# PROGRAM SCHEDULE

| July 7, 2021 (Wednesday) | |
|---|---|
| 09:00-10:00 | **Local Arrangement Meeting**<br>Chair: Yang-Sun Lee<br>**Cherry Hall** |
| 10:15-11:15 | **DCS & DigiCon-21 Steering Meeting**<br>Chair: Yoon-Ho Kim<br>**Cherry Hall** |
| 11:30-12:30 | **DigiCon-21 Conference Committee Meeting**<br>Chair: Young-Ae Jung<br>**Cherry Hall** |
| 12:30-14:30 | **Lunch**<br><br>*The place will be probably changed in accordance with the Corona Prevention Guidelines. If changed, we will inform you again.* |
| 14:30 | **Registration**<br><br>**Ocean Suites Jeju Hotel, 2nd Floor** |
| 14:30-18:00 | **Session C-1 : Hyodol-bot R&D Seminar**<br>**Hanshin University (Closed Session)**<br>Chair: Yang-Sun Lee<br>**Canola Hall** |
| 18:10-19:00 | **DigiCon-21 Committee & DCS Meeting**<br>Chair: Young-Ae Jung<br>**Canola Hall** |

1. A paper presentation should be made by one of authors of the paper, during a 20 minute time slot (15 minutes for the presentation itself and 5 minutes for Q/A).

2. All speakers of each session should meet the session chair at its room 10 minutes before the session begins.

3. All speakers have to check the session types to be divided into On-site, Hybrid (conducted both online and offline), Online. We will provide the 'Zoom login detail' of the Hybrid and Online session.

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| July 8, 2021 (Thursday) | | |
|---|---|---|
| **10:30** | **Registration** <br> **Ocean Suites Jeju Hotel, 2nd Floor** | | |
| **11:00 - 12:00** | **Session A-1** <br> **Special Session "NSM-21"** <br> **<Hybrid Session>** <br> Chair: Kun Chang Lee <br> **Cherry Hall** | **Session B-1 (Poster)** <br> **<Online Session>** <br> Chair: Young-Ae Jung <br> **Online Zoom Meeting Room** <br> *Please Check the Zoom login detail to be provided later.* | **Session C-2** <br> **Hyodol-bot R&D Seminar** <br> **Hanshin University** <br> **(Closed Session)** <br> Chair: Yang-Sun Lee <br> **Canola Hall** |
| **12:00- 13:30** | **Lunch** <br> **BlueOcean (2nd Floor)** <br> *The place will be probably changed in accordance with the Corona Prevention Guidelines. If changed, we will inform you again.* | | |
| **13:30 - 14:30** | **Session A-2** <br> **<Hybrid Session>** <br> Chair: Ki-Hong Park <br> **Cherry Hall** <br> **and Online Zoom Meeting Room** <br> *Please Check the Zoom login detail to be provided later.* | **Session B-2** <br> **<Online Session>** <br> Chair: Ka Lok Man <br> **Online Zoom Meeting Room** <br> *Please Check the Zoom login detail to be provided later.* | **Session C-3** <br> **Hyodol-bot R&D Seminar** <br> **Hanshin University** <br> **(Closed Session)** <br> Chair: Yang-Sun Lee <br> **Canola Hall** |
| **14:45 - 15:45** | **Session A-3** <br> **<Hybrid Session>** <br> Chair: Jeong-Dong Kim <br> **Cherry Hall** <br> **and Online Zoom Meeting Room** <br> *Please Check the Zoom login detail to be provided later.* | **Session B-3** <br> **<Online Session>** <br> Chair: Guenjun Yoo <br> **Online Zoom Meeting Room** <br> *Please Check the Zoom login detail to be provided later.* | |
| **15:45- 16:30** | **Coffee Break** <br> **Ocean Suites Jeju Hotel, 2nd Floor** | | |
| **16:30- 17:00** | **Award Ceremony** <br> Chair: Young-Ae Jung <br> **Canola Hall and Online Zoom Meeting Room** | | |
| **17:00- 17:50** | **Invited Talk** <br> ***Best practice for building low-latency and high-volume APIs with Serverless Cloud Computing*** <br> by Engineer, Mashhur Sattorov, Amazon, Canada <br> Chair: Jae-Myeong Choi <br> **Canola Hall and Online Zoom Meeting Room** | | |
| **17:50- 18:00** | **Closing Ceremony** <br> Chair: Young-Ae Jung <br> **Canola Hall and Online Zoom Meeting Room** | | |
| **18:30- 20:00** | **DCS 20th Anniversary Ceremony** <br> **Canola Hall and Online Zoom Meeting Room** <br> Chair: Young-Chul Kim | | |

