2020 5th International Conference on Mechanical, Manufacturing, Modeling and Mechatronics (IC4M 2020)

In Conjunction with ICDES 2020

Conference Programme

http://www.ic4m.net/

Conference organized by

Hong Kong Society of Mechanical Engineers

2020.02.27-02.29 ● China

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WELCOME MESSAGE

Dear All:

As you know the onset of the Wuhan coronavirus has held many communities around China on halt. Our conference, the 2020 5th International Conference on Mechanical, Manufacturing, Modeling and Mechatronics (IC4M 2020) and in conjunction with 2020 5th International Conference on Design Engineering and Science (ICDES 2020), are not an exception. Originally, it is planned to carry out in Shenzhen from Feb. 27 to Feb. 29, now, following the instruction by the government, it has been changed to an online conference. Given the circumstance, I hope you and all the participants would agree that the change would be the best for all of us.

Changing the format however shall not affect the desire of the conference. We wish to continue our communication to share our new research ideas, discuss challenges and form collaborations to solve various issues on mechanical, manufacturing, modeling and mechatronics implementation.

As a result of the change, all the presentations shall be converted to online presenting or posters. The organizing committing will select a number of papers, give additional review comments, and then publish them in a special volume. While we may not see each other face-to-face in Shenzhen, we hope the conference can still establish a solid linkage among all the participant as desired. I look forward to your contribution to making IC4M 2020 & ICDES 2020 a success.

Conference Chair of IC4M 2020 & ICDES 2020

Prof. Du Ruxu, South China University of Technology, China

CONFERENCE SPEAKERS

Keynote Speakers

Prof. Mohd Hamdi Bin Abd Shukor
University of Malaya, Malaysia

Biography: Professor Ir Dr Mohd Hamdi bin Abd Shukor received his B.Eng. (Mechanical), from Imperial College London and his M.Sc. In Advanced Manufacturing Technology & System Management from University of Manchester Institute of Science & Technology (UMIST). His Doctoral study was in the field of thin film coating for biomedical applications for which he was conferred Dr. Eng by Kyoto University. He is a Fellow of the Institution of Mechanical Engineering, UK, and a professional engineer registered with the Board of Engineers Malaysia. Prof Hamdi has devoted his career in nurturing research and innovation and has mentored over 130 postgraduate students, particularly in the field of advanced manufacturing, materials processing and biomaterials. He has authored more than 160 ISI journals and h-index of 27. He is also a director and founder of the University of Malaya's Centre of Advanced Manufacturing & Materials Processing (AMMP Centre), in which has grown from modest-size team of researchers and engineers to an interdisciplinary research hub. Prof Hamdi has obtained recognition from various international and local organizations. Recently, he was appointed as the Vice Chancellor of The National University of Malaysia (UKM).

Keynote Lecture: A journey from engineering research to lab prototype and commercial ready devices

The Centre of Advanced Manufacturing and Material Processing (AMMP), University of Malaya has been involved in developing several innovative precision and specialized machines which are an evolution from a much earlier, mostly fundamental, research activities. The development phases of these machines would involve machine design conceptualization and analysis, lab prototyping, testing and commercial packaging. The first in the series of machine tool development are the modular CNC lathe and gantry machines coupled with a smart lubrication system, designed for the education as well as small and medium enterprises. Next is the Automated Thermo-Cyclic Dipping Machine which is a specialized apparatus for the thermal testing of dental materials that has been successfully commercialized and installed in several dental research facilities throughout the country. The Micro-pulsed Jet Minimal Quantity Lubrication system was designed for lubrication during metal cutting operation while Powder-based Physical Vapour Deposition system, a novel apparatus used for the deposition of thin films, is the latest being developed. Such development has successfully overcome the notion of what being described as 'the valley of death' in research, development and commercialization phases.

