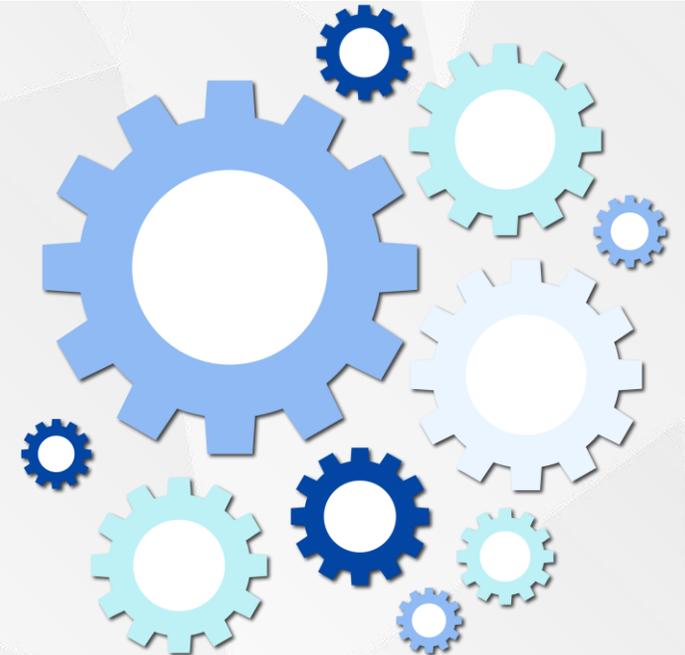


6th International Conference on Mechanical, Manufacturing, Modeling and Mechatronics

6th International Conference on Design Engineering and Science

IC4M 2021 & ICDES 2021 Conference Programme

Feb. 25, 2021 | Virtual Conference



Organized by



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01 / WELCOME MESSAGE



Dear Participants,

Currently, the entire world is struggling against the virulent pandemic COVID-19. Unfortunately, each of us is affected, either overtly or covertly. Our conference, 6th International Conference on Mechanical, Manufacturing, Modeling and Mechatronics (IC4M 2021), is not an exception.

To actively respond the call of the government, to strengthen the protection work, to effectively reduce people gathering and prevent coronavirus transmission, IC4M 2021 which should be held in Guilin, China from Feb. 25 to 27, 2021 as planned, is now changed as on-line conference. 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.

We would like to thank our outstanding Speakers: Prof. Mohd Hamdi Abd Shukor from University of Malaya, Malaysia; Dr. Khamis Essa from University of Birmingham, UK; Prof. Min Wang from Central Academy of Fine Arts (CAFA), China and Prof. Cees de Bont from Loughborough University, UK for sharing their deep insights on future challenges and trends.

We would like to thank all the committees for their great support on organizing the conference. We also would like to thank all the reviewers for their great effort on reviewing the papers submitted to IC4M 2021. Special thanks to all the researchers and students who with their work and participate in the conference.

While we may not see each other face-to-face in Guilin, we hope the conference can still establish a solid linkage among all the participant as desired. We look forward to your contribution to making IC4M 2021 a success.

IC4M 2021 Organizing Committee



Prof. Mohd Hamdi Abd Shukor
(Keynote Speaker)

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 Chartered Engineer registered with the UK Engineering Council and a Fellow of the Institution of Mechanical Engineering (IMechE), 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 33. He was 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. He was also the founder and director of Centre for Research in IR4.0 (CRI4.0). Prof Hamdi has obtained recognition from various international and local organizations. He was appointed as the Vice Chancellor of The National University of Malaysia (UKM) and is currently serving as the Vice Chancellor of University of Malaya (UM).

02 / CONFERENCE SPEAKERS



Prof. Mohd Hamdi Abd Shukor
(Keynote Speaker)

University of Malaya, Malaysia

Keynote Lecture: Development of a new Physical Vapor Deposition systems for functional coatings preparation

Abstract: Several functional ceramic coatings were developed mainly for mechanical and aerospace applications. The used of different Physical Vapor Deposition techniques like electron beam deposition, simultaneous vapour deposition and magnetron sputtering deposition, were utilized to deposit the coatings. The main objective of applying such coatings were to improve the overall mechanical performance of the parts or devices. Finite element method was carried out to ascertain the mechanical behaviour of the coating. Samples were subjected to relevant characterization analysis and physico-chemical tests, particularly to determine the mechanical properties of the coatings. Recently, a newly designed powder based magnetron sputtering system was successfully developed. A lot of exciting experiments were conducted using the system which is able to effectively sputter various type of ceramics, metallic and metallic alloy powders.

