattering process

Chung-Hsiang Jiang, Pei-Jun Huang, Song-Ling Tsai, Chen-Jui Lan, Ming-Tsang Lee

C1-2. 10:45

012687 Investigating the heat transfer phenomena of Water-EGS in the reservoir by experiment verification

Yi-Hong Chen, David Lin, Jui-Ching Hsieh, Chun-Ping Jen, Yuh-Chung Hu

C1-3. 11:00

012704 Magnetowetting of Magnetic Nanofluids on AAO Surface

Huei-Chu Weng, Yu-Chin Chien

C1-4. 11:15

012782 Electrochemical Impedance Spectroscopy Study of the Electrode Microstructure of the Lithium-Ion Battery

Hironori Nakajima, Akiko Inada, Tatsumi Kitahara

C1-5. 11:30

013326 Development of Hybrid Model for Electricity Short-Term Load Forecasting in Taiwan Power Company

Kai-Wei Yu

C1-P1.

012649 Highly Stretchable and Transparent Copper Nanowire Heater for Wearable Electronics

Dongkwan Kim, Habeom Lee, Seung Hwan Ko, Sukjoon Hong

C1- P2.

012804 Effect of nanoparticles mean diameter on thermal transition of convective nanofluids flow in a square cavity

Chuan-Chieh Liao

C1-P3.

012843 Enhancing Convective Heat Transfer on the Roughened Surfaces using Mist Flow

Yao-Hsien Liu, Yi-Hsuan Huang, Szu-Kai Wang, Kuan-Tzu Huang

C1-P4.

012852 Enhanced CHF on the ZnO Nanostructured Surfaces

Ming-Chang Lu, Yu-Chi Chen, Wei-Shen Chiang, Pu-Wei Wu

C1-P5.

012809 Enhancement of Photo-thermal Energy Conversion and Utilizations Using Nanomaterials

Ming-Tsang Lee, Hironori Nakajima

C1-P6

012793 Flexible Thermoelectric Power Transmitter

Yuh-Chung Hu

Sunday, October 1st, 2017

Oral Session A2 1F RoomA
13:30-16:30

J. Design/modeling/computing methods

K. Inventions and Innovation in smart design

M. Others related to Inventions

Chairman: Chih-Wen Chang
- National Chung Hsing University

Chairman: Cheng-Chi Wang
- National Chin-Yi University of Technology, Taiwan

A2-1. 13:30

012741 Prediction of the Frequency Response Function of a Milling Tool Based on Receptance Coupling Method
Jui-Pin Hung, Jian-Xuan Xiao, Zhe-Hao Haung

A2-2. 13:45

012745 Modelling the Contact Behavior of Linear guide with Different Interferences
Jui-Pin Hung, Wei-Cheng Shi

A2-3. 14:00

012783 Discovering Association Rules Among Software Libraries
Wei-Guang Teng, Chen-Ya Chang, Jung-Hua Chou

A2-4. 14:15

012784 A Novel Approach to Improve Quality Control by Comparing the Tagged Sequences of Product Traceability
Jing-Doo Wang

A2-5. 14:30

012805 Forming three-dimensional hollow shapes from two-dimensional elastic ribbons by controlled buckling
Jia-Yang Juang, Michio Aoki

A2-6. 14:45

012772 Applying Design Thinking Process in Student Project: A case of EGF Products
Chun-Ming Yang

Sunday, October 1st, 2017

Oral Session B2 1F RoomB
13:30-16:30

G. Inventions/innovation in energy and thermal/fluidic science

X2. Invention/innovation in energy saving technology

Chairman: Win-Jet Luo

- National Chin-Yi University of Technology

Chairman: Ming-Tsang Lee

- National Chung Hsing University

B2-1. 13:30

012707 Development of two - stage spiral high temperature heat pump system

Win-Jet Luo, Fikri Rahmat Fasya

B2-2. 13:45

012778 Numerical study on thermal performance of phase change material (PCM)-based heat sinks with three-dimensional transient cooling

Jin Hyun Lee, Sung-Min Kim, Ju-Ho Jeong, Jung-Youn Song

B2-3. 14:00

012779 Numerical investigation of thermal characteristics of spray cooling with minimum quantity lubrication in milling process

Sangmok Han, Sung-Min Kim, Seong Hoon KIM, Sung-Min Kim

B2-4. 14:15

012861 Development of two - stage screw high temperature heat pump system

Fikri Rahmat Fasya, Win Jet Luo, Po-Yuan Hsieh, Yu-Sheng Cheng

B2-5. 14:30

012882 Ambient Conditions effect on Hybrid Solid Desiccant Vapor–Compression Air-Conditioning System

Dini Faridah, Win Jet Luo

B2-6. 14:45

013304 Economic Analysis of Cooling Water Tower Applied in Conventional Tire Industry

Yean-Der Kuan, Win-Jet Luo, Yu-Wei Chiu, Wei-Ming Chiu

Sunday, October 1st, 2017

Poster 2 1F Recreation Center
13:30-16:30

C. Inventions/innovation in applied optics and lasers

F. Inventions/innovation in Electro/Opto/Mechatronic Systems

H. Invention/innovations in biotechnology/materials

L. Inventions and Innovation in Electrical Engineering/Energy/Communications

M. Others related to Inventions

X1. Advanced Materials and Sensors

X3. Innovation in Smart Sensor Metrology & Intelligent Automation System

Poster 2-1

012666 Development of the on-line measurement system for micro-cutters

Chien-Hung Liu

Poster 2-2

013346 Study and Development of Inspection System for Rice Seeds with Image Processing

Hao-Sheng Lien, Kuo-Yi Huang, Chiao-Yun Hsu, Mao-Chien Chien

Poster 2-3

013347 Study of Rice Seedling Inspection with Machine Vision

An-Qin Xu, Kuo-Yi Huang, Shi-Jie Luo

Poster 2-4

013362 A Novel Auto-sorting Device for the Sorting of Chinese Cabbage Seeds with Machine Vision

Jian-Feng Cheng, Kuan-Chung Huang, Kuo-Yi Huang

Poster 2-5

013336 Vibration Measurement and Suppression for Laser Galvanometers Using a MEMS-based Accelerometer

Yu-Liang Hsu, Shih-Chin Yang, Po-Huan Chou, Hsing-Cheng Chang, Yu-Chen Kuo, Li-Feng Chiu

Poster 2-6

011681 Design the imaging system on video laryngoscope with 7mm blade for neonatal patient

Han-Chao Chang, Ming-Ying Hsu, Feng-Yi Hsu

Poster 2-7

012842 An Integrated LED Driver with Unity Power Factor and Zero-Voltage Switching

Hung-Liang Cheng, Chien-Hsuan Chang, Yong-Nong Chang, Hau-Chen Yen, Rong-Zong Lin

Poster 2-8

013279 Wide-Area Synchrophasor-Based Voltage Security Assessment Considering Generator Equivalent Circuit Model

Heng-Yi Su, Tzu-Yi Liu

Poster 2-9

012712 Bifurcation Analysis and Control for High Speed Gas Bearing Systems with Variation of Bearing Number

Cheng-Chi Wang, Tsui-Er Lee

Poster 2-10

012387 Effects of Atmospheric Plasma Surface Modification on the Tribological Behavior of Artificial Total Knee Joints

Shih-Chen Shi, Ting-Wei Chang

Poster 2-11

012731 Mechanical properties and fracture behavior of Cu based bulk metallic glasses

Tao-Hsing Chen, Yi-Chun Lin, Te-Hua Fang

Poster 2-12

012742 Temperature sensor using tilted fiber Bragg grating with PDMS

Chia-Chin Chiang

Poster 2-13

012743 Glucose sensor using U-shape optical fiber probe with gold nanoparticles

Chia-Chin Chiang

Poster 2-14

012790 Improved Field Emission Properties of Open-ended MWCNTs on Flexible Carbon Cloth Substrate

Tsung-Chieh Cheng, Wen Shih Lin

Poster 2-15

012799 The Analysis of Engine Performance and Exhaust Emissions by Using By-Pass Cooling Air Compressor Device in the Internal Combustion Engine

Ming-Hsien Hsueh

Poster 2-16

013196 A vision-based system for automated extension measurement

Terry Chen, Yi-Ru Liu

Poster 2-17

012698 Real-Time Intelligent Diagnosis of Islanding in a Solar Power Grid System based on Fractional Order Lorenz Chaos Synchronization

Her-Terng Yau

Poster 2-18

013881 The kinetics of chromogenic reaction during the cultivation of Escherichia coli

Ching-Hsun Chen, Guan-Liang Chen, Si-Yu Li

Poster 2-19

012808 Combined Adaptive Link-Aware Clustering Algorithm with Optimal Relays in Wireless Sensor Networks

Young-Long Chen, Siao-Jhu Shih, Pin-Lun Huang

Poster 2-20

012885 A Study on the Design Stability Evaluation of Telescopic Type Boom Crane for ROV LARS (Launch and Recovery System)

Namsub Woo, Hyunji Kim, Sangmok Han, Sunchul Huh

Poster 2-21

012883 A Study on the Numerical Analysis of In-line type Subsea Separator for Multiphase Flow from Oil-Well

Youngju Kim, Hyunji Kim, Sangmok Han, Namsub Woo

Saturday, September 30th, 2017

SPINTECH Session

1F Room A 1F Room B

2F Room C

1F Recreation Center

10:40-12:10 / 13:30-15:45

16:00-17:00

A. SPINTECH Technology Thesis Awards Section

Chairman: Chien-Hung Liu

National Chung Hsing University

012149 The bonding strength of simultaneous laser drilling and bonding

Hirofumi Hidai, Shun Sato

012506 Dynamic observation of glass fiber generation with continuous laser illumination by high-speed imaging

Hirofumi Hidai, Nobuyasu Nishioka, Souta Matsusaka, Akira Chiba, Noboru Morita

012614 Silver Nanowire Based Stretchable and Transparent Heater

Seung Hwan Ko, Dongkwan Kim, Habeom Lee, Sukjoon Hong

012650 Processing of diamond by laser-induced graphitization and selective chemical etching

Hirofumi Hidai, Haruna Hirai, Noboru Morita, Souta Matsusaka. Akira Chiba

012693 A Segmentation Based Cubic-Spline Path Generation Strategy For Laser Machining

Chao-Chung Peng, Shi-Xian Su, Li-Hsin Chen

012695 Formation of multi layer structure in borosilicate glass by electric field-assisted solid-state ion exchange

Souta Matsusaka, Ryuta Suzuki, Hirofumi Hidai, Akira Chiba, Noboru Morita

012819 A Predictive Model for Identifying Bearing Faults of a Machine Tool Spindle

Jhy-Cherng Tsai, Zhi-Chi Chen, Oliver Tsai

013173 Electrochemical Deep Drilling by Using Epoxy-Insulated Tube Electrode

Jung-Chou Hung, Ling-Zhou Lin, Zhi-Wen Fan, Chia-Wei Cheng

013226 Implementation of the Cyber-Physical System for a Computer Numerical Control Hobbing Machine

Ying-Chih Lai, Jui-Hung Hsu, Po-Yuan Yu, Yu-Lin Xie

013269 New Volumetric Heat Source for 3D Selective Laser Melting System-Simulation and Experiment

Yu-Lung Lo, Hong-Chuong Tran

013370 Development of a 5-DOF Nanopositioning Stage with Error Compensation System
Chih-Liang Chu, Hung-Chi Chen, Ming-Han Sie

013372 Feasibility Study on Application of Bismuth-coated Platinum Electrodes in Microbial Fuel cells
Yi-Ta Wang, Yi-Chi Hsieh, Yue-Sheng Lin

013373 Numerical Analysis of CNC Milling Chatter Using Embedded Miniature MEMS Microphone Array System
Y. T. Tsai, P. L. Wang

013718 Analysis and Prediction for Surface Roughness of Milling Using Vibration Signal and Artificial Neural Network
Tian-Yau Wu, Kai-Wei Lei, Shi-Yo Hsieh, Chi-Hsuan Lu

013309 Development of the Flow Channel Structure of an Anode-Supported Honeycomb Solid Oxide Fuel Cell for High Power Density
Shunzaburo Murakami, Hironori Nakajima, Tatsumi Kitahara

012699 Ball Bearing Fault Diagnosis by using Fractional Lorenz Chaos Extenics Detection Method
Her-Terng Yau

012933 Control and analysis of various loads for the rod-less pneumatic servo system
Hao-Ting Lin

012753 Parameters Evaluations of the Thermal Network Model of a Machine Tool Spindle by Self-made Bluetooth Temperature Sensor Modulus
Yuh-Chung Hu, Yuan-Chieh Lo, Pei-Zen Chang

013364 Hand-Held Device for Assessing Dental Implant Osseointegration Stability through Vibro-Acoustic Technique
Min-Chun Pan, Shih-Yao Wang, Chin-Sung Chen

013300 Development of 2-DOF energy converter for self-power monitoring buoys
Yu-Jen Wang, Chih-Kuang Lee, Shao-Fu Sun

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A012149

The bonding strength of simultaneous laser drilling and bonding

Hirofumi Hidai, Shun Sato, Souta Matsusaka, Akira Chiba and Noboru Morita
Chiba University, Department of Mechanical Engineering

Abstract

In circuit formation, stacking the substrates and electrical connection between the upper and lower surfaces has been extensively studied. The wire connection inside the substrate realizes high performance of the circuit. The process contains three steps: firstly, through-holes are drilled in the substrate. Secondly, conductive path is formed in the hole by metal plating. Finally, the substrate and wiring on another substrate are bonded and connected electronically to stack the substrates. However, metal plating in fine holes and connecting electrodes with high positional accuracy are challenging. We have proposed a method of drilling substrate and wiring inside the hole simultaneously by the laser illumination of samples which a glass substrate and metal plate are stacked. First, the glass substrate was drilled through. Then, the metal was ablated and deposited on the inner surface of the hole in glass substrate. In this study, we demonstrate that electrical connection and bonding in addition to drilling and wire formation in the hole at the same time. The sample is two borosilicate glass substrates (thickness was 0.15mm) and a copper sheet piled together. The glasses are used for preventing contamination of surface and bonding with copper. Laser illumination drilled through two glass substrates and copper sheet was ablated. As the results, the glass substrate was bonded with copper, and copper was deposited on the inner surface of hole. The conductivity between top surface of glass substrate and copper sheet was ~5Ω per 100 points. The bonding strength was also examined. By the observation of the cross section of the joint, it was confirmed that ablated copper adhered closely to the inner surface of the hole of glass and copper. It is believed that the adhered copper worked as an adhesive layer and leaded to bonding.

Keywords: Laser, Drilling, Bonding, Conductive wiring, Glass, Copper

A012506

Dynamic observation of glass fiber generation with continuous laser illumination by high-speed imaging

Hirofumi Hidai, Nobuyasu Nishioka, Souta Matsusaka, Akira Chiba and

Noboru Morita

Department of Mechanical Engineering, Chiba University

Abstract

Glass fibers have been applied for optical fiber, Glass Fiber Reinforced Plastics (GFRP), medical use and so on. One of the glass fiber generation methods is laser illumination to a glass substrate. We suggest the new method of glass fiber generation with a Continuous-wave laser. A sample consists of borosilicate glass, metal foil, and a heat insulator clamped by a jig. Laser illumination to the glass induced glass fiber ejection from the side surface into the air in the vertical direction to the optical axis. Glass fiber consisted of spherical head and fibrous tail part. The diameter of the fiber decreased from the head to the tail and was 0.1 μm~100 μm for each fiber. Nanoparticles were attached on the fiber. In-situ observation of the time lapse images by using a high speed camera (10000 flame per second) revealed the surface of the sample bulged by laser illumination (bulge), the bulge expanded additionally (bubble) and burst to emit the fiber. The duration from bubble formation to bubble explosion was 700 μs. The diameters of the fibers were in different sizes. Since the fibers emit from the bubble, the controlling the fiber diameters requires controlling bubble sizes with laser illumination condition.

Keywords: Glass fiber, Laser, Glass nanoparticle, Fiber fuse, High-speed imaging

A012614

Silver Nanowire Based Stretchable and Transparent Heater

Dongkwan Kim[1], Habeom Lee[1], Sukjoon Hong[2] and Seung Hwan Ko[1]

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[2]*Department of Mechanical Engineering, Hanyang University*

Abstract

Using silver nanowire based percolation network on a soft substrate, stretchable and transparent electrical heater is demonstrated. In fabrication process, the nanowires are partially embedded on the substrate yielding better mechanical thermal stability. Due to its unique interfacial morphology, the stretchable and transparent heater successfully operates under both elevated temperature (60℃) and large strain (60%) with excellent reliability. This silver nanowire based heater is applied on human wrists under real-time bending and has potential for lightweight, biocompatible, and versatile wearable applications.

