CONFERENCE ABSTRACTS

2021 THE INTERNATIONAL CONFERENCE ON COMPUTER, CONTROL AND ROBOTICS

ICCCR 2021

JANUARY 8-10, 2021

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Content

Welcome Remarks

Welcome to ICCCR 2021!

It is a great pleasure to welcome you to 2021 International Conference on Computer, Control and Robotics (ICCCR 2021), which will be held during January. 8-10, 2021 in full virtual style by ZOOM.

The safety and wellbeing of our participants is of paramount importance to the conference organizing committee. On 11 March 2020 the World Health Organization (WHO) declared Covid-19 a pandemic. After careful consideration and in light of the global health emergency and pervasive travel restrictions, we have made the difficult decision to convert the conference to a virtual conference. We were looking forward to seeing everyone in Shanghai, China, but we are excited for the opportunity to innovate by creating an engaging virtual conference that will be rewarding for both presenters and attendees.

The success of ICCCR 2021 depends on the contributions of many individuals and organizations. In this view, we thank all the authors who submitted their work to the conference. The quality of submissions this year was again extremely high and we feel gratified by the high quality of the resulting program. The organizing committee would like to express the deepest appreciation also to the technical program committee members and session chairs for their strong support to the conference preparation and development. The organizing committee is in debt to the reviewers who volunteer and sacrifice their precious time appraising the submissions and providing useful feedbacks to the authors.

On behalf of the Organizing Committee, we wish to thank the keynote speakers and authors of selected papers for their outstanding contributions. We would also like to thank members of the organizing committee, anonymous reviewers and volunteers for their great efforts. Without their contribution, dedication and commitment, we would not have achieved so much. We sincerely hope that you will find the ICCCR 2021 beneficial and fruitful for your professional development.

ICCCR2021 Organizing Committees

📖 Conference Room ID & Time:

Room I: 648 5239 6311 (main room)

Room II: 654 8729 1596

* **Note**: Conference rooms will be open **30 mins** before scheduled time.

📖 Zoom Download

URL: https://zoom.us/ (English)

https://www.zoom.com.cn/download (Chinese)

Zoom Using Instruction: click.

📖 Tips:

- Please unmute audio and start video while your presentation;
- It's suggested to use headset with microphone or earphone with microphone;
- Please rename your screen name before entering the room

Note: Please rename your name to below format before come in the Zoom Room
Author: Paper ID-Name
Listener: Listener-Name
Keynote Speaker: KN-Name
Conference Committee: Position-Name

📖 Conference Time (GMT+8)

- January 9, 2021: 8:55 am—18:00 pm
- January 10, 2021: 8:55 am—17:50 pm

Materials Provided by the Presenters

- **Oneline Presentation:** PowerPoint or PDF files.
- **Video Presentation:** please send your video presentation to conference secretary with MP4 before 3rd January, 2020. It should be about 10-15 minutes.

Duration of Each Presentation

- **Regular Oral Session:** about **15** Minutes of Presentation including Q&A.
- **Keynote Speech:** **45** Minutes of Presentation including Q&A.

Enter in Advance

Please enter conference room 10 mins before session start.

Certificates

Presentation certificates will be sent to presenters after the conference by email.

Time Zone

GMT+8

Day 1, January 8, 2021 (GMT+8)

Zoom I: *648 5239 6311* & Zoom II: *654 8729 1596*

10:00-17:30	Test on Zoom

Day 2, January 9, 2021 (GMT+8)

Zoom ID: *648 5239 6311*

09:25-09:30	**Welcome Regards** **Yingjie Yu,** Shanghai University, China
09:30-10:15	**Keynote Speaker 1** **Prof. Chun-Hung Chen (IEEE Fellow),** Dept. of Systems Engineering & Operations Research, George Mason University, USA
10:15-11:00	**Keynote Speaker 2** **Prof. Mo-Yuen Chow (IEEE Fellow),** Director of Advanced Diagnosis, Automation, and Control (ADAC) Laboratory North Carolina State University, USA
11:00-11:15	**Group Photo (Online)& Break**
11:15-12:00	**Plenary Speaker** **Prof. Jangmyung Lee**, Pusan National University, Korea
12:00-13:30	**Lunch & Break**

(GMT+8)	**Zoom ID: *648 5239 6311***	**Zoom II: *654 8729 1596***
13:30-16:00	**Session 1: Information and signal processing** **SC:** *Prof. Badrul Hisham bin Ahmad, Universiti Teknikal Malaysia* AR2040, AR2044, AR2067, AR2113, AR2052, AR2103, AR2107-A, AR2112, AR2035, AR2098	**Session 2: Image analysis and processing** **SC:** *Dr. Qin Zhiliang, Deputy Chief Engineer Weihai Beiyang Electrical Group Co. Ltd Weihai, Shandong, China* AR2047, AR2070, AR2061, AR2094, AR2093, AR2084, AR2088, AR2104, AR2056
16:00-16:15	**Session photo online & Break**	
16:15-18:15	**Session 3: Manipulator design and control** **SC:** *Prof. Jang-Myung Lee, Pusan National University, Korea* AR2027, AR2043, AR2046, AR2053, AR2080, AR2048, AR2102	**Session 4: Mechanical Design Manufacturing and Automation** **SC:** *Asst. Prof. Vaitheeswaran Vembarasan, Sri Sivasubramaniya Nadar College of Engineering, India* AR2066, AR2108, AR2101, AR2058, AR2060, AR2041, AR2059, AR2077

Day 3, January 10, 2021

(GMT+8)	Zoom ID: *648 5239 6311*	Zoom II: *654 8729 1596*
09:30-11:30	**Session 5: Robot design and control** **SC:** *Dr. Shuai Wang, Tencent Robotics X, Shenzhen, China* AR2030-A, AR2042, AR2083, AR2087, AR2097, AR2086, AR2110, AR2023	**Session 6: Robot motion and path planning** **SC:** *Prof. Mo-Yuen Chow, North Carolina State University, USA* AR2025, AR2063, AR2033, AR2091, AR2092, AR2109, AR2075, AR2051
11:30-14:00	**Session photo online & Break**	
14:00-16:00	**Session 7: Medical Electronics and Automation** **SC:** *Prof. Jiang Zhu, Department of Mechanical Engineering, Tokyo Institute of Technology, Japan* AR2039, AR2079, AR2069, AR2054, AR2024, AR2028, AR2096, AR2082	**Session 8: Communication and Information System** **SC:** *Prof. Badrul Hisham bin Ahmad, Universiti Teknikal Malaysia* AR2105, AR2038, AR2068, AR2062, AR2089, AR2099, AR2037, AR2078

Day 1 (January 8, 2021)-Please check your assigned Zoom test time

Please follow the schedule below to enter the online conference room. When you enter the conference, the conference staff will assist you to test your microphone and screen share, etc.

Zoom ID: ***648 5239 6311***

Shanghai Local Time (GMT+8)	Paper ID
10:00-10:10	AR2030-A
10:10-10:20	AR2042
10:20-10:30	AR2083
10:30-10:40	AR2087
10:40-10:50	AR2097
10:50-11:00	AR2086
11:00-11:10	AR2110
11:10-11:20	AR2025
11:20-11:30	AR2063
11:30-11:40	AR2091
11:40-11:50	AR2109
11:50-12:00	AR2092
12:00-12:10	AR2082
Break Time	
14:00-14:10	AR2075
14:10-14:20	AR2066
14:20-14:30	AR2108
14:30-14:40	AR2101
14:40-14:50	AR2058
14:50-15:00	AR2060
15:00-15:10	AR2059

15:10-15:20	AR2027
15:20-15:30	AR2028
15:30-15:40	AR2043
15:40-15:50	AR2033
15:50-16:00	AR2053
16:00-16:10	AR2035
16:10-16:20	AR2080
16:20-16:30	AR2048
16:30-16:40	AR2102
16:40-16:50	AR2039
16:50-17:00	AR2054
17:00-17:10	AR2069
17:10-17:20	AR2079
17:20-17:30	AR2024

Zoom ID: ***654 8729 1596***

Shanghai Local Time (GMT+8)	Paper ID
10:00-10:10	AR2096
10:10-10:20	AR2047
10:20-10:30	AR2070
10:30-10:40	AR2061
10:40-10:50	AR2094
10:50-11:00	AR2093
11:00-11:10	AR2084
11:10-11:20	AR2088
11:20-11:30	AR2104
11:30-11:40	AR2056

11:40-11:50	AR2040
11:50-12:00	AR2040
Break Time	
14:00-14:10	AR2041
14:10-14:20	AR2046
14:20-14:30	AR2067
14:30-14:40	AR2113
14:40-14:50	AR2052
14:50-15:00	AR2103
15:00-15:10	AR2023
15:10-15:20	AR2107-A
15:20-15:30	AR2112
15:30-15:40	AR2098
15:40-15:50	AR2051
15:50-16:00	AR2037
16:00-16:10	AR2038
16:10-16:20	AR2068
16:20-16:30	AR2105
16:30-16:40	AR2062
16:40-16:50	AR2089
16:50-17:00	AR2099
17:00-17:10	AR2078
17:10-17:20	AR2044
17:20-17:30	AR2077

Prof. Chun-Hung Chen (IEEE Fellow)

Dept. of Systems Engineering & Operations Research, George Mason University, USA

Chun-Hung Chen received his Ph.D. degree from Harvard University in 1994. He is currently a Professor at George Mason University. Dr. Chen was an Assistant Professor at the University of Pennsylvania before joining GMU. He was also a professor at National Taiwan University (Electrical Eng. and Industrial Eng.) from 2011-14. Sponsored by NSF, NIH, DOE, NASA, FAA, Missile Defense Agency, and Air Force in US, NSFC in China, MOST in Taiwan, and SMI in Singapore, he has worked on the development of very efficient methodology for simulation-based decision making and its applications. Dr. Chen received several awards such as Best Paper Award from IEEE International Conference on Automation Science and Engineering, "K.D. Tocher Medal" for the best paper in the Journal of Simulation, "National Thousand Talents Award" from China, and Eliahu I. Jury Award from Harvard University. Dr. Chen has served on the editorial boards of IEEE Transactions on Automatic Control, IEEE Transactions on Automation Science and Engineering, IIE Transactions, Asia-Pacific Journal of Operational Research, Journal of Simulation Modeling Practice and Theory, International Journal of Simulation and Process Modeling, and Journal of Traffic and Transportation Engineering. Dr. Chen is an author of two books, including a best seller: "Stochastic Simulation Optimization: An Optimal Computing Budget Allocation". He is an IEEE Fellow.