Prof. Kai Cheng
Brunel University London, UK

Biography: Professor Cheng is a Chair Professor in Manufacturing Systems at Brunel University London. His current research interests focus on design of high precision machines, ultraprecision and micro/nano manufacturing, smart tooling and smart machining. He is currently leading the Ultraprecision and Micro/Nano

Manufacturing Theme at Brunel University London, which involves 12 academic staff, 5 postdoctoral fellows and about 40 PhD students. Professor Cheng and his team have enjoyed working closely with industrial companies in the UK, Europe, USA and Far East. They are working on a number of research projects funded by the EPSRC, NATEP Program, RAEng, Innovate UK program, EU Horizon 2020 Programs, and the industry. Professor Cheng is a Charted Engineer and a Fellow of the IMechE and IET, and honored as the visiting professor at Harbin Institute of Technology.

Keynote Lecture: Development of ultraprecision machines and machining systems for industrial scale ultraprecision manufacturing: fundamentals, case studies and future perspectives

In this presentation, it firstly provides a critical review on the fundamentals and key enabling technologies for design and development of ultraprecision machines and machining systems. The fundamentals and key enabling technologies cover ultraprecision machines, tooling design, machining processes/cutting mechanics, in-process monitoring and measurement, and the integration of the machining system. Secondly, it discusses and explores the design methods for existing and next generation ultraprecision machines, comprising of 12 precision engineering design principles but focusing on the machine design configuration and specifications, mechanical design, actuation system, control system, tooling interfacing and interaction, in-process monitoring and measurement, the machine system integration. Furthermore, design case studies and application exemplars are presented and discussed including design of ultraprecision machines for manufacturing vari-focal lenses, and ultraprecision machining of contact lenses and PMMA devices respectively in an industrial scale. The presentation is concluded with a further discussion on the potential and future perspectives of developing ultraprecision machining systems for broad precision engineering industries.

Prof. Yongbo Wu
Southern University of Science and Technology, China

Biography: Prof. Wu received his PhD degree from Tohoku University. After professionally experienced for more than 20 years in industries and academic institutes in Japan, he joined Southern University of Science and Technology, China and has served as a chair professor at department of mechanical and energy engineering since May 2017. The current research interests of Prof. Wu are in the multi-field (magnetic, electric, ultrasonic, solid-state chemical reaction) assisted machining. He holds 16 Japanese and 20 Chinese invented patents in precision processing and is author of 5 book chapters, more than 170 refereed journal articles, and more than 200 international/domestic conference papers. Prof. Wu is also active in academic societies and organizations. He has been serving for JSME as chief secretary of technical committee, JSPE as representative member, JSAT and KSMTE as executive board members, ICAT as active member, and ISNM as fellow, respectively, and successfully organized several domestic/international conferences as chairmen.

Keynote Lecture: The Role the Ultrasonic Plays in Precision Machining

In modern manufacturing industries, not only the machining accuracy but also the machining efficiency become important day by day in order to fabricate machine parts or opto-electro devices in high precision and low cost. As a promising machining technology, ultrasonic assisted machining has been extensively employed in precision machining processes. In this presentation, it firstly talks about the generation of the ultrasonic vibration followed by the introduction to its applications in science and technology. Secondly, after the brief presentation of the history of ultrasonic assisted machining, several typical ultrasonic assisted machining processes such as UVM (ultrasonic

assisted machining), RUM (rotary ultrasonic machining), Ultrasonic elliptic assisted machining (UEVM) and so on are explained orderly early or late by proposed time. Furthermore, typical practices on the ultrasonic assisted processes in the speaker's lab are explored including ultrasonic regulating centerless grinding, spiral ultrasonic assisted grinding, ultrasonic assisted internal grinding, ultrasonic assisted turning, ultrasonic assisted fixed abrasive CMP and plasma oxidation/ultrasonic hybrid assisted grinding. Finally, the presentation is concluded with the outlook of vibration assisted machining and manufacturing.

Invited Speaker

Dr. Simon K.S. Cheung
Open University of Hong Kong, HongKong S.A.R., China

Biography: Dr. Simon K.S. Cheung is currently the Director of IT at the Open University of Hong Kong. He received his BSc and PhD in Computer Science from the City University of Hong Kong. He is a Chartered Engineer, Chartered Scientist, and IET Fellow, BCS Fellow, IMA Fellow, HKIE Fellow, and HKCS Fellow. He has served as a guest editor or editorial board member of international journals, and a keynote speaker, technical/programme chair of international conferences. His publications include 1 research monograph, 25 edited books, 12 edited journal issues, 150+ journal articles, book chapters and conference papers. He won the Outstanding Research Publications Award from the Open University of Hong Kong in 2016, the 1st class Achievement in Computer and IT from Shenzhen Science and Technology Association in 2016, and the 1st class Outstanding CIO from the Hong Kong IT Joint Council in 2015. He has been listed in the Who's Who in Science and Engineering since 2006.