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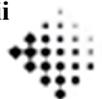
# TECHNICAL SCHEDULE FOR DIGICON-21

## July 7, 2021 (Wednesday)

*09:00-10:00*    *Local Arrangement Meeting*

Chair: Yang-Sun Lee (Hanshin University, Korea)


*10:15-11:15*    *DCS & DigiCon-21 Steering Meeting*

Chair: Yoon-Ho Kim (Mokwon University, Korea)


*11:30-12:30*    *DigiCon-21 Conference Committee Meeting*

Chair: Young-Ae Jung (Sun Moon University, Korea)


*12:30-14:30*    *Lunch*

BlueOcean (2nd Floor)
*(The place will be probably changed in accordance with the Corona Prevention Guidelines. If changed, we will inform you again.)*


*14:30*    *Registration open*

Ocean Suites Jeju Hotel, 2nd Floor


*14:30-18:00*    *Session C-1*    *Hyodol-bot R&D Seminar (Closed Session)*

**Room: Canola Hall**
Chair: Yang-Sun Lee (Hanshin University, Korea)


*18:10-19:00*    *DigiCon-21 Committee & DCS Meeting*

**Room: Canola Hall**
Chair: Young-Ae Jung (Sun Moon University, Korea)

ix

## July 8, 2021 (Thursday)

*10:30*      *Registration open*

Ocean Suites Jeju Hotel, 2nd Floor

*11:00 -12:00*     *Session A-1*     *Special Session - "NSM-21"*     *<Hybrid Session>*

Room: Cherry Hall and Online Zoom Meeting Room

Chair: Kun Chang Lee (Sungkyunkwan University, Korea)

### BA-AM: An Advanced Prediction Model for Business Problem Solving Creativity Using fNIRS

Min Gyeong Kim, Kun Chang Lee (Sungkyunkwan University, Korea)

*[Abstract] In this paper, deep-learning-based business problem-solving creativity (BPSC) classification using functional near-infrared spectroscopy (fNIRS) is investigated. The creative brain signals from problem-solving were acquired from 28 healthy subjects while drawing a cognitive map. The brain activities were measured with a constant-wave fNIRS system, in which the ventrolateral prefrontal, dorsolateral prefrontal, frontopolar prefrontal, and orbitofrontal cortices were focused. These cortex areas are based on Brodmann area, and each area is known to have a distinctive character. Brodmann Area-based Attention Model (BA-AM) is a Deep learning model powered by an attention mechanism and LSTM. BA-AM attempts to classify creativity, valence, and arousal. For training and testing the model, 5-fold cross-validation was applied to keep the model's consistent performance. The BA-AM architecture resulted in an average accuracy of 93.4%, showing the model to be capable of differentiating the states of creative/non-creative. The proposed approach is promising for detecting creativity successfully and contributes to future neuroscience mining research.*

### Predicting User's Perceived Price Perception of e-commerce Products via Distinct UI Modes : A Neuroscience Mining Approach

Francis Joseph Costello, Kun Chang Lee (Sungkyunkwan University, Korea)