Speech Title: Fast-time Decision and Control of Complex Systems with Digital Twin-Based Look-Ahead Learning

Abstract: Digital twin is a digital manifestation of physical systems. We will present a new digital twin-based learning framework. It represents a fundamental advance in learning and decision making. Instead of passively learning from observational data limited to historical scenarios and experiential-based actions, the new digital twin-based learning framework proactively learn successful actions under different future scenarios generated using digital twins, and integrate the learned knowledge with online digital twin analysis assimilating dynamic data input to achieve operational efficiency. This new approach will enable fast-time decision and control. We will also present two key components of our methodologies: Optimal Computing Budget Allocation (OCBA) and Ordinal Transformation (OT), initially developed by the speaker. OCBA intends to maximize the overall simulation or sampling efficiency for finding an optimal decision/control. OT intelligently transforms the decision space into a smart space which is smoother and has nice properties. The search for a good decision/control becomes easier and more efficient in the transformed space.

Prof. Mo-Yuen Chow (IEEE Fellow)

Director of Advanced Diagnosis, Automation, and Control (ADAC) Laboratory

North Carolina State University, USA

Mo-Yuen Chow earned his degree in Electrical and Computer Engineering from the University of Wisconsin-Madison (B.S., 1982); and Cornell University (M. Eng., 1983; Ph.D., 1987). Upon completion of his Ph.D. degree, Dr. Chow joined the Department of Electrical and Computer Engineering at North Carolina State University as an Assistant Professor. He became an Associate Professor in 1993, and a Professor since 1999. He worked in U.S. Army, TACOM TARDEC Division as a Senior Research Scientist during the summer of 2003. He spent his sabbatical leave as a Visiting Scientist in 1995 in ABB Automated Distribution Division, and as a Distinguished Consultant, SAS Institute, Fall 2016. Dr. Mo-Yuen Chow is the founder and the director of the Advanced Diagnosis, Automation and Control Laboratory at North Carolina State University. His recent research focuses on collaborative distributed control and fault management with applications on smart grids, PHEVs, batteries, and mechatronics/robotics systems. He has served as a Principal Investigator in projects supported by various federal agencies and private companies. He has published one book, seven book chapters, and over three hundred journal and conference articles. Dr. Chow is an IEEE Fellow, the co-Editor-in-Chief of IEEE Transactions on Industrial Informatics 2014-2018, was the Editor-in-Chief of IEEE Transactions on Industrial Electronics 2010-2012, a co-Editor-in-Chief of IEEE Transactions on Industrial Electronics, a past Technical Editor of IEEE Transactions on Mechatronics, a past Associate Editor of the IEEE Transactions on Industrial Electronics and IEEE Transactions on Industrial Informatics. He was the Vice President for Publication of IEEE Industrial Electronics Society in 2006-2007, and the Vice President for Membership of IEEE Industrial Electronics Society in 2000-2001. He was the General Chair of IEEE-IECON05, the General Co-Chair of IEEE-IECON10, IEEE-ISIE12, IECON18, ISIE19. Dr. Chow served as a guest editor for the IEEE Transactions on Mechatronics Focus Section on Mechatronics in Multi Robot Systems (2009), IEEE Transactions on Industrial Electronics special sections on Distributed Network-Based Control Systems and Applications (2003), on Motor Fault Detection and Diagnosis (2000), and on Application of Intelligent Systems to Industrial Electronics (1993). He was a Senior Fellow of Japan Society for the Promotion of Science in 2003. He has received the IEEE Eastern North Carolina Section Outstanding Engineering Educator Award in 2004, the IEEE Region-3 Joseph M. Biedenbach Outstanding Engineering Educator Award in 2005, the IEEE Eastern North Carolina Section Outstanding Service Award in 2007, the IEEE Industrial Electronics Society Anthony J Hornfeck Service Award in 2013. Dr. Chow received the IEEE Industrial Electronics Society Dr.-Ing. Eugene Mittelmann Achievement Award in 2020. He is a Distinguished Lecturer of IEEE IES.

Speech Title: Mechatronics Education with iSpace Platform

Abstract: Mechatronics is a popular subject in many universities. In addition to the basic knowledge and principles of sensors, actuators, controllers and their integration to solve mechatronics problems, hands-on experience and projects are invaluable for students to learn about Mechatronics. This presentation will describe a sequence of two Mechatronics courses, the rationales and demonstrations of using Matlab/SIMULINK, Mindstorm Lego ev3, and the project platform iSpace in the courses to allow students to effectively learn the integration of distributed sensors, distributed actuators, and distributed controllers over communication networks to solve large scale problems.

Prof. Jangmyung Lee

Pusan National University, Korea

Jangmyung Lee has been a Professor at the Department of Electronics Engineering, Pusan National University since 1992, where he is currently a director for the robotics research center, SPENALO. He received the B.S. and the M.S. degrees in electronics engineering from Seoul National University in 1980 and 1982, respectively and the Ph.D. degree in computer engineering from University of Southern California in 1990. He is currently leading a research laboratory working on intelligent robots (http://robotics.pusan.ac.kr). His current research interests include intelligent robotic systems, integrated manufacturing systems, cooperative control and sensor fusion. Dr. Lee is an IEEE Senior member, and a fellow of ICROS. He served as a president of Korean Robotics Society in 2010 and as a vice-president of ICROS and IEIE several years. He was the general chair for IEEE AIM 2015, IEEE ICIT 2014, ICIRA 2013 and ICT-ROBOT 2017. He has several awards including the presidential award for the contribution to robotics in 2015.

Speech Title: Autonomous Landing of a Drone onto a Moving Vehicle

Abstract: A robust landing algorithm has been developed for the recreation drone which can be carried on the roof of the recreation vehicle. The drone is very useful for various applications since it opens a new working space which is not used heavily so far. There are two limitations on the usage of the drone: short flying time and unstable landing. In this research, the charging station is provided on the roof of the recreation vehicle safely. The unstable landing problem has been resolved by using the visual servoing technique and by using the robust control of the landing platform. Specifically, a new urban scene adaptive network has been developed to improve the performance of the semantic segmentation and 2-link structured landing legs are designed/applied for stably landing on an inclined surface or obstacle with a suitable control algorithm. To achieve the stable landing on a slanted surface, a cooperative control algorithm of the quadcopter and the landing platform has been also proposed. With this autonomous landing technique, the applications of the drone become wide.

Moring Schedule--Conference Speeches ***Zoom ID: 648 5239 6311***	
09:25-09:30 (GMT+8) **Welcome Regards**	**Ms. Yingjie Yu** **Shanghai University, China**
09:30-10:15 (GMT+8) **Keynote Speaker 1**	***Speech Title:*** *Fast-time Decision and Control of Complex Systems with Digital Twin-Based Look-Ahead Learning* **Prof. Chun-Hung Chen (IEEE Fellow),** **Dept. of Systems Engineering & Operations Research, George Mason University, USA**
10:15-11:00 (GMT+8) **Keynote Speaker 2**	***Speech Title****: Mechatronics Education with iSpace Platform* **Prof. Mo-Yuen Chow (IEEE Fellow)** **Director of Advanced Diagnosis, Automation, and Control (ADAC) Laboratory North Carolina State University, USA**
11:00-11:15	**Group Photo (Online)& Break**
11:15-12:00 (GMT+8) **Plenary Speaker 1**	***Speech Title:*** *Autonomous Landing of a Drone onto a Moving Vehicle* **Prof. Jangmyung Lee** **Pusan National University, Korea**
12:00-13:30	**Lunch & Break**

Session 1 Topic: Information and signal processing

Session Chair: Prof. Badrul Hisham bin Ahmad, Universiti Teknikal Malaysia

Time: 13:30-16:00 (GMT+8), 9 January, 2021

Zoom ID: *648 5239 6311*

13:30-13:45 **AR2040**	**Study on Wireless Signal Propagation In Residential Outdoor Activity Area Based On Deep Learning** Sunying Hu, Liguo Shuai*, Qiang Yang, Huiling Chen **Presenter**: Sunying Hu, School of Mechanical Engineering, Southeast University, China **Abstract**: As explosive growth of mobile data traffic brings great challenges to the mobile networks, how to reasonably deploy the latest generation mobile networks to meet the needs of users for communication becomes an urgent technical problem to be solved. Since machine learning technology has shown its superiority in processing big data in recent years, researches on the application of machine learning technology in wireless communication are expanded and explored gradually. In this paper, a wireless signal propagation model based on deep learning neural network is proposed to evaluate the wireless signal propagation characteristics and signal coverage status in different scenarios in the complex and changeable residential outdoor activity areas. The massive data generated in practical applications are reasonably utilized to predict the signal propagation characteristics of each cell with high accuracy and stability. The model has is of good adaptability to different complex scenarios and can providing provide a certain reference value and engineering guidance for further wireless network deployment and optimization development.
13:45-14:00 **AR2044**	Using Deep Learning for Object Distance Prediction in Digital Holography Raphaël Couturier, Michel Salomon, Elie Abou Zeid, Chady Abou Jaoudé **Presenter**: Michel Salomon, Univ Bourgogne Franche-Comté, France **Abstract**: Abstract—Deep Learning (DL) has marked the beginning of a new era in computer science, particularly in Machine Learning (ML). Nowadays, there are many fields where DL is applied such as speech recognition, automatic navigation systems, image processing, etc [1]. In this paper, a Convolutional Neural Network (CNN), more precisely a CNN built on top of DenseNet169, is proven to be helpful in predicting object distance in computer-generated holographic images. The problem is addressed as a classification problem where 101 classes of images were generated, each class corresponding to a different distance value from the object at a micrometer scale. Experiments show that the proposed network is efficient in this context, being able to classify with a 100% accuracy level if trained properly.
14:00-14:15 **AR2067**	Deep Convolutional Neural Network with Transfer Learning for Environmental Sound Classification Jianrui Lu, Ruofei Ma, Gongliang Liu, Zhiliang Qin **Presenter**: Jianrui Lu, Department of Communication Engineering, Harbin Insitute of Technology, Weihai, China **Abstract**:Environmental sound classification (ESC) is an important issue. However, due to the lack of datasets, high-accuracy ESC has always been challenging. In this paper, we propose a new convolutional neural network (CNN) model using transfer learning technology for ESC task. First, we represent sound as RGB image, where the red channel corresponds to the Log-Mel spectrogram, the green channel corresponds to the scalogram, and the blue channel corresponds to the Mel frequency cepstrum coefficient (MFCC). Second, we train a CNN architecture based on Xception model