Keywords: Stretchable and transparent heater, Nanowire, Wearable

A012650

Processing of diamond by laser-induced graphitization and selective chemical etching

Hirofumi Hidai, Haruna Hirai, Noboru Morita, Souta Matsusaka and Akira Chiba

Department of Mechanical Engineering, Chiba University

Abstract

Diamond has a high thermal conductivity and chemical stability, but its hardness and brittleness make it difficult to cut. We demonstrated diamond cutting by applying laser internal processing that converts diamond to graphite, and successive etching that removes the graphite selectively. This method enables the processing of diamond with a small kerf loss. A femtosecond laser beam (pulse energy of 3 μJ, pulse duration of 550 fs) that was focused tightly by an objective lens (numerical aperture of 0.5) was scanned (scanning speed of 100 μm/s) parallel to the laser optical axis in bulk diamond. A 10-μm-diameter continuous modified area was formed in the diamond. Adjacent single lines with a 5-μm spacing were formed, and a planar-modified area with a 10-μm thickness was generated in bulk diamond. Raman spectroscopy proved that the modified layer contained graphite. The modified layer was etched and studied in cross section. The strength was confirmed to decrease by cracking along the planar-modified area.

Keywords: Ultrashort pulsed laser, Diamond Internal processing, Etching

A012693

A Segmentation Based Cubic-Spline Path Generation Strategy For Laser Machining

Chao-Chung Peng, Shi-Xian Su and Li-Hsin Chen

[1]*Department of Aeronautics and Astronautics, National Cheng Kung University*

Abstract

It is well known that machining tool is accompanied by vibration and it affects final manufacturing accuracy during traditional machining. To avoid this drawback, high speed laser machining becomes more and more popular over the last few years. Based on the demands of high throughput and high machining quality, a smooth machining path planning becomes a major design issue. Evidently, high quality products rely on sophisticated machining processes and path planning is definitely one of the key techniques. To guarantee machining continuities on motion profiles, enhance machining precision as well as reduce machining time, a novel segmentation cubic-spline path generation strategy is proposed. In addition, the path planning subject to system physical constrains is taken into consideration as well. As a result, the developed method is adequate for practical machining integration. Finally, the effectiveness and feasibility of the proposed path planning algorithm are going to be verified by applying a smartphone pattern.

Keywords: Cubic-spline, Point reduction, Segmentation

A012695

Formation of multi layer structure in borosilicate glass by electric field-assisted solid-state ion exchange

Ryuta Suzuki, Souta Matsusaka, Hirofumi Hidai, Akira Chiba and

Noboru Morita

Department of Mechanical Engineering, Chiba University

Abstract

Using electric field-assisted solid-state ion-exchange technique, metal ions were doped into borosilicate glass surface and a buried metal thin layer was formed in glass substrate. In this study, a silver foil was used as a dopant. Silver ions were doped to glass surface by voltage application using the silver foil as an anode (referred to as forward voltage). After silver ion doping by forward voltage application, a buried silver layer was formed in glass substrate by additional voltage application with opposite direction to the case of doping (referred to as reverse voltage). Because the silver layer is electrically conductive and surrounded by glass matrix with high electric resistivity, the formed layer can be used as a buried electrical circuit in glass substrate. In order to form multi silver layers in glass, we alternatively doped silver and sodium ions to glass surface. In the case of sodium doping, a soda-lime glass sheet was used as a sodium ion source. Doped sodium ions exchanged the sites occupied by silver ions which doped in advance. As a result, we successfully formed the multi layered structure consisted of silver-rich and sodium-rich layers. In addition, two silver precipitation layers separated by sodium-lich layer were formed by reverse voltage application.

Keywords: Ion doping, Metal-doped glass, Metal thin layer, Electric-field-assisted solid-state ion exchange, Borosilicate glass

A012699

Ball Bearing Fault Diagnosis by using Fractional Lorenz Chaos Extenics Detection Method

Her-Terng Yau

National Chin-Yi University of Technology

Abstract

In this study we used a non-autonomous Chua's Circuit, and the fractional Lorenz chaos system together with a detection method from Extenics theory to analyze the voltage signals. The measured bearing signals were introduced into the master and slave systems through a Chua's Circuit. In a chaotic system minor differences can cause significant changes that generate dynamic errors, and extension matter-element models can be used to judge the bearing conditions. Extenics theory can be used to establish classical and sectional domains using the dynamic errors of the fault conditions. The results obtained were compared with those from Discrete Fourier Transform analysis, Wavelet analysis and an integer order chaos system. The diagnostic ratio showed the fractional order master and slave chaos syster calculations. The results show that the method presented in this paper is very suitable for monitoring the operational state of ball bearing systemsem to be superior to the other methods. The diagnosis ratio was better and there were other significant advantages such as low cost and few.

Keywords: Fractional Lorenz chaos system, Extenics theory, Chua's Circuit, Fault diagnosis

A012753

Parameter estimation of the Thermal Network Model of a Machine Tool Spindle by Self-made Bluetooth Temperature Sensor Modules

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[1]*Institute of Applied Mechanics*

[2]*Department of Mechanica and Electromechanical Engineering, National ILan University*

Abstract

Sudden catastrophic failures may occur due to the unexpected thermal issue of machine tool spindles; hence, the thermal characteristic analysis is indispensable. In this article, the lumped-parameter thermal network model and parameters identification scheme are presented to characterize both the steady-state and transient thermal behavior of spindle. Even under complicated operating condition (various speeds and different initial conditions), the results show that this modeling methodology provides a robust and trustworthy tool for spindle temperature prediction. Moreover, a Bluetooth temperature sensor module and corresponding temperature probes are specifically designed for high precision temperature measurement of industrial application. Based on above contributions, the estimated thermal network model has ability to predict the spindle temperature distribution, and the Bluetooth temperature sensor module provides real-time temperature monitoring. In other words, the thermal characteristics of the machine tool spindle can be further forecasted.

Keywords: System identification, Thermal network model, Machine tool spindle, Bluetooth temperature sensor module

A012819

A Predictive Model for Identifying Bearing Faults of a Machine Tool Spindle

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[2]*Royal Precision Tools Co., Ltd., Taichung, Taiwan*

Abstract

Spindle is the most crucial component of a machine tool. While the most critical factor affecting spindle performance is the condition of its bearings, this research presents a diagnostic method to improve accuracy for identifying bearing fault of the spindle via a predictive model. The developed method is also testified against a batch of spindles from market to show it effectiveness. The failure mode and effect and the feature corresponding to the fault of spindle bearings are analysed first. Items and signals of the spindle to be measured are then designed accordingly. These signals are then collected from a batch of spindles, with some damaged. These measured signals are used to establish a model that predicts the bearing conditions. Two approaches, two-step and one-step approaches, are further conducted to compare the accuracy of the models. The result shows that the accuracies of the two approaches are 85% and 81% respectively but the one-step approach is more practical as it can be employed to industrial application directly. The major contribution of this research is to develop a method to build up a predictive model that can be used to identify the status of spindle bearings with fairly good accuracy.

Keywords: Spindle, Bearing fault, Predictive model

A013173

Electrochemical Deep Drilling by Using Epoxy-Insulated Tube Electrode

Jung-Chou Hung[1], Ling-Zhou Lin[1], Zhi-Wen Fan[2] and Chia-Wei Cheng[3]

[1]*Feng Chia University*

[2]*Metal Industries Research and Development Centre*

[3]*INTAI TECHNOLOGY CORP*

Abstract

In this paper, an epoxy-insulated hollow electrode tube is being used as a tool for electrochemical drilling, the electrochemical drilling experiments are carried out with spinning coolant electrode. It's been expected that the machining quality and efficiency can be promoted due to a proper insulation, and various results are analyzed by Taguchi method in order to find better parameters for electrochemical drilling machining. The final results in the completion of the stainless steel rod through the hole depth of 100 mm of electrochemical drilling processing, the use of DC power supply with insulated copper electrode processing an average angle of 0.016^{o} and the aspect ratio was about 77.27, the use of insulated stainless steel tube electrode is processed The angle of the vertebrae was 0.00802^{o} and the aspect ratio was about 74.96. In addition, with the pulsed power supply and the insulated copper tube electrode, the angle of 0.000573^{o} was about the aspect ratio of 79.94. As a result, it was confirmed that the good insulating layer could be effectively applied to electrochemical deep hole processing, and pulse power supply can be more effective to enhance the finished product of the geometric accuracy and size. The relative applications could be used as cooling hole or channel for spindles, blades, molds etc.

Keywords: Insulation, Electrochemical machining, Aspect ratio

A013226

Implementation of the Cyber-Physical System for a Computer Numerical Control Hobbing Machine

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Abstract

In recent years, the fourth industrial revolution, Industry 4.0, attracts a lot of attention from industry and government. It is the current trend of automation and data exchange in manufacturing technologies. In general, Industry 4.0 focuses on the following aspects: cyber-physical systems (CPS), the Internet of things, and cloud computing. The technology of intelligent sensing and decision plays an important role in Industry 4.0. In this study, the development and implementation of a CPS for the computer numerical control (CNC) hobbing machine has been conducted by integrating a PC-based CNC controller, an imbedded system, and a cloud platform. A user interface (UI) with dialogue window was developed and installed on the PC-based CNC controller. One feature of this UI is that it allows the user to key in the parameters for hobbing process, and then the relevant G-code, which is a standardized programming language that many CNC machines understand, will be generated for manufacturing. The developed imbedded system is capable of real-time manufacturing quality and fault detecting. The vibration produced by manufacturing will be acquired by using a low-cost accelerometer module. With the vibration information, a manufacturing quality and fault detecting algorithm based on artificial intelligent technology will be utilized to perform the online intelligent detection of the manufacturing quality. Therefore, the parameters of CNC hobbing machine, manufacturing vibration, and detecting manufacturing quality will be sent to the cloud platform to realize the cyber-physical system for CNC hobbing machine.

Keywords: Cyber-Physical System (CPS), Hobbing Machine, User Interface

A013269

New Volumetric Heat Source for 3D Selective Laser Melting System-Simulation and Experiment

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Abstract

Selective Laser Melting (SLM) is a typical Additive Manufacturing (AM) process for manufacturing three-dimensional (3D) parts by selectively melting specific areas of metal powder using a controlled laser beam. The physical phenomena associated with SLM are highly complex, and include scattering and absorption of laser radiation in the packed powder bed, heat conduction, melting and fusion of the powder particles, the formation and solidification of the melt pool, and so on. Consequently, relying on experimental trial–and–error methods to determine the optimal SLM processing conditions is extremely inefficient and time consuming. Thus, simulation models for estimating the suitable parameters are commonly preferred.For simulating the geometry of melt pool's cross-section more accurately in SLM process, modeling the volumetric heat source is considered as the key issue. In the present study, a three-dimensional finite element heat transfer simulations with new volumetric heat source are performed to estimate the size of the melt pool cross-section during SLM. The simulations are based on a new volumetric heat source which takes into account the effect of the powder size distribution on the propagation of the laser energy through the depth of the metal powder layer. In modeling the volumetric heat source, a modified sequential addition method is used to construct the metal powder layer with different powder particle sizes and the absorptivity profile along the depth of the powder layer is then calculated by means of Monte Carlo ray-tracing simulations. It is shown that the peak melt pool temperature obtained in the present simulations (3005K) is in better agreement with the experimental value than that obtained in previous simulation studies. Furthermore, the peak temperature is lower than the evaporation point of the powder particle layer, and is hence consistent with the stable melt track reported in experimental studies. To further confirm the validity of the proposed finite element heat transfer model, the simulation results obtained for the contact width between the melt pool and the substrate and the width of the powder-consumed band are compared with the experimental results and simulation findings presented in the literature. Finally, simulations are performed to predict the stability condition of a single scan melt track in the SLM process. The prediction results are shown to be consistent with the experimental findings.

Keywords: Ray Tracing, Powder Bed, Absorption, Volumetric Heat Source, Melt Pool, Selective Laser Melting

A013300

Development of 2-DOF energy converter for self-power monitoring buoys

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Abstract

Ocean conditions should be monitored because they reflect the influence of global climate change . Buoys equipped with sensors and wireless transmitters can monitor ocean conditions, but for long-term use (i.e., several years), how to power the sensors and transmitters is a critical consideration. Therefore, this study aimed at developing a two-degrees-of-freedom (2-DOF) energy converter with pitch and roll motion, composed of an eccentric rotor and a novel circular Halbach-array magnetic rotor to harvest wave energy from the motion of a floating buoy in three dimensions. The principle is to transform the kinetic energy of the wave into electricity. The eccentric rotor enhances power generation by revolving in a hula-hoop motion rather than small-amplitude oscillation because the angular velocity is higher. The kinetic equations of the eccentric rotor mounted on the buoy were derived using the Lagrange method, and the motion of the buoy was measured. The parameters for the hula-hoop motion of the eccentric rotor were found for irregular and periodical wave motion. The magnetic flux density and electromagnetic damping of the circular Halbach-array magnetic rotor were evaluated by using magnetic field strength simulations and Faraday's law of induction. The magnetic flux density of the circular Halbach-array design is 20% more than that of the multipolar array. According to the simulation, the power of the eccentric rotor in hula-hoop motion is approximately 39.5 W, which is six times of that in reciprocating motion. The power density of the 2-DOF energy converter is 655 W/Kg-m2, twice that of a 1-DOF converter. The distance between the two centroids of the buoy and the eccentric rotor is 1.6 m, the pitch and roll buoy frequency is 1.4–2 Hz, and the distance between the eccentric rotor centroid and the counterweight centroid (about 0.05 m) enhances the probability of the hula-hoop motion occurring.

Keywords: Energy converter, Biaxial hula-hoop motion, Buoy, Pitch, Roll, Heave, Halbach array, Electromagnetic damping, Power generation, Oscillation

A013364

Hand-Held Device for Assessing Dental Implant Osseointegration Stability through Vibro-Acoustic Technique

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Abstract

Based on resonance frequency analysis (RFA), the noncontact detection device through vibro-acoustic technique with acoustic excitation and vibration response is developed to quantify the stability of implants. Interface-tissues made of different mixing ratios of epoxy and casted in artificial bone blocks were used to imitate varying stages of osseointegration in in-vitro experiments. Besides, animal trails using rabbits were conducted to justify the developed device for assessing the implant osseointegration with tibia. In-vitro experiment results show that the frequencies in mesial-distal (MD) measurements increase with mixing ratio getting higher except for one designated case. The reason which makes the trend changeful in buccal-lingual (BL) measurements comes from the fixing condition. The connection between the implant structure and implant also effect experimental results. As to in-vivo experiment, the results show that secondary stability dominates stability after stability dip and increases with time passing. Primary stability influences the success of following adaptation. In conclusion, the detection technique and developed assessment device are capable of monitoring the dental implant osseointegration stability without extra accessories during the whole healing process.

Keywords: Medical device, Dental implant osseointegration, Resonance frequency analysis, Animal trail

A013370

Development of a 5-DOF Nanopositioning Stage with Error Compensation System

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Abstract

The purpose of this study is to develop a 5-DOF (Degree-of-Freedom) measuring system and a 5-DOF nano-positioning stage be integrated into error compensation system. The system can immediately provide active compensation linear positioning stage in motion the process of Abbé error. In addition, the 5-DOF nano-positioning stage with a flexural pivot as the base and using micro-displacement of the piezoelectric actuator to achieve horizontal, vertical, pitch, yaw and roll movements. In the 5-DOF measuring system, the micro autocollimator is developed for the detection of pitch and yaw angular errors. Moreover, 3-DOF sensor that can measure the horizontal straightness, vertical straightness and roll angular error are fabricated by use of two collimated laser and two position sensor detectors. Finally, the micro autocollimator and the 3-DOF sensor are integrated into 5-DOF measuring system, which can measure horizontal straightness, vertical straightness, pitch, yaw and roll angular errors. This developed error compensation system is to be built in the linear positioning stage controller to enhance the positioning stage accuracy. Based on the validation of experiments, the accuracy of linear positioning stage have a great improvement.

Keywords: 5-DOF Nano-positioning Stage, 5-DOF Measuring System, Abbé Error

A013372

Feasibility Study on Application of Bismuth-coated Platinum Electrodes in Microbial Fuel cells

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Abstract

In this study, bismuth (Bi) was applied as coating to carbon (C) and platinum (Pt) electrodes in microbial fuel cell (MFC). The performance of various electrodes involved in the electro-Fenton reaction were evaluated and compared in terms of power density, voltage discharge, H_2O_2 concentration, chemical oxygen demand (COD) removal, and pH value. Results show that MFC with Bi-coated Pt electrode displayed good electricity generation performance; producing a maximum power density of 1390mW/m^2, far higher than that of MFC with Bi-coated carbon felt (304 m W/m^2) and MFC with uncoated carbon felt (222 m W/m^2). Moreover, MFC with Bi/Pt cathode attained 85% COD removal after 288 h, also higher than that of MFC with Bi/C (79%) and with C (73%). Hence, application of Bi coating to Pt electrodes in MFC is not only feasible but also effective for power generation and wastewater treatment.