*[Abstract] User interface (UI) modes are being considered more in application and software design these days. Two years has passed since Android and iOS announced adoption of the dark UI mode allowing users to decide on their preferred UI mode. This paper investigates the use of dark and light mode UI in online commerce and attempts to understand users' perceptions. We investigate this using EEG data obtained from participants and neuroscience mining techniques (NSM) to understand: (a) how consumers perceived price perceptions of products differ for distinct UI modes; and (b) how Neuromarkers of participants can explain these findings. Based on our results we found that the use of the dark UI mode increased the perceived price of the products shown and was predicted with the greatest accuracy using brain data obtained from the dark UI condition using an LSTM model. This paper is an example of the power on neuroscience mining in uncovering objective truths of people's intentions while interacting with distinct UI designs.*

*11:00 - 12:00*     *Session B-1 ( Poster Session)*     *<Online Session>*

Room: Online Zoom Meeting Room

Chair: Young-Ae Jung (Sun Moon University, Korea)

### Emotional Image Recommendation System Based on Biometric Information and Collaborative Filtering

Tae-Yeun Kim , Young-Eun An (Chosun University, Korea)

*[Abstract] In this paper, we propose an image recommendation system that considers the user's emotions in the proposed system. We measure ECG and PPG, which are biological information of the user, and then use frequency analysis algorithm and SVM-GA algorithm implemented the recommended system and tried to improve the reliability of recommendation system by using collaborative filtering. We implemented a user friendly interface to verify the emotion information of the images through the recommended values and measurement graphs of the emotional images through the mobile application, thereby enhancing the usability of the proposed system. Experimental results showed that subjects' biometric information (ECG, PPG) were classified and learned by SVM-GA algorithm and classified into 4 kinds of emotion information according to biometric information. The average accuracy of the classified data was 89.2%. In addition, 86.7% of the users' satisfaction was measured, suggesting that the proposed emotion based search result is comparable to the emotion felt by a person.*

### A combination of uniform label training strategy and AutoAugment policies to identify the category of foliar diseases in apple trees

Vo Hoang Trong, Le Hoang Anh, Lee JuHwan, Kim JinYoung (Chonnam National University, Korea)

**[Abstract]** Applying a conventional training method on an imbalanced dataset makes the Convolutional Neural Network (CNN) model biased to majority classes. In this paper, we propose a uniform label training strategy, in which the distribution of labels in a single batch is uniform. This strategy allows the model to learn samples from minority classes frequently. Furthermore, to increase the variety of samples in minority classes, we apply the AutoAugment policies collected from the ImageNet dataset as a data augmentation technique, in which samples from minority classes have more opportunities using these techniques than those from majority classes. Finally, we experiment with the EfficientNet B0 on the Plant Pathology dataset from the Plant Pathology 2021 Challenge on Kaggle. By applying the Learning Rate (LR) Range test to find the optimal learning rate in each model, results on the Kaggle scoreboard show that our strategy gets 0.74761 on Efficientnet B0.

### Development of virtual reality fire training contents based on standalone HMD

Eun-Jee Song, Hwa-Soo Jin (Namseoul University, Korea)

**[Abstract]** Now, it is necessary to raise public safety awareness more than ever, and it is time to do disaster response training frequently. As a solution, the training system utilizing the virtual reality, which is the major technology of the 4th industrial revolution, is attracting attention. The virtual training system industry is an ICT convergence industry that implements computer simulations of virtual environments similar to defense, medical, and disaster scenes [1]. Existing fire safety education requires a lot of manpower and cost, and since the training is not practical, the students participating in the training have little immersion. In this paper, we propose a virtual training system for effective fire disaster response training. In particular, we develop fire training virtual reality contents using Oculus Go, a standalone HMD that can experience VR alone without a smartphone or computer.

### Fingerprint-based Cooperative Beam Selection for Cellular-Connected mmWave UAV communication

Sangmi Moon (Korea Nazarene University, Korea), Hyeonsung Kim, Intae Hwang (Chonnam National University, Korea)

**[Abstract]** In this paper, we propose a fingerprint-based cooperative beam selection scheme for cellular-connected millimeter-wave (mm-wave) unmanned aerial vehicle (UAV) communication. The proposed scheme consists of offline fingerprint database construction and online beam cooperation. System-level simulations are performed to assess the UAV effect based on the 3rd generation partnership project new radio mmWave and UAV channel models. Simulation results show that the cooperative beam selection scheme can reduce the beam sweeping overhead and improve the signal-to-interference-plusnoise ratio and spectral efficiency.