	which has a better performance on the JFT dataset. Test results show that the proposed approach is with a better performance on the ESC accuracy.
14:15-14:30 **AR2113**	Research on Bird Songs Recognition Based on MFCC-HMM Xie Shan-shan,Xu Hai-feng,Liu Jiang,Zhang Yan,Lv Dan-jv **Presenter**: Shanshan Xie, College of Big Data and Intelligence Engineering, Southwest Forestry University, China **Abstract**: HMM (Hidden Markov Model) is a statistical-signal based model, and MFCC (Mel frequency Cepstrum Coefficient) is one kind of characteristic parameters, both of which are widely used in speech recognition. This paper studies MFCC-HMM bird song recognition technology. Firstly, it collected bird songs through web crawler. Then, bird audios were preprocessed and MFCC features were extracted. Through differential methods calculation, improved MFCC feature parameters are obtained, which are fed into the HMM model to classify different kinds of bird songs. Experimental results show that the MFCC-HMM model achieve a recognition rate of 90.47% among the six kinds of birds.
14:30-14:45 **AR2052**	Using Neural Networks to Deal with Three Phonon Scattering in Phonon Monte Carlo Simulation Wenhui Ni, Minhua Chen **Presenter**: Wenhui Ni, School of Mechanical Engineering, Southeast University, China **Abstract**: The Boltzmann transport equation can well characterize the sub-micron heat transfer, and the motion and interaction of phonons are simulated by the Monte Carlo method. The approximate theory of relaxation time is used to simulate the phonon scattering process, and the energy and momentum conservation of the scattering event is considered through the method of Neural Networks. In this work, the phonon scattering process is calculated first, and all the scattering processes which can satisfy the conservation of energy and momentum are searched and used as training samples. A neural network is trained to quickly search for phonons that conform to the conservation of energy and momentum in a Monte Carlo simulation. The thermal conductivity of bulk silicon obtained by simulation is consistent with the experimental results.
14:45-15:00 **AR2103**	Distributed Secure Consensus for First-Order Multi-Agent Systems under Replay Attacks Ling Wang, Zhihai Wu **Presenter**: Ling Wang, Jiangnan University, China **Abstract**: This paper is concerned with secure consensus of first-order discrete-time multi-agent systems under replay attacks. State information is transmitted over a communication network and each agent may be attacked by an adversary who is able to replay the state information sent from its neighbors maliciously. To resist the attackers, we design a control protocol by applying the distributed model predictive control methodology. The sufficient conditions for multi-agent systems to achieve consensus under replay attack is derived. Numerical examples are presented to verify the validity of the proposed consensus protocol.
15:00-15:15 **AR2107-A**	DACNN: Convolutional Network Integrating Dense Connection and Attention Mechanisms Jinpeng Chen, Xinkai Chen, Zhenning Xie, Hui Dong, Hao Sun **Presenter**: Xinkai Chen, Fuzhou University, China **Abstract**: CNNs are suitable for designing sophisticated architectures with outstanding ability of learning features. Depth of structure is crucial for 1-Dimension classification issues. While, the algorithm lacks 1-D data signal learning mechanism for

	complex data types, scenes and interference events in real applications. Also, traditional CNN employs identical processing methods for various types of time series signals, and results in lower accuracy and weak generalization. Therefore, the procedure of understanding and learning discriminant industrial signals features from complex applications is challengable. In this work, we develop a novel classifier architecture based on the characteristics of 1-D data signals, namely Dense-Attention CNN (DACNN). The architecture is composed of Channel Attention Module (CAM), Excitation Attention Module (EAM) and Densely connected layer. Of these, CAM is used to improve the sensitivity to channel features and build the interdependence between feature channels. Then, it is able to enhance the adaptation of features, obtain meaningful features according to this interdependence and suppress useless features. EAM can effectively improve the efficiency and reliability of feature learning. Also, it makes the learning mechanism of network feature more explanatory. Densely connected layer alleviates the vanishing-gradient problem, strengthens feature propagation, encourages feature reuse and substantially reduces the number of parameters. It extracts middle and low complex industrial signals features to distinguish the relationship between data. We evaluate the proposed architecture using the rolling bearing datasets provided by the Bearing Data Center of Case Western Reserve University. Compared with existing methods, the DACNN obtains significant improvements by presenting an average testing accuracy as high as 99.98%. Furthermore, the performance of the proposed method is found to be fine even if the training data are limited.
15:15-15:30 **AR2112**	A feature selection method based on variable weight in fault isolation Li Qiang, Xia Zhijie, Zhang Zhisheng **Presenter**: Qiang Li, School of Mechanical Engineering, Southeast University, China **Abstract**: In the fault isolation of multivariable features, it is very important to select effective features from hundreds of features for feature classification. Fault isolation based on intelligent model has received considerable attention in academic research, most of which optimize the classification model, but little research worked on feature selection. This paper focuses on the study of the feature selection method to reduce the selected feature. The generic information entropy is usually applied to measure the dispersion of each feature and to construct the Entropy-weight of the feature. To emphasize the discriminability of feature and modify the entropy weight, this paper proposes a method, constructing the feature weight by partial F value based on multivariate hypothesis testing to measure the effect of each feature on the difference between different feature sets. Then the modified weight is utilized as criteria for selecting the most effective feature for fault isolation, reducing the number of selected features to achieve same effect of fault isolation and relieving the computational pressure of the classifier. The performance of hydraulic equipment fault isolation illustrates the effectiveness of the presented method.
15:30-15:45 **AR2035**	Mel-spectrogram and Deep CNN based Representation Learning from Bio-Sonar Implementation on UAVs M. Hassan Tanveer, Hongxiao Zhu, Waqar Ahmed, Antony Thomas, Basit Muhammad Imran, Muhammad Salman **Presenter**: M. Hassan Tanveer, Kennesaw State University Marietta, USA **Abstract:** In this paper, we present an approach for estimating the leaf density of trees while navigating in a forest. To this end, we consider an Unmanned Aerial Vehicle (UAV) equipped with a biosonar sensor that mimics the sonar sensors of echolocating bats. Such sensors provide a light-weight and cost-effective alternative to other widely used sensors such as camera, LiDAR and are gaining popularity among the robotics research community. The obtained echo signals during UAV navigation are processed to obtain the leaf density in the main lobe of the sonar first using a mel spectrogram

	and then a Deep Convolutional Neural Network (CNN) trained on a set of known environments. We further evaluate our approach in simulation by considering trees with different leaf density (that is, resolution). It is seen that our method achieves promising results with an accuracy of 98.7%.
15:45-16:00 **AR2098**	The design of linear TM mode filters with nonresonating TE mode Bin Tang, Ying Yang, Xiaoxia Zheng **Presenter:** Bin Tang, Chengdu Aeronautic Polytechnic, China **Abstract:** A new compact linear pseudoelliptic function filters were introduced, which is implemented by TM mode cavity structure. The transmission zeros are generated by nonresonating modes in the structure to provide additional paths for the energy transmission between adjacent resonators. Design guidelines to generate transmission zeros and how to control it are presented. Finally, various distributions of transmission zeros are given when two cavities are cascaded. Chebyshev and elliptic function filter are realized respectively, which verifies the flexibility of the filter design.

Session 2 Topic: Image analysis and processing

Session Chair: Dr. Qin Zhiliang, Deputy Chief Engineer Weihai Beiyang Electrical Group Co. Ltd Weihai, Shandong, China

Time: 13:30-16:00 (GMT+8), 9 January, 2021

Zoom ID: *654 8729 1596*

13:30-13:45 **AR2047**	Image non-significant target detection based on depth metric Particle Swarm optimization Xinxin Song, Quansheng Dou **Presenter**: Xinxin Song;Shandong Technology and Bussiness University **Abstract**: In the problem of target detection,the degree of discrimination between the target area and the background area will directly affect the detection result.The existing target detection algorithms relies too much on the difference between the target area and the background area.When the boundary between the target region and the background region is fuzzy or even intersects,the detection effect is not good. In order to overcome this problem,this paper proposes a depth measurement particle swarm optimization method for target detection of blurred images.By constructing a depth measurement model,the similarity between the target and the detection area is solved, combined with PSO (particle swarm search algorithm).Search the target area.Compared with the existing target detection algorithms,the proposed in this paper is more effective in dealing with medical image target detection problems.
13:45-14:00 **AR2070**	Real-time object Tracking Based on Optical Flow Xie Xing, Yang Yongjie,Xinming Huang **Presenter**: Xie Xing, Nantong University **Abstract**: The optical flow algorithm has been widely used in object detection and tracking. These applications are hard to implement on the hardware level in real-time, due to their high computational complexity. In this paper, we propose an efficient hardware architecture for the accurate computation of the Lucas-Kanade (L-K) optical flow. The optical flow estimation involves several tasks such as Gaussian smoothing, gradient computation, integral calculation, and the vector computation , which are processed in a parallel architecture. The proposed architecture was simulated and verified by synthesizing onto a Xilinx Field Programmable Gate Array(FPGA),which can process 640×480 resolution frames at 30 frames/s.
14:00-14:15 **AR2061**	A Cauchy-Distribution-Based Point Spread Function Model for Depth Recovery from a Single Image Ming Ying **Presenter**: Ming Ying, College of Politics, National Defense University of PLA Shanghai, China **Abstract**: Most approaches to recover a scene's 3D depth from a single image often model the point spread function (DSF) as a 2D Gaussian function. However, those method are suffered from some noises, and difficult to get a high quality of depth recovery. We present a simple yet effective approach to estimate exactly the amount of spatially varying defocus blur at edges, based on the Cauchy distribution model for the DSF. The raw image is re-blurred twice using two known Cauchy distribution kernels, and the defocus blur amount at edges can be derived from the gradient ratio between the two re-blurred images. By propagating the blur amount at edge locations to the entire image using the matting interpolation, a full depth map is then recovered. Experimental results on several real images demonstrate both feasibility and