Keywords: Microbial fuel cell (MFC), Wastewater treatment, Power performance, Chemical oxygen demand (COD), Bismuth

A013373

Numerical Analysis of CNC Milling Chatter Using Embedded Miniature MEMS Microphone Array System

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Abstract

With the trend of industrial automation for mass production, there are many computer numerical control (CNC) machine tools which requires the data collection from intelligent sensors to analyze its processing quality. In general, for high speed rotating machines, the accelerometer can be attached on the spindle to collect the data from the detected vibration of the CNC. However due to its cost, the accelerometer has not been widely adopted in typical CNC machine tool. This paper attempts to develop the embedded miniature MEMS microphone array system (5.25 cm * 8 channel) to discover the vibration source of the CNC from spatial phase array processing. The proposed method yields the voice activity detection to divide the presence or absence of abnormal noise in the pre-stage, and the traditional direction of arrival method (DOA) via multiple signal classification (MUSIC) to isolate the spatial orientation of the noise source in the post-processing. In the numerical simulation, the non-interfering noise source location is calibrated in the anechoic chamber, and is tested with the real milling processing in vertical CNC. As the result in high background noise level, the vibration sound source is more accurate in the presented energy gradation graphs as compared to the traditional MUSIC method.

Keywords: Beamforming, Direction of Arrival, Voice Activity Detection, CNC Milling Chatter

A013718

Analysis and Prediction for Surface Roughness of Milling Using Vibration Signal and Artificial Neural Network

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Abstract

This study primarily investigates the correlation among the cutting parameters, the surface roughness level of S45C steel through the milling process and the vibration signals that are recorded synchronously. With different combinations of cutting parameters, such as: feed rate of per cut, cutting depth and clamping torgue of vise, the different levels of surface roughness are predicted by using the artificial neural network (ANN). The vibrations are measured by the accelerometers which are mounted on the spindle and the vise. The features of vibration signals are extracted through utilizing the envelope analysis, RMS (root-mean-square), kurtosis, skewness, fast Fourier transform (FFT) and frequency normalization. The features of higher priority are selected based on the analysis of correlation and then collected as the input layer parameters of ANN for surface roughness prediction. The prediction accuracy and results of using different classes of input features are also disscussed and compared.

Keywords: Milling, S45C steel, Surface roughness, Correlation analysis, Back propagation articifial neural network, Envelope analysis, Multi-scale entropy, Frequency normalization

A013309

Development of the Flow Channel Structure of an Anode-Supported Honeycomb Solid Oxide Fuel Cell for High Power Density

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Abstract

An anode-supported honeycomb solid oxide fuel cell (SOFC) gives high volumetric power density owing to the thin electrolyte layer and large anode active surface area, improving thermo-mechanical durability at high temperatures. We have so far shown the promising power densities and investigated the effect of the assignments of the constituting fuel and air flow channels on the cell performance in terms of the hydrogen partial pressure distributions in the cell under operation.In this study, we measure current-voltage characteristics and internal Ohmic resistances depending on the flow channel assignment of the anode-supported honeycomb cell. With the help of numerical modeling, we analyze the effect of the flow channel assignments on three-dimensional fuel transfer through the porous honeycomb support, aiming at developing optimal flow channel structures for practical applications with different power density requirements.

Keywords: Solid oxide fuel cell, Honeycomb, Anode-support, Porous substrate, Fuel transport, Numerical modeling

B012624

Sparse Coding for Manufacturing Quality Prediction

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Abstract

In this paper, a sparse coding based method is proposed for manufacturing quality prediction. Product quality is a key factor for manufacturing enterprises to assess production capability and increase their competence. However, failure cases are not expected to happen frequently, resulting in unbalanced positive and negative samples to train prediction models. To address this problem, a novel sparse coding based feature extraction method is proposed to predict manufacturing quality. Firstly, local class-specific sub-dictionaries are trained for positive and negative classes. In addition, a global dictionary is trained on all training data. These dictionaries are combined to capture intra-class and inter-class characteristics and extract discriminative features. Then, they are used to train SVM classifiers. We demonstrate the proposed method on publicly available datasets. Experimental results indicate the superior performance of the proposed method to the existing methods.

Keywords: Industry failure inspection, Sparse coding, Manufacturing quality prediction, Imbalanced data

B012658

The Invention of Tooling and Manufacturing Process of Curvature Hollow Composite Structure Tube

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CSIST

Abstract

The invention of tooling and manufacturing process of curvature hollow composite structure tube is shown in the study. A hybrid method of vacuum assisted resin transfer molding (VARTM) and blowing bag is used and modified to manufacture a hollow curvature composite structure. There are two polyethylene (PE) tube bags, and one is inserted by the other. The bags are warped by the layup of reinforced fiber braided tube and fabrics, which are placed inside the mold. Then, the two bags are individually sealed on the mold. Where, the outer bag is used for VARTM to get vacuum and let resin flow in the mold and wet the fiber fabrics, and the inner one is used for air blowing in and adjusting inner pressure higher or lower for pressing and loosing the fiber layup to get better resin wetting. The dimension and sequence of layup can be optimized and tapered by loading requirement. As the resin is vacuumed in, fully wetting the fiber layup and overflowed from the vacuum ports, the air is pressed into the inner PE tube bag and the pressure as high as designed value during curing period. After cured and de-molded, a high quality hollow curvature composite structure is get as well as the autoclave curing process. Therefore, the tooling design and manufacturing process of a hollow curvature composite structure has been fully developed and certificated by Intellectual Property Office (IPO) of Ministry of Economic Affairs in Taiwan, R.O.C. 2016, as shown in Figure 1.

Keywords: Composite, Hallow, Curvature, Tooling, Manufacturing

B012664

A novel technique for reducing thermal errors associated with thermal bending of machine tools

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Chieh-Wen Tseng

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Abstract

In this study the thermal deformation of a 3-axis machining center was analyzed experimentally and numerically. Characteristics of the thermal behavior of the spindle head were discussed based on comparing the experimental and numerical results. It was found that the displacement of the cutting point was significantly titling. The key component that greatly affects this thermal bending type of deformation was revealed to be the ribs on the spindle head. This thermal bending deformation cannot be reduced by using conventional thermal error compensation techniques. Therefore, to address this issue, a novel adaptive thermal balance (ATB) technology was proposed and tested in this study. Small rubber heaters were used to adjust the temperature distributions on the spindle head. Design parameters of the heaters were determined from optimization analyses based on the constructed simulation model aforementioned. Experimental results confirmed that by applying the ATB technique, nearly 80% reduction on the spindle tilting can be achieved. The current study provides a comprehensive analysis of the thermal characteristics of the modeled machine tool. In addition, the developed ATB technology is proven to be able to adaptively and smartly adjust the temperature distribution, which in turn significantly reduces the thermal errors associated with the imbalanced temperature distributions of the machine tool and thus improves the machining accuracy.

Keywords: Thermal deformation, 3-axis machining center, Adaptive thermal balance

B012681

mplementation of Communication Protocol for Machine Tool in Reference Architecture of Fog Computing

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Abstract

By far Machine Tool Industry has not unified standards of data access to cause difficulties in data analysis and industrial reform. International organizations of standards formulation such as OPC UA Foundation and MTConnect Institute, their presented communication protocols can solve problem of data disunity. This thesis introduced and implemented communication protocol architecture and introduced fog computing architecture which not only displays real-time status of machine tools but also provides solutions to mitigation of data process loading in the future.

Keywords: IoT, Fog Computing, OPC UA, MTConnect

B012690

Innovative RFID Based Product Portfolio Automatic Management System

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Abstract

In the recent years, a "Product Portfolio" system is usually needed by many businesses or government for letting customers to retrieve the product manufacturing information. During the product manufacturing period, many factories still use manual type to key in information data to record product information or manufacturing processes information. In this work, we propose an "Innovation Product Portfolio Automatic Management System" to automatically record the related manufacturing information. In this developed system, eights-layers, such as physical, data link, network, transport, application layers and user interface layer are included. This model based on OSI model (Open System Interconnection Reference Model) which proposed by ISO. Two modules and three functions are included. They are real-time product manufacturing information delivery and management modules; and real-time product manufacturing information monitoring, management, and retrieval functions. The proposed innovation product portfolio automatic management model provides an innovative way which construct product portfolio automatically. Not only the manufacturing performance can be improved but also the production cost can be reduced. Even better is the system can automatically record the related manufacturing information which will be very important or necessary for digital manufacturing.

Keywords: Product Portfolio, RFID, Manufacturing, Management Model

B012696

An investigation of Vibration Assisted Deep groove EDM of Titanium alloy (Ti-6A-4V)

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Abstract

In this paper an inexpensive vibration auxiliary device is presented that improves the efficiency of deep groove electrical discharge machining (EDM). A titanium alloy (Ti-6Al-4V) was machined by traditional EDM and vibration assisted EDM using three different kinds of electrode: copper, copper tungsten and graphite. The material removal rate, electrode wear rate, and the surface roughness of test specimens using traditional EDM and vibration assisted EDM at three different frequencies (40, 90 and 140 Hz) were compared. Experimental results revealed that the material removal rate with vibration assisted EDM was better than that obtained using traditional EDM when copper and copper tungsten electrodes were used. Vibration frequency was found to have an optimum value with respect to surface roughness, and this can be improved by selection of the appropriate vibration frequency. It was found that the machining time for a deep groove (10mm) with vibration assisted EDM was reduced by 200% compared with traditional EDM. This new vibration device can help in the development of more efficient deep groove EDM.

Keywords: Electrical discharge machining, Material removal rate, Electrode wear rate, Surface roughness, Deep groove EDM

B012716

Research on Injection Molding of Bevel Gear

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Abstract

This study aims investigated different injection molding factor, the amount of warpage of the molded product effect in plastic filling, an example in plastic bevel gear. The best combination parameters were found by Moldex3D R14.0 analysis to combined with the Reaction surface and Taguchi experiment using CAE mold flow software. The experimental injection molding factor used the cooling time, holding pressure, holding time, mold temperature, plastic material temperature, that will be the most appropriate conditions to be verifiled the injection molding experiments. This study help to understand the correlation between the injection molding factor and warpage amount of bevel gear.

Keywords: Injection molding, Reaction surface, Taguchi experiment, Bevel gear

B012735

Application Implementation of Genetic Algorithm in Flowshop Scheduling

Sheng-Yi Huang, Hsiu Fen Lee, Hung-Sheng Chiu and Yung-Yi Huang

Institute For Information Industry

Abstract

At present scheduling problems of factory workflow are usually categorized as Combination Prioritization. The Objective Functions which are typically used for performance evaluation such as Minimum Makespan, Total Flow Time, and Total Tardiness. This research regards Genetic Algorithm (GA) as a basis of theoretic development. Concentrating on that scheduling problem, C# development procedures are used to design a computer program for simulating solution to workflow scheduling problem of factory. Three objectives of Maximum Make-Span (MakeSpan, *C*max), Total Flow Time (total flow time, *F*), and Total Tardiness (total tardiness, *T*) are regarded as evaluation principle for implementation to find the optimal job order.

Keywords: Flowshop Scheduling, Genetic Algorithm, Make-span, Total Flow Time,Total Tardiness,C#

B012747

The Effect of Ball Grooves Configuration on the Dynamic Characteristics of Linear Rolling Guides

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Abstract

This paper proposes a method for investigating the changes of dynamic characteristics of single linear rolling guides with different ball contact configuration, subjected to vertical and lateral excitations. Linear guide generally designed as HG or CG type ball contact configuration, which may further affect structure characteristics. In order to evaluate the dynamic characteristics such frequency, damping ratio and dynamic stiffness, the block is excited by impulse hammer in the vertical *(z)* and lateral *(y)* directions. The response is detected by accelerometer sensors mounted on the block. Excitations force and acceleration are input to FFT and then frequency response function (FRF) is calculated. As a result, in vertical direction the modal frequency and modal damping ratio of CG type is higher by 8.89% and 11.2% compared with HG type. Different trends are found in FRFs in lateral direction, the modal frequency of CG type is higher by 38.62% but modal damping ratio is lower 32.76% compared with HG type. Besides, the HG and CG series linear guide show different dynamic stiffness in vertical and lateral directions, respectively. As the conclusion, this study shows that overall HG type demonstrate a superior damping ability stiffness as compared with the CG type.

Keywords: Frequency response function, Contact configuration, Linear guide

B012748

Investigation of the Correlation between Cutting Parameters and Surface Roughness

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Abstract

Surface roughness is an important parameter to evaluate the quality and performance of the machining process in manufacturing. Basically, the surface quality can be affected by the cutting conditions in machining. Establishment of the relationship between surface roughness and cutting parameters can help to improve the machining performance with better surface quality. This study was aimed to develop a mathematical model to predict the surface roughness under specific machining conditions. To this purpose, we conducted the machining tests under various cutting conditions that were selected following the stability lobes diagram of the cutter. The surface roughness of each specimen was measured by white light Interferometers. Correlation between the machining conditions and surface roughness was examined by ANOVA analysis.

The Results of machining tests were marked on the lobes diagram, on which the stable and unstable machining conditions are clearly identified from the stability diagram. The ANOVA analysis reveals that the surface roughness show a positive correlation with machining conditions. Using multivariable regression analysis, the mathematical model describing the relationship between surface roughness (Ra) and cutting depth (a), feed rate (f) and spindle speed (s). The predicted roughness is shown to agree well with the measured roughness, an average percentage of errors of 6.44%. As a summary of this study, the stability lobes diagram was verified experimentally, which can help to identify the machining conditions without chattering in machining. Besides, a mathematical model was successfully developed to predict the surface roughness under different cutting condition.

Keywords: Machining Parameters, Surface Roughness, Stability Lobes Diagrams

B012754

Characteristics of the effect of swirling gas jet assisted electrochemical discharge machining for glass based on machine vision

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Abstract

In this paper, a machine-vision-based system is used for in-situ monitoring and characterization of the effect of swirling gas jet assisted electrochemical discharge machining for glass. Feasibility of electrochemical discharge machining on nonconductive materials, i.e., quartz glass with the implementation of assisting swirling gas jet, was explored. The influence of the gas jet on the mechanism of material removal and gas film formation is reported. Consequently, in order to understand and monitor the gas jet effects in electrochemical discharge machining, real-time in situ metrology is employed to observe the details. Effects of the swirling flow on the machingin efficiency of the holes are investigated.

Keywords: Electrochemical discharge machining, Micro drilling for glass, Machine vision

B013640

BIM Applied to the Light Gauge Steel Structure Modular Design and Automated manufacturing

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Abstract

In order to establish an economic, fast and effective housing design and construction system, light gauge steel structure (LGS) houses have been important issues of global concern. In this study, the building information modeling (BIM) technology applied to the modular design and automated manufacturing, is introduced into the patent "The C-type steel structure system of LGS ". The C-type steel connection system of the LGS building structure, referred to as" bamboo-style steel ", is designed to use the existing mature technology and material specifications, the international standard specification head cap screws and cap, and the connector, integrate the C-shaped steel into a whole system. This study "BIM applied to the modular design and automation of light gauge steel structure" aims to reduce possible errors from the side of design to the end of the manufacturing and construction, and make construction and assembly easier. It is capable of effectively reducing the total cost and duration of the construction and therefore avoiding risks of change designs, that is, design for manufacturing and assembly, DFMA. On the other hand, with the steel structure construction manual established by the study, it can be used as a guide to the construction process. The research and the developed patent have been applied to build the user satisfied, eased maintained, safely structural "low floor buildings."

Keywords: Light Gauge Steel Structure, Modular design, Building information modeling, Assembly Buildings, Open building

C012666

Development of the on-line measurement system for micro-cutters

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Abstract

This project proposed a micro cutter online measuring system using the knife edge scanning method and the energy intensity difference method. When the micro cutter pass to laser focus point, the energy distribution of the laser point spread function on the quadrant photodiode detector can be analyzed using the knife edge method. The experimental results show the resolution of diameter of micro cutter is approximately 0.2μm, and related measurement error is 0.15%. The resolution of tip position of micro cutter is 0.17μm and the tool tip position measuring error is about ±0.2μm.

Keywords: Micro cutter, Knife-edge method, Tip position, Miniaturized CNC machine tools

C013346

Study and Development of Inspection System for Rice Seeds with Image Processing

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Abstract

There are many varieties of rice which do not differ greatly in the characteristics of their appearance. As a result, their identification is complicated and, thus, requires time- and effort-consuming manual inspection by a professionally trained inspector. This study developed a rice conveyor device that automatically feeds rice, counts grains, captures images, recollects grains, and constructs an image database.

