

2021 IEEE International Symposium on Product Compliance Engineering - Asia (ISPCE-ASIA 2021)

**Taipei, Taiwan
30 November – 1 December 2021**



**IEEE Catalog Number: CFP21BWD-POD
ISBN: 978-1-6654-4343-2**

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IEEE Catalog Number:	CFP21BWD-POD
ISBN (Print-On-Demand):	978-1-6654-4343-2
ISBN (Online):	978-1-6654-4342-5

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November 30 / Auditorium, 1F

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[IS I] Invited Speech I

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[KS II] Keynote Speech II

Chair: Maxi Tsai (CSA Group)

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Daniel Liang (TCIC Global Certification Co. Ltd., Taiwan)

[O2] System Safety

Chair: Edward Lin (UL Taiwan)

- | | | |
|------|-------------|---|
| O2-1 | 14:15-14:30 | <p>Performance Evaluation of Video Surveillance System for Use In Automatic Recognition Application...48</p> <p><i>Jase Liao* and Jack Lee (Underwriters Laboratories, Taiwan)</i></p> <p>Automatic Recognition image analysis is playing a major role in supporting the advancement of modern safety and security protections. Correct and reliable detection of human and object in the video is one of the biggest challenges in the recognition system. This paper presents a systematic testing method to help evaluate the performance of the black box models used in machine learning systems. Computational image analysis technology as well as a standardized test plan is one of the best solutions to the video surveillance system used in recognition applications.</p> |
| O2-2 | 14:30-14:45 | <p>Health Monitoring and Prediction of Cells in a Battery Module or Pack under Operating Condition...53</p> <p><i>Limin Chen* (Freelancing, Taiwan)</i></p> <p>The state of health of cells in a battery pack under operating condition is difficult to obtain through existing IEC and ISO standard methods under laboratory conditions. However, a cell SOH profile shall be able to establish by the comparison of electroimpedance spectroscopy generated statically versus dynamic operating data retrieved by BMS communication interface as fragments of EIS.</p> |
| O2-3 | 14:45-15:00 | <p>3D Printed Manikin for Human Factor Testing Programs...56</p> <p><i>Limin Chen* (Freelancing, Taiwan)</i></p> <p>Personalized and customized electronics is a technical trend, however, the test of human factor by using manikin with traditional mold cast metal become expensive and inability to simulate the real human due to flexibility of sizing and molding designs. By body scanning, software image post processing, material selection and different printing methods, 3D printing can provide flexibilities in the geometry of human factor design, while also reserve the conveniences to build in embedded channel and slots for various sensors and selection of materials.</p> |
| O2-4 | 15:00-15:15 | <p>Hazard Identification for Consumer-Grade Head-Mounted Displays (HMDs)...59</p> <p><i>Jim Kao* (Underwriters Laboratories, Taiwan)</i></p> <p>Head-Mounted Display (HMD), including optical see-through (e.g., AR glasses), video see-through or non-see-through types (e.g., VR), is one type of display devices which is worn on the head. Depends on the applications, it could be used by different age group, in different environmental conditions and may be used for a dozen of minutes to even a few hours.</p> <p>The HBSE (Hazard-based safety engineering) standard IEC 62368-1 is applicable to the safety of electrical and electronic equipment within the field of audio, video, information and communication technology, including HMDs. In this study, we discussed IEC 62368-1 requirements for HMDs. Then we identified possible hazards of HMDs with reference to IEC Guide 104 and risk assessment standards ISO 12100 and EN Guide 32. After that, we identified possible hazards and provided recommendations based on the existing research.</p> <p>We limited the scope on the consumer-grade HMDs only due to page restrictions. Possible hazards occur in other domains/ applications may need more supporting reference and will be the future work.</p> |

[IS II] Invited Speech II

Chair: Edward Lin (UL Taiwan)

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[KS III] Keynote Speech III

Chair: Maxi Tsai (CSA Group)

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[O1] Autonomous Vehicles Technologies

Chair: Chih-Peng Fan (National Chung Hsing University)

O1-1 10:00-10:15 Driver Distracted Behavior Detection Technology with YOLO-Based Deep Learning Networks...30*Yen-Sok Poon, Ching-Yun Kao, Yen-Kai Wang, Chih-Chin Hsiao, Ming-Yu Hung, Yu-Ching Wang and Chih-Peng Fan* (National Chung Hsing University, Taiwan)*

In order to develop a non-contact driving behavior detection system for the improvement of driving safety, in this study, the YOLO-based deep learning technology is utilized by setting up a webcam on the dashboard to detect the driver's behaviors. By RGB-channel images as inputs, the YOLO-based deep learning models, including YOLOv3-tiny, YOLOv3-tiny-3l, YOLO-fastest, YOLO-fastest-xl are adopted and trained as the candidate detectors. The detected behaviors involve normal driving, distracted head turning, drowsiness, eating, talking on the phone, etc. The experimental results show that when the same parameters are set, the YOLO-fastest-xl has the best performance with multi-category datasets, and its F1-Score, false negative rate (FNR), and mAP are 91.84%, 6.94%, and 95.81%, respectively. By the software implementation, the proposed design performs 30 frames per second (FPS) on the NVIDIA GPU-based embedded platform.