Invited Lecture: Petri-net-based Modelling and Analysis of Flexible Manufacturing Systems

Petri nets are theoretically rich for the modelling and analysis of discrete event systems, such as flexible manufacturing systems. A subclass of Petri nets, augmented marked graphs exhibit a special structure for modelling discrete event systems with some shared resources. They possess many desirable properties and characterizations, especially on liveness, boundedness and reversibility. More important, these properties can be preserved after composition. Given a set of live, bounded and reversible augmented marked graphs, after composition, the liveness, boundedness and reversibility can be preserved in the integrated augmented marked graph. These can be effectively applied to the modelling and analysis of flexible manufacturing systems which are typically component-based discrete event systems with some shared resources. This presentation introduces augmented marked graphs and their properties and characterizations. The property-preserving composition of augmented marked graphs is illustrated. It would then show how the manufacturing system components can be modelled as augmented marked graphs, and how the integrated system can be effectively analyzed through the property-preserving composition. All these contribute to an error-free component-based integration for flexible manufacturing systems.

PRESENTATION GUIDE

Oral Presentation

1. File format: MS-PowerPoint (*.ppt) or Adobe PDF (*.pdf)

2. Time: About 15mins, including Q/A time.

3. Language: English

4. Fonts: Arial or Times New Roman

5. Dress code: Formal clothes

6. Facility: Presenters need to use own laptop, please notify conference secretary via e-mail in advance and test the connection before session start.

7. Vedio conference software: TBA

Poster Presentation

1. Poster Size: 1m*0.8m (height*width).

2. Language: English.

3.Poster format: jpg

4. The poster should include: Paper ID, Conference Name's Acronym, Significance of the research, the methods used, the main results obtained, and conclusions drawn.

5. Posters are required to be condensed and attractive.

6. The conference organizer won't send/keep any posters after the conference.

PROGRAMME OVERVIEW

Date	Time	Programme	Location
Feb. 28, 2020	09:00-09:10	Opening Remark	Online Meeting
	09:10-09:50	Keynote Lecture Yongbo Wu	
	09:50-10:30	Keynote Lecture Mohd Hamdi Bin Abd Shukor	
	10:30-12:00	Technical Session I	
	12:00-12:20	Poster Presentation I	
Feb. 29, 2020	14:00-14:40	Keynote Lecture Kai Cheng	
	14:40-15:10	Invited Lecture Simon K.S. Cheung	
	15:10-16:40	Technical Session II	
	16:40-17:00	Poster Presentation II	

TECHNICAL SESSION

Keynote Lecture

Session Chair: Du Ruxu

9:10-10:30, Feb. 28, Friday | Online Meeting

Time	No.	Content	Page
9:10-9:50	K1	The Role the Ultrasonic Plays in Precision Machining ***Yongbo Wu***, Southern University of Science and Technology, China	2
9:50-10:30	K2	A journey from engineering research to lab prototype and commercial ready devices ***Mohd Hamdi Bin Abd Shukor***, University of Malaya, Malaysia	3

Technical Session I

Session Chair: Yongbo Wu

10:30-12:00, Feb. 28, Friday | Online Meeting

Time	No.	Content	Page
10:30-10:45	D006	Structure design and analysis of a novel forward-folding rotor used in a downwind horizontal-axis turbine ***Haoran Meng,*** Tsinghua University, China	10
10:45-11:00	D007	The aero-elastic-wake coupling behavior for a two-wind- turbines case with power control process ***Zhe Ma,*** Tsinghua University, China	10
11:00-11:15	D010	A resonant pressure sensor based on magnetostrictive/piezoelectric magnetoelectric effect ***Lunan Liu,*** Shanghai Jiao Tong University, China	10
11:15-11:30	D036	Investigation on Drill Wear and Micro Hole Quality in High Speed Drilling of High Frequency Printed Circuit Board ***Xianwen Liu,*** Shenzhen University, China	11
11:30-11:45	D1028	Transient quality performance evaluation of multi-stage flexible manufacturing systems ***Shihong Liu,*** Shanghai Jiaotong University, China	11
11:45-12:00	D1029	Branch point algorithm for structural irregularity determination of honeycomb ***Cui Can,*** Central South University, China	11