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***11:00 - 12:00***    ***Session C-2***    ***Hyodol-bot R&D Seminar Hanshin University (Closed Session)***
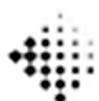
**Room: Canola Hall**

Chair: Yang-Sun Lee (Hanshin University, Korea)

***12:00 - 14:00***    ***Lunch***

**BlueOcean (2nd Floor)**

*(The place will be probably changed in accordance with the Corona Prevention Guidelines. If changed, we will inform you again.)*

**13:30 -14:30    Session A-2     <Hybrid Session>**

**Room: Cherry Hall and Online Zoom Meeting Room**

Chair: Ki-Hong Park (Mokwon University, Korea)

### Intelligent Infection Prevention Monitoring System Through CCTV Video Analysis around a Confirmed Patient Distance

Dongsu Lee, Sang-Joon Lee (Chonnam National Univerisity, Korea), ASHIQUZZAMAN AKM (XISOM INC, Korea), Seungmin Oh, Jihoon Lee, Yeonggwang Kim, Sangwon Oh and Jinsul Kim (Chonnam National Univerisity, Korea)

**[Abstract]** In this research, we use the K-means clustering technique and a deep learning-based crowd coefficient to group and group-specific infection rates on a confirmed person basis using CCTV images near new confirmed traffic lines in an intelligent anti-epidemic monitoring system. We show that PSNR is 21.51 and the final MAE for the entire dataset is 67.98 after 300 cycles of learning for all input images.

### A Study on the Improvement of Resource Utilization Using Deep Learning Applications in Virtualized Platforms

Seungmin Oh, Yeonggwang Kim, Sangwon Oh, Jinsul Kim (Chonnam National University, Korea)

**[Abstract]** Recently, a lightweight virtualization technology based on Linux OS, known as Docker, has been used a lot in deep learning application services. Because deep learning applications require high-performance computing resources, research using computing resources efficiently is essential to providing services through virtualization platforms. This paper monitors CPU and GPU resources using cAdvisor and nvidia-smi when operating deep learning application fire/smoke detection model and fashion-MNIST classification model in the docker container. We also studied ways to improve resource utilization by comparing GPU resource usage with the time required for learning due to the optimization of deep learning applications. Through this, when operating a single deep learning application within a virtualization platform, it is used in parallel with multiple GPUs on average 88% more efficiently than a single GPU, and 19% more efficiently when operating multiple deep learning applications. Comparing the learning time performance of deep learning applications, a single GPU produced more efficient results when operating multiple deep learning applications.

### A Study of VR Interactive Storytelling using Planning

Su-ji Jang, Byung-Chull Bae (Hongik University, Korea)

**[Abstract]** This paper proposes a VR interactive storytelling content using planning which automatically generates an action sequence to build a story. The generated content can provide two types of story endings depending on the player's choice. As a story material, we adopt the well-known fairy tale "Little Red Riding Hood" to implement the content.   The players can select the VR story's point of view – either a first-person or a third-person perspective. We expect that the player's different viewpoints can contribute to the player's immersion and emotional induction in the VR environment.

### An Emotion Detection based Models using Electroencephalogram (EEG)

Wajiha Ilyas , Anum Moin, Muzammil Noor, Maryam Bukhari (COMSATS University Islamabad, Attock Campus, Pakistan)