02 / CONFERENCE SPEAKERS



Dr. Khamis Essa
(Keynote Speaker)

University of Birmingham, UK

Biography: Dr Khamis Essa is Reader in Advanced Manufacturing and Process Modelling. He is the Deputy Head of the Advanced Manufacturing Centre at the School of Engineering, the University of Birmingham. Dr Essa holds PhD in Mechanical Engineering from the University of Birmingham (2011), BSc and MSc degrees from the University of Alexandria, in Production Engineering. His research is focused on advanced manufacturing technologies for instance Metal and ceramic 3D printing, Hot Isostatic Pressing and Incremental Sheet Forming. He has been developing novel manufacturing routes and applications for aerospace, defence, automotive and biomedical industries. The scientific emphasis of his research is on material and process interaction. He has been also developing holistic modelling for comprehensive understanding of process and material behaviours. He has been leading a number of research projects funded by EU, UK research councils and industry. His research portfolio has a research income in excess of £12M. His research has been supporting major companies across the world including Rolls-Royce, BAE Systems, MBDA Missiles, MicroTurbo, Ford, European Space Agency and Caterpillar. He has been also supporting Small to Medium enterprises through major ERDF funding programmes such as CASIM2 and SmartFub. Dr Essa is currently supervising 15 PhD students and 6 Research Fellows, and he successfully completed the supervision of 14 PhD projects. He was appointed as an examiner for quite large number of PhD and MRes students and acted as reviewer for a number of grant applications.

02 / CONFERENCE SPEAKERS



Dr. Khamis Essa
(Keynote Speaker)

University of Birmingham, UK

Keynote Lecture: Advanced Processing Routes for Netshape Manufacturing

Abstract: There is a growing interest in developing resource-efficient manufacturing processes. This is due to the growing demand, continuous reduction in natural resources and rapid changes in customer needs. Traditional manufacturing processes such as machining and forging have failed to address those challenges. Introducing high temperature materials such as nickel-based superalloys adds more difficulties in terms of shaping these materials. Netshape manufacturing has been introduced as a possible solution for challenges that face existing manufacturing technologies. This presentation will provide insights into the advanced manufacturing routes for netshape manufacturing. In particular, the presentation will explore the recent development in additive manufacturing, hot isostatic pressing and incremental sheet forming. The presentation will also provide insights into the utilisation of numerical modelling such as finite element analysis and computation fluid dynamics to advance these processing technologies. The application of these netshape manufacturing approaches in aerospace, defence and medical industries will be also covered.

02 / CONFERENCE SPEAKERS



Prof. Min Wang
(Keynote Speaker)

Central Academy of Fine Arts (CAFA), China

Biography: Min Wang is Distinguished visiting professor of Beijing Normal University, and professor at China Central Academy of Fine Arts (CAFA) in Beijing, Vice Chair of Central Academy of Fine Arts (CAFA) Academic Committee. Min Wang was the Dean of School of Design at CAFA from 2003 to 2016, he was appointed by the Ministry of Education as Chang Jiang Scholars Professor in 2007 and he was Chair Professor at School of Design of Hongkong PolyU in 2013. Min Wang was council member of Creative Economy, World Economic Forum and he is member of AGI (Alliance Graphique Internationale) and was President of AGI China Chapter from 2013 to 2016.

Min Wang is DeTao Master and partner at De Boer & Wang Studio in Shanghai. Min was the Design Director at Square Two Design in San Francisco from 1998 to 2003, he joined Square Two in 1998 after serving 8 years at Adobe as Design Manager, Senior Art Director, Graphic Designer. Min received MFA from Yale University in 1988 and he had been a visiting fellow in Germany. In 1989, he began lecturing in graphic design at Yale University, teaching graduate students until 1997. Min's work has been exhibited internationally and in the collection of Museums. Square Two Design clients include: Adobe, IBM, Intel, Netscape, and Stanford University.