Keywords: Paddy seeds, Image processing, Identification

C013347

Study on Paddy Seedling Inspection with Machine Vision

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Abstract

This study presents a novel machine vision-based autosorting system for paddy seedlings. The system comprises an inlet-outlet mechanism, machine vision hardware and software, and control system for sorting seed quality. The proposed method can estimate the geometry and color features of seedlings that are provided as Bayesian classifier in order to classify seedlings as "good" and "not good"(NG)

Keywords: Machine vision, Rice seedling

C013362

Chinese Cabbages Classified Device

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Abstract

In this study, an auto-sorting system for detecting and sorting Chinese cabbage seeds is developed because Chinese cabbage seeds are sorted manually. The functions of device include auto-feeding, image capture, classification and seeds collection. In this study, an application of neural network and image processing techniques were used to detect and classify Chinese cabbage seeds. The size, shape, color and texture features of seeds were estimated using image processing. The seeds classifier was proposed to classify seeds according to the features of seeds. The grade of seed includes excellent, good and bad. The accuracies of classification were 91.53 % and 88.95 % for excellent and good seeds. The average accuracy was 90.38 %. The speed of sorting arrived to 200 seeds/min. The testing results show that the Chinese cabbage seeds can be sorted using the developed system efficiently.

Keywords: Chinese cabbage seeds, Machine vision, Neural network

D011633

Measurement of TCP Errors of the Five-axis Machine Tools by Combining Double Ball-Bar with an Orthogonal Ball Cup Array Plate

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Abstract

This research paper dedicated in developing a new measuring method for five-axis CNC machining center. By combining a DBB(Double Ball-Bar) with a newly designed orthogonal plate, the measuring function of DBB will be expanded to measuring three-axis simultaneous operations. Current method is to setup at least three DBB measuring arrangements with different TCPs(Tool Centering Paths) which may cause setup errors and other errors from different TCPs. This research proposed a method by combining a DBB with an orthogonal plate which only needs one setup with the same TCP can measure the correct dynamic contouring errors and other simultaneous operation errors in three-axis directions. A type-B five-axis machine tools was conduct measuring three-axis(XYC,YZA) simultaneous operations. Our experiments can determine several errors of five-axis machine tools which includes: location errors of C-axis and A-axis , servo mismatch errors of XYC and YZA simultaneous operation, XY-axis backlash and thermal influence to eccentricity. Results showed that contouring errors of XYC and YZA can be decreased from 37 μm and 13.7 μm to 9 μm and 10 μm. Mismatch errors of XYC and YZA operations can be decreased from 15.5 μm and 13.5 μm to under 0.5 μm and 1 μm. Eccentricity can be decreased from 50 μm to 1 μm. By combining DBB with an orthogonal plate and software, we can complete fast measuring procedure and analysis within six minutes and overall cost is cheaper than current commercial instruments.

Keywords: Double Ball-bar(DBB), Orthogonal plate, Contouring error, Three-axis simultaneous operation measurement, Servo mismatch

D011757

Wearable Tracking and Sensing Devices used for Internet of Things

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Abstract

In recent years, as the rapid development of the Internet of Things (IoT), the wireless sensor network becomes a popular topic. Especially the application of wireless ad-hoc networks has become irreplaceable technologies in this field, which provides sensing of objects in anywhere. In this paper, we present a novel sensing system based on wireless ad-hoc networks, which can sense and track the target in a wide area. Initially, we build a wireless network by LoRa devices and set a reference position via initial scheme. Then it maps the real position through the triaxial accelerometer. Therefore, we can get the node of position in a LoRa network without the other networks. This paper proposed a method which can resolve the problem of out of range nodes. The proposed method expands the communication range via nodes. This system can be used in a non-network environment and build a wireless ad-hoc network quickly. In IoT, this system brings more convenience for managers.

Keywords: IoT, Ad-hoc, Wearable, Track, Sensor

D012729

Oil pressure method to detect tool life

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Abstract

This paper mainly uses the pressure change of oil pressure to diagnose the tool life. In the processing mechanism to the main force of the hydraulic feed into the drilling process, when the tool passivation wear, the required infeed pressure will increase, and finally due to tool passivation to damage and cannot remove the material, resulting in broken knife. The process of damage can be used to increase the pressure in the infeed, the use of repeated data collection, analysis, summed up the safety and recession pressure range, the most tool life diagnosis basis.

Keywords: Oil pressure, Tool life, Diagnosis, Hydraulic

D012933

Control and analysis of various loads for the rod-less pneumatic servo system

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Abstract

Aim of the study is to drive and control rod-less pneumatic cylinder by pneumatic system. By input signal to determine the orifice area of two sides of proportional servo valve, the pneumatic system allow the different volume of air to flow into two sides of cylinders, producing pressure difference applied to the slide object to move. Thus, the pneumatic system can successfully control the tracking path of the slide object. In order to unknown function to tackle the dynamic models and time-varying uncertainties of the pneumatic system, the study adopts Fourier series-based functional approximation technique. Besides, use of the adaptive sliding-mode control method combine with H-infinity tracking can improve the dynamic tracking performance, such as approximation errors, un-modeled dynamics and disturbances. Finally, the study analyze different loading conditions, including weight of slide object, making rod-less cylinder on different angle with respect to the horizon, and add additional weights on the slide object to understand influence of the weights for the pneumatic system.

Keywords: Rod-less pneumatic cylinder, Servo control, Fourier series approximation technique, Loading condition

D013293

Flexible four-in-one microsensor for PEMFC interior monitoring

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Abstract

The development of proton exchange membrane fuel cell (PEMFC), biomass energy, solar energy and tidal energy and other green energy has become a hot research topic these days. The focus of this paper is to embed the flexible four-in-one microsensor into the PEMFC having the real time micro-diagnosis. In order to develop a flexible four-in-one microsensor capable of measuring pH, temperature, humidity and voltage, it is necessary to select the most suitable micro pH sensor between the potential pH sensor and the conductivity type pH sensor. In order to combine the humidity, temperature and voltage of the microsensor, the use of conductive pH sensor in the four-in-one microsensor is more advantages. Therefore, uses micro-electromechanical systems (MEMS) technology to combine micro humidity sensor, micro pH sensor, micro temperature sensor and micro voltage sensor into flexible four-in-one microsensor and complete the correction. And then embed the flexible four-in-one micro-sensor inside the PEMFC with almost no effect on the effectiveness measuring the internal operation of the fuel cell humidity, pH, temperature and voltage of the local state.

Keywords: MEMS, Flexible four-in-one microsensor, PEMFC.

D013663

Study of Temperature Failure on UIS for Innovated High-side Side-isolated LDMOS Device

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Abstract

Low Power loss for power device design is the most important factor. It is not only considering the high breakdown and the low specific on resistance ($R_{on, sp}$), but also need to pass some reliability test, such as electrostatic discharge (ESD), hot carrier injection (HCI) or high temperature reverse bias (HTRB) to make sure the power device operate stably. In addition, unclamped inductive switching (UIS) can help us to comprehend the power device robustness. In this paper, we used Synopsys tool to analyze temperature failure for innovated high-side side-isolated LDMOS device in UIS test. According to the result, the device reliability is affected by impact ionization and hotspot location. The impact ionization more than 5E22 $cm^{-3}s^{-1}$ and at the hotspot near the drain side will increase the temperature failure seriously in the UIS test. Finally, we establish the curve of our device SOA region with the I_{AS} and the t_{AV} by different test of inductor.

Keywords: LDMOS, High-side, UIS, Impact ionization, Hotspot

E012685

Machine Doctor: A Feed Drive Diagnosis System for CNC Machine Tools

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Abstract

This paper introduces a diagnosis system, called Machine Doctor, of feed drive systems for CNC machine tools based on system identification technique. The purpose of this paper is developed a software system which core technology is system identification and auto-tuning of PID controller. The health diagnosis system is developed based on the variations of each axis ball-screw stiffness, bandwidth, and the first reason frequency. The proposed technique is introduced as follows. First, the feed drive system model of each axis including mechanical dynamics should be modeling, i.e., obtain the corresponding transfer functions of velocity and position loops. Secondly, system identification is used to build a virtual CNC feed drive system for employing the intelligent efficient method. Herein, the sinusoidal sweep input signals of velocity and position loops are done and to have the corresponding outputs. Subsequently, the frequency response functions (FRF) technique is utilized to have the corresponding frequency response (magnitude and phase responses). And then the particle swarm optimization (PSO) algorithm is adopted to obtain the system parameters and maximize the corresponding bandwidth. The system parameters include Jm: rotary inertia [kgms2], Bm: damping coefficient of the rotary motion [Ns/m], Mt: table mass [kg], Ct: damping coefficient of the lead-screw [Ns/m], and K: stiffness coefficient of the lead-screw [N/m]. After system identification in frequency domain, the corresponding virtual feed drive systems are established. Based on the virtual system, the servo tuning of PI controller can be done by PSO algorithm. Finally, we then develop a cloud platform for storage and data communication between the servo and user. User uploads the required data (the corresponding outputs of system identification step) via internet, and the Machine Dr. would give user the information (system parameters) of machine tools after analysis. Based on the nominal values, the user can understand the health status of feed drive systems from Machine Dr. In addition, the corresponding recommendation processes will guide the users to treat some problems due to system aging, e.g., servo tuning, system identification, etc. Besides, we also develop the Android App of Machine Dr. for users to know the health status.

Keywords: Feed drive systems, Health diagnosis, CNC machine tools, System identification, App

E012739

A Novel Thermal error control system of machine tool for smart manufacturing

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Abstract

For the machine tool, the machining accuracy is mainly affected by the thermal deformation error, which is about 40 to 70 percent. The reduction of thermal error is essentially important for machine tool accuracy, manufacturing quality and productivity increase. In the past, the local heat was effectively controlled by the cooling techniques. And, the z-axis linear error can be improved by the linear thermal compensation techniques. Thermo-friendly technique also can be used to reduce the linear errors, but it cannot be applied to the existing machine tool. In this paper, a novel thermal error control system proposed was called Intelligent Precision WatchMan (IPW). It is capable of reducing the skew error of machine tool spindles by 80% and more. IPW also provides other benefits such as high product quality, cost reduction, an increase in machine reliability and uptime, as well as efficiency gains and added industry value. IPW will be an important technique for constructing the environment of Industry 4.0 or smart manufacturing in the future.

Keywords: Machine Tool, Machining Accuracy, Thermal Deformation Error, Spindle Skew Error, Thermo-Friendly Concept, Industry 4.0, Smart Manufacturing

E012961

Prediction of Thermal Displacement of Spindle in Vertical Machining Center by Neural Network

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Abstract

here are many reasons that effect of the machine tool precision, including the servo control stability, mechanical deformation, machining load deformation, thermal deformation, the thermal deformation of the maximum error of about 50% or more. The influence of thermal deformation can be divided into two kinds of external heat source and internal heat source, while the internal heat source to the maximum heat of the main spindle. This experiment is designed to run the machine main spindle under no-load conditions, measure the temperature variation and displacement of the main spindle, save the data. The relationship between the temperature variation and the displacement was observed. The influence of the temperature variation of each part of the main spindle system on the precision of the machine is discussed.

Thermal deformation caused by the temperature variation of the main spindle will have an indirect impact on the offset after workpiece. Through this study can be obtained from the thermal deformation caused by temperature variation to the main spindle will have an indirect impact on the offset after products. Finally, the thermal deformation of the main spindle is predicted by using the Neural Network, the error ratio is less than 10%.

Keywords: Numerical control, Neural Network, Thermal Displacement

F013336

Vibration Measurement and Suppression for Laser Galvanometers Using a MEMS-based Accelerometer

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Abstract

This paper develops a vibration measurement, analysis, and suppression system for laser galvanometers. A galvanometer control system integrates a notebook computer, an intelligent motion control platform (IMP-2), a servo driver circuit, and a galvanometer driver module for driving laser galvanometers. The proposed vibration measurement, analysis, and suppression system composed of a microelectromechanical systems (MEMS) piezoelectric accelerometer, the fast Fourier transformation (FFT) algorithm operated on a notebook computer, and an analog comb filter circuit is utilized to measure, analyze, and suppress vibrations generated from the mirror-installed galvanometer motors during rotation motions, respectively. First, we use the MEMS-based accelerometer to measure and record the vibration signals resulting from the mirror-installed galvanometer motors during rotation motions. Second, the frequency spectrum analysis of vibration acceleration signals has been carried out by FFT algorithm. Subsequently, an efficient analog comb filter is designed based on the appeared harmonic or resonance frequencies for suppressing the galvanometer vibrations. Finally, the experimental results have successfully validated that the proposed inertial-sensing-based vibration measurement, analysis, and suppression system can measure and analyze the galvanometer vibrations, and suppress them effectively for improving the accuracy and stability of the laser galvanometer scanning systems.

Keywords: MEMS-based accelerometer, Laser galvanometers, Analog comb filter, Vibration analysis

G012707

Development of two - stage spiral high temperature heat pump system

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Abstract

This study designed a new type water/water two-stage screw heat pump with a vapor injection flash tank and investigated the performance of the heat pump under various condensation temperatures of the refrigeration cycle. In addition to the flash tank, a flooded type evaporator and a shell-tube cooler for refrigeration oil heat recovery are implemented in the heat pump system. A suitable vapor injection pressures corresponding to different condensation temperatures were found. In comparison to the preliminary type of two-stage screw heat pump with a plate heat exchanger for vapor injection and direct expansion evaporator; with the suitable operating conditions of vapor injection pressure, the average coefficient of performance enhancement of 23% of the new type heat pump can be achieved under various condensation temperature. From the performance measurements, it can be found that the average 10% of heat recovery enhancement can be obtained by the oil cooler under different condensation temperatures.

Keywords: Kinematic model, Error motion, LaserTRACER, Geometric error

G012350

Application of Laplace Adomian Decomposition Method to Nonlinear Fin System Problems

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Abstract

In this study, the Laplace Adomian decomposition method (LADM)—a hybrid of Laplace transform and the Adomian decomposition method—is used to find approximate analytical solutions to problems of a nonlinear heat transfer system involving fins. We analyze how thermal convection, thermal radiation, and various parameters (e.g., thermal conductivity and surface emissivity, both of which may vary with temperature) affect the problems in discussion, and then compare the results with the literature. It is found that LADM is simple and produces matching results. This research aims to provide further understanding of how fin materials and convective fluids should be selected in the future. According to the research results, better heat dissipation from a plate can be achieved when any one of the nondimensionalized parameters Nc (the ratio of thermal convection coefficient to thermal conductivity), Nr (the ratio of thermal radiation rate to thermal conductivity), and B (the slope of surface emissivity in relation to temperature) is increased, and a rise in A (the slope of thermal conductivity in relation to temperature) leads to faster heat transfer, meaning a smaller temperature drop along a fin of a fixed length. Assuming the variation of the thermal convection coefficient observes a power law, then the higher the power, the lesser the overall effect of thermal convection, and the more the nonlinear terms generated by the mathematical system.

Keywords: Adomian decomposition method, Laplace transform, Nonlinear system, Fin.

G012424

Flexible three-in-one microsensor embedded in the vanadium redox flow battery stack for in-situ microscopic sensing and diagnosis

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Abstract

Voltage, temperature distribution and electrolyte flow rate play very critical roles in terms of the performance and service life of a vanadium redox flow battery (VRFB) stack. The fuel delivery of a vanadium redox flow battery stack uses a pump to deliver electrolyte from the outside to the inside for reaction. Flow rate is an important control factor for a vanadium redox flow battery stack because it can bring away excessive heat of reaction. The three physical parameters (voltage, temperature and flow) inside the vanadium redox flow battery stack will affect its performance and service life. The bottleneck currently is that we can only adopt methods like external methods, theory, simulation, and single measurement which fail to reflect the actual information inside the stack. Therefore, according to the demand for internal in-situ microscopic diagnosis of vanadium redox flow battery, this study applied the micro-electro-mechanical systems (MEMS) technology to develop a flexible three-in-one (voltage, temperature and flow) micro sensor, which is embedded in the vanadium redox flow battery stack for in-situ microscopic sensing and diagnosis. The flexible three-in-one micro sensor can measure the local operating conditions inside the vanadium redox flow battery accurately, and the internal information is fed back instantly. Thus, the vanadium redox flow battery control system can be adjusted to optimum operating parameters immediately, so as to improve the vanadium redox flow battery performance and to prolong the product life.

Keywords: VRFB stack, MEMS, Flexible three-in-one microsensor

G012425

Study on the internal real-time microscopic diagnosis and aging of proton exchange membrane water electrolyser

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Abstract

The proton exchange membrane (PEM) water electrolyser consists mainly of the bipolar plate, proton exchange membrane, catalyst layer and carbon paper. The simple and lightweight device can produce high-purity hydrogen and is characteristic of high safety and non-pollution production. It is found from the literatures that during the operation of water electrolyser, five different internal physical parameters (temperature, flow, voltage, current and pressure) would affect its performance and service life. However, the current bottleneck is that all the methods available are only limited to the external, theory, simulation or single measurement level and there is no way to find out the real information inside the water electrolyser. With the micro-electromechanical systems (MEMS), this paper integrated the micro temperature, flow, voltage, current and pressure sensor, then embedded them into the PEM water electrolysis to facilitate the observation on and modification of the parameters thus further achieving the purpose of performance optimization and service life extension of the water electrolyser.