	effectiveness of our method, being a non-Gaussian model for DSF, in providing a better estimation of the defocus map from a single un-calibrated defocused image. These results also show that our method is robust to image noises, inaccurate edge location and interferences of neighboring edges. It can generate more accurate scene depth maps than the most of existing methods using a Gaussian based DSF model.
14:15-14:30 **AR2094**	Combining LiDAR scan matching with Stereo Visual Odometry using Curvefusion Shitong Du, Xuyou Li, Helge A. Lauterbach, Dorit Borrmann, Andreas Nüchter **Presenter**: Shitong Du, College of Intelligent Systems Science and Engineering, Harbin Engineering University **Abstract**: In this paper, we present a novel algorithm, namely Curvefusion for integrating LiDAR scan matching with stereo visual odometry. First, 6-DOF pose trajectories are estimated by utilizing SOFT odometry, which is the state of the art stereo visual odometry based on feature selection and tracking, and the well-known ICP scan matching algorithm, respectively. Second, a deformation-based multi-sensor fusion method, namely curvefusion is applied. The proposed fusion method does not rely on a sensor model. As long as the trajectories of the sensors to be fused are given, we can obtain an optimized fusion trajectory, which greatly improves the computational efficiency. Experiments based on publicly available KITTI data set show that the proposed method outperforms or achieves similar performance compared with the state-of-the-art odometry methods.
14:30-14:45 **AR2093**	Frontal Face Generation Based Multi-Angle Face Identification System Zihao Zhang, Huayan Zhang, Hui Liu, Shan Xin, Ning Xiao, Lei Zhang **Presenter**: Zihao Zhang, Beijing University of Civil Engineering and Architecture, China **Abstract**: Precise identity recognition is a pre-condition for robots to enter the human living environment. Most of the existed face identification methods cannot work on the non-frontal face since the severe texture loss. In this paper, we propose a novel system to deal with multi-angle face identification in video sequence based on frontal face generation, which replaces the process of detection, alignment in the typical face identification system. To solve the problem of face texture loss in large pose variation, we creatively combine generative adversarial networks (GAN) with the state-of-the-art facial landmark localization method. The proposed system was tested on video database containing multi-angle faces, and the experimental results indicate that our system can recognize more faces in the frames, and improve the accuracy of identification for multi-angle face by 130%.
14:45-15:00 **AR2084**	Rapid and accurate regional star-map simulated method Jian Han, Jiahui Tong, Cheng Tang **Presenter**: Jian Han, Beijing Electro-Mechanical Engineering Institute, Science and Technology on Complex System Control and Intelligent Agent Cooperation Laboratory, China **Abstract**: In Celestial Navigation System, star-sensor completes attitude determination of carrier via using stars in starry skies. Star-sensor usually adopts simulated star-map instead of field observation in situations of test and simulation due to the limitations of uncontrollable factors involved by observation condition and environment. To cooperate with performance tests and function verifications of star-sensor to judge the accuracy of matching and recognition, regional simulated starmap needs to be generated timely and precisely. The quality of imaging is decided by the accuracy of centroid position and magnitude grayscale of each single star-spot, and the rapidness of refreshing is decided by the speed of star extraction. In order to improve the precision and realtime, sub-pixel star-spot reconstruction method, wide grayscale

	distribution method and rapid regional star-map generation method are proposed to generate simulated regional star-map rapidly. In the situation of ensuring the star magnitude being consistent with ephemeris, the centroid accuracy of star-spots achieve the level of 1% pixel.
15:00-15:15 **AR2088**	Research on the Horizontal View Scheme of Automatic Capacity Verification of Working Glass Container Juan Shi, Bin Li, Xueqing Hou, Jiajie Xu **Presenter**: Juan Shi, Shanghai Institute of Quality Inspection and Technical Research, China **Abstract**: At present, the verification of glass container is mostly manual. However, in manual verification, the verification personnel's workload is large, the efficiency is low, easy to appear the human error. In this paper, an automatic capacity verification device of the working glass container is developed. The servo motor drives the camera to move along the vertical slide track, and the liquid level is obtained through camera, collected images are processed to obtain the position of the liquid level and target scale line. Finally, whether the gauge is qualified is judged by the electronic scale weighing. Through theoretical and experimental analysis, the main solution to the camera level shot will greatly reduce the operator's repetitive labor, improve work efficiency and measurement accuracy.
15:15-15:30 **AR2104**	Image-based Wind Power Curve Data Cleaning Algorithm via the Matching of Deformation Template Yahao Su, Guoyuan Liang, Zekai Zhang, Yu Liang and Yong Gan **Presenter**: Yahao Su, Guilin University of Electronic Technology, China **c** The Supervisory Control And Data Acquisition (SCADA) system can collect the wind turbine data, which plays an important role in wind farm maintenances and operations. Due to some unforeseen circumstances, the wind power curve (WPC) contains many abnormal data which should be cleaned. This paper proposed an image-based WPC data cleaning algorithm via the matching of deformation template (MDT). The proposed method can be summarized into the following steps: Initially, the unprocessed data are cleaned by the Local Outlier Factor (LOF) algorithm in three-dimension space (wind speed, rotor speed, wind power). Then, the pre-processed WPC data is transformed into a WPC image with a mapping between the data and the pixels. The reference WPC is aligned to the WPC image via affine transformation based on the bounding box of the contour. In the third step, a feature image representing the confidence of being normal is built based on the distances in eight directions. In this way, the data cleaning task is transformed into an image segmentation problem. The image thresholding method is employed and the optimal threshold to is determined by the dissimilarity of Hu moment with the deformed reference WPC. Comparative experiments were operated with some typical data-based and image-based algorithms on the datasets from 17 wind turbines to verify the effectiveness and versatility of the proposed method.
15:30-15:45 **AR2056**	Single Image Super-resolution with Gradient Guidance Wang Man, Xiaofeng Du **Presenter:** Wang Man, School of Computer and Information Engineering Xiamen University of Technology, Fujian Province, China **Abstract**: Recovering high-frequency image details such as edges and textures is a challenge of image super-resolution. To improve the reconstruction accuracy, image gradient maps are widely introduced as an additional input or a regularized term directly to existing methods. We argue that the best way to exploit gradient information is to learn from the training data. We propose a convolutional neural

	network for image super-resolution which is guided by image gradient maps. The gradient guidance provides a selective condition during superresolution, leading to a more faithful super-resolved image. Our method is a flexible framework for image super-resolution, which can be easily incorporated into existing methods. Extensive benchmark evaluation shows that the proposed method achieves highly competitive performance, outperforming state-of-the-art performance in single image super-resolution.

Session 3 Topic: Manipulator design and control

Session Chair: Prof. Jang-Myung Lee, Pusan National University, Korea

Time: 16:15-18:15 (GMT+8), 9 January, 2021

Zoom ID: *648 5239 6311*

16:15-16:30 **AR2027**	A Novel Safety-Oriented Control Strategy for Manipulators Based on the Observation and Adjustment of the External Momentum Jian Liu, Yoji Yamada, Yasuhiro Akiyama, Shogo Okamoto, Yumena Iki **Presenter**: Jian Liu, Nagoya University, Nagoya, Japan **Abstract**: Human safety assurance in physical human-robot interactions (pHRIs) has become a challenge for current robotic applications. Considering the safety assurance of a pHRI validation experiment, the viscoelastic properties of a human body part were investigated in a previous study and were added in a pHRI simulation. This study focuses on a threshold momentum value as an injury criterion for momentum control strategy design. A novel safety-oriented control strategy is proposed, which consists of a conventional proportional-derivative (PD) controller, an external momentum observer-based compensator for monitoring the external momentum, and an adjustment loop for shaping the trajectory motion command to bind the external momentum within the injury criterion. The proposed control strategy can be designed without needing to obtain the mechanical properties of the environment. The strategy can also be combined with the related injury criterion. In addition, it shows the effectiveness of ensuring safety even in the worst pHRI clamping situation, where a human body part can escape from such a situation. Simulation results show that the proposed control strategy performs well in the trajectory tracking task, and the adjustment loop successfully shapes the predetermined trajectory motion command to bind the external momentum within the injury criterion.
16:30-16:45 **AR2043**	Optimization of the Manipulator with Hybrid Kinematic Chains Based on Nonlinear Programming Genetic Algorithm Longfei Sun **Presenter**: Longfei Sun, Shenyang Ligong University, China **Abstract**: In order to improve the stiffness and reduce the mass of the manipulator with hybrid open and closed-loop kinematic chains, an optimization method based on nonlinear programming genetic algorithm (NPGA) is proposed. The stiffness mass ratio is selected as the objective function, the scale parameters are selected as design variables, the workspace, stiffness matching coefficients and the end stiffness are selected as constraint conditions, and the optimal structural parameters of the manipulator are obtained by using NPGA. The simulation results using finite element analysis (FEA) show that the stiffness of the manipulator is increased and the weight is reduced effectively after the optimization.
16:45-17:00 **AR2046**	Kinematic Control of compliant serial manipulators composed of dual-triangles Wanda Zhao, Anatol Pashkevich, Alexandr Klimchik, Damien Chablat **Presenter**: Wanda Zhao, Laboratoire des Sciences du Numérique de Nantes Ecole Centrale Nantes Nantes, France **Abstract**: The paper focuses on the kinematics control of a compliant serial manipulator composed of a new type of dual-triangle elastic segments. Some useful optimization techniques were applied to solve the geometric redundancy problem, ensure the stability of the manipulator configurations with respect to the external forces/torques

	applied to the end-effector. The efficiency of the developed control algorisms is confirmed by simulation.
17:00-17:15 **AR2053**	Obstacle Avoidance Path Planning of Manipulator Based on Improved RRT Algorithm Yang Wen, Wen Haiying, Zhang Zhisheng **Presenter**: Yang Wen, School of Mechanical Engineering,Southeast University,China **Abstract**: Rapidly-exploring Random Tree (RRT) algorithm is suitable for solving path planning problems under high-dimensional space and complex constraints. To solve the problem of the RRT algorithm such as strong randomness, path redundancy, an improved-RRT algorithm with target probability offset and variable step size control is proposed in this paper. The improved-RRT algorithm can improve the operation efficiency and optimize the path. The average planning time of the improved RRT algorithm is reduced by 70.05%. At the same time, the end effector of the manipulator can reach the target position and orientation and each joint will not collide with obstacles in space. The correctness and effectiveness of the proposed method are demonstrated and validated via a MATLAB simulation.
17:15-17:30 **AR2080**	A Three-fingered Robot Hand Based on the Slider and Rocker Mechanism Lei Zhang, Tianyi Zhang, Xuguang Wang, Xingtian Yao, Dan Zhang **Presenter**: Lei Zhang, School of the Mechanical Engineering of Nantong University **Abstract**: In modern times, humanoid dexterous hands have been developed to a high level. However, they are often complicated or have high cost. A three-fingered robot hand is proposed and developed in this paper for simplicity. For each finger, the structure is designed based on the slider and rocker mechanism to increase the driving power. The new robot hand also has the advantage of easy assembly and low cost. The mechanics analysis is done on the fingers to verify the reason why driving power is increased. Experiments show that the new robot hand can perform the precision grasping and envelop grasping on the objects with suitable shape and size. The experiments of grasping different mass objects show that the new robot hand has more power than our old robot hand. These advantages show the new robot hand would be more useful in practical situation.
17:30-17:45 **AR2048**	Shared control strategy based on driver's trajectory following intention Lanei Abi, Dafeng Jin, Liangyao Yu **Presenter**: Lanie Abi, Tsinghua university, China Abstract: Although everything brought by driverless technology is full of attractiveness, until the related technologies and laws are perfected, human-machine shared control is still the best choice at present. There are two main methods in the current shared control strategy. One is that the assisted driving system guides the driver to control the vehicle through voice or tactile. This method cannot guarantee the effectiveness of the assist function when the driver is not attentive. The second is to take over the vehicle based on the risk assessment algorithm by monitoring the vehicle's dynamic state and the surrounding environment. This method can improve the safety of the vehicle, but its comfort is poor. This paper studies the real-time identification method of driver's intention, by constructing the steering angle envelope based on the planned trajectory, establishes a flexible control transfer mechanism, through trajectory switching within the kinematic envelope, the human-machine shared control for trajectory following is realized. Firstly, a series of safety trajectories are obtained by constructing a safe envelope for vehicle kinematics. Then, by using the decoupling characteristics of the steer-by-wire system, the driver's intention recognition algorithm is established by constructing the accuracy envelope of the steering wheel angle, and a trajectory that meets the driver's intention is selected to ensure the driver's confidence. Finally, the path tracking controller using a linear time-varying model prediction algorithm will