Keynote Lecture & Invited Lecture

14:00-15:10, Feb. 29, Saturday | Online Meeting

Time	No.	Content	Page
14:00-14:40	K3	Development of ultraprecision machines and machining systems for industrial scale ultraprecision manufacturing: fundamentals, case studies and future perspectives ***Kai Cheng***, Brunel University London, UK	2
14:40-15:10	I1	Petri-net-based Modelling and Analysis of Flexible Manufacturing Systems ***Simon K.S. Cheung***, Open University of Hong Kong, HongKong S.A.R., China	3

Technical Session II

Session Chair: Kai Cheng

15:10-16:40, Feb. 29, Saturday | Online Meeting

Time	No.	Content	Page
15:10-15:25	D004	Plasma Sprayed Titanium Coatings With/Without A Shroud ***Hong Zhou,*** Waikato Institute of Technology, New Zealand	10
15:25-15:40	D008	Structure analysis of an innovative vertical axis wind turbine with inclined pitch axes using finite element method ***Jia Guo,*** Tsinghua University, China	10
15:40-15:55	D016	Output Force Control of a Pneumatic Soft Gripper with a Jointed Endoskeleton Structure ***Zhaoping Wu,*** Nanjing University of Science and Technology, China	10
15:55-16:10	D022	Study on influence of micro-tool tip arc waviness on cutting micro aspheric surface ***Yi Liu,*** Research Center of Laser Fusion, China Academy of Engineering Physics, China	11
16:10-16:25	D031	Importance Measure Analysis Method for Maintenance based on Mutil-Function Testability States ***Zhiyuan Cao,*** Shanghai Jiao Tong University, China	11
16:25-16:40	D1014	Analysis of the Vacuum Chamber Based on the Environmental Simulation Experiment of the Lunar Surface ***Yi Zhang,*** Beijing Institute of Spacecraft Environment Engineering, China	11

Poster Presentation I 12:00-12:20, Feb.28, Friday | Online Meeting	
D003	Workspace Analysis and Dynamics Simulation of Manipulator based on MATLAB ***Niu Guoxian,*** Beijing Institute of Mechanical Equipment, China
D013	A Welding Unit Partition Method of Complex Weld Parts ***Yunfeng Hu,*** Wuhan University of Technology, China
D014	Research on Automatic Manual Transmission of Pure Electric Vehicle ***Hao MEN,*** Xi'an University of Science and Technology, China
D019	Method to integrate human simulation into Gazebo for human-robot collaboration ***Linxi He,*** Tongji University, China
D020	A New Method To Identify The Diesel Engine Modal Parameters Based On Self-Excitation ***Xing Liu,*** Naval Petty Officer Academy, China
D021	Based On Self-Excitation To Identify The Diesel Engine Modal Parameters ***Xing Liu,*** Naval Petty Officer Academy, China
D023	Lean improvement of product P assembly line based on Value Stream Map ***Kai Chang,*** Shenyang Institute of Automation Chinese Academy of Sciences, China
D025	The Design of Hardware System of High Precision Dynamic Flow Controller ***Jie Chen,*** Shanghai University, China
D028	Problem Solving Strategy for Product Variant Design Combined with Improved Neural Network Method ***Liu Yang,*** Nanjing University of Science and Technology, China
D032	Neural Network Based Modelling and Steering Control of an Intelligent Vehicle Under Dynamic Sensitive Conditions ***Kun Zhang,*** Brilliance Automobile Research Institute, China
D034	Adaptive Sliding Mode Control of Artillery Coordinator Based on Disturbance Observer ***Jinjie Gan,*** Nanjing University of Science and Technology, China
D1002	Continuous forming system for forming 3D surface parts and its finite element model ***Mi Wang,*** Changchun Normal University, China
D1004	Problem Solving Strategy for Product Variant Design Combined with Improved Neural Network Method ***Liu Yang,*** Nanjing University of Science and Technology, China
D1008	Multiscale Modelling and Analysis on the Heavy-duty Hydrostatic Journal Bearing for a Precision Press Machine ***Youyun Shang,*** Harbin Institute of Technology, China