02 / CONFERENCE SPEAKERS



Prof. Min Wang
(Keynote Speaker)

Central Academy of Fine Arts (CAFA), China

Keynote Lecture: Design in the Age of Artificial Intelligence

Abstract: Today we are faced with opportunities and challenges brought by artificial intelligence, machine deep learning, brain-computer connection, and many technologies and concepts are quickly entering our world. Technology will once again change the way designers work, will it also change the value of design? Will the machine replace the designer? Through the desktop publishing revolution, the Internet and the changes in designer work and design industry during the industrial revolutions, we explore the relationship between machines and people, algorithms and imagination, technology and art in the future of artificial intelligence.

02 / CONFERENCE SPEAKERS



Prof. Cees de Bont
(Keynote Speaker)

Loughborough University, UK

Biography: Cees de Bont is the dean of Loughborough School of Design and Creative Arts School. Before that, Cees was the dean of the Faculty of Industrial Design Engineering of the Delft University of Technology (2005-2011) and dean of the School of Design of the Hong Kong Polytechnic University (2012-2018). Cees also worked for Royal Philips Electronics in various leadership roles related to design, marketing and strategy (1995-2005).

Cees co-authored many academic papers in top journal, such as: Design Studies, Design Issues, International Journal of Design, Journal of Product Innovation Management, She ji: The Journal of Design, Economics and Innovation, Journal of Engineering Design, etc. His academic interests are in design education, consumer behavior, the adoption of innovations and responsible design.

Cees de Bont holds a BSc in Psychology and a MSc in Consumer Psychology from Tilburg University and a PhD from Delft University of Technology (1992). In 2017, Cees won the ICoNNN Award.

02 / CONFERENCE SPEAKERS



Prof. Cees de Bont
(Keynote Speaker)

Loughborough University, UK

Keynote Lecture: Re-inventing design: how design evolved and gained new significance

Abstract: Over the years the design profession has progressed from analogue to digital. Currently design manifestations often consist of tangible and intangible elements. This has changed the design profession and design education in profound ways. Another major change to the design profession is the increase in taking on board of projects with social and societal relevance by many design practitioners and design academics. Projects are nowadays about topics related to social inclusion, homelessness, etc. Another evolution in our field is the way we engage with stakeholders. Co-creation has become increasingly popular and we continue to develop our design research methods to better understand buyers and users of products and services.



Oral Presentation

1. File format: MS-PowerPoint (*.ppt) or Adobe PDF (*.pdf)
2. Time: About 15mins, including Q/A time. Each presentation should have at least **10 minutes**.
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.

Poster Presentation

1. Poster Size: 1m*0.8m (height*width).
2. Language: English.
3. The poster should include: Paper ID, Conference Name's Acronym(IC4M 2021), Significance of the research, the methods used, the main results obtained, and conclusions drawn.
4. Posters are required to be condensed and attractive.
5. The conference organizer won't send/keep any posters after the conference.

Note:

1. We'll record the whole conference. If you do mind, please inform us in advance. We'll stop to record when it's your turn to do the presentation.
3. The recording will be used for conference program and paper publication requirements. It cannot be distributed to or shared with anyone else, and it shall not be used for commercial nor illegal purpose.

04/ PROGRAMME OVERVIEW



Feb. 25, 2021 Thursday | Beijing time, GMT+8 | Room ID: 593 209 871

9:30-9:40		Opening Remark
9:40-10:20	Keynote Lecture 1	Development of a new Physical Vapor Deposition systems for functional coatings preparation Prof. Mohd Hamdi Abd Shukor, University of Malaya, Malaysia
10:20-11:00	Keynote Lecture 2	Design in the Age of Artificial Intelligence Prof. Min Wang, Central Academy of Fine Arts (CAFA), China
11:00-12:15	Technical Session 1	M001; M003; M1006; M1008; M1011
12:15-14:30		Lunch
14:30-15:45	Technical Session 2	M312; M1301; M1303; M1311; M1312; M1314
15:45-16:00	Poster Session	M306; M307; M308; M309; M310; M1305; M1306; M1309; M1310
16:00-16:40	Keynote Lecture 3	Re-inventing design: how design evolved and gained new significance Prof. Cees de Bont, Loughborough University, UK
16:40-17:20	Keynote Lecture 4	Advanced Processing Routes for Netshape Manufacturing Dr. Khamis Essa, University of Birmingham, UK