Keywords: Proton exchange membrane water electrolyser, MEMS, flexible 5-in-1 micro-sensor, Long-term real-time microscopic monitoring

G012736

Internal Resistance of an Anode-Supported Honeycomb Solid Oxide Fuel Cell Depending on the Flow Channel Configurations

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Abstract

An anode-supported honeycomb solid oxide fuel cell (SOFC) gives high volumetric power density and improves thermo-mechanical durability at high temperatures. We have so far shown the promising power densities and investigated the effect of the internal flow channel assignments and the porous anode support thicknesses on the cell performance in terms of the hydrogen partial pressure distributions in the cell under operation. In this study, we measure ohmic resistances of the honeycomb cells by current interrupt method, and indicate the impact of Ni reoxidation in the anode support resulting in high internal ohmic resistances. Fuel depletion in the cell causes the Ni reoxidation, and deteriorates the performance of the honeycomb cell.

Keywords: SOFC, Honeycomb, Anode-support, Porous substrate, Fuel transport, Reoxidation

G012778

Numerical study on thermal performance of phase change material (PCM)-based heat sinks with three-dimensional transient cooling

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Abstract

Three-dimensional numerical model is constructed to examine the thermal performance of phase change material (PCM)-based heat sink. PCM is stored in a rectangular heat sink and a uniform heat flux applied at the bottom of the heat sink. The PCM used in this model is paraffin wax and the heat sink is made of aluminum. The numerical transient simulations are conducted with different power level (15 W, 20 W and 25 W). As the power level increases, the melting rate increases and the melting time decreases. The convection of liquid PCM is observed by monitoring the temperature and velocity vector inside PCM. During melting process, the convection effect is enhanced with increasing amount of molten PCM.

Keywords: Phase change material (PCM), Paraffin wax, Heat sink

G012779

Numerical investigation of thermal characteristics of spray cooling with minimum quantity lubrication in milling process

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Abstract

This study explores the cooling performance associated with spray cooling with minimum quantity lubrication (MQL) in milling of Ti-6Al-4V using Tungsten-Carbide (WC). Vegetable oil is used as a cutting fluid, and it impacts the cutting zone. A numerical model using sliding mesh under the application of discrete phase model (DPM) is developed to calculate the temperature distributions in both the WC and Ti-6Al-4V subjected to conjugated heat transfer. The effect of spray angle relative to the feed direction on cooling performance in milling process is examined. The results show that the temperatures of both WC and Ti-6Al-4V for 0 and 90 degrees of spray angle are lower than those for 45 degree of spray angle.

Keywords: Milling, Spray cooling, Discrete phase model, Sliding mesh

G012823

Simulation analysis of dynamic distribution of the high-temperature furnace with two burner on the furnace temperature

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Abstract

This paper is studied the furnace temperature distribution of the high temperature furnace with the two burner under the variable air fuel ratio. This analyzes the furnace temperature by using the ANSYS software. This considers the variable air fuel ratio and the variable air velocity on burner. From this analysis result, this can be found the uniformity temperature in the furnace under the AFR=11. As the cold air velocity on the burner increase, this can cause the burning brush phenomenon in the furnace. This high hot air velocity can reduce the phenomenon in the furnace. This can control the uniformity temperature in the furnace by using the variable conditions.

Keywords: Fluent, Furnace, Temperature

G013085

Laser Assisted Material Synthesis and Pattering Technology for Microelectronics Fabrication and Lab-on-a-Chip Applications

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Abstract

The laser assisted material synthesis and patterning technology has advantages in terms of processing time and cost compared to conventional microfabrication processes. In typical laser process, a scanning laser on the substrate surface induces nanomaterial sintering and/or chemical reactions in the reactive liquid solution and selectively patterns/deposits target material in a preselected pattern on the substrate. In this series of studies, we experimentally investigated the effect of the processing parameters on the properties and growth rate of the resulting metal film fabricated by the laser assisted microfabrication technologies. Two types of laser assisted microfabrication were investigated, Laser Selective Nanomaterial Processing and Laser Direct Synthesis and Patterning. The resulted metallic patterns showed great electrical conductivities. Numerical analyses were also carried out to investigate the coupled photo-thermal-fluidic-mass transport phenomena and the effects on the metallic patterns being fabricated. The characteristics of the temperature field and the thermally induced flow as well as mass transfer associated with the moving heat source are discussed. It had been shown that the processing temperature range of these novel laser assisted microfabication technologies are in the range that’s compatible to flexible polymer substrates. The topology and the morphology of the metallic patterns can also be well regulated by adjustment of the processing parameters, and thus can be utilized for controllable additive nano/microfabrication. The laser assisted microfabrication techniques thus are proposed to directly pattern microcircuit in microchannel for on-demand bio-sensing microfluidic devices, i.e. Lab-on-a-chip.

Keywords: Laser Assisted Material Synthesis, Lab-on-a-chip

H011681

Design the imaging system on video laryngoscope with 7mm blade for neonatal patient

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Abstract

When the newborn infant was pushed from the birth canal, due to the meconium-stained amniotic fluid or ventilation failure while using resuscitation mask, the doctor must implement infant intubation and other emergency steps to maintain the baby's life. However, newborn or premature infant's mouth area is excessively small, doctors cannot visually glottis entrance leading to failed intubation or longer intubation time, resulting in blood oxygen levels drop or rise in intrathoracic pressure and other emergency situations. Although foreign import of video laryngoscope improves this type of difficult intubation indeed, as well as reduce intubation cause throat tissue injury, however, its metal blade size is 12mm, Taiwanese doctors often complain about the depth of field (DOF) is insufficient and width of blade is over wide when intubation for neonatal patients. Therefore, this study aims to develop two modules of infant’s video laryngoscope, ultra-thin 7mm metal blade and the optical imaging system. The core technology includes optical design of 2.5mm lens and verifications of imaging quality. In order to allow physicians to determine the infant’s airway position immediately and to avoid the binocular disparity from a physician while giving intubation, this study will simulate the optical properties of monolithic lens while design the imaging system, the doctor can get a clearer and undistorted image within the field of view.

Keywords: Infant, Video laryngoscope, 7mm metal blade, Optical imaging system, 3D metal printing

H013881

The kinetics of chromogenic reaction during the cultivation of Escherichia coli

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Abstract

According to our current regulations for food safety (CNS10984), the food sample subject to *Escherichia coli* test must be negative while to the most probable number of coliform bacteria (MPN/g-sample) must be less than 10. However, the most probable number (MPN) is not a good method. It takes a long time about 24-48 hours. The X-gluc-based chromogenic agar medium is a power tool to distinguish *E. coli* from coliform since 97% of *E. coli* produces β-glucuronidase. *E. coli* will form blue colonies on the agar plate while coliforms form mauve ones. This principle has been widely used in food or water quality management and can be an alternative to CNS10984 to achieve a high through-put check during food processing or food storage. In this study, we investigated the kinetics of chromogenic reaction during the cultivation of *E. coli* and quantitatively find out the relationship between the cell growth and color formation. From our results, the medium turns visually blue when the culture entered log phase. Furthermore, while the specific growth rate (μ) of *E. coli* culture is 0.25 h^{-1}, it is found that the color formation shows growth-associated behavior with the specific rate of product formation (q_P) of 0.28μ.

Keywords: Food safety, Escherichia coli, Chromogenic medium, Kinetics

J012689

Predict influence of rare events in power of combined power cycle plant by Copula method

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Abstract

In this paper, we introduce a Statistical Modeling method which called "Copula". We use the data set " CCPP" which contains 9568 data points collected from a Combined Cycle power plant over 6 years (from 2006-2011). The data is collected when the power plant was set to work with full load. The variables of data set are Temperature (AT) Ambient Pressure (AP), Relative Humidity (RH) Exhaust Vacuum (V) and electrical energy output (EP) of the plant. The data is come from "UCI (UC Irvine Machine Learning Repository)" which is a website contain hundreds of data set as an open source. The Copula method was used in high-dimensional statistical problem. We can model and estimate the distribution of the data by estimating marginals and copula separately. The Copula method are usually used in finance, which are being used for warranty data analysis in which the tail dependence is analysed. That is, for those rare events, we have more information from the model, which can help to make decision. Our main result is fixed a linear regression and copula model of the data set CCPP. We use the Copula model of "CCPP" to simulate a new data set "SimuCCPP", which contained more attention on the rare events. We comparison the linear regression of these two data sets to realize the influence of the rare events

Keywords: Copula, CCPP, Linear regression

J012741

Prediction of the Frequency Response Function of a Milling Tool Based on Receptance Coupling Method

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Abstract

Regenerative chatter is a major factor restricting the process efficiency and the longevity of cutting tools in high speed milling process. Basically, machining condition without chattering can be selected from the stability lobes diagram, which is estimated from the frequency response functions (FRFs) of the tool tip of a spindle tool system. However, measurements of the tool point FRF would be a complicated and time-consuming task with less efficiency. This study was then aimed to develop a robust prediction of the frequency response of a milling machine when it is equipped with different tool holder-cutter assemble. In this method, the FRFs of a specific tool holder-cutter assemble were predicted by finite element analysis, instead of the experiment measurements and the FRFs at spindle tool tip were obtained by coupling operation from the FRFs of substructures spindle nose and tool holder-cutter assemble. Using this method, the effects of the overhang length of the cutter and tool holder type on the dynamic characteristics have been proven and successfully verified by the experimental measurements. Subsequently, the machining stability of a specific cutter can be effectively illustrated according to the predicted tool tip frequency response functions.

Keywords: Frequency response function , Machining stability, Tool system

J012745

Modelling the Contact Behavior of Linear guide with Different Interferences

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Abstract

Linear guides with rolling elements have been widely used in high-precision linear positioning stages because of their superiority in rolling resistance and precision accuracy. In application, the linear guide are preloaded to increase the load carrying capacity by using the oversized rolling balls in the raceways. The contact status will be altered to affect the rigidity due to the interference between rolling balls and raceway rigidity. The changing of the rigidity of the linear guide are expected to affect the structure characteristics of the linear positioning stage. Therefore, realizing the variation of structure characteristics of the linear guides can help the design of the linear guide and applications in positioning system.

The purpose of this study was to analyze the nonlinear contact behaviors of the linear guide with different interferences of the rolling balls by finite element modeling approach. The contact configurations of the ball raceways discussed in this study is a front to front type (DF type). For simulating the preloaded contact behavior, a finite element model of the linear guide was created, in which different interferences at the contact interfaces between rolling balls and raceways were assumed. Simulation results show that in the absence of the interference the linear guides demonstrates a nonlinear relationship between the applied loads and the displacement of the sliding block, which accurately conforms to the Hertz contact mode. However, with the increasing of the interference, the nonlinear relationship was found to change to a linear behavior when the applied load exceed the preload. Besides, linear guide behaves different contact behaviors under different loading directions. As a whole, this study clearly shows the preload amount greatly affects the contact behaviors and rigidity of the linear guides and the effects vary with the loading direction. This results can provide a reference for application of the linear guide under different loading cases.

Keywords: Contact Stiffness, Hertz Theory, Interference, Linear Rolling Guide

J012780

Indoor Positioning System Based on BLE Location Fingerprinting

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Abstract

Location estimation is an important technique for location based services (LBS). Many services and applications have been developed based on users' location, such as navigation assistance, surveillance of patients and social networking. Although the GPS plays an important role on positioning system, its signal strength is very weak inside buildings. Hence, we need other devices to improve the accuracy of indoor localization. In the past decade, researchers have developed a series of indoor positioning technology based on the received signal strength (RSS) of Wi-Fi, ZigBee or Bluetooth devices under the infrastructure of wireless sensor network (WSN) for location estimation. We can compute the distance of the devices by measuring the RSS of the devices, but the correctness of the result is not satisfactory. Because the radio signal interference is a considerable issue and the indoor radio propagation is too complicated to modeling. Using the location fingerprinting to localize a target is a good strategy, because the location fingerprint represents the characteristic of the signals. The type of algorithms that estimate the location of a target by matching online measurements with the closest a-priori location fingerprints. The matching or clustering algorithm is a key issue for the correctness of location fingerprinting. In this paper, we'll propose an effective and correct location fingerprinting algorithm based on k-nearest neighbor clustering and other further techniques for indoor location estimation. The experimental results show the feasibility of our algorithm.

Keywords: Indoor Positioning, Location Fingerprint, K-Nearest Neighbor Clustering

J012783

Discovering Association Rules Among Software Libraries

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Abstract

In the field of software application development, several crucial issues arise from the rapid process of software production and corresponding stability requirements. Teams consisting of dozens of people typically have their libraries, i.e., suites of data and programming codes, to speed up software development. As a consequence, software programmers must use a large number of libraries in their codes. In this work, we utilize the data mining technique to discover association rules among software libraries so as to identify the relevance, i.e., to know which libraries are commonly being used together. Our testing datasets are from the codes of a commercial software program developed for data exchanging between banks. The major software is developed using Java language and contains 536 modules and 343 libraries. By introducing the terminology of mining association rules, we consider each module as a transaction and each imported library in a module as an item. Therefore, the aim of this work is to discover the item relevance using the well-known Apriori algorithm. Our findings based on the data exploration are two-fold. First, it is discovered that several sets of libraries are imported together frequently. This shows the significance of keeping these libraries work smoothly and stably. Second, we could ask software programmers to be familiar with the frequently co-occurring libraries so as to increase their productivity of the software development.

Keywords: Association rules, Data mining, Software productivity

J012784

A Novel Approach to Improve Quality Control by Comparing the Tagged Sequences of Product Traceability

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Abstract

Quality control is an essential issue for manufacture, especially when the manufacture is toward intelligent manufacturing that is associated with the technology of "Internet of thing" and "Big Data" to speed up the product line automatically nowadays. To monitor product quality automatically, it is necessary to monitor the values generated by sensors, or to record parameters by machine operators, or to save the types (brands) of materials used when producing products. The approach proposed in this study is to reduce the range of searching factors that result in unqualified products by comparing the tagged sequences of product traceability, where the traceability of one product is the sequential data generated while that product is produced, e.g. values collected by sensors, machine parameters, materials or components used or the identifier of operators; the tags are labels given by quality control staff. It is assumed that the sequences of the traceability of unqualified products are different from that of qualified ones, and these different values (or points) within the sequences result in these products qualified or unqualified. This approach extracts maximal repeats from the tagged sequences of product traceability, and meanwhile computes the class frequency distribution of these repeats, where the classes, e.g. "qualified" or "unqualified", are derived from the tags given manually. Instead of checking all of the sequences of product traceability aimless, quality control staff can focus on checking the values of those maximal repeats whose class frequency distribution is biased between "qualified" and "unqualified". To have the computation as described above practical, this study adopts one previous work that is a scalable approach based on hadoop MapReduce programming model and has been applied for U.S.A patent (Patent Application Serial Number 15/208,994. 13 July 2016). With the tagged sequences of product traceability, this novel approach is expected to improve quality control in the future.

Keywords: Traceability, Quality control, Maximal repeat, Hadoop

J012803

Inverse Current Measurement Method for Parameter Estimating of Miniature Loudspeaker

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Abstract

This paper develops a new electroacoustic inverse operation method, so as to solve the failure in measuring miniature electroacoustic lumped parameters by laser due to undersize or transparent material of miniature loudspeaker diaphragm. First, the estimated current value $I(t)$ is obtained by using miniature loudspeaker lumped parameter model, a minimum objective function is defined by the measured value $I_{mea}(t)$ and estimated value $I(t)$. Based on the inverse computation of differential equation and simple added mass, the accurate electroacoustic parameter group can be obtained only by measuring the miniature loudspeaker current, including five electroacoustic parameters, voice-coil inductance L_e, mechanical mass M_m, mechanical resistance R_m, mechanical stiffness K_m and force factor Bl. In addition, with the normal measurement error, the simulated current also has good prediction value with measurement error.