D033	Numerical simulation of radial compression and high-temperature creep of metal elastic elements ***Hua Li,*** Shanghai Jiao Tong University, China
D1005	novel comprehensive model of wet clutch during the engagement process ***Baoshan Peng,*** Shenzhen Technology University, China
D1024	Modeling and Analysis of Micro-cantilever Plate Piezoelectric Energy Harvester with a Tip Mass ***Chao Ran Hou,*** Beijing University of Technology, China
D1025	Study on Vibration Characteristics of Cantilever Plate with Annular Mass Frame ***Chao Ran Hou,*** Beijing University of Technology, China
D1033	A Health Status Assessment Approach of Intelligent Manufacturing System based on Fuzzy Analytic Hierarchy Process ***Yu-Yun Kang,*** Linyi University, China
D1034	Experimental study on friction torque of wet clutch under three kind of contact areas ***YAN Xu,*** Beijing Institute of Technology, China
Poster Presentation II **16:40-17:00, Feb.29, Saturday | Online Meeting**	
D1009	Sound Quality Prediction of Vehicle Door Closing Based on Experiment and Boundary Element Method ***Liu Zhe,*** Tongji university, China
D1011	Simulation Study on Flow-induced Vibration Characteristics of Multi-nozzle Ejector ***Yang Yisheng,*** China aerodynamics Research and Development Center, China
D1017	Influence of the clearance of the transmission mechanism of the transmission characteristics ***Jian XU,*** China Academy of Launch Vehicle Technology, China
D1018	Hybrid impedance control of robot manipulators based on generalized momentum ***Kaining Li,*** South China University of Technology, China
D1019	Immersive virtual reality for fire safety behavioural skills training via gesture-based technology ***Fu Yaqin,*** Shanghai University of Engineering Science, China
D1021	Research on Process Reliability of RF Coaxial Cable in Spacecraft Assembly ***Yougao Fan,*** Beijing Institute of Spacecraft Environment Engineering, China
D1026	High Definition Map Based Motion Plan and Control of Autonomous Vehicle on Structured Road ***Kun Zhang,*** Brilliance Automobile Research Institute, China
D302	Restoration and Reuse Design of Industrial Heritage based on Virtual Reality

	Technology ***CHENJUE,*** Guangdong University of Finance & Economics, China
D303	Research and design for hotel security experience for women traveling alone ***Hong-Jiao Wang,*** Guangdong University of Technology, China
D304	Motion analysis-based design of wall painting tool storage ***CHEN LUWEI,*** China Jiliang University College of Modern Science and Technology, China
D306	A Comprehensive IDEF0 Model for System Engineering ***Mina Ebrahimiarjestan,*** Tsinghua University, Beijing, China
D1302	Appling TRIZ Theory in ship overall EMC design ***Xiangxiang Cheng,*** China Ship Development and Design Centre, China
D1306	Design of pre-stressed cable rod radar array structure based on finite element analysis ***Baofu Tang,*** Nanjing Research Institute of Electronics Technology, China
D1309	Research on artificial intelligence in the field of art design under the background of convergence media ***Yan Yu,*** School of art and design, Beijing institute of fashion technology, China
D309	Innovative Design Analysis of Storage Cabinet Based on Traditional Palindrome Symbol ***Kun Li,*** Guangdong Ocean University, China
D310	Research on Public Service Facility Arrangement and Function Distribution in Shopping Malls ***ZHANG QIAN,*** Kyushu University,JAPAN
D1311	Park Accessibility Analysis Based on Location Information and GIS：Take Shanghai Hongkou District as An Example ***Ziran Zhang,*** Shanghai University of Engineering Science, China
D1315	Study on the brine storage design during the engine running in the climatic facility ***Zhang Hui,*** Aircraft Strength Research Institute, China
D040	Research on the density of magnetic fluid and its application in mineral separation ***Ruican HAO,*** Beijing Polytechnic, China
D1006	Temperature variation of wet clutches in the DSG vehicle during a 10km driving cycle ***Jikai Liu,*** Chinese Academy of Sciences, China