**[Abstract]** To build the best communication between person to person or person to machine emotion plays an essential role. In this research, we propose a solution to detect human emotion using machine learning approaches with an electroencephalogram (EEG). These emotions are classified into four different classes. In the first step, the data is preprocessed in which frequency bands are extracted from Power Spectral Density (PSD) and Discrete Wavelet Transform (DWT) with three statistical features, Hjorth parameters, and two statistical features were extracted. For the classification purpose, we use multi-layer perceptron, decision tree, and KNN to classify the emotion. The dataset used in this work is the DEAP dataset in which the EEG signal of 32 participants was recorded. There are a total of 40 videos present in the dataset (60 seconds of each video).   The classification accuracy of four classes by using multi-layer perceptron is 77.6 %( sad), 79.1% (calm), 76.8(anger), and 66.4 (happy). Similarly, by using the Decision tree we have achieved the 78.9%, 79.4%, 77.2%, and 68.5% accuracy while by using KNN the accuracy values are 90.2%, 90.3%, 89.1%, and 86.5% respectively.
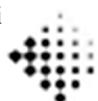
**13:30 -14:30    Session B-2     <Online Session>**

**Room: Online Zoom Meeting Room**

Chair: Ka Lok Man (Xi'an Jiaotong-Liverpool University, China)

### A Trustable and Traceable Method for Secondhand Market based on Blockchain Technology with Committee Consensus

Dongkun Hou, Yinhui Yi, Jie Zhang(Xi'an Jiaotong-Liverpool University, China),
Ka Lok Man(Xi'an Jiaotong-Liverpool University, China, Swinburne University of Technology Sarawak, Malaysia, KU Leuven, Belgium, Kazimieras Simonavicˇius University, Lithuania, Vytautas Magnus University, Lithuania)

[Abstract] The secondhand market is promising in recent years, but the trust problem hindered its development. Many research solves the problem by third-party intermediaries, and the trust is from third-party platform reputation. Some consumers, how- ever, have no idea to recognize the qualification of secondhand products, and it is difficult to safeguard rights if the third-party platform is malicious. In this paper, consortium blockchain technology is employed to solve these problems, and a novel committee based Byzantine consensus is designed in the secondhand market. Committee nodes can validate published transactions, other client nodes can also check the recorded transactions and update product states. The recorded transactions need to be validated by many committee nodes, and these transactions are transparent, permanent and traceable. Thus, buyers and sellers can trust the blockchain based secondhand market. Moreover, comparing with a public blockchain, our consortium blockchain based secondhand market system can be more secure and efficient.

### A Feasibility Study of a Security Mechanism for Blockchain-Powered Intelligent Edge

Jie Zhang(Xi'an Jiaotong-Liverpool University, China),
Ka Lok Man(Xi'an Jiaotong-Liverpool University, Suzhou, China, Swinburne University of Technology Sarawak, Malaysia, imec-DistriNet, KU Leuven, Belgium, Kazimieras Simonavicius University, Lithuania, Vytautas Magnus University, Lithuania),
Young B. Park(Dankook University, Korea),
Jieming Ma, Xiaohui Zhu (Xi'an Jiaotong-Liverpool University, China)

[Abstract] Blockchain-powered intelligent edge is a new paradigm which integrates blockchain and edge computing into the Intelligent Internet of Things (IIoT). It enables the edge-devices to process data for end-devices on behalf of the cloud center, and it also allows the cloud center to trace data via blockchain. It is expected to address some obstinate problems in many IoT applications, such as data management in intelligent building, data privacy in e-health, response delay in self-driving cars, etc.

### Smart Contract-based Operation Technique for Secure Accessing Distributed Contents

Yunhee Kang (Basekseok University, Korea), Young B. Park (Dankook University, Korea)

[Abstract] In a cloud environment, a centralized content management naturally embeds security risks including personal information exposure [4]. In this paper, to solve the security risk, the original digital content is divided and encrypted, and then the system is designed for distributing it securely in a decentralized P2P storage system and then constructing a prototype.   To achieve the goal, a digital content is encrypted using a symmetric key based encryption technique, and the encrypted content is stored in the IPFS storage. In this process, access information is managed by smart contracts. To access the distributed encrypted content, a smart contract is defined for delivering a secure digital content.