Keywords: Inverse electroacoustic problem, Miniature loudspeaker, Measurement error

J013308

Nonlinear Modelling of the Cerebral Blood Flow Responses to Carbon Dioxide for Diabetic Patients and Healthy Subjects

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Abstract

With the use of two nonlinear regression models, this paper is aimed to study the cerebrovascular response to carbon dioxide for patients with autonomic dysfunction and to explore the interaction between cerebral autoregulation and ventilatory control. The subjects were classified into the groups of 10 healthy elders over 45 years of age (Healthy 45^{+}), 13 healthy youths under 45 years of age (Healthy 45^{-}), and 18 patients with diabetes autonomic neuropathy (DAN). The subjects underwent hyperventilation to perform the cerebral autoregulation based on CO_2 Reactivity during the experiment. The comparisons of the measurement of CVMR (cerebral vasomotor reactivity) utilized nonlinear regression of CBFV (cerebral blood flow velocity) versus P_{ETCO2} (end-tidal CO_2) based on models utilized by earlier researchers. To minimize the effects of arterial blood pressure on CVMR estimation, the cerebrovascular conductance index (CVC_i) was also derived to quantify the relationship between CVC_i and P_{ETCO2}. Among those parameters used for the relationship of CBFV(%) vs. P_{ETCO2} and CVMR vs. P_{ETCO2}, results showed the DAN group demonstrated a greater range of change, a lower level of P_{ETCO2} that exhibited highest CO_2 sensitivity, and a higher maximal value of CBFV(%) than the healthy youths group (Healthy 45^{-}), but only lower responding level in P_{ETCO2} was found in comparison with the elder group (Healthy 45^{+}). The relationship of CVC_i(%) vs. P_{ETCO2} showed that DAN group accessed extremely lower level of P_{ETCO2} that exhibited highest CO_2 sensitivity than both healthy groups. This consequently resulted in a much higher CO_2 sensitivity (CVMR(%)) with a lower P_{ETCO2} level for DAN than both groups. With the use of a second model that employed non-linear regression of Levenberg–Marquardt algorithm, the relationship of CBFV(%) vs. P_{ETCO2} and CVMR vs. P_{ETCO2} demonstrated similar effects of CO_2 responses but with significance in lower mid point value of CBFV(%) and higher CO_2 sensitivity (CVMR(%)) for DAN group to healthy youths.

Keywords: Nonlinear regression, Carbon dioxide, Cerebral autoregulation, Diabetes, Cerebral vasomotor reactivity, Cerebrovascular conductance index

K012611

Study on the effects of molding parameters on tie bar deformation and part weight

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Abstract

In recent years, domestic injection molding machines are moving toward to energy saving, high precision, high productivity, and intelligent development; however, injection machine manufacturers lack the technology to design clamping unit parallel-precision, clamping force precision prediction, and intelligent control. While establishing intelligent technology is an important issue for injection machine manufacturers, such sensing technology and its high costs are challenges to the development of intelligent injection molding systems. In this study, the effects of molding parameters on tie bar deformation and part weight during injection molding processing are executed. The results indicate that higher injection speed and higher packing pressure will result in larger deformation and cause greater part weight. In addition, the relationship among the initial molding parameters and injection pressure and packing pressure has important influence on part weight.

Keywords: Tie bar, Structural analysis, Clamping force, Injection molding, Intelligent

K012805

Forming three-dimensional hollow shapes from two-dimensional elastic ribbons by controlled buckling

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Abstract

Conventional manufacturing techniques exist to produce three-dimensional (3D) shapes, such molding, machining, and casting. However, these industrial processes are typically geared for mass production and are not directly applicable to residential settings, where inexpensive and versatile tools are desirable. Moreover, those techniques are, in general, not adequate to process soft elastic materials. Here, we study the rapid forming of 3D hollow shapes from two-dimensional (2D) elastic ribbons by controlled buckling. We numerically and experimentally characterize how the profile and thickness of the ribbon determine its buckled shape. We find a 2D master profile with which various elliptical 3D shapes can be formed. More complex natural and artificial hollow shapes, such as strawberry, hourglass and wheel, can also be achieved via strategic design and pattern engraving on the ribbons. The nonlinear buckling is rationalized through finite element analysis, which shows good quantitative agreement with experiments. This robust fabrication should complement conventional techniques, and provide a rich arena for future studies on the mechanics and new applications of elastic hollow structures.

Keywords: Controlled buckling, Three dimensional 3D thin hollow shapes

L012698

Real-Time Intelligent Diagnosis of Islanding in a Solar Power Grid System based on Fractional Order Lorenz Chaos Synchronization

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Abstract

A survey of the literature shows that many different methods have been proposed for the determination of islanding. Most of them have drawbacks. The main issue being that existing methods cannot be used to detect islanding if the current and voltage are of the same phase, or the frequency remains within the normal range during the islanding event. In this study a non-autonomous Chua's circuit was used to preprocess the grid signal and this was followed by the use of a detection method based on the fractional Lorenz chaotic system and extension theory to analyze the preprocessed voltage signal. The characteristic capability of the chaotic system to amplify an extremely small error can be effectively utilized in the diagnosis of grid islanding. Simulation results showed that the diagnostic accuracy of the proposed method could be 100% and so far no other diagnostic method offers this kind of accuracy. Furthermore, the method proposed in this study is simple, easy to implement and could be used on a portable system for the real-time monitoring and diagnosis of islanding in a conventional home grid system.

Keywords: Islanding, Fractional lorenz chaotic system, Extension theory, Chua's circuit

L012808

Combined Adaptive Link-Aware Clustering Algorithm with Optimal Relays in Wireless Sensor Networks

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Abstract

In wireless sensor networks (WSNs), the energy consumption of a wireless sensor node is an important issue. This is because WSNs are composed of many sensor nodes, and their distribution is non-uniform. Sensor nodes collect the data of their immediate environment and transmit that data to a base station. No matter which sensor nodes gather or send data to the base station, both processes consume energy. However, each sensor node has limited energy, and it is infeasible to replace or replenish their power sources. This study therefore focuses on ensuring that sensor nodes gather and transmit data in the most energy-efficient manner possible, thereby extending individual node lifespans, as well as the lifespan of the overall network. To this end, a cluster-based topology architecture based on a link-aware mechanism called adaptive link-aware clustering mechanism with optimal relays in wireless sensor networks (ALCOR). ALCOR topology architecture adopts energy-efficient beaconless geographic routing (EBGR) to calculate the number of relay nodes required in a network in order to reduce the time required in searching for relay nodes, and to conserve relay node energy. Experimental data demonstrate that the ALCOR mechanism is able to improve the energy-efficiency and prolong the life cycle of the overall network.

Keywords: Wireless sensor networks, Cluster-based topology architecture, Link-aware, Relay nodes

L012842

An Integrated LED Driver with Unity Power Factor and Zero-Voltage Switching

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Abstract

Traditional LED derivers with PWM-typed converters suffer the problem of hard switching, leading to low circuit efficiency and low reliability. Meanwhile, LED drivers using an ac line source generally require using an additional power-factor correction (PFC) stage to satisfy the regulations on power factor and total current harmonic distortion (THDi). It results in more circuit losses, especially when the active switch of the PFC stage operates at hard switching. This paper presents an ac/dc converter for driving high brightness LEDs with the features of soft switching and high power factor. The proposed single-stage circuit is formed by integrating a buck-boost converter and a buck converter. By elaborately rearranging the wirings between the circuit components of both converters, the power MOSFETs can be switched on at zero voltage. The operating modes at steady-state are analyzed and the mathematical equations for derived circuit parameters are conducted. Finally, a prototype converter for driving 60 W LEDs was built and measured. Based on the experimental results, the feasibility and satisfactory performance of the proposed LED driver is proved.

Keywords: Hard switching, Light-emitting diode (LED), Power-factor correction, Single stage, Soft switching

L013079

A Digital Reverse Current Self-calibration Technique in 90% High Efficiency Rectified Power Supply for Near Field Communication through Magnetic Field Induction

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Abstract

It is crucial in near field communication (NFC) controllers for power source transferred from mutual induction of coils when the devices are battery-off. NFC devices can be operated at the condition of low battery or even battery-off due to the requirement of payment any time. Thus, the proposed wireless power transfer (WPT) power supply can have high efficiency due to the remove of reverse leakage current by the digital reverse current self-calibration (DRCS). NFC standards including A, B, and F can be continuously supplied by the WPT supply system. The WPT power supply with the DRCS technique was fabricated in 0.25μm CMOS process can rectify AC source from induction of magnetic field to unregulated DC voltage source and to supply power the NFC controller through low dropout regulator (LDR). Moreover, test chip achieves as high as 92% voltage conversion ratio and 89.4 % power conversion efficiency (PCE) due to reduction of unnecessary current loss.

Keywords: Wireless, Wireless power transfer, Near field communication

L013233

Performance Improvement Evaluation of a Controller Retrofitted Wind Turbine

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Abstract

Wind energy has a rapid growth recent years. According to GWEC's report, a total cumulative wind capacity is 486 GW in 2016. These means thousands of turbines been installed all over the world. For a modern wind turbine certificated by IEC or GL guidelines, the design lifetime is 20 years. After the installation of a wind turbine, the manufacturer will go through a tuning procedure to optimize the turbine's operating performance based on the design requirement and in-situ measurement. However, the efficiency of the turbine will degrade after 8 or 9 years' operating. Some component, especially the turning blade, the efficiency may vary due to the surface condition change. Meanwhile, the controller technology may also have been improved after years. So, the turbine needs an overall examine and controller to improve the turbine availability. This paper evaluates a 2 MW wind turbine with different design and operating parameters like blade efficiency, wind direction alignment, high/low wind control strategy, then with the software BLADED simulation, to simulate and calculate the output differences and availability of the turbine. Besides the output performance, the load variation of the structure was also reviewed to see the overall improvement of the retrofit. It can not only improve the efficiency but also elongate the lifetime of the wind turbine.

Keywords: Wind turbine, Controller retrofit, Availability

L013264

Load Analysis of the Yaw Operation Strategy to a Wind Turbine System

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Abstract

The yawing system in a wind turbine keeps the nacelle facing the incoming wind direction to obtain a better efficiency while it also induces the vibration and fatigue load to the structure. In this paper, the yawing mechanism was discussed to find out the fatigue effect among different yawing operation. Finally, an update/replacement of the yaw system of a real 2 MW wind turbine has also been implemented to verify the effect. The result has shown the significant improvement on the load output after the update.

Keywords: Wind turbine, Yaw system, O&M

L013279

Wide-Area Synchrophasor-Based Voltage Security Assessment Considering Generator Equivalent Circuit Model

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Abstract

With the advent of wide-area measurement system (WAMS), there is a trend toward utilizing wide-area measured data in transmission grid monitoring, control, and protection. This paper proposes a new methodology based on the generator equivalent circuit model (GECM) and the phasor measurement unit (PMU) technology for online voltage security monitoring of a power grid. First, the proposed methodology utilizes synchronized phasor (synchrophasor) measurements to determine the impedance parameters of a transmission grid by means of the recursive least squares (RLS) algorithm. Furthermore, it incorporates the dynamic models of generators to handle the cases with generator reactive power limit violations. After that an enhanced voltage security index with GECMs incorporated is developed for accurate voltage security assessment. Multiple power grids under various operating conditions are utilized to illustrate the accuracy and capability of the presented methodology.

Keywords: Generator equivalent circuit model, Phasor measurement unit (PMU), Power grid monitoring, Synchrophasor, Voltage security, Wide-area measurement system (WAMS)

L013363

Analysis of Flux-Switching Permanent Magnet Generator for Hydro-power Systems

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Abstract

A new type permanent magnet generator which called flux-switching permanent magnet generator (FSPMG) has been extensively investigated. The advantages of FSPMG are both high torque and power density, and its magnets locating on the stator part leads to forming a robust structure and becoming easier for heat dissipation.In this paper, a three-phase FSPMG with 12 stator slots and 10 rotor poles was proposed. The topologies with different rotor pole combinations including 11 rotor poles and 13 rotor poles also comparatively studied in this study. The design parameters and the generator dimensions were optimized by evaluating the electromagnetic performance, including back-emf, cogging torque, stator and rotor iron losses, output power etc., which obtained by using the Maxwell, a two-dimensional analytical simulation software.

Keywords: Flux-switching permanent magnet generator(FSPMG), Back-emf, Strand losses

M012573

The Observation of Internet of Things

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Abstract

The Internet of Things issues filled the newspaper every day. However, what is the direction of Taiwan should go? What technology applications are the masters of enterprises focused on? The survey would give some answers for these questions. The survey collected many different countries' policies for Internet of Things and lasted products on the world. And hope the research would help you to clarify the relationship of international standards. It just as the complete solution of Internet of Things would combine many technologies besides of industries, the communicate standards will cooperate another one to create a new strong standard. If Taiwan considers greatly introduce the international standards to apply them on the machines. It will help industries of country connect to the world more efficiently.

Keywords: CNC, Controller, IOT, MTConnect, OPC UA, DDS

M012686

Statistical Assessment of Location Accuracy for a Questionnaire Input System by Computer Vision

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Abstract

Questionnaire survey is a common research tool for scholars to conduct quantitative information collections. The authors are developing an automatic questionnaire input system by computer vision that is capable of continuously capturing, digitizing and processing the CCD images to accomplish data input. This study discusses a major aberration in all radial directions encountered when using a camera to measure the photogrammetic positions on questionnaire images. The authors address this calibration issue and provide a solution with a geometric closed form. This study further developed an automatically adjusting function for the optimal parameter of the focal length for the system. In order to find the relation between the distance of two designated locating marks and the optimal focal length parameter, a higher order equation was generated by regression and integrated into the system. Moreover, a function of recognition ratio was introduced to the system to cope with the varying shooting distance as well. The experiment results showed statistically that both automatic adjusting functions can reduce the errors between the aiming ROI centers and the aimed checkbox centers. Therefore, the modified system will not only increase the accuracy of the questionnaire input but also provide convenience to software usage.

Keywords: Questionnaire, Fisheye effect, Image processing, Computer vision

M012712

Bifurcation Analysis and Control for High Speed Gas Bearing Systems with Variation of Bearing Number

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Abstract

High Speed Gas Bearing system has been developed and applied for industrial and mechanical engineering parts. The current study presents a detailed theoretical and experimental analysis of bifurcation phenomena and bearing performance, in which a hybrid method combing finite difference method and differential transformation method is used to solve the governing equations of bearing system. The simulation results of rotor dynamics obtained from hybrid approach reveal better accuracy than traditional finite difference approach. The rotor center behavior is calculated to realize the occurrence of non-periodic motion. Meanwhile, in order to control and suppress non-periodic motion, a proportional differential controller using integral absolute error as a fitness function was utilized as well as particle swarm optimization to find the optimal gain constant values for the proportional differential controller. The experimental results showed that the dynamic error can approach zero and the effect of chaos can be controlled.

Keywords: High Speed Gas Bearing systems, Bifurcation, Hybrid method, Control, particle swarm optimization

M012772

Applying Design Thinking Process in Students Project: A case of EGF Products

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Abstract

Design Thinking Process is best known as an effective, human-centered approach to more creative problem solving. This methodology has been applied as an innovative idea generation technique not only for designers but in many different disciplines as well. While Epidermal Growth Factor (EGF) is an important growth factor in human body. It plays a crucial role in recent biological researches for many health-care applications. This study, incorporated the design thinking process in EGF application products, aims to encourage students designers to embark on this freshly new problem-solving methodology in biological application, and hope to help introduce new medical products in daily life. Two cases as the results came out from the hands-on class project were also presented.

Keywords: Design thinking, Collaborative design, Problem solving, EGF applications

N012692

Microscale transport phenomena in the novel laser direct metal synthesis and pattering process

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Abstract

A novel technology which is based on laser-induced photo-thermal-chemical reactions for rapid and green microfabrication of highly conductive microscale metal patterns on a low-cost and flexible polymer substrate is introduced in this talk. Metallic microstructures are synthesized and patterned simultaneously in a predetermined fashion using a low-power continuous wave laser in this process. The resultant metal patterns show both great electrical conductivity and mechanical robustness. This improved technology does not rely on any hazardous chemical process and, furthermore, it can apply to both tinted and transparent polymer substrates and uses a low-cost continuous wave visible laser as the energy source. Therefore, this fast, environmentally benign, and cost-effective technique provides a way for preparing nano/microscale circuitry on inexpensive polymer substrates for flexible electronics. Multiphysics numerical simulations were also carried out to investigate the effect of the coupled photo-thermal-chemical transport phenomena on the morphology of the deposited patterns. Specifically, the numerical analysis shows that the formation and deposition of the metal patterns highly depend on the temperature distribution and flow field in the vicinity of processing region which are functions of processing fluid properties and laser operating parameters. By combining both the experimental and numerical results, a semi empirical model for the growth of the metal layer has been proposed, validated and verified. The results of this study not only show a realization of a feasible method of green manufacturing for customer-designed microelectronics but also provide insights to further modifications to this laser-assisted microfabrication technique.

Keywords: Laser direct synthesis and patterning, Flexible electronics, Laser direct write, Transparent conductors

N012793

Flexible Thermoelectric Power Generator

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Abstract

This paper proposes a flexible thermoelectric power generator which can deforms according to the environment space and the appearance of articles to convert the waste heat from environment or hot articles into electricity. The thermoelectric power generator is composed of many in-plane thermocouple-couple connected in series and packaged in flexible ultraviolet light curing glue (UV glue). The thermocouple-couple is composed of N-type Bi_2Te_3 and P-type Sb_2Te_3, which is fabricated by electroforming. The flexible thermoelectric power generator is manufactured into a flexible tape; the users can trim the required length according to the requirement of power generation and deform it adaptive to the application environments.