	control the vehicle to follow the trajectory determined by the driver. In this way, unlike driverless technology or some other assisted driving systems, by constructing a flexible transfer mechanism of control rights based on the steering angle envelope, although sacrificing driver expectations within a certain range, not only can the steering wheel shake be filtered to ensure driving comfort, but also the accuracy of trajectory tracking can be improved.
17:45-18:00 **AR2102**	Solving finite-horizon HJB for optimal control of continuous-time systems Ziyu Lin, Jingliang Duan, Shengbo Eben Li, Jie Li, Haitong Ma, Qi Sun, Jianyu Chen, Bo Cheng **Presenter**: Ziyu Lin, Tsinghua University, China **Abstract**: Hamilton-Jacobi-Bellman (HJB) equation is the sufficient and necessary condition for continuous-time optimal control problem (OCP). Different from HJB equation in infinite horizon, finite-horizon HJB equation contains a time-dependent value function, whose partial derivative with respect to time is an intractable unknown term. My study has found that the partial derivative exactly equals the terminal-time utility function by analyzing the initial-time equivalency between fixed time horizon OCP and fixed terminal time OCP. We also provide another proof, which uses the definition of partial derivative. This finding allows reusing traditional approximate dynamic programming (ADP) algorithm to approximate optimal policy with a parameterized function like neural network, thus solving the continuous-time finite-horizon OCP. The correctness of our finding is evaluated by analyzing a linear quadratic problem.

Session 4 Topic: Mechanical Design Manufacturing and Automation

Session Chair: Asst. Prof. Vaitheeswaran Vembarasan, Sri Sivasubramaniya Nadar College of Engineering, India

Time: 16:15-18:15 (GMT+8), 9 January, 2021

Zoom ID: *654 8729 1596*

16:15-16:30 **AR2066**	Digital twin-based operation simulation system and application framework for electromechanical products Yang Lu, Xiaoli Qiu, Yan Xing **Presenter**: Yang Lu, Southeast University, China **Abstract**: Aiming at the problems of changeable operating environment of electromechanical products and the difficulty of obtaining operating data, this paper proposes an operation simulation system and application framework for electromechanical products driven by digital twin. By improving the product twin model and building a virtual operating environment, the real operating state of the product is simulated. Then, the realization mechanism of product design iterative optimization, fault diagnosis and prediction is elaborated. Finally, the effectiveness of the system is verified by the simulation of the electronic accelerator pedal.
16:30-16:45 **AR2108**	Research on Control of Engine Start and Stop in P2.5 Hybrid System Junchao Jing, Fucheng Zhao,Yiqiang Liu, Weishan Huang **Presenter**: Junchao Jing, Ningbo Geely Royal Engine Components Co. Ltd **Abstract**: Due to the high economy performance and low cost, the P2.5 hybrid system which has only one motor is developed. In the P2.5 system, there are three type of engine start methods which are the ISG start,12V start, the clutch start. The main evaluation indicators of the engine start and stop involve the drive intension, the power dynamic performance, the smoothness, the start safety, the start time, as well as the degree of jerk. In order to satisfy the standards, five start modes and some strategies are defined. First, the prefill torque during the ISG start time is used to improve the smoothness of ISG start and the prepare torque for the clutch start is requested all the time except when target speed has been reached and clutch should be completely opened to improve the smoothness of clutch start. Second, the engine speed prediction function of the clutch start allows for a higher gear selection during the acceleration to improve the smoothness of the drivability. Third, the clutch gear selection criterion of clutch start is developed to satisfy the driver intension and avoid the power loss. The engine inject delay time is defined according to start mode and the engine coolant temperature to satisfy the driver intension and avoid the engine speed drop to ensure the start safety. Fourth, the motor torque reserve in the pure electric mode is defined according to the vehicle speed and the starting gear to ensure basic starting smoothness and pure electrical power performance. Fifth, the wait for the clutch strategy is used to improve the smoothness during the engine start when the vehicle speed is below 10km/h instead of 12V start. Sixth, the engine stop with motor assist is develop to reduce the impact and improve the NVH performance. Finally, real vehicle tests are also conducted successfully to prove that the innovative and feasible control of engine start and stop in P2.5 system is demonstrated.
16:45-17:00 **AR2101**	Data-driven Fault Prediction for Electrical Machinery based on Novel Sample Preprocessing Hongqiao Wang, Mian Wang, Ling Wang, Yanning Cai, Xiaofeng Tang **Presenter**: Xiaofeng Tang, Shanghai Institute of Optics and Mechanics, Chinese

	Academy of Science, China **Abstract**: Focusing on the data-driven fault prediction for electrical machinery, a hyperplane model of one-class SVM using novel sample preprocessing is studied in this paper. By analyzing the distribution characteristics of the support vectors from the one-class SVM algorithm, a hyperplane modeling method with the samples owning some geometry characters is proposed. On this basis, a large number of novel samples, namely the non-support-vectors can be eliminated. The experimental results for electrical machinery show the effectiveness of the presented fault prediction method, and the novel sample preprocessing method can remarkably reduce the training samples and bring higher modeling efficiency.
17:00-17:15 AR2058	A Detection and Identification Method Based on Machine Vision for Bearing Surface Defects Zhengyan GU, Xioanhui LIU and Lisheng WEI **Presenter**: Zhengyan GU, Anhui Polytechnic University, China **Abstract**: In view of the disadvantages of manual testing of bearing surface defects in the bearing production process, an automatic detection and identification method of bearing surface defects based on machine vision is proposed. Firstly, the source image is pre-processed by gamma correction algorithm, and the Canny algorithm is improved by adaptive selection of the Canny algorithm based on iterative threshold segmentation method and Ostu algorithm to improve the integrity and precision of the segmentation of bearing surface defects. The experimental results show that the method can be accurately detected of bearing surface defects, and the defect recognition rate has reached 93.33%.
17:15-17:30 **AR2060**	Accuracy Improvement of a Redundant Inertial Measurement Unit Brought about by the Dual-Axis Rotational Motion Ting Zhu, Yuan Ren, Lifen Wang, Xuerui Zhai, Fandong Lu, Tao Zou **Presenter**: Ting Zhu, Space Engineering University, China **Abstract**: The inertial measurement unit (IMU) can achieve high reliability by configuring redundant sensors. However, the improvement in navigation accuracy of the redundant inertial measurement unit (RIMU) is minor. To achieve high accuracy and high reliability of the inertial navigation system (INS), a novel method to control dual-axis rotation of the RIMU to compensate its errors is proposed in this paper. First, a general error model of RIMU which can be applied to various sensor configurations is established. Second, the dual-axis turntable in INS is controlled to make the RIMU rotate periodically which can compensate the errors and improve the navigation accuracy. However, the effect of error compensation by rotation will be reduced when the vehicle is in angular motion, so a method of dual-axis rotational motion based on navigation frame which can alleviate the negative effect caused by the angular motion of vehicle is proposed. Simulation results show that the proposed method can greatly improve the navigation accuracy whether the vehicle is in angular motion or not.
17:30-17:45 **AR2041**	Automation of Quality Control in the Automotive Industry using Deep Learning Algorithms Charbel El Hachem – Gilles Perrot – Loïc Painvin – Raphaël Couturier **Presenter**: Charbel El Hachem, Univ. Bourgogne Franche-Comté (UBFC) **Abstract**: Quality control is an essential operation for an automotive company like Faurecia. A vast number of references is produced, and many regions of interest need to be checked. For that, quality control is necessary and should be applied to every reference part. Visual inspection is achieved by the operator who checks each part manually. After several checks per day, the operator gets tired and thus may misqualify

	a welding seam or a component control. To avoid that, Faurecia is trying to integrate automatic quality control to obtain better overall equipment effectiveness (OEE), especially to avoid performance degradation over the operator's shift. Researches demonstrate the ability of a neural network to reach high precision in detecting object presence or absence. We have been able to achieve an accuracy of 99% with ResNet-50. Apart from accuracy, the other performance matrices used in this work are reliability and cycle time. Our contribution will help the current state of manufacturing by offering an automatic visual inspection, which will lead to other innovative projects in the automotive industry.
17:45-18:00 **AR2059**	Digital Twin-based Process Optimization System Research for Micro-assembly Products Yi Zhang, Xiaojun Liu, Jiasheng Huang, Zhonghua Ni **Presenter**: Yi Zhang, School of Mechanical Engineering, Southeast University, China **Abstract**: Micro-assembly products are the core components in the field of radar satellites. Due to the lack of intelligent micro-assembly technology, there are problems such as long product development cycles and poor product consistency. Aiming at solving the above problems, this paper carries out the research on the digital twin-based process optimization system for micro-assembly products. The paper first introduces the application of digital twin technology in the optimization of micro-assembly process. Then the model of micro-assembly digital twin data and the real-time data acquisition scheme are presented. Further, this paper constructs the process evaluation model from the perspective of process optimization rate and process confidence, and introduces the process optimization method based on the process evaluation model. Finally, the implement of the system is introduced, and the process design of a certain type of T/R components is used as an example to verify the effectiveness and feasibility of the system.
18:00-18:15 **AR2077**	A Full Caterpillar Robotic Vehicle Design Dequn Teng **Presenter**: Dequn Teng, University of Liverpool **Abstract**: This paper discusses a Full-Caterpillar Robotic Vehicle Design, including a carriage, the engine of which is bolted to the centre at both sides of the bottom of the interior cavity of the carriage, the output shaft of which is bolted to a first gear, the bearings embedded in both sides of the front and back of the interior cavity of the carriage, and the inner ring of which is rotatingly connected with a rotating shaft. The invention improves the driving force through the two engines, so that the armoured car can reach the battlefield more quickly and sensitively to annihilate the enemy, improves the annihilating power of the armoured car by equipping the flame thrower, speeds up the annihilation speed of the enemy, facilitates the identification and locking of the armoured car to the enemy through the cooperation of the camera and the infrared sensor camera, improves the speed of annihilation of the enemy through the flame thrower, and speeds up the annihilation speed of the enemy through the flame thrower along the carriage. The top axis is symmetrically distributed, which makes it easy for the armoured vehicles to destroy the enemies in the front and rear directions at the same time, increasing the speed of the armoured vehicles in destroying the enemies and solving the problem of the traditional Fire Centipede armoured vehicles being slow in destroying the enemies.