O1-2 10:15-10:30 A Delay Analysis for the Delivery of Downstream Safety Related Messages in Vehicle Ad Hoc Networks...35*Jeng-Ji Huang*, Jia-Hong Lu and Jih-Yue You (National Taiwan Normal University, Taiwan)*

The delay incurred during which messages are transmitted by a vehicle to its downstream vehicles in a vehicle ad hoc network (VANET) is analyzed in this paper. In related works the recovery delay of rebuilding network disconnection has been calculated; however, most of them only consider upstream message transmissions. This work continues our previous research but uses a different analytical method. It is because our previous calculation method, in which the central limit theorem is used, is suitable for long distance message transmissions. When message transmissions are short-distance, previous analysis may lack good accuracy. Therefore, the recovery delay probability distribution for repairing a single network disconnection will first be calculated in this paper. Since the calculations include the sum of random variables, Laplace transform and its inverse transform will be used. Numerical results show that our analysis is very accurate.

O1-3 10:30-10:45 Surface Defect Segmentation based on Deep Active Learning...N/A*Jing-Ming Guo*, Ting-Hsuan Chen and Sheng-Jie Liao (National Taiwan University of Science and Technology, Taiwan)*

This study proposed a surface defect segmentation method based on the deep active learning. By adding active learning mechanism to deep learning architecture, the model can be optimized through manual intervention. Active learning is a mechanism to design a set of computing processes to determine which unlabeled image is selected by analyzing the data computed by the model. Most active learning algorithms determine the priority based on the uncertainty and diversity of the candidate images. Their ultimate goals are mainly twofold. One is to annotate the selected data instead of the entire unlabeled dataset to reduce the labor cost. The other is to make the model select objects that are conducive to the optimization of the model so that the model can obtain good results with a small amount of data. This study conducts experiments on the surface defects of the object. Taking advantage of the characteristics of all elements in images is in the same material, the objects of comparison are divided into two parts. First, comparing the deep features of different positions of the same candidate. Second, comparing the similarity between different candidates. This study conducts experiments on the Crack-Forest Dataset to simulate the imbalance of positive and negative samples in practical applications, we cropped and reformates the images of the dataset. Experimental results show that adding active learning mechanism can effectively select more defective samples in the first few rounds so that the accuracy can be improved quickly.

[O1] Autonomous Vehicles Technologies

Chair: Chih-Peng Fan (National Chung Hsing University)

O1-4 10:45-11:00 Path-Permutation Code for Unmanned Aerial Vehicles (UAV) Network with Opportunistic Links...40*Jyun-Sian Wu*, Syuan-Yi Chen and I-Wei Lai (National Taiwan Normal University, Taiwan)*

In this work, we investigate the possibility of applying the path-permutation code (PPC) for the unmanned aerial vehicles (UAV) network. In particular, due to several issues like limited bandwidth and energy, the end-to-end transmissions in UAV networks are constituted by opportunistic links, which can be mathematically abstracted by the erasures fading channels. In such channels, the end-to-end feedback and controls require tremendous overheads and may be still unreliable. Originated from the virtual multiple-input multiple-output (MIMO) framework in the cognitive radio network, the PPC and its generalization have been demonstrated as a promising solution to communications in fading erasure channels. Our numerical simulations show that PPC may also be suitable for the UAV networks.

O1-5 11:00-11:15 Three Dimensional Light Detection and Ranging Decoder Design for Autonomous Vehicles Technologies...43*Yu-Cheng Fan* (National Taipei University of Technology, Taiwan)*

In the area of automation, a major development trend in the next few years will be autonomous cars. Because autonomous driving is the future trend and Light Detection and Ranging (LiDAR) is the core of autonomous driving, one of the key themes in autonomous car research in LiDAR. We propose an efficient COordinate Rotation Digital Computer (CORDIC) iteration circuit design for Light Detection and Ranging (LiDAR) sensors.