ABSTRACT

Technical Session I

Time	Content
10:30-10:45 Feb.28	**D006:** Structure design and analysis of a novel forward-folding rotor used in a downwind horizontal-axis turbine **Presenter:** Haoran Meng, Tsinghua University, China **Abstract:** To alleviate the stiffness constraints of the conventional blade and thus reduce the rotor mass, a novel forward-folding rotor (Downwind Forward-folding Rotor, DFFR) used in a downwind horizontal-axis turbine is presented. This novel rotor is designed to align the combination of gravitational, centrifugal, and thrust forces along the blade path, resulting in primarily tensile loads instead of cantilever loads on the blades. The DFFR blades fold forward at a power-limited condition, which induces the change of the blade pitch angle and cone angle and thus maintains a constant power output. To quantify the mass savings, a 5-MW DFFR was designed based on the NREL 5-MW reference rotor. According to the results calculated by an improved BEM method, the rotor power and torque of the 5-MW DFFR have a slight increase compared with those of the NREL-5MW reference rotor, while the rotor thrust of the 5-MW DFFR is smaller than that of the NREL-5MW reference rotor. Furthermore, based on the finite element analysis, the blade of the 5-MW DFFR had an 18.9% mass saving and an 8.4% peak stress reduction compared with the blade of the NREL-5MW reference rotor, over a range of operating wind speeds and azimuthal angles.
10:45-11:00 Feb.28	**D007:** The aero-elastic-wake coupling behavior for a two-wind- turbines case with power control process **Presenter:** Zhe Ma, Tsinghua University, China **Abstract:** This study focuses on the aero-elastic-wake coupling behavior of wind turbines. A newly developed code called FALM (Flexible Actuator Line Model), which combines the wake simulation ability of the actuator line mothed (ALM) and the structural simulation ability of the flexible multibody dynamics method, was employed to achieve these simulations. The power output and thrust, the natural frequency and deformation and the wake characteristics of a single NREL 5MW wind turbine were studied to validate this code. It shows that nonlinear effects such as spin softening and stress stiffening were fully considered by FALM and it can also guarantee a reliable prediction of power and thrust of wind turbines. Furthermore, a case of two-wind-turbines with the inlet wind speed of 14m/s (exceeding the rated wind speed) were carried out to study the aero-elastic-wake coupling behavior in a wind farm. It shows that FALM is able to simulate multiple wind turbines with power control system involved. The pitch control process of the upstream wind turbine was predicted and the dynamic loads of the downstream wind turbine caused by the wake effect were studied. These results will contribute to the study of reducing the fatigue load caused by wake effect.
11:00-11:15 Feb.28	**D010:** A resonant pressure sensor based on magnetostrictive/piezoelectric magnetoelectric effect **Presenter:** Lunan Liu, Shanghai Jiao Tong University, China