Technical Session 1

Session Chair: Prof. Ismail Fidan

11:00-12:00, Feb. 25, Thursday | Room ID: 593 209 871

M001

11:00-11:15

Effects of misalignment on the sliding rates of parallel line gear pair

Yifan Lin, South China University of Technology, China

Abstract: The sliding rates of parallel line gear pair (PLGP) are equal to zero and pure rolling meshing can be achieved under ideal condition. In this paper, effects of misalignment on the sliding rates of PLGP were studied. Firstly, the geometric model of PLGP was presented. Then the contact curves of PLGP with misalignment were obtained by the tooth contact analysis (TCA) method and the sliding rates were calculated. The calculation results of the example show that PLGP under ideal condition or with only axial deviation accomplishes transmission along the theoretical contact curves, the sliding rates are equal to zero, and pure rolling meshing can be achieved. For PLGP with centre distance deviation and parallelism misalignment, the sliding rates are not equal to zero and the form of relative motion between the meshing surfaces combines rolling and sliding. This investigation provides a theoretical basis for the further study of meshing efficiency and wear prediction of line gear pair under actual operating condition.

M003

11:15-11:30

Research on speed control strategy of chassis dynamometer assisted driving

Xiaorui Zhang, Xi'an University of Technology, China

Abstract: It is an inevitable trend of the development of the vehicle industry to realize the automation of the unmanned test workshop and the chassis dynamometer. In order to meet the precise control of the speed of the tested vehicle on the chassis dynamometer, a fuzzy PID control strategy was proposed according to the working process of the assisted driving control system, that is, on the basis of the traditional PID control, the parameters of the fuzzy inference module were added for real-time adjustment to achieve faster response to changes in vehicle speed and more precise control of vehicle speed. The Matlab-Cruise joint simulation platform was established, and NEDC operating conditions were used for simulation. The simulation results showed that both PID control and fuzzy PID control could achieve vehicle speed following accuracy of $\pm 2\text{km/h}$. Fuzzy PID control had higher vehicle speed following accuracy, and the response was faster when the speed changed, and the overall control effect was better than PID control. The research results provide a technical basis for assisted driving to achieve precise vehicle speed control, and at the same time provide a reference for the realization of an unmanned test workshop for chassis dynamometers.

05/ TECHNICAL SESSION 1

M1006

11:30-11:45

A melt pool geometry prediction model for selective laser melting

Binqi Liu, Tsinghua University, China

Abstract: In selective laser melting (SLM), there is an urgent need to control the building process and eliminate the common defects, such as lack of fusion and keyhole pores. A proper prediction of the melt pool geometry is of great value to help to optimize the process parameters and upgrade the final quality. Based on the thermal balance within the melt pool front, a novel analytical model of the melt pool is proposed under a few assumptions supported by previous experimental and simulation discoveries. Single-track experiments and corresponding numerical simulations are carried out for validation of the analytical calculations. The results prove that the new analytical model gives a quick and accurate prediction of the melt pool dimensions when the input energy density is in the medium range. It is shown that the recoil pressure and the flow of the melted metal play an important role in the heat equilibrium. Further investigation links the analytically predicted melt pool geometry and the defect thresholds of the inadequate fusion and the keyhole transition as well. The potential of the analytical model in rapidly predicting molten pool cross-section geometry and determining the process window is demonstrated.

M1008

11:45-12:00

Optimization of edge extraction algorithm for objects in complex background

Jiang Yu, Wuhan University of Technology, China

Abstract: In the field of artificial intelligence, machine vision is expected because of its low cost and easy popularization. Feature extraction is one of the core steps of machine vision. When we use Canny algorithm, which extracts edges by gray level change, we cannot directly separate the object from the background. The edge information of the object will also be lost when the Gaussian filter smoothes the image. The research proposes an improved edge extraction algorithm based on Canny algorithm. We use the image difference method and object envelopment method to separate the object from the background, so the data to be processed is greatly reduced and the speed and accuracy of the algorithm are improved. Then we use bilateral filtering instead of Gaussian filtering, which increases the weight of gray difference on the basis of Gaussian filtering, so we can to retain more edge information. Finally, we improve the gradient operator, by determining the gradient operator coefficient according to the inverse ratio of the Euclidean distance between the pixel and the center pixel. The average performance of the new gradient operator in the center of the picture is better than that of Sobel operator. Experimental simulation shows that the algorithm has good detection accuracy. Compared with traditional algorithms, the improved algorithm is not affected by complex backgrounds, and reduce the influence of light. The improved algorithm has clear edges in the center area of the image.