[O3] Product Compliance

Chair: Yen-Lin Chen (National Taipei University of Technology)

O3-1 14:15-14:30 Energy Management System for a Hybrid Electric Vehicle Using Reinforcement Learning...65*Syuan-Yi Chen*, Hsiang-Yu Lo, Tung-Yao Tsao and I-Wei Lai (National Taiwan Normal University, Taiwan)*

This study develops an energy management system (EMS) for an engine/motor hybrid electric vehicle (HEV) using reinforcement learning (RL) approach. Firstly, the vehicle is modeled on the basis of second-order dynamics, and featured by five major segments: a battery, a spark ignition engine, a lithium battery, transmission and vehicle dynamics, and a driver model. Subsequently, a four-mode rule-based (RB) control strategy is designed to allocate the power distribution of dual power sources of HEV. In addition, to improve the energy efficiency for the HEV, the RL method is further utilized to find the optimal power-split ratio according to the built model. Meanwhile, a state reduction mechanism is developed to decrease the state number and thereby reducing the computational complexity of the RL method. During the RL search, equivalent fuel consumption of the engine and motor is used as the fitness function. Suitable energy allocation between the gasoline engine and the battery pack can be determined by the Q-learning algorithm. To compare the energy control performances of the RB and RL, an equivalent consumption minimization strategy is evaluated as the best case. The simulation results including equivalent fuel consumption and CO₂ emission verify that the proposed RL-based EMS searches the optimal solution more efficiently than the RB control for the engine/motor HEV.

[O3] Product Compliance

Chair: Yen-Lin Chen (National Taipei University of Technology)

- O3-2 14:30-14:45 **A Study on Safety of Pet Food Products...67**
Shu-Lun Mak, Tanya Wu, Fanny Tang and Jimmy Li (Hong Kong Metropolitan University, Hong Kong); H Wang and Kim Fung Tsang (City University of Hong Kong, Hong Kong)*
 The population of pets in the developed countries was increased significantly in the past ten years. The owners concerned the safety of pet products. However no special pet product safety standards or certification schemes are available. The industry applied the human product safety standards on the pet products, which may be detrimental to pets because some human-safe food could be toxic for pets. This paper develops a pet food safety evaluation (PFSE) scheme to distinguish the harmful human food for pets based on artificial intelligence (AI) schemes. The paper firstly introduced the current market of pet products in the developed countries. Secondly the major differences of toxic substances to human and pets were reviewed. The available pet food standards were then discussed. Then, the feasibility of applying human food certification schemes to pet food products is studied. Finally, the PFSE is described, and an illustrative simulation is done.
- O3-3 14:45-15:00 **3D Image Inpainting for Rotor Detection Using 3D Encoder-Decoder Generative Adversarial Network...72**
Yen-Lin Chen, Yi-Hao Chung, Chao-Wei Yu and Bo-Rui We (National Taipei University of Technology, Taiwan)*
 3D sensors are widely applied in modern manufacturing automation. The overexposed images for rotors are major issues for rotor dynamic balancing system using 3D sensor technology. This paper presents a new image reconstruction for rotors using depth information (IRRUDI) which applies 3D sensor to obtain amplitude and depth images for a rotor. The overexposed areas can be detected by using depth information. Therefore, the mean value of amplitude images can be obtained to repair overexposed pixels. Experimental results showed that our proposed method was superior in terms of efficiency, effectiveness, and robustness in online, real-time manufacturing automation system.
- O3-4 15:00-15:15 **A Review of Compliance Design for Semiconductor Fabrication Equipment...74**
George CF Chan (ASM Pacific Technology Ltd., China); Chi Chung Lee (The Open University of Hong Kong, Hong Kong); Yang Wei and Kim Fung Tsang (City University of Hong Kong, Hong Kong)*
 In order to fulfill a great demand of IoT and 5G technology, more and more Semiconductor Fabrication Equipment (SFE) have been manufactured. The fastest and most accurate machinery have been launched to the semiconductor industry. Without stringent and smart manufacturing consideration, it would lead the customers' safety risk. This review article introduces the newest European Union (EU) and United States (US) regulatory requirement and propose a detail compliant design rationale for SFE manufacturer. This article is a comprehensive tool for designer to understand the compliance design solution and implementation measures.

[O4] Functional Safety & Regulations

Chair: Cheng-Hung Lin (National Taiwan Normal University)