Session 5 Topic: Robot design and control

Session Chair: Dr. Shuai Wang, Tencent Robotics X, Shenzhen, China

Time: 09:30-11:30 (GMT+8), 10 January, 2021

Zoom ID: *648 5239 6311*

9:30-9:45 **AR2030-A**	Bone recognition of orthopedic surgical robot based on signal feature extraction and SVM Qing Yang, Mei Shui, Xisheng Weng **Presenter**: Qing Yang, School of Biological Science and Medical Engineering, Beihang University **Abstract**: Cortical and cancellous bone can be distinguished by bone recognition. In this study, the unit energy consumption is used as the bone feature to extract signal in the bone grinding process of surgical robot to obtain the feature vector, which is used to train support vector machine (SVM) for recognizing the bone layer. The feature extraction method mainly searches for the best transformation matrix according to the specific separable linear criterion or the optimal data distribution attribute, and establishes the unit energy consumption function which reflects the bone characteristics. The feature vector of the unit energy consumption function is obtained using principal component analysis (PCA). The bone recognition algorithm can be applied in the process of dynamic safety control of bone grinding of orthopedic surgical robot, reduce the damage of bone grinding and improve the dynamic stability of surgical robot to ensure the safety.
9:45-10:00 **AR2042**	Robot automatic assembly system based on current feedback Lindong Xu, Yuanlou Gao, Jizhe Ge **Presenter**: Lindong Xu, BeiHang university, China **Abstract**: This paper analyzes the geometric and mechanical relationships in the process of active assembly of the circular shaft hole, and derives the relationship between the assembly lateral error and the assembly force and moment, and proposes a method for searching and finding holes and compensating the position error of the shaft hole. Active assembly method. Perform statics analysis on the robot and establish a mechanical model of the robot in a static state. The joint torque obtained by the sampling function of the robot's own joint motor current is used to analyze the force in the assembly process, to obtain the size and direction of the assembly error, and realize the error judgment without external sensors. Afterward, the shaft hole assembly process can be completed through the error adjustment algorithm.
10:00-10:15 **AR2083**	Influence of Reconfigurable Modular Robot Arm Linear Module on Configuration ZIYU Zhang, DAN Wang, DONGLIANG Lei **Presenter**: ZIYU Zhang, Shenyang Jianzhu University, China **Abstract**: Based on design ideas of reconfigurable modular robotic arm, a reconfigurable modular robotic arm satisfying the strategic mission of China's space station is studied. Based on the manipulator configuration of the space screw operation task, the kinematics and dynamics models for the non-redundant 6-DOF configuration and the redundant 9-DOF manipulator configuration containing linear modules are established, and the linear type is compared and analyzed. The influence of the linear module on the kinematics and dynamics of each manipulator configuration is compared and analyzed.
	Design and Research on Impact Deicing Mechanism of Cable Climbing Robot Zicun Hong, Kai He, Yaohui Xu, Haitao Fang, Qiyang Zuo, Zheng Li **Presenter**: Zicun Hong, Shenzhen Institutes of Advanced Technology,Chinese

10:15-10:30 **AR2087**	Academy of Sciences, China **Abstract**: In the cold area, the PE sleeve on the cable surface of cable-stayed bridge is easy to freeze, so it needs to be deiced regularly. Compared with manual deicing, cable climbing robot deicing is a more efficient method. In this paper, a deicing mechanism which can be installed on a cable climbing robot is designed. The deicing mechanism is composed of a crank slider mechanism and a special ice blade, which can break the icing by reciprocating impact to complete the deicing maintenance operation. This paper also uses ADAMS to conduct dynamics simulation to compare the force of the deicing mechanism on the icing at different operating speeds, and uses the Explicit Dynamics module in ANSYS to perform finite element simulation of the deicing mechanism to analyze its deicing effect. Finally, a deicing experiment was carried out to verify the effectiveness of the deicing mechanism.
10:30-10:45 **AR2097**	Robotics and Artificial Intelligence Applications in Manage and Control of COVID-19 Pandemic Khalid Hussain, Xingsong Wang, Zakarya Omar, Muhanad Elnour,Yang Ming **Presenter**: Khalid Babiker Fadlelmula Hussain, Southeast university **Abstract**: Robotics and Artificial Intelligence (AI), applications have played an essential role in manage and control of COVID-19 pandemic specifically in hospitals, hotels, restaurants, airports, transportation systems, schools and at the community level. Artificial intelligence technologies, autonomous vehicles, drones, mobile robots, humanoid robots, manipulator robots and other intelligent robots are used potentially during the outbreak in control of the transmission network from person to person. Due to the highly uses, we consider AI and robotics in health will likely continue after the COVID-19 pandemic and development of these technologies is needed for fighting against infectious diseases. Furthermore, uses of these systems in different fields like industry, sports, ergonomics, distribution of goods, and social life will keep going in the coming years.
10:45-11:00 **AR2086**	A novel design of a wall-climbing robot and experimental study on magnetic wheels Yaohui Xu, Kai He, WenLiang Zhao, Haitao Fang Qiyang Zuo **Presenter**: Yaohui Xu, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences,China **Abstract**: The adhesion of marine organisms will increase resistance and accelerate corrosion of the vessel, so the hull must be cleaned and repaired regularly. At present, underwater cleaning mainly relies on divers carry the cleaning equipment to operate the tool in the water, which is costly and inefficient. Compared with the manual maintenance, the wall-climbing robot can clean and inspect the hull safely, efficiently and at low cost. One of the key technologies of the underwater wall-climbing robot (UWCR) is to ensure that it could attach to the hull to achieve flexible movement and complete safe operations such as cleaning or inspection. In this paper, we present the mechanical design of an UWCR used for inspecting the hull. The novel design of magnetic wheel of the UWCR is discussed in detail. In order to avoid the unstable phenomena such as tumbling or overturning, the static model of the UWCR was established. The ANSOFT MAXWELL is used to simulate the magnetic force provided by the magnetic wheel. The structure of magnetic wheel is optimized based on the simulation result. The experiment verifies the reliability of the magnetic wheel, the motion characteristics of the UWCR and the feasibility of the optimal design.
11:00-11:15 **AR2110**	Mechanism Design and Statics Analysis of Walking Module of Orbital Machine Room Inspection Robot Na Ge, Ruiming Qian

	Presenter: Na Ge, Southeast University, China **Abstract**: In order to realize the intelligent inspection of the machine room, a new type of orbital inspection robot walking mechanism and track structure is designed. The walking module can walk on slopes and curves smoothly and reliably, and realize rapid disassembly at any position of the track. Compared with the horizontal motion, the climbing process obviously needs more power, and the force condition during the turning process is more complicated. Therefore, statics analysis of the inspection robot in climbing and turning stages is performed, and the driving force required by the robot and the supporting force of each guide wheel are solved. The analysis results provide theoretical support for the selection of driving motor, statics analysis and parameter optimization of track structure. The offset of the center of mass affects the force condition of the robot. Therefore, the influence of the position of the center of mass of the robot on each force is studied, and the optimal position range of the center of mass is obtained. The research provides theoretical basis for the overall structure layout and optimization of the robot.
11:15-11:30 **AR2023**	Realistic Mechanism and Behaviour Co-design of a One Legged Hopping Robot Antonios E. Gkikakis and Roy Featherstone **Presenter**: Antonios Emmanouil Gkikakis, Istituto Italiano di Technologia, Genoa, Italy and Dibirs, University of Genoa, Italy **Abstract**: In contrast to the high specifications of commonly available mechanical parts, mobile robots (especially legged robots) display a relatively low performance when compared to the potential of their individual parts. Moreover, such robots are designed and optimized to perform only a small number of tasks. In this study, we present a two-layer multi-objective optimization framework, used for mutual optimization of the mechanism and the behavior of an agile monopod robot called Skippy. We use highly realistic dynamic models, with the aim to close the gap between reality and simulation, and we concurrently optimize the design and the behavior parameters. The result is a Pareto front of robot designs and a set of command signals to achieve several athletic feats. This design study does not address the control aspect, but deals only with the physical ability of the robot, and it focuses on a planar one-legged robot.

Session 6 Topic: Robot motion and path planning

Session Chair: Prof. Mo-Yuen Chow， North Carolina State University, USA

Time: 09:30-11:30 (GMT+8), 10 January, 2021

Zoom ID: *654 8729 1596*

9:30-9:45 **AR2025**	Learning Ball-balancing Robot Through Deep Reinforcement Learning Yifan Zhou, Jianghao Lin, Shuai Wang, Chong Zhang **Presenter**: Yifan Zhou, Zhejiang University,China **Abstract**: This The ball-balancing robot (ballbot) is a good platform to test the effectiveness of a balancing controller. Considering balancing control, conventional model-based feedback control methods have been widely used. However, contacts and collisions are difficult to model, and often lead to failure in balancing control, especially when the ballbot tilts a large angle. To explore the maximum initial tilting angle of the ballbot, the balancing control is interpreted as a recovery task using Reinforcement Learning (RL). RL is a powerful technique for systems that are difficult to model, because it allows an agent to learn policy by interacting with the environment. In this paper, by combining the conventional feedback controller with the RL method, a compound controller is proposed. We show the effectiveness of the compound controller by training an agent to successfully perform a recovery task involving contacts and collisions. Simulation results demonstrate that using the compound controller, the ballbot can keep balance under a larger set of initial tilting angles, compared to the conventional model-based controller.
9:45-10:00 **AR2063**	A Novel Multi-configuration Quadruped Robot with Redundant DOFs and Its Application Scenario Analysis Guanglin Lu, Teng Chen, Qibing Liu, Guoteng Zhang, Xuewen Rong, Shuai Wang **Presenter**: Guanglin Lu, The Center for Robotics, School of Control Science and Engineering, Shandong University, China **Abstract**: To improve the adaptability and robustness of the quadruped robot to the environment, we design a novel multi-configuration quadruped robot with redundant degree-offreedoms (DOFs). Compared with traditional quadruped robots, the presented robot can adapt to rugged terrain with optimal leg configurations. The quadruped robot can use insect-like or reptile-like configurations to pass through rough terrain. The transformation between different configurations is realized by redundant DOFs. The quadruped robot uses dynamic gait and optimal configuration to pass through complex terrain, instead of traditional crawling gait. To solve the redundant inverse kinematics, a simplified jacobian pseudoinverse (JP) algorithm based on quadratic integral programming is used. The algorithm based on spring loaded inverted pendulum (SLIP) is used to control the motion of the quadruped robot in various configurations. The multi-configuration motion of the robot is verified by dynamic simulation software Webots. The optimal configuration of the quadruped robot is explored by comparing the performance of each configuration in multiple scenarios.
10:00-10:15 **AR2033**	A New Gap Selection Strategy for Follow the Gap Method Hosein Houshyari, Volkan Sezer **Presenter**: Hosein Houshyari, Autonomous Mobility Group, Control & Automation Engineering Department, Istanbul Technical University, Turkey **Abstract**: Obstacle avoidance methods guarantee the robot's safety during the tracking of the planned path. Follow the Gap Method known (FGM) is a geometry-