Keywords: Electroforming, Flexible electronics, Thermoelectric power generator

N012794

Laser-induced plasma drilling of silica glass

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Abstract

Fiber fuse is a phenomenon that plasma runs in a optical fiber toward the light source. Fiber fuse is initiated when the fiber is heated above 1,050˚C, because it becomes absorptive. We have reported the same phenomenon occurred in a bulk glass. We applied this phenomenon for the drilling of glass. When the plasma region was reached to the glass surface, the glass material was ejected. As a result, a hole was drilled and the shape was the same as the plasma. The hole formation process was observed with a high speed camera.

N012649

Highly Stretchable and Transparent Copper Nanowire Heater for Wearable Electronics

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Abstract

A highly stretchable and transparent copper nanowire based heater for wearable electronics is fabricated by transferring copper nanowires on PDMS substrate. The copper nanowire percolative network is partially embedded on the elastic substrate. The stretchable network heater can be applied on heat treatment for alleviating a pain and has potential for soft, lightweight and versatile wearable applications.

Keywords: Stretchable and transparent heater, Nanowire, Wearable

N012687

Investigating the heat transfer phenomena of Water-EGS in the reservoir by experiment verification

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Abstract

The purpose of this study is to obtain the better operating condition of extracting geothermal energy based on water in order to find the maximum geothermal energy under the reservoir of the enhanced geothermal system (EGS). The heat transfer model conjugated with the Brinkman model is used. This numerical model is validated by the experiment result. The heat extraction and temperature difference of test section between experiment and numerical model is validated from the correction of the thermal dispersion of numerical model. The uncertainty of this simulated model will be handled through this process. Further, the heat extraction with different operating conditions such as pressure, volumetric flow rate of working fluid are built in this study. This study can show the tendency of the heat extraction in different operating conditions.

Keywords: Enhanced geothermal system (EGS), Numerical simulation, Heat extraction

N012704

Magnetowetting of Magnetic Nanofluids on AAO Surface

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Abstract

In magnetowetting, the properties of liquid, surface structure of solid, and applied external field are three major factors used to determine the wettability of a liquid droplet on a surface. For many experimental measurements, an irregular and non-homogeneous surface usually provides lower precision results. A periodic array of structures with hexagonal symmetry is the primary advantage of anodic aluminum oxide (AAO). This study presents rich results of the wetting properties of magnetic nanofluid sessile droplets on surfaces of various pore sizes of AAO under applied external magnetic field gradients. Stable water-based magnetic nanofluids are prepared by combining the co-precipitation and sol-gel methods in the beginning. Then, AAO structures are made by anodic oxidation process. Finally, the influences of pore size and magnetic field gradient on the magnetowetting of magnetic nanlofluids on AAO surfaces are investigated by an optical test system. Experimental results show that applying magnetic field gradient could result in a great increase of wettability. Moreover, such a magnetic field effect could be increased by increasing the pore size of AAO structures. Consequently, AAO structures can be formed on solid surfaces for magnetowetting applications, such as liquid lens, liquid iris, and biochips.

Keywords: Magnetowetting, Magnetic nanofluids, Anodic aluminum oxide, Contact angle

N012804

Effect of nanoparticles mean diameter on thermal transition of convective nanofluids flow in a square cavity

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Abstract

Numerical investigations are carried out for natural convection within domains with Al2O3 − H2O nanofluids having temperature-dependent properties. A two-phase mixture model is adopted, where Brownian diffusion and thermophoresis are regarded as the primary slip mechanisms between solid and liquid phases. The numerical integration is based on a combination of second-order accurate Adams-Bashforth and Crank-Nicholson methods applied to a fractional-step technique implemented with a staggered-grid arrangement of dependent variables. Influence of the Rayleigh number on the heat transfer behavior with increasing nanoparticle volume fraction are systematically investigated for various nanoparticle diameter. The heat transfer behavior is found to experience transition by increasing the Rayleigh number, and the critical Rayleigh numbers at different nanoparticle diameter are also addressed.

Keywords: Nanofluids, Two-phase mixture model, Nanoparticle diameter, Transition

N012843

Enhancing Convective Heat Transfer on the Roughened Surfaces using Mist Flow

Yao-Hsien Liu, Yi-Hsuan Huang, Szu-Kai Wang and Kuan-Tzu Huang

National Chiao-Tung University

Abstract

Heat transfer on the roughened surfaces can be effectively enhanced using the air-water mist flow. The mist flow was generated by mixing the micro water droplets with the air stream. This experiment was conducted in a vertical square duct with a hydraulic diameter of 40mm. The roughness elements considered in this study included orthogonal ribs, pin-fin arrays, and broken ribs. Results indicated that the enhancement ratio by the mist flow was up to four times as high as the air flow. Furthermore, heat transfer distributions were highly influenced by the mist flow and the roughness element. Comparing to the single phase flow, the secondary flow induced by the roughness element broke the liquid films on the surface and resulted in lower heat transfer enhancement.

Keywords: Heat transfer, Mist flow, Pin-fin, Rib

N012852

Enhanced CHF on the ZnO Nanostructured Surfaces

Ming-Chang Lu, Yu-Chi Chen, Wei-Shen Chiang and Pu-Wei Wu
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Abstract

The tendency to increase the number of transistors per unit area for increasing the performance of electronic devices has caused a server challenge for thermal management. Pool boiling which absorbs a large amount of heat over a small temperature difference is an efficient cooling method. The largest amount of heat that can be removed by pool boiling without causing the burn-out of a heater is referred to as the critical heat flux (CHF). In this work, pool boilings on the surfaces with zinc oxide porous nanostructures were conducted. The experiments were conducted under atmospheric pressure using deionized water at saturation conditions. The highest CHF obtained on the zinc oxide porous nanostructures was 210 W/cm2. This value was 176% the CHF on the plain silicon dioxide surface. The results suggest that the capillary force provided by the porous structure could delay the dry-out and therefore enhance the CHF.

Keywords: Pool boiling, Critical Heat Flux (CHF), ZnO nanostructures

N013326

Development of A Hybrid ARIMA-ANN Model for Electricity Short-Term Load Forecasting in Taiwan Power Company

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Abstract

A short-term load forecasting (STLF) model is developed to forecast stable electrical energy supply in power system. The paper proposes a hybrid seasonal ARIMA-ANN model that integrates the autoregressive integrated moving average (ARIMA) and artificial neural networks (ANNs) estimate both the linear and the nonlinear properties in time series for forecasting. It is shown that the model with the selected input variables of historical daily electricity load data from the Taiwan Power Company, weather data and holiday effect variables can produce reliable short-term load forecasting. The results of the hybrid seasonal ARIMA-ANN can enhance power system reliability and further help better energy strategy planning.

Keywords: Artificial Neural Network (ANN), Autoregressive Integrated Moving Average (ARIMA), Short-term load forecasting (STLF), Back-Propagation Network (BPN), Hybrid model

X1012387

Effects of Atmospheric Plasma Surface Modification on the Tribological Behavior of Artificial Total Knee Joints

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National Cheng Kung University

Abstract

Total knee arthroplasty (TKA) is the most effective form of long-term therapy currently available for patients suffering from end-stage degenerative arthritis. The number of the patients suffering from degenerative arthritis has increased because of the gradual aging of the population. The generation of ultra-high molecular weight polyethylene (UHMWPE) wear particles is one of the most important factors determining the long-term effectiveness of TKA. However, mechanical wear remains a major unsolved problem with regard to total knee joint replacements, and it limits their lifespan to 10–15 years or less. In this study, atmospheric plasma was used to modify the surface of zirconia in a total knee joint prosthesis that used a zirconia femoral implant. Collagen was then injected into the knee to act as a joint lubrication supplement to reduce polyethylene wear.

The experimental results indicated that atmospheric plasma surface modification effectively increased the hydrophilicity of zirconia, without leading to detrimental effects such as decrease in mechanical strength or significant changes in the surface roughness of the material. This treatment further improved the boundary lubrication efficiency of zirconia with respect to UHMWPE in the collagen solution. Because surface modification resulted in high surface hydrophilicity levels, proteins were readily adsorbed at high densities onto the treated surface. The adsorption of proteins improved the boundary lubrication effect of the surface during frictional processes, subsequently reducing polyethylene wear by 50%. The combination of atmospheric plasma modification and collagen is thus highly beneficial for extending the lifespan of total knee prostheses.

Keywords: Atmospheric Plasma, Surface modification, Tribology, Artificial Total Knee Joints, Collagen

X1012731

Mechanical properties and fracture behavior of Cu based bulk metallic glasses

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Abstract

The paper investigates the mechanical and fracture properties of Cu based bulk metallic glasses(BMG) under different quantities of the Nd element. The experiment results indicate that the stress and strain rate sensitivity for three types of Cu-based bulk metallic glasses vary clearly with the strain and strain rate. As the strain rate increases, the plastic true stress and strain rate sensitivity increase. This phenomenon is even more significant when the results of the static and dynamic tests are compared. Furthermore, the plastic true stress and strain of the Cu based metallic glasses are enhanced when the addition of Nd content is up to 2%. The fracture surfaces are observed by using scanning electron microscope.. The appearance and densities of the dimple structure are found to depend on the strain rate and the content of Nd element.

Keywords: Cu-based BMG, Nd element strain rate effect, Fracture properties

X1012742

Temperature sensor using tilted fiber Bragg grating with PDMS

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Abstract

In this study, we propose a tilted fiber Bragg grating (TFBG) temperature sensor fabricated by using the phase mask method to produce TFBG that was etched with diameters of 50 μm, and then package in the Polydimethylsiloxane(PDMS), The experimental results showed that the core mode wavelength sensitivity was 0.015 nm/℃ and the linearity was 0.999, the cladding mode wavelength sensitivity was 0.012 nm/℃ and the linearity was 0.999. Furthermore, the measurement results showed that when the temperature change was the effect on induced refractive index change and on the thermal expansion coefficient of the SM fiber meaning that the TFBG spectrum wavelength was shifted. Therefore, the proposed temperature sensor of TFBG with PDMS has good potential to be an effective temperature monitor.

X1012743

Glucose sensor using U-shape optical fiber probe with gold nanoparticles

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Abstract

In this research, we produced U-shape optical fiber probe by flame heat method. It was packaged in glass tube to reduce human factors in experiment which acted as glucose sensor in this project. U-shape fiber probe had high sensitivity to detect the very small molecule. When sensor dipped in different refractive index solution, wavelength or transmission loss will change. We used electrostatic self – assembly to bond gold nanoparticles and glucose oxidase (GOD) on sensor surface. Finally, sensor was connected to broadband light source and optical spectrum analyser (OSA) to read information. In the experiment results showed that transmission loss changed in different glucose concentration. When glucose concentration changed 0.1% to 0.5%, the transmission loss varied -3.904dB. The sensitivity was -9.659dB/% and R-squared value was 0.9938.

Keywords: Glucose Sensor, U-shape optical fiber probe, Glucose oxidase

X1012790

Improved Field Emission Properties of Open-ended MWCNTs on Flexible Carbon Cloth Substrate

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Abstract

In this study, well-aligned and very long multiwall carbon nanotube (MWNT) thin films were first grown on flexible carbon cloth by microwave plasma enhanced chemical vapor deposition (MPECVD) and then carboxylated by HNO3 solvent. After surface modification of HNO3, the cap of MWNT was removed. The open-ended MWNT was characterized by transmission electron microscopy (TEM) image. The field emission (FE) behaviors of as-grown and HNO3-modifed MWNT thin films have been investigated. The field emission measurement of carboxylated MWNTs showed that a very low threshold voltage of 1.78 V/μm was required to reach the emission current of 1 mA/cm2. The improved field emission characteristics of carboxylated MWNTs can be attributed to the geometrical configuration of a well-aligned, high aspect ratio, open-ended nanotube. A numerical simulation based on particle-in-cell parallel computing technique has also been performed. Both experimental and simulation results indicate that the opened nanotube (after HNO3 modification) shows larger emission current than the closed nanotube (as-grown). In summary, MWNTs grown on carbon cloth and a simple, but very effective, HNO3-modification method, providing improved field emission properties, show great potential in the applications of flexible electron source.

Keywords: Carbon Nanotube, Carbon cloth, Thermal CVD

X1012799

The Analysis of Engine Performance and Exhaust Emissions by Using By-Pass Cooling Air Compressor Device in the Internal Combustion Engine

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Abstract

This paper presents a new device for the internal combustion to increase the combustion efficiency and improve the exhaust gas emissions. An additional cooled air is input to the inlet manifold by the device to provide more comburent or combustibles for the engine. The device is set between the intake valve and the throttle. A reinforced air fan is designed in the device to input the additional air to the inlet manifold from the side of the manifold. The additional air not only increases the capacity of comburent or combustibles but also speeds up the flow velocity of the intake air which is similar to the air multiplier technology. Because of no blades on the inlet manifold, the intake airflow can be accelerated smoothly instead of the problem of the turbo lag in a turbo-charger engine. The thermoelectric module is applied in the device to cool the additional intake airflow which can increase the oxygen density for combustion of the engine by the physical property of thermal expansion and contraction.

Keywords: Thermoelectric Module, Intake air system, By-pass

X2012861

Development of two - stage screw high temperature heat pump system

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Abstract

This study designed a new type water/water two-stage screw heat pump with a vapor injection flash tank and investigated the performance of the heat pump under various condensation temperatures of the refrigeration cycle. In addition to the flash tank, a flooded type evaporator and a shell-tube cooler for refrigeration oil heat recovery are implemented in the heat pump system. A suitable vapor injection pressures corresponding to different condensation temperatures were found. In comparison to the preliminary type of two-stage screw compression heat pump with a plate heat exchanger for vapor injection and direct expansion evaporator; with the suitable operating conditions of vapor injection pressure, the average coefficient of performance enhancement of 23% of the new type heat pump can be achieved under various condensation temperature. From the performance measurements, it can be found that the average 10% of heat recovery enhancement can be obtained by the oil cooler under different condensation temperatures.

Keywords: Heat pump, Flash tank, Two-stage compression

X2012882

Effect Taiwan Ambient Conditions on Hybrid Solid Desiccant Vapor–Compression Air-Conditioning System

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Abstract

Solid desiccant cooling system is considered as alternative to the typical air conditioning system which consume lot of energy. The latent and sensible loads are handled separately and more effectively in desiccant wheel and cooling coil. In this paper, performance of typical solid desiccant system has been analyzed and compared with hybrid solid desiccant vapor compression air-conditioning system. Hybrid desiccant system use waste heat from condenser for regeneration process at desiccant wheel to removes the moisture at desiccant material. This system has been analyzed at typical hot and humid weather of Taichung, Taiwan. The results show that hybrid desiccant cooling system has 5.3% higher COP than typical cooling system. Higher outdoor temperature and humidity ratio leads to a better desiccant cooling performance. These results confirm that hybrid desiccant cooling system is feasible for hot and humid weather conditions in Taiwan.

Keywords: Hybrid solid desiccant, Air conditioning system, Vapor-compression system

X2013304

Economic Analysis of Cooling Water Tower Applied in Conventional Tire Industry

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Abstract

The purpose of this study is to use cooling tower for the traditional tire vulcanizer heat and analyze the energy saving, In the study, four identical cooling towers were subjected to physical energy calculations, there will be used four cooling towers, two cooling towers with frequency control will be monitored by the central monitoring system, and analyze the energy dissipation and analyze the operation mode of vulcanization equipment. First of all, for tire curing machine energy analysis and understand the performance of the curing machine, characteristics of the structure, and then calculate the energy analysis by energy conservation. Four cooling towers were packed in two cooling towers. This system will control the frequency and the actual operation of the state curing machine, according to the frequency conversion results of the traditional cooling tower, it can be learned that the cooling tower in the past is based on the outside air wet bulb temperature in the frequency control. But that the external wet bulb temperature control for the curing machine heat dissipation is inadequate, Therefore This paper studies the operating temperature of the vulcanization machine to set the heat dissipation temperature and with the frequency control has reached the economic effect of energy saving, the initial cost is 37 million, After the frequency control operation can save electricity 160,000/year, the equipment recovery period is 2.3 years.

Keywords: Cooling tower, Variable frequency control, Similarity law, Vulcanizing machine

X2013377

An Investigation of Efficiency Improvement and Energy Saving of Waste Heat Source Recovery in the Air Compressor System

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Abstract

In this study, the air compressor heat source recovery system is used to apply in Make-up Air Handling Unit (MAU) and efficiency improvement of chiller in a panel factory. A large amount of compressed air is used in the panel factory process. The air compressor can convert the mechanical energy of the motor into pressure energy of the air. The air compresses and produces a large number of heat sources, which it is discharged after air cooling. The centrifugal compressor is based on three stage cooling methods of thermal cooling compression heat source. The first, second, and third cooler use ice water cooling. The MAU use the heat source in a clean room to control the temperature and humidity requirements.