M1011

12:00-12:15

Research on Adaptive Grasping of Robotic Manipulator with Depth Visual Perception

Wenjiang Liang, Southwest Petroleum University, China

Abstract: Aiming at the problem of poor grasping performance and low repetitive teaching efficiency when traditional machine vision-based robots are facing the grasping tasks of objects with unknown heights, an adaptive grasping method of robotic manipulator based on depth visual perception feedback control is proposed. The RGB-D image is acquired through the depth camera, and the embedded computing device is used to process the RGB-D image based on ROS(Robot Operating System) to obtain the object positioning information. Finally, the coordinate information of the object is used to control the joint motion of the robot to perform the grasping task. The experimental results show that the method is robust and requires a small amount of data, and it can grasp the target object with unknown height without teaching..



Technical Session 2

Session Chair: Ts. DR VELU PERUMAL KMW

14:30-16:00, Feb. 25, Thursday | Room ID: 593 209 871

M312

14:30-14:45

Dynamic and static analysis of a AGV forklift

Wen Yan, Southeast University, China

Abstract: In this paper, a dynamic counterweight device is designed to avoid the offset of AGV forklift in the actual vehicle operation; the strength of the working device under dangerous working conditions is verified by finite element static analysis; based on the multi-body dynamics theory, the dynamic analysis of the forklift truck shows that the reason for the deviation is the eccentric load of the forklift after lifting. The function of the dynamic counterweight device is verified by the dynamic analysis of whether there is a dynamic counterweight device or not. The results show that the dynamic counterweight device can significantly improve the running deviation of AGV forklift when the eccentric load meets the design requirements, and improves the motion accuracy.

M1301

14:45-15:00

A Study on the SW Coding Education Method Using Arduino in the Age of Internet of Things

Chun Hyunjin, Nanjing University of Aeronautics and Astronautics, China

Abstract: With the advent of the Fourth Industrial Revolution, education suitable for future society is important. In general, the talent required in the future society is a person with problem-solving skills and creativity. In developed countries like the United States, various educational methods are studied to improve these abilities. A typical education is computer software education. In particular, with the development of the Internet of Things, computer coding education using hardware is becoming more and more important. So this paper tries to study the SW coding education method using Arduino, the representative educational hardware. The results of the study are as follows. SW coding education should develop into a problem-solving curriculum. In particular, a curriculum should be developed to solve problems that can be found in our real lives. The results of this study can be basic data for computer software education related to the Internet of Things.

M1303

15:00-15:15

A Study on the Methods and Utilization of Drone Education in the Fourth Industrial Revolution

Chun Hyunjin, Nanjing University of Aeronautics and Astronautics, China

Abstract: In the era of the Fourth Industrial Revolution, various high-tech technologies are developed. Among these technologies, drone field is currently very burgeoning and important. Especially when drones become cheaper, drone technology gets more popular. Therefore, research on the methodology of drone education is very necessary. And in future societies, the demand for creative talent increases. However, there is a lack of relevant research compared to the importance of drone education. So this study is about the methodology of drone education that is practically available in educational institutions. The results of this study can enhance learners' understanding of drones and the opportunity to use drones in various fields. In addition, the learners will be able to improve their problem-solving skills and creativity. And these findings can be used in future drone projects. In addition, the result of the study can be a theoretical basis for future education.