- O4-1 15:45-16:00 **A Review on Mechanical Properties Modification of Polymer with Talc Powder...80**
Shu-Lun Mak (Hong Kong Metropolitan University, Hong Kong)*
 Recycling always acts as the best solution for the aggravated plastic pollution. One of the potential applications for these recycled plastics is 3D printing filaments in the Fused Deposition Modelling (FDM) Printers. However, the mechanical performance of recycled plastics may not up to standard for application, thus additives are essential to improve their mechanical properties. Talc powder has been used in the polymer industry for many years owing to its abundance, non-toxicity, high aspect ratio and low-cost. Besides traditional additive, the alternative to talc powder is the bio-oil extracted from food waste using in the recycled 3D printing filaments is also being investigated under our research study. The objective of this paper is studying the effectiveness of talc on mechanical properties alteration in different types of polymers, and the production method and ratio of talc content for talc-filled composites in previous works of literature. It is found that the twin-screw extrusion process is commonly adopted for many studies. It is confirmed that talc can improve stiffness, crystallization, thermal stability and modify the viscosity behavior of different polymers, but high talc content would reduce the impact strength and strain at break.
- O4-2 16:00-16:15 **Virtual /Augmented Reality (V/AR) Inspection Training and Education in Modular Integrated Construction (MiC)...N/A**
Chi Ho Li, Shu Lun Mak, Fanny Tang, Sing Kit Pang, Ka Chun Wong and Wai Yui Lau (Hong Kong Metropolitan University, Hong Kong)*
 Modular Integrated Construction (MiC) is an emerging construction method in the last decade, the construction industry can enjoy both physical and environmental benefits to shorten the construction lead time and cost. Many researchers focused on the virtual and augmented reality (V/AR) applications on the traditional construction method but seldom on MiC. This paper will discuss (1) traditional and MiC construction methods, (2) V/AR trainings and (3) potential V/AR inspection in MiC.
- O4-3 16:15-16:30 **An Efficient Anomalous Action Recognition Model based on Out-of-Distribution Detection...85**
Pei-Lun Yu, Po-Yung Chou, Cheng-Hung Lin and Wen-Chung Kao (National Taiwan Normal University, Taiwan)*
 Detecting anomalous data is very important for the security issues of machine learning. Misjudging anomalous data as normal data may cause serious consequences. For supervised machine learning methods, detecting anomalous data is a big challenge, because anomalous data may be very diverse and it is difficult to collect all possible anomalous data. In recent years, action recognition has been widely used in surveillance systems and home care systems. The recognition of anomalous actions has also become an important requirement of the action recognition system.
 In this paper, we apply the method that has successfully detected anomalous data on 2D images to identify anomalous actions in videos. The proposed approach can directly identify anomalous actions as long as we train on normal action data. The experimental results show that the proposed approach has achieved significant improvements on anomalous action recognition.

[O4] Functional Safety & Regulations

Chair: Cheng-Hung Lin (National Taiwan Normal University)

O4-4 16:30-16:45 **Perception of VR-Based Safety Training Platform in Jewelry Industry in Hong Kong...N/A**

Chi Ho Li, Shu Lun Mak, Fanny Tang, Lok Yee Kwok, Wing Hin Sze and Wei Chen Lai (Hong Kong Metropolitan University, Hong Kong); Tak Wai Lee (Vocational Training Council, Hong Kong)*

Hong Kong's jewelry industry remains basically a handicraft industry. However, it brings up physical damage concerns during metal casting. In addition, there is a lack of highly-skilled craftsmen to inherit experience and techniques to the next generation. With the emerging advanced technology, VR based training platforms have been applied in different aspects of education and especially efficient and safe for high risk working processes. This paper will study (1) jewelry industry, (2) challenges, (3) metal casting, (4) training modes and (5) application of VR based training platforms for metal casting in the jewelry industry.

O4-5 16:45-17:00 **Development of Automatic Tester for Handle of Household Brewing-Type Appliance...88**

Chi Chung Lee (Hong Kong Metropolitan University, Hong Kong)*

In this paper, a prototype of automatic testing machine which is unique for conducting electrical safety tests on electric kettle was proposed and demonstrated. By investigating various studies and technical reports, the testing machine for electric kettle was designed, developed and investigated. Both of the software and hardware were firstly introduced in the related tests. The performance of prototype was evaluated experimentally. A low-cost and multi-functional static load and handle securement testing machine was produced to evaluate the hardness of the kettle handles according to the international standard. The suggestion for further improvement of the prototyped automatic tester for handle of household brewing-type appliance in the commercial testing laboratory was summarized at the end.

[KS IV] Keynote Speech IV

Chair: Wen-Chung Kao (National Taiwan Normal University)

- KS-4 09:00-09:45 **How to Be Successful at Product Safety and Certifications- A Hands on, Practical and Real-World Process & Philosophies You Can Implement into Your Product Development Process Immediately...10**
John Allen (Product Safety Consulting, Inc., USA)

[IS III] Invited Speech III

Chair: Maxi Tsai (CSA Group)

- IS3-1 10:00-10:30 **ICT for Health- Adding Business Value through Regulatory Compliance...18**
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- IS3-2 10:30-11:00 **Automotive Cybersecurity...19**
Roy Luo (Dekra, China)
- IS3-3 11:00-11:30 **Interoperability and Conformance Test for the E-mobility...20**
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