	based obstacle avoidance method that continuously leads the robot to the goal point by selecting the largest gap existing around the robot. This approach calculates the heading angle by considering the distance to the closest obstacles, the angle to the goal, and the center of the gap. In this paper, a new procedure is developed to improve the gap selection in FGM, where the gaps are selected based on the prediction of gap changes during the time, considering the distance between the robot and obstacles in the future. In order to test the proposed methodology, Monte-Carlo simulations are used and the results are presented for comparison. The results demonstrate that the new procedure leads the robot to safer trajectories in comparison with classical FGM.
10:15-10:30 **AR2091**	Research on Path Planning of AUV Based on Improved Genetic Algorithms Feng Pan **Presenter**: Feng Pan, Jiangsu Automation Research Institute Lianyungang, China **Abstract**: As an important underwater detection tool, AUV is playing an increasingly crucial role in the military and civilian fields.In order to improve the convergence speed and avoid local minimum, the paper improves the traditional genetic algorithm firstly.The improvements mainly reflect in the following three aspects: first,the elitist strategy is proposed to ensure that excellent individuals will not be lost because of mutation and crossover; second, the reverse transcription is introduced to ensure that the offspring can get as many excellent genes as possible from the excellent parents;third,an adaptive crossover probability and an adaptive mutation probability are used to prevent the local convergence of the algorithm, which results from the improper setting value. Then,a path planning model is established based on the improved genetic algorithm.Finally,combined with the improved genetic algorithm,the path of AUV cruising multiple points continuously is planned successfully.The simulation results show that the improved genetic algorithm not only solves the local convergence problem effectively, but also has fast convergence speed and strong optimization ability.
10:30-10:45 **AR2092**	Greedy BIT* （GBIT*）: Greedy Search Policy for Sampling-based Optimal Planning with a Faster Initial Solution and Convergence Liu Chen, Liu Yu, Song Libin, Zhang Jiwen **Presenter**: Chen Liu, Tsinghua University, China **Abstract**: This paper presents Greedy Batch Informed Trees (GBIT*), a greedy version of Batch Informed Trees (BIT*) and Advanced Batch Informed Trees (ABIT*) with a greedy search policy inspired by RRT-Connect. BIT* and ABIT* use an edge queue ordered by the (inflated) potential path cost to find the best next edge to process. GBIT* builds on ABIT* by adding another preferential way, which is defined by the greedy search policy, to choose the next edge to process. Otherwise, it will follow ABIT*'s method. The greedy search policy guides the search moving forward greedily and towards the goal, which can make it faster to find the initial solution. An earlier initial solution can lead to a faster upper bound to define the informed set and start the convergence process earlier. The experiment results show that in different maps, GBIT* can find an initial solution faster than any other sampling-based asymptotically optimal planners, as well as RRT-Connect in most cases.
10:45-11:00 **AR2109**	Inverse Kinematics Study for Intelligent Agriculture Robot Development via Differential Evolution Algorithm Chen Li, Hui Dong, Xubing Li, Weikang Zhang, Xiaodong Liu, Ligang Yao, Hao Sun **Presenter**: Chen Li, College of Mechanical Engineering and Automation, Fuzhou University, China

	Abstract: Robots with intelligent moving and manipulating ability are able to improve productivity of agriculture work. We prototyped a mobile robot equipped with reductant manipulator (7-DOF). Here, for controlling the manipulator precisely, we investigate the inverse kinematics (IK) issue of the manipulator. A novel IK solving method by adopting an improved differential evolution algorithm has been validated. Also, random change crossover is employed to restrict the tendency of falling into local optimization when we use the algorithm. In parallel, considering the position and posture errors, boundary processing has been redesigned for avoiding joint limits. Thereafter, we obtain the global optimal IK solutions. Simulation tests have been carried out using the numerical model of the redundant arm. By testing accuracy and stability of the arm, we verify the feasibility and efficiency of the proposed approach.
11:00-11:15 **AR2075**	Path Planning for Autonomous Underwater Vehicle Based on Artificial Potential Field and Modified RRT Jia Zhu, Shili Zhao, Ran Zhao **Presenter:** Jia Zhu, China Agricultural University, China **Abstract:** Autonomous underwater vehicle (AUV) plays an important role in modern aquaculture. For example, it can be applied to monitor water quality as well as the fish biomass. In these activities, path planning is significant for AUV. This paper proposed a path planning algorithm for underwater vehicles based on improved rapidly expanding random tree (RRT). The artificial potential field (APF) algorithm is introduced into the heuristic function of bidirectional RRT to improve the expansion efficiency as a global path. To solve the problem of dynamic obstacles, global path planning and local path planning are combined. The dynamic window method is used in local path planning to deal with dynamic obstacles. This approach takes the robot's speed as the reference point. It sets the window and then selects a better path by the evaluation function. In this way, the path planning of underwater vehicle in a dynamic environment is realized. Finally, the algorithm was simulated in both static and dynamic environments. The results show that the proposed algorithm can provide effective paths for underwater vehicles quickly.
11:15-11:30 **AR2051**	An Industrial Distributed Network of Intelligent Robotic Security Guards based on the Internet of Robotic Things Paradigm A. Antenucci, A. Brancati, S. Mazzaro, G. Bastianelli, R. Rovella, A.Massa, W.Matta **Presenter**: Silvio Mazzaro, Vitrociset – a Leonardo Company, Italy **Abstract**: The purpose of this paper is to present an advanced robotic security solution based on the Internet of Robotic Things (IoRT) paradigm under design and prototyping by Vitrociset – a Leonardo Company. An internet of intelligent security robotic guards based on a Vitrociset AI framework called VIKI, with an integrated biometric module able to provide ePassport instant photo images, downloading them by RFID and correlating them with enhanced and cutting-edge deep learning-based face recognition techniques, using commercial-off-the-shelf (COTS) electro-optical sensors. The distributed robots will be equipped also with enhanced functions like real-time thermal image analysis for illness prediction alarms and license plate recognition for vehicles access into the controlled area. The solution is under design for a fixed internet of multi-robot configuration, and successively will be switched easily to a mobile one. The internet of robotic guards will have a human interaction module with speech synthesis functions and natural language processing for knowledge-based automatic reasoning useful for question-answering sessions during access control interactive interviews. In this way, during the biometric reading, people will be able to ask questions to the robotic guards, which will interact and collaborate with humans, adding security questions and clarifications during access control to restricted and protected areas.

Session 7 Topic: Medical Electronics and Automation

Session Chair: Prof. Jiang Zhu, Department of Mechanical Engineering, Tokyo Institute of Technology, Japan

Time: 14:00-16:00 (GMT+8), 10 January, 2021

Zoom ID: *648 5239 6311*

14:00-14:15 **AR2039**	A novel porous structural design of the orthotic insole for diabetic foot Tong Chen, Mengqian Tian, Xingsong Wang **Presenter:** Tong Chen, College of Mechanical Engineering, Southeast University, China **Abstract:** Diabetic foot is a common complication of diabetes with a significant symptom of excessive plantar pressure. Studies have shown that reducing plantar pressure can effectively lower the incidence of diabetic foot. In this work, a new design method is proposed to reduce plantar pressure by dividing the orthotic insole into two areas. Support area is under the midfoot and shares a part of plantar pressure compared to flat structure. Soft area helps in decreasing the plantar pressure of the forefoot region and rearfoot region by low young's modulus structure. Honeycomb structure and auxetic structure are applied in the novel porous insole. The orthotic insoles were manufactured by fused-deposition modeling. Finite element analyses show that the auxetic structure of soft area enhances larger deformation than ordinary flat structure by 18% under pressure. Results show that the support area reduces the pressure of the forefoot region and rearfoot region by 30% during upright position. The scene of wearing orthotic insoles with pressure sensors is explored. Consequently, the novel porous insoles can be used to bring better plantar pressure reduction for the treatment of diabetic foot.
14:15-14:30 **AR2079**	Simulation of Assisted Human Walking using Musculoskeletal Model Coupled with Exoskeleton via Deep Reinforcement Learning Ruiming Luo, Shouqian Sun **Presenter:** Ruiming Luo, Zhejiang University, China **Abstract**: This paper presents a novel approach to simulate assisted human walking to evaluate the assistance of the powered lower-limb exoskeleton. We first construct a subject specific musculoskeletal model as an agent that generates muscle forces according to internal and external states, and describe the exoskeleton as a rigid multi-link structure with compensatory torques applied at the joints. Then we train the agent to produce walking motion using a deep reinforcement learning algorithm given recorded experimental data on a biomechanical simulator. Next, we combine the pre-trained musculoskeletal agent with the exoskeleton and perform the assisted walking simulation which takes into account the human exoskeleton dynamics. Simulated energy expenditures under different experimental conditions are compared to evaluate the assistance effectiveness of the exoskeleton. Results show that the proposed method has great potential in providing insights into the human-exoskeleton interaction.
14:30-14:45 **AR2069**	Optimization of gait assistance pattern for Charcot-Marie-Tooth patients based on forward predictive simulation Fengchao Zhang, Jianyu Chen, Wei Wang, Hong Han, Xin Li, Juanjuan Zhang **Presenter:** Fengchao Zhang, College of Artificial Intelligence, Nankai University, Tianjin, China **Abstract:** Muscle weakness of Charcot-Marie-Tooth (CMT) patients makes their gaits abnormal. Powered orthoses are expected to adjust the gaits, save metabolic energy and reduce the risk of falling. However, there is no guidance for the assistance pattern for CMT patients. Therefore, we optimized the gait assistance pattern using forward