M1311

15:15-15:30

Research on Symbol Color of Automotive Augmented Reality Head-up Display

Xingjian Zhou, Southeast University, China

Abstract: Complex environmental information and lighting conditions will affect the usability of automotive augmented reality display in the outdoor environment. In this way, users' recognition and semantic understanding of AR-HUD information may be affected. The driver's cognitive performance directly affects the driving safety and driving experience, so the color-coding of AR-HUD is very important for the driver to identify information easily, quickly, and accurately. Taken the automotive AR-HUD display as the object, this paper compared the visibility and significance of foreground object colors in different backgrounds in the way of combining both subjective and objective experiment methods. The experimental results show that the color of white, cyan, and green are recommended to be used in automotive AR-HUD display, which has a positive influence to improving the automobile AR-HUD color design.

06 / TECHNICAL SESSION 2

M1312

15:30-15:45

Research on User Experience Based on Competition Websites

Jiawei Xu, SouthEast University, China

Abstract: The design of the website interface has an impact on the user experience in all aspects. A set of relatively perfect interactive interface is often in line with the needs, cognition and behavior of the target user to form a good experience. In order for users to have a good experience in their use, subjective evaluation and usability evaluation methods are usually used to test and tune after the interface is designed. This analysis method has its limitations. For example, it cannot reveal the thinking process and psychological activities of the user and the interface in the interaction process for the designer, and provide the tester with the time and space information of the user's search and processing process. This paper adopts more cutting-edge research methods. First, we analyze the usability of three websites of the same type and different structure, such as evaluating the effectiveness by task completion rate and error rate, and evaluating efficiency by operating time and operating path. Secondly, conduct eye movement experiments on users, further assist and re-verify the usability evaluation method, and analyze its dynamic interaction characteristics, and conduct a comprehensive user experience research on competition websites from qualitative and quantitative perspectives.

M1314

15:45-16:00

Analyze the quality of Math Kangaroo problems with a content analysis

Peijie Jiang, East China Normal University, China

Abstract: The research analyzed problems in Math Kangaroo (5&6) with a content analysis method from four aspects: problem background, knowledge structure, cognitive structure and thinking mode. There were several detailed analysis indicators for each aspect. The research results show that the problems in Math Kangaroo have the following characteristics: the pictures are beautifully presented, the backgrounds are natural and interesting, and it does not deviate from the essence of mathematics; the knowledge points are not much, but a deep understanding is required; mathematical thinking and problem analysis are needed. The enlightenment is: good problems are problems that the problem solving process should help improve students' thinking ability and they should be solved by serious thinking.



Poster Session

Session Chair: Ts. DR VELU PERUMAL KMW

14:30-16:00, Feb. 25, Thursday | Room ID: 593 209 871

M306

Research and optimization of nonlinear damping vibration isolator based on parallelogram linkage

Junwen Luo, Southeast University, China

M307

Research on Structure Design of The Dual Steel Disc in Brake Based on Rigid-Flexible Coupling Simulation Analysis

Changyuan Li, Southeast University, China

M308

Adaptive Modification of Digital Twin Model of CNC Machine Tools Coordinately Driven by Mechanism Model and Data Model

Peng Zhao, Southeast University, China

M309

Active control of the space-borne antenna reflector considering thermal load

Rui Huang, Southeast University, China

M310

Thermomechanical Coupling Simulation and Analysis of Wet Multi-Disc Brakes During Emergency Braking

Ziyun Wang, Southeast University, China

M1305

The use of digital advancement technology in protecting the Longmen Grottoes Art

Li Xiaoshu, University Putra Malaysia, Malaysia

M1306

Research on the persuasive design of healthy living products

Ji Kang, University Putra Malaysia, Malaysia



M1309

Cultural Elements Extraction and Cultural Creation practice of Chinese Frontier Fortress
Jie Du, Xi'an University of Technology, China

M1310

Product Innovation: A Multimodal Interaction Design Method based on HCI and TRIZ
Shaohan Chen, Universiti Putra Malaysia, Malaysia



Conference Co-chairs

Ruxu Du, South China University of Technology, China

Cees de Bont, Loughborough University, UK

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Zhifeng Liu, Beijing University of Technology, China

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Jan Detand, Ghent University, Belgium

Kai Cheng, Brunel University, UK

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Yu Liu, Jiangnan University, China

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Anantkumar Dada Ozarkar, Manipal University Jaipur, India

Fang Xu, The University of New South Wales, Australia



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Zisong Wang, Tongji University, China

Lei Zhang, Tongji University, China

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