	Abstract: This study proposed a resonant pressure sensor based on magnetoelectric effect induced in magnetostrictive/piezoelectric materials. Due to the magnetoelectric effect, the resonant frequency of the sensor varies as the external applied pressure changes. By studying the nonlinear constitutive parameters of the magnetostrictive material and adopting the equivalent circuit method, the sensor is theoretically analysed and the relationship between the resonant frequency and applied pressure is determined. The prototype of the sensor is optimized based on theoretical model. Optimal parameters of the sensor are determined to ensure high sensitivity. The measurement range of the sensor is 0-360 kPa and experimental studies show that the sensitivity reaches to 11.63 Hz/kPa. The experimental result is in good agreement with theoretical analysis. It can be concluded that the pressure measurement method based on magnetostrictive/piezoelectric magnetoelectric effect is of robustness and accuracy. Analysis shows the proposed mechanism also has the potential in mass measurement.
11:15-11:30 Feb.28	**D036:** Investigation on Drill Wear and Micro Hole Quality in High Speed Drilling of High Frequency Printed Circuit Board **Presenter:** Xianwen Liu, Shenzhen University, China **Abstract:** Due to the severe wear of micro drill and the difficulty on controlling of hole quality, high speed drilling process of high frequency printed circuit board (PCB) was attracted comprehensive attention. In this investigation, the wear width of drills' primary face were measured, and the wear morphologies of micro drills were studied at once. Furthermore, regularity of micro hole quality concerning drilling burr and nail heading while drilling with different types of drills were analyzed. The research results indicated that the wear width of diamond coating drill reduced slightly. Abrasive wear and adhesive wear were mainly occurred on uncoated drill and diamond like carbon coating drill, but some micro breaches appeared on uncoated drill. Meanwhile drilling with diamond like carbon coating drill could obtain better hole quality than drilling with uncoated ones. However, diamond coating drill performed well in terms of ability of wear resistance, as well as micro hole quality.
11:30-11:45 Feb.28	**D1028:** Transient quality performance evaluation of multi-stage flexible manufacturing systems **Presenter:** Shihong Liu, Shanghai Jiaotong University, China **Abstract:** This paper addresses the problem of transient quality performance evaluation in multi-stage manufacturing systems. An analytical method is proposed using Markov model to investigate quality propagation in manufacturing systems with remote quality information feedback during transients. Based on the developed mathematical model, closed expressions for evaluating transient quality performance including the real-time system quality, settling time, are formulated. A computationally efficient aggregation procedure is developed to approximate the transient quality performance measures with high accuracy. A case study is presented to validate the proposed approach on the factory floor, and the results demonstrate the effectiveness for transient quality evaluation in multi-stage manufacturing systems.
11:45-12:00 Feb.28	**D1029:** Branch point algorithm for structural irregularity determination of honeycomb **Presenter:** Cui Can, Central South University, China

	Abstract: Recently, more and more attentions have been paid to structural defect suppression. In this study, branch point algorithm was first constructed for structural irregularity determination of honeycomb structure, so as to identify the geometric defect of similar cellular structures. Detailed principle and process were presented with key steps as image binarization, smoothing & noise suspension, skeletonization, vertex identification and reconstruction. A representative illustration was given. Afterwards, the routine difference has been discussed between the present method and classic Harris algorithm. Some examples in different cases were presented. As the findings turning out that, the branch point algorithm efficiently identifies the vertices of each cell with high precision, even in cases of poor images with low resolution. All these achievements pave a way for high standard honeycomb structure in consistency, reliability and homogeneity.
Technical Session II	
15:10-15:25 Feb.29	**D004:** Plasma Sprayed Titanium Coatings With/Without A Shroud **Presenter:** Hong Zhou, Waikato Institute of Technology, New Zealand **Abstract:** Titanium coatings were deposited by plasma spraying with and without a shroud. The titanium coatings were then assessed by scanning electron microscopy. A comparison in microstructure between titanium coatings with and without the shroud was carried out. The results showed that the shroud played an important role in protecting the titanium particles from oxidation. The presence of the shroud led to a reduction in coating porosity. The reduction in air entrainment with the shroud resulted in better heating of the particles, and an enhanced microstructure with lower porosity in the shrouded titanium coatings were observed compared to the air plasma sprayed counterpart.
15:25-15:40 Feb.29	**D008:** Structure analysis of an innovative vertical axis wind turbine with inclined pitch axes using finite element method **Presenter:** Jia Guo, Tsinghua University, China **Abstract:** Pitch regulation is critical to power performance of wind turbines. However, the complexity of the conventional pitch system of vertical axis wind turbines (VAWTs) retards its appliance. In the present study, an innovative pitch system of a VAWT with inclined pitch axes was proposed where a slider in the main shaft actuated upwards or downwards drives blades to be folded by linkage mechanisms. Effect of design parameters of the pitch system on blade folding movement control sensitivity was evaluated. Loads of joints, deformation of blades and stresses of components were analyzed as well as natural frequencies of the wind turbine with various azimuth and fold angles under rated operational conditions by finite element method and effect of design parameters on structural performance of the wind turbine was investigated. It was found that deformation of blades and stresses of supporting arms deteriorated but natural frequencies of the wind turbine increased when blades were folded in the negative direction. In addition, the increasing arm interval height improved structural performance with the increasing natural frequencies. In the contrary, the decreasing blade linkage length, shaft linkage length and slider height improved structural performance with the decreasing natural frequencies. This study laid the foundation for the further design optimization of the novel pitch system.