**13:30 -15:45    Session C –3    Hyodol-bot R&D Seminar Hanshin University (Closed Session)**

**Room: Canola Hall**

Chair: Yang-Sun Lee (Hanshin University, Korea)

**14:45 -15:45     Session A-3     <Hybrid Session>**

**Room: Cherry Hall and Online Zoom Meeting Room**

Chair: Jeong-Dong Kim (Sun Moon University, Korea)

### Study on the Future Prediction Service Based on Ultra-Low Power Communication Application using the Edge Platform

Yeonggwang Kim, Jinsul Kim (Chonnam National University, Korea)

[Abstract] Along with A.I. technology, IoT technology has grown rapidly as a AIoT(AI of Things) technology. In addition, recognizing data values through sensors and performing deep learning tasks have become a reality. In this paper, we introduce the utilization of low-power communication protocols to reduce data loss using IoT sensors and techniques to store data values in the form of Cloud Database through web servers. The collected data is learned over the Artificial Neural Network, and we introduce an intelligent weather prediction monitoring system that predicts weather through this model.

### Application of TadGAN for detecting Electric Power Usage Anomaly

Sangwon Oh, Jinsul Kim (Chonnam National University, Korea)

[Abstract] In modern society, energy use has increased exponentially compared to the past, regardless of household, commercial or business use. As a result, suppliers who provide power need to manage how users consume electric power. Most power data are time series data, and the emerging problem is anomaly detection. Therefore, it is necessary to detect anomalies in users' electirc power usage data in order to efficiently manage power. In this paper, we use the TadGAN model to detect outliers in power consumption. To evaluate the performance, we specify thresholds using the ARIMA model and set ground-truth, which considers values beyond them as outliers. We compared the number of TadGAN hyperparametric settings in nine cases with ground-truth, respectively, to yield F1-Score.

### Fourier Random Features and LSTM for Healthcare Irregular Pattern Detection

Ermal Elbasani, Jeong-Dong Kim    (Sun Moon University, Korea)

[Abstract] In this era of continuous innovations, the healthcare monitoring systems are changing continuously and becoming closer to an individual for more detailed monitoring. Wearable technologies are becoming a subcategory of the personal health system that provides continuous health monitoring through non-invasive biomedical, biochemical, and physical measurements. An important topic in health monitoring is to detect irregular pattern the correspond serious matter in taking care are raising awareness for individual health to prevent chronic disease. In this paper, the Random Fourier Features (RFF) model incorporates the Long-Short-Term Memory architecture into kernel learning, which significantly boosts the flexibility and richness of detection while keeping deep learning kernels methods to have a significant performance in different scale of data. The results indicate that the proposed model performs more effectively can yield a satisfactory accuracy in irregular pattern detection.

### An Augmented Reality based System for Interior Designing

Syeda Aqsa Fatima Rizvi, Mahnoor Javaid, Maryam Bukhari (COMSATS University Islamabad, Attock Campus, Pakistan)

[Abstract] In today's world, technology is developing gradually so is the urge of people to surround themselves with the latest tech gadgets. To accomplish this rate of demand, AR (Augmented Reality) is a mixture of real and virtual reality and is known for its splendid work in interior designing and making it easy for people to shop. Nowadays, it is facilitating a lot by creating an atmosphere where people can visualize the interior design models in their physical spaces virtually in real-world at their comfort zone by rotating, dragging, and zooming in and out of the interior designing models. All this can be done with the help of Marker-less-based Augmented Reality and Google ARCore. It is a platform for the design and deployment of Augmented Reality. With the help of this framework, people can sense the real environment but not all applications serve in the same way. Many other applications support the feature of augmented reality that is of no good for people to cherish for example SayDuck. ARCore framework is the solution for it in interior designing applications for purchasing desire items after looking at it virtually in their real environment.