Keywords: Waste Heat Source Recovery, Air Compressor System, Make-up Air Handling Unit (MAU), Efficiency Improvement, Energy Saving

X2013679

Simulation Study on the Mode of Smart Control on the Comfort of Living Room

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Abstract

Due to the increasingly severe problem of global warm, how to relieve the heat island effect caused by urban development and put forward rational improvement measures would be an important topic for the future urban development and architecture design. This study would discuss about the installation of indoor smart monitoring and control system and propose a feasible structure to establish a smart system for sensing and controlling the temperature and humidity inside the building. The sensor offers the capability of learning and automatically controlling the indoor temperature and humidity to automatically adjust the indoor heat environment. Meanwhile, computational fluid dynamics (CFD) is used as the prediction and analysis tool to analyze the feasibility and benefits of improving the indoor cooling by means of controlling such variables as temperature and humidity. Based on the analysis results, the study would propose methods for relieving indoor heat environment to meet people's demand for indoor living quality and energy saving.

Keywords: Smart buildings, Building energy saving, Indoor thermal environment

X3012703

Model Reference Adaptive Control and Fuzzy Neural Network Synchronous Motion Compensator for Gantry Stage

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Abstract

In this paper, a fuzzy neural network (FNN) compensator is proposed for the synchronous motion control of a gantry position stage. Firstly, the cascade control strategy, involved the model reference adaptive control (MRAC), is applied to reduce the single axis position tracking error. However, the synchronous error between dual servo systems is inevitable due to their inequality in characteristics, the plant uncertainties and environmental disturbance. The FNN compensator and an online learning algorithm perform a fuzzy reasoning with two inputs of synchronous position and velocity errors between dual drive servo systems and generate the compensated force; the compensated force is then fed back to the controller of each axis to compensate the unsynchronous motion. The online learning algorithm adjusts the connected weighting of the neural network by using a supervised gradient descent methods, such that the define error function can be minimized. Finally, two kinds of position commands with high and low frequency are designed for the experiments, and the experimental results show that the proposed FNN compensator is feasible to improve the synchronous error of gantry stage.

Keywords: Fuzzy neural network compensator, Synchronous motion control, Gantry position stage, Online learning algorithm

X3012721

A Low Cost of IoT Laser Interferometer by Using a Raspberry Pi3

Tsung-Han Hsieh, Huay-Chung Liou, Bing-Lin Ho, Jr-Rung Chen and Hau-Wei Lee

Industrial Technology Research Institute

Abstract

Data transmission of traditional laser interferometers in length measurement is usually through USB and UART (Universal Asynchronous Receiver/Transmitter) interfaces. For Industrial 4.0 needs, the length measurement data is collected by a master computer through wireless interface. The IoT (Internet of Things) technique has been employed along with big data collection in recent years. An idea of laser interferometer integrated to IoT technique is proposed in this study. First, the interference signal is transformed into digital signal (i.e. A/B phase signal) by a Schmitt trigger. And then the displacement is calculated by the GPIO (General-purpose input/output) interfaces of the Raspberry Pi3. Finally, the Raspberry Pi3 is connected to the master computer with a wireless device like Wi-Fi (Wireless Fidelity), Bluetooth or ZigBee, and then the low cost IoT laser interferometer is carried out. The IoT Laser interferometer with low cost is designed for the error motion measurement of large machine tools. The measured range can be reached 5 m and the resolution is about 0.1 μm.

Keywords: Laser Interferometer, Raspberry Pi3, Schmitt Trigger

X3012732

Use electricity to diagnose the components

Jun Ren Chen and JIE Lin

Abstract

In recent years, various types of computer 3C products and the development trend of the cars are mainly used light mining materials to reduce the weight of finished products to enhance the added value of products, and it is necessary to process for corresponding with the special curve of the such metal to enhance the process capacity. In addition, because of the influence of process capability and market orientation, stamping processes are towards the high precision, shape diversification, and high efficiency direction of production. Therefore, this paper is used in the punch industry based on the diagnosis of electrical components, for the motor equipment is indispensable in the manufacture of punch components for the acquisition of abnormal diagnosis. However, the current market for industrial power extraction of the output frequency of the meter are all 1Hz, and the punch time which this paper detected is needed to be less than 1 second. It is known that the existing meter does not meet the requirements of this study. Therefore, we and the cooperation of manufacturers improve the meter to capture motor electrical information with the higher frequency (50Hz sampling frequency). And this study captured the motor electrical signals to diagnose and analyze. It can be effectively diagnosed its abnormalities and shorten the time of the breakdown to increase Availability and reduce cost.

Keywords: Punch, Motor, Electricity

X3012781

Calibration of a Robot and Compensation for Stiffness model Using a 3D Camera

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Abstract

Industrial robots can successfully perform their tasks with high repeatability levels as they are used in repetitive applications. It is possible to reach precision levels within the repeatability range as a robot is programmed in teach mode; however, the accuracy of goal positions and orientations is much lower in the offline programming. Therefore, robot kinematic calibration is a key process to improve the position and orientation accuracy of the robot or to minimize the error caused by uncertainties of its kinematics by calculating the kinematic model parameters. Especially, the torque due to gravity force based on the mass of the links makes a great influence for the actual position and orientation of the end-effector. These static errors can be modeled through the measurement of the external sensory system, such as a laser tracker. However, the laser tracker is a very expensive instrument. In this study, we developed a novel measurement system based on Intel real-sense 3D camera to calibrate the stiffness model of a HIWIN robot. The application is developed in C # to integrate the image depth information with the tactile sensor to achieve automatic calibration tasks.

Keywords: 3D camera, Robot calibration, Stiffness model, Neural network

X3012787

Geometric Error Measurement of Machine Tool Using an Auto-tracking Laser Interferometer

Jr-Rung Chen, Bing-Lin Ho, Hau-Wei Lee, Shan-Peng Pan and Tsung-Han Hsieh

Center for Measurement Standards, Industrial Technology Research Institute

Abstract

Geometric error measurement with traditional laser interferometers is generally a complex process, especially for the measurement of squareness errors, which requires a 90° Pentagon prism. For the development of the aviation industry, the size and travel of a machine tool are becoming large and long. However, the setup of optical alignment becomes difficult to deal with. An auto-tracking laser interferometer (ATLI) is proposed in this paper for the squareness error measurement of machine tools or coordinate-measuring machines (CMMs). The procedure involves measurement of only one line of an axis, and the measurement results can not only provide us the information with the positioning errors but also with the squareness errors. This specially designed interferometer instrument can help the industry to reduce the working time of the machine tool assembly by approximately 50 %.

Keywords: Machine tool, CMM, ATLI, Squareness errors

X3013045

Multiple-point Measurement for Mechanical Strain, Raising Temperature and Working Frequency of a High Speed Spindle using One Fiber Bragg Grating Sensor

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Abstract

High speed spindle is one of core components of a machining center, both thermal expansion and induced deformation within the spindle reduces the accuracy in machining and processing. The direct measurement of temperature and elongation of the spindle is one of key technologies for precision machinery, but the measurement usually needs many sensors and several analog-to-digital converters. It also needs additional efforts to synchronize of measured data. This study uses only one Fiber Bragg Grating (FBG) sensor with multiple gratings to measure the raising temperature, induced strain and working frequency of a built-in type spindle. We first use material testing system (MTS) and a heating plate to quantify the strain coefficient (Ke) and temperature coefficient (Kt) of the FBG sensor, respectively. The two independent coefficients (Ke and Kt) gauge the relation between wavelength shifting and mechanical strain, and between wavelength shifting and temperature difference. This study uses the measured coefficients, Ke and Kt, to construct mechanical deformation and the raising temperature of the high speed spindle. The self-developed program automatically decouples the dynamic response of wavelength shifting, and retrieves raw data of 10 sensing points on the spindle surface. The results of FBG sensors provide time-temperature curve, time-strain curve, and time-displacement curve. We also compare the experimental results of the temperature distribution and elongation of the spindle measured by FBG sensors with those obtained from infrared camera and digital image correlation method, respectively. The agreements between different measured systems not only verify the experimental accuracy of the proposed FBG metrology, but also demonstrate that the FBG system is capable of measuring micro strain. The FBG sensor also provides high signal-to-noise ratio (SNR) than the conventional thermal couple and strain gauge because the optical wave is able to resist the electronic noise induced from the electromagnetic effect. Furthermore, the FBG sensor is only 100 um in diameter and is waterproof, and is suitable for in-situ measurement. The proposed metrology is neat and simple and takes only one fiber to monitoring temperature, deformation and vibration of a spindle for multiple-points. The self-developed system is able to provide feedback signal for industrial controllers, and enhances accuracy and quality of precision machinery.

Keywords: Fiber Bragg Grating sensor, Digital Image Correlation, High Speed Spindle

X3013196

A vision-based system for automated extension measurement

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Abstract

Materials testing is frequently used in the last step of manufactur-ing process. In forming materials, it is better to understand their properties in order to predict the manufacturing outcome. Elongation at Fracture is the amount of uniaxial strain at fracture. Generally elongation is measured by using an ex-tensometer clipped on the specimen through break. Therefore the test specimen may be affected by the extensometer, and the error of measurement may be increased due to knife-edge slippage. Thus an improved method for extension measurement is needed.

Machine vision measurement has become much more popular, and can be applied for rapid, accurate, and non-contact measurement. In this paper, a machine vision measurement system for automatic elongation measurement is developed. By attaching two targets on the specimen under tensile testing, the location of the targets could be determined more accurate using the centroid methods. Thereafter, the elongation between two targets is determined. An image processing scheme consisting of an image interpolation process for sub-pixel edge detection, and a local-thresholding binarization process for target detection is developed to measure the elongation of test specimen automatically. Test of the system on rubber specimen was done. The influence of image interpolation and target size on the accuracy of the measurement was investigated. Comparing to the conventional extensometer measurement, a different of 1.5% between them could be achieved with proper size of target, image interpolation, and calibration.

Keywords: Machine vision, Image processing, Target, Extension measurement

X3013330

A self-tuning cross-coupled two degree-of-freedom PID control for positions synchronization of parallel linear motors

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Abstract

The object of this study is to propose a self-tuning cross-coupled two degree-of-freedom (DOF) proportional-integral-derivative (PID) control strategy for positions synchronization of a parallel linear motors (PLMs) driven stage. First, independent one DOF PID (I1PID) control and cross-coupled 1PID (C1PID) control are designed to control the PLMs, respectively. Subsequently, independent two DOF PID (I2PID) control and cross-coupled 2PID control (C2PID) are further examined to show the enhanced control performances of the two DOF control systems. Though the structure of the C2PID control improves the control performance of the C1PID control, tuning numerous control parameters is arduous. In this regard, a self-tuning C2PID (SC2PID) control is developed in which all the control parameters are optimized dynamically and concurrently through an artificial bee colony algorithm. Numerical simulations show that the proposed SC2PID control performs the best tracking performance with lowest synchronous error compared with the other control schemes.

Keywords: Artificial bee colony algorithm, Cross-coupled control, Parallel linear motors, Synchronous control, Two degree-of-freedom proportional-integral-derivative control

X3013732

Defect Classification and Evaluation System Based on Deep Learning

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Abstract

Artificial intelligence has been widely used in automated optical inspection (AOI) equipment, which enables the detection system to achieve immediate and accurate defect detection. Although the results improved the inspection rate of defects, but did not propose to improve the production of the most fundamental solution - to assess and make effective recommendations and improvements for the manufacturing process. This paper devoted to the development of a fast and intelligent defect classification and evaluation system based on the detected images from an AOI instrument utilizing deep learning techniques.In this study, an artificial neural network based on deep learning method and supervised learning technique was constructed for defect classification and evaluation. Defect images obtained from an imaging module consists of a 12288 pixel-line CCD camera (Basler raL12288-66km) with 3.5 μm per pixel resolution and 10 kHz linear rate was adopted as the training and test samples. In the training process, 224 x 224 pixels were randomly extracted from 100 defect images with a fixed window size of 256 x 256 pixels and 72,000 training runs were performed. Here, the ZF-Net network model was used to train the data for deep learning and a piece of GPU operation card (GTX 1080) was installed to reduce the training time. The inspected surface was a touch panel glass with a size of 43 mm x 229 mm which has 805 million (12288 x 65536) pixel data points and up to 16,115 test images (each 224 x 224 pixels in size). However, the total time for the classification can be finished within 2 seconds. In the classification process, the detail of defect features, such as the flaws in the inclination, size, quantity, and settlement are also provided. The restricted Boltzmann machine (RBM) model training is then carried out to evaluate the test samples and put forward the influencing factors of the manufacturing process. Therefore, the feedback mechanism for improving the manufacturing performance can be achieved by using the unsupervised training method based on the classification results. Experimental results show that an automated defect classification catalogue integrated to an optical inspection result for improvement of any manufacturing operation can be expected with the proposed method.

Keywords: Automated Optical Inspection, Defect Classification, Defect Evaluation, Deep Learning

X3013797

Displacement measurement simulation of three-axis gantry type structure with auto-tracking ranging principle

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Center for Measurement Standards, ITRI

Abstract

Machine tools and coordinate measurement machines (CMMs) are commonly constructed by three linear kinetic chains. There are twenty-one terms of error motion for three-axis structures. Among them linear positioning error has been generally considered because it is convenient to be measured by means of a laser interferometer. However, the squareness error becomes more significant when machine stroke is increasing. The traditional method to evaluate squareness using a laser interferometer is time-consuming and limited to specific implements. The other measuring instrument like a LaserTRACER could be used to measure robot arms, machine tools or CMMs. This kind of auto-tracking ranging system could also be used in squareness evaluation, and even in geometric error evaluation. In this study, a single auto-tracking ranging system is simulated to measure a virtual target. We built a kinetic model of gantry type structure machine which included linear positioning and squareness error motion. Misalignment error which is generated from multilateration method is also considered. These simulation results could be compared with actual experiment data and give scope for geometric error analysis of machine tools.

Keywords: Kinematic model, Error motion, LaserTRACER, Geometric error

X4012782

Electrochemical Impedance Spectroscopy Study of the Electrode Microstructure of the Lithium-Ion Battery

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Abstract

We have investigated the influence of mixing conditions during the positive electrode fabrication on the discharge performance and internal resistances under high rate discharge of a test lithium-ion battery at 30 ℃, employing fast Fourier transform electrochemical impedance spectroscopy in-situ to minimize the change in the state of charge. Components of the internal resistance are identified in the positive electrode by comparing with cross-sectional scanning electron micrographs. The mixing conditions of the active material and conductive filler with the binder and solvent give different active contact area between agglomerated conductive filler and the active material, affecting interfacial resistance. Impedance spectra for metal electrodepositions at the negative electrode from electrochemically dissolved metal contaminants at the positive electrode, which is assumed to adhere during manufacturing, are also investigated for diagnosis of internal short-circuiting, taking advantage of characteristic changes of the impedance spectra (phase angle).

Keywords: AC Impedance, Pre-mixing, Slurry mixing, Porous Electrode, Electrodeposit, Short circuit

X4012809

Enhancement of Photo-thermal Energy Conversion and Utilizations Using Nanomaterials

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Abstract

Studies on the photo-thermal energy conversion enhancement and effective utilization with applying nanomaterials are presented. The first section is emphasized on the development of a microscale solar-thermal reformer for hydrogen production with nanocatalyst. The solar thermal steam-methanol reformer is an effective way of producing energy from renewable resources. The fabrication and investigation of heterogeneous nanoporous catalysts for solar-thermal reformer is then reported. Preliminary experiments were conducted to investigate the performance of the nanocatalytics matrix integrated in a solar thermal reformer. Specifically, CuO/ZnO nanowire catalyst for hydrogen production by solar thermal steam-methanol reforming was fabricated. Such nanowire catalyst is more durable than the conventional nanoparticle catalysts by avoiding agglomeration, and it exhibits ideal optical properties. The nanocatalytic matrix was then fabricated and tested on a large area glass plate substrate demonstrate scaling-up.

The second study is solar-drying of porous thin plates with the assistance of nanowire matrix in an attempt on enhancing the solar energy harvesting and utilization. Experiments and analysis were conducted to understand the transport phenomena of the micro-porous thin plate drying processes. To utilize the solar energy on drying the porous thin plate effectively, the usage of a nanomaterial-based solar absorber, silicon nanowires, was investigated. The significantly reduced spectral reflectivity of silicon nanowire to visible light makes it attractive in solar energy applications. Spectral hemispherical reflectivity and transmissivity of the black silicon nanowire array on silicon wafer substrate were measured. It was observed that the reflectivity is lower in the visible range but higher in the infrared range comparing to the plain silicon wafer. A drying experiment and a theoretical calculation were carried out to evaluate the effects of the trade-off between scattering properties at different wavelengths. It is shown that silicon nanowires can significantly improve the solar thermal energy harnessing.

Keywords: Nanomaterials, Solar energy, Hydrogen

MEMO