15:10-15:25 Feb.29	**D016:** Output Force Control of a Pneumatic Soft Gripper with a Jointed Endoskeleton Structure **Presenter:** Zhaoping Wu, Nanjing University of Science and Technology, China **Abstract:** Soft grippers are suitable for gripping various objects without damage owing to their high flexibility. But current soft grippers have a general problem of insufficient gripping force. To grip objects with different mass and sizes on assembly line safely and reliably, a novel pneumatic soft gripper with a jointed endoskeleton structure was developed and fabricated successfully. The actuation and force bearing functions of the gripper were separated to increase the gripping force. Moreover, to control the output force of the finger tip of the soft gripper, a fuzzy auto-tuning PID controller was designed and the relevant parameters of the controller were determined. Furthermore, a test platform with the designed fuzzy auto-tuning PID controller was developed to control the output force of the finger tip. The test results showed that the controller was able to maintain the desired target output force with a maximum deviation of 0.6 N. At last, the soft gripper was used to grip material objects for testing. From the experiment, it indicated that the output force of the finger tip can reach up to the desired values accurately and various objects can be gripped safely and reliably.
15:25-15:40 Feb.29	**D022:** Study on influence of micro-tool tip arc waviness on cutting micro aspheric surface **Presenter:** Yi Liu, Research Center of Laser Fusion, China Academy of Engineering Physics, China **Abstract:** In this paper, the influence of the waviness of tip arc profile on the surface quality of micro transition arc workpiece is studied. Firstly, the contour curve of the surface of the micro tool was measured by using the radius amplitude measuring instrument, and the characteristic parameters of the waviness in the contour curve were found. A simulation study of the effect of feed rate on the quality of the machined surface of a sine wave model with different characteristics was performed by Matlab. It can be known from the simulation results that when a sine wave of 0.05sin(10t) exists in the contour of the tool tip arc, when the feed rate is small, the impact on the surface accuracy of the workpiece is greater, and a sin wave of 0.02sin(30t) locally affects the regional surface roughness is greater. With the increase of feed rate, a sin wave of 0.02sin(30t) has no effect on the surface roughness of the partial area, while a sin wave of 0.05sin(10t) still has a greater effect on the surface roughness of the partial area.
15:10-15:25 Feb.29	**D031:** Importance Measure Analysis Method for Maintenance based on Mutil-Function Testability States **Presenter:** Zhiyuan Cao, Shanghai Jiao Tong University, China **Abstract:** Maintenance order plays an important role in industrial field, which influences multiple factors such as costs. Current method is based on importance measure using the fault tree analysis. Simply based on the fault tree of the failure condition, such method ignore some vital information hidden in other testability states, and may results in unsuitable maintenance order. This paper puts forward a novel method to evaluate importance measure based on multi-function testability states, which can be used to optimize the maintenance order. To illustrate the utility of this method, the article uses a vehicle model, and compares the different results to validate the effect of the proposed importance measure. This method can be utilized to evaluate the maintenance order containing multiple functions.

15:25-15:40 Feb.29	**D1014:** Analysis of the Vacuum Chamber Based on the Environmental Simulation Experiment of the Lunar Surface **Presenter:** Yi Zhang, Beijing Institute of Spacecraft Environment Engineering, China **Abstract:** The vacuum chamber based on the environmental simulation experiment of the lunar surface mainly provides the simulation space for the comprehensive environmental effect tests such as vacuum, low temperature, irradiation and charged dust, and provides the interface for the relevant environmental sources, in-situ testing instruments, etc. In this paper, a set of vacuum chamber for the experiment is provided, and the finite element analysis, surface temperature analysis and radiation dose analysis of the chamber are carried out. The analysis results provide a guarantee for the experiment and a reference for the related research work.

CONFERENCE COMMITTEE

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