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**14:45 -15:45      Session B-3      <Online Session>**

**Room: Online Zoom Meeting Room**

Chair: Geun-Jun Yoo (Sumo Logic)

### Video Anomaly Detection by the Combination of C3D and LSTM

Yuxuan Zhao, Gabriela Mogos(Xi'an Jiaotong-Liverpool University China) ,
Ka Lok Man (Xi'an Jiaotong-Liverpool University, China, Swinburne University of Technology Sarawak, Malaysia, imec-DistriNet, KU Leuven, Belgium, Kazimieras Simonavicius University, Lithuania, Vytautas Magnus University, Lithuania)

**[Abstract]** *Video anomaly detection is a significant problem in computer vision tasks. It asks methods to detect unusual events in videos. The kernel of this task is to produce a correct understanding of the input video. To achieve this target, both spatial and temporal features are needed to be extracted by methods. Based on the research of image processing, the deep convolutional neural networks have been evaluated that they have good performance on the spatial feature extraction. Thus, the problem becomes how to get temporal features in the video. This paper proposes a model that combine two effective temporal features processing methods, Convolution 3D and Long Short-term Memory to handle the video anomaly detection. We do experiments on a famous video anomaly dataset, UCF-crime, and achieve a better performance compared with other methods.*

### A Study on Radar Target Detection and Classification Methodologies

Yu Du (Xi'an Jiaotong-Liverpool University, China), Jeremy S. Smith (University of Liverpool, UK),
Eng Gee Lim, Ka Lok Man (Xi'an Jiaotong-Liverpool University, China)

**[Abstract]** *Target detection and classification is the most important part of scenario analysis in autonomous driving and intelligent transportation systems (ITS). Moreover, robust all-weather sensing ability is one of the indispensable characteristics for the sensing elements in such systems, while radar has shown a great potential as the major sensor to handle this task which thanks to the environmental insensitivity of electromagnetic waves. However, unlike the informative images captured by cameras, reliable classification and detection of objects by radar sensor in real-time has proved to be quite challenging. To achieve the target, a comprehensive study on radar perception methodologies would be a good step stone. In this paper, major classical and the state of the art approaches are throughout summarized, and several potential deep neural network attempts have been discussed in comparison with traditional methodologies.*

### Modeling of Mechatronic Systems with Multi-Axis

Liye Jia, Yujia Zhai (Xi'an Jiaotong-Liverpool University, China), Kejun Qian (Suzhou Power Grid Company, China),
Sanghyuk Lee, Ka-Lok Man (Xi'an Jiaotong-Liverpool University, China)

**[Abstract]** *Recently, the market has rigorous requirements on accuracy and efficiency in the manufacturing industry, so the multi-axis system has been used in many advanced industrial devices to fit current demand. Using an independent servo-motor to actuate a single moveable axis is the basic principle of the multi-axis mechanism. However, the asynchronous problems will severely reduce the performance of this mechanic system. Therefore, to compensate for the synchronous error caused by external disturbances, the multi-axis should be simultaneously controlled by the synchronization control principles, and B&R Company provides the Evaluation and Training for Automation (ETA) workstation for testifying the control methods. Based on the practical structure of the ETA, this paper's exception is to create a digital dynamic model using MATLAB to replace the workstation with the Digital Twin technique, and the output of the virtual model can apply as the control signal to restrain the motion of the veritable mechanisms.*

**15:45- 16:30      Coffee Break**

**Ocean Suites Jeju Hotel, 2nd Floor**

*16:30- 17:00*    *Award Ceremony*

**Room: Canola Hall and Online Zoom Meeting Room**

Chair: Young-Ae Jung (Sun Moon University, Korea)

*17:00-17:50*    *Invited Talk*

**Room: Canola Hall and Online Zoom Meeting Room**

Chair: Jae-Myeong Choi (Mokwon University)

## *Best practice for building low-latency and high-volume APIs with Serverless Cloud Computing*

**by Engineer, Mashhur Sattorov, Amazon, Canada**

*17:50-18:00*    *Closing Ceremony*

**Room: Canola Hall and Online Zoom Meeting Room**

Chair: Young-Ae Jung (Sun Moon University, Korea)

*18:30 –20:00*    *DCS 20th Anniversary Ceremony*

**Room: Canola Hal and Online Zoom Meeting Room**

Chair: Young-Chul Kim