	predictive simulation framework based on musculoskeletal model. First, we modified plantar flexor and dorsiflexor parameters of the model to simulate pathological gaits. Then, we applied ideal ankle plantarflexion & dorsiflexion, ankle plantarflexion, ankle dorsiflexion, knee flexion & extension, and hip flexion & extension assistance torques to the model. The pathological gait data collected by simulation and experiment were compared. The mean of metabolic rate, root mean square of muscle activations, and ankle angles with the different assistance patterns were analyzed. Results showed that the simulated gait can capture the characteristics of the pathological gait and ankle plantarflexion & dorsiflexion assistance with a plateau was the optimal assistance pattern. This provides a guidance for gait assistance in CMT patients.
14:45-15:00 **AR2054**	Computer-aided Detection Breast Cancer in Whole Slide Image Chang Li, Xi Lu **Presenter:** Chang Li, School of Mechanical Engineering Southeast University, China **Abstract:** The diagnosis of the whole slide images of breast cancer is highly dependent on the experience of the pathologist, and the diagnosis results are prone to large human errors. Along with the rapid develop of the technique of computer and image manipulation, the computer-aided diagnosis is gradually used in medicine. Based on visual perception, we propose a model for rapid detection and refined segmentation of breast cancer regions in this paper. We adopt a classification model ResNet101 or MobileNetV2 to quickly filter out obvious non-cancer areas. Then, the semantic segmentation model U-Net is used to refine the segmentation. Experimental results show that our approach can quickly classify the lesion, ResNet101 model patch classification accuracy rate reaches 98.3%, MobileNetV2 model in the case of relatively few parameters, the patch classification accuracy rate reached 97.2%. When the results are not much different, the MobileNetV2 model can quickly classify the patch image. In accurately locating the lesion area, the FROC score best reached 79.5%. The results are competitive compared to the results of other state-of-the-art methods.
15:00-15:15 **AR2024**	Aspect-based sentiment analysis of individual equipment ergonomics evaluation Chunchen Bu,Yaping Wang, Shubin Zhao, Long He,Xinrui Wang **Presenter:** Chunchen Bu, Nanjing University of Science and Technology, China **Abstract**: The man-machine adaptability between soldiers and equipment affect the operational effectiveness of the whole individual soldier integrated system. In view of the complex semantic information and various equipment tendencies of individual soldier equipment evaluation, in order to extract key insights from soldiers' comments on equipment, this paper constructs a Chinese multi-faceted and multi emotional (MME) dataset, and proposes an aspect-based sentiment analysis model. This model combines attention mechanism and context feature dynamic weighting method with global perceptual aspect embedding to enhance the BERT representation of aspect-based sentiment analysis. Then this study adds the offset correction to the ADAM algorithm, and finally maps the target to the correct context representation. The experimental results show that BERT's dynamic weighting model has higher accuracy and score than MGAN, ATAE-LSTM, BERT-AEN, and BERT-Base models respectively in the classification of soldier equipment evaluation. It proves the effectiveness and feasibility of the data processing of soldier equipment evaluation.
15:15-15:30 **AR2028**	Updating Potential Runaway Motion Volume in Task Space and Introducing Minimum Volume Enclosing Ellipsoid Hiroki Kito, Yoji Yamada, Jian Liu, Shogo Okamoto **Presenter: Hiroki Kito, Nagoya University, Japan** **Abstract**: Human-robot collaboration (HRC) has gained considerable interest among researchers, particularly in the manufacturing field. In such systems, new risks that have not previously been considered may now need to be assessed. One of these risks is that

	of a robot and worker colliding with one another. To avoid such collisions, a definition of the separation distance between a robot and a worker is needed. According to the ISO10218-1 standard, the safety of a worker needs to be maintained even in the case of a single safety system fault. Therefore, in defining the separation distance, a single fault needs to be considered, so that a robotic manipulator may safely run away when it occurs. As a method to quantify running away, a potential runaway motion in the task space (PRAM-t) was proposed. In the PRAM-t, a dynamic manipulability ellipsoid was used to calculate the acceleration as the robot runs away. However, when we consider running away originating from a single fault, it can be exaggerated. Therefore, this paper proposes a new method to compute acceleration during the running away of a robot using an algorithm to compute minimum volume enclosing ellipsoids. The proposed method and the dynamic manipulability ellipsoid (DME) method are compared using a case study.
15:30-15:45 **AR2096**	Weighted Scan Context: Global Descriptor with Sparse Height Feature for Loop Closure Detection Xin Cai, Wensheng Yin **Presenter:** Xin Cai, Department of Mechanical Engineering, Tsinghua University, China **Abstract**: In simultaneous localization and mapping (SLAM), the loop detection module has an important impact on the global consistency of trajectory and mapping. Compared to vision-based methods, LIDAR-based methods are gaining attention because they can acquire a complete 360° horizontal field of view and are not affected by changes in illumination. However, pure height features extracted from LIDAR point clouds are subject to feature degradation in specific environments. To reduce the adverse effects of height feature degradation, we propose a global descriptor, Weighted Scan Context, that uses the intensity information of the points to sparse the geometric features in the height direction. To reduce the sensitivity of cosine distance to viewpoint translation motion, a hybrid distance metric that integrates cosine distance and Euclidean distance is used to measure the similarity of two scenes. Through experiments on the KITTI dataset, the proposed method shows better performance compared to existing methods.
15:45-16:00 **AR2082**	Development of a Memory-based Homing Algorithm Using a Tracking Camera for an Autonomous Cart Takumi Miyamoto, Jae Hoon Lee, Shingo Okamoto **Presenter:** Takumi Miyamoto, Ehime University, Japan **Abstract**: Transportation is a key sector in various fields and highly affects the efficiency of industries and other related organizations. Especially, in warehouses, the transport of goods from one point to another is dominated by manually operated carts or forklifts, which makes it labor-intensive work. In this paper, to reduce the burden of workers engaged in the transportation of goods and materials, a new memory-based system integrated into a wheeled robot was developed. It records a route previously taken through the use of a tracking camera and an IMU sensor. The saved motion trajectories are later used as a reference by the robot for its autonomous movement when carrying a burden. The developed system was confirmed through experiments by the developed hardware and software systems. As a result, a reasonable result was obtained when tested in an indoor environment.

Session 8 Topic: Communication and Information System

Session Chair: Prof. Badrul Hisham bin Ahmad, Universiti Teknikal Malaysia

Time: 14:00-16:00 (GMT+8), 10 January, 2021

Zoom ID: *654 8729 1596*

14:00-14:15 **AR2105**	Auto-generated Wires Dataset for Semantic Segmentation with Domain-independence Riccardo Zanella, Alessio Caporali, Kalyan Tadaka, Daniele De Gregorio, Gianluca Palli **Presenter:** Riccardo Zanella, University of Bologna, Italy **Abstract**: In this work, we present a procedure to automatically generate an high-quality training dataset of cablelike objects for semantic segmentation. The proposed method is explained in detail using the recognition of electric wires as a use case. These particular objects are commonly used in an extremely wide set of industrial applications, since they are of information and communication infrastructures, they are used in construction, industrial manufacturing and power distribution. The proposed approach uses an image of the target object placed in front of a monochromatic background. By employing the chroma-key technique, we can easily obtain the training masks of the target object and replace the background to produce a domain-independent dataset. How to reduce the reality gap is also investigated in this work by correctly choosing the backgrounds, augmenting the foreground images exploiting masks. The produced dataset is experimentally validated by Moreover, they are compared to a baseline algorithm specifically designed to recognise deformable linear objects.
14:15-14:30 **AR2038**	Quantized Turbo Equalization for Non-binary LDPC Nina Zhang,Zhiliang Qin,Yingying Li,Luyan Xing,Qidong Lu,XiaoweiLiu **Presenter:** Nina Zhang, Weihai Beiyang OptoElectronic Info-Tech Co. Ltd., China **Abstract**: In this paper, we consider iterative detection and decoding (i.e., turbo equalization) for nonbinary low-density parity-check (LDPC) coded partial-response channels, where a quantizer is present to discretize the continuous received signal. We propose a turbo equalizer that uses the pre-computed quantized channel transition probabilities in the symbol-level BCJR channel detection algorithm, which significantly reduces the computational complexity by avoiding real-time floating-point multiplications. The proposed approach is further extended to nonbinary LDPC coded bit-patterned media recording (BPMR) channels. Simulation results show that with a small number of quantization bits, the proposed receiver approaches closely the performance of the conventional turbo equalizer operating on unquantized signals.
14:30-14:45 **AR2068**	A Review of Redundant Inertial Navigation Technology Xuerui Zhai, Yuan Ren, Lifen Wang, Ting Zhu, Yang He, Bo Lv **Presenter:** Xuerui Zhai, Department of Aerospace Science and Technology, China **Abstract**: The precision and reliability of inertial navigation system can be greatly enhanced by raising the number of inertial sensors. This article first introduces the redundant inertial navigation system, then gives the research development of several key techniques of the redundant inertial navigation system: the system configuration scheme, the initial alignment technology, error calibration technology, fault detection and isolation technique, data fusion technology, and so on. Finally, the future research hotspots of redundant inertial navigation technology are discussed.
14:45-15:00 **AR2062**	Limited-Search Chase Decoding Algorithm for LDPC Coded Underwater Acoustic Multiuser Channels Xingming Li, Zhiliang Qin, Yu Qin, Yuanhao Sun, Qidong Lu, Xiaowei Liu **Presenter:** Qidong Lu, Weihai Beiyang Electrical Group Co., Ltd, China

	Abstract: In this paper, we propose a low-complexity soft-input/soft-output (SISO) Chase multiuser detector that has a polynomial computational complexity in terms of the number of the least reliable bit positions for low-density parity-check (LDPC) coded code-division multiple-access (CDMA) systems, which is a potentially competitive technology for underwater acoustic networks (UWAN). Simulation results over highly correlated channels show that the proposed detector can afford searching over a larger number of the least reliable bit positions and achieve better bit-error-rate (BER) performance as compared with the Chase-II detector at much lower complexity.
15:00-15:15 **AR2089**	A Compensation Method for Random Error of Gyroscopes Based on Support Vector Machine and Beetle Antennae Search Algorithm Pengfei Wang, Guangchun Li, Yanbin Gao **Presenter:** Pengfei Wang, Harbin Engineering University, China **Abstract**: Gyroscope is a common inertial sensor for inertial navigation system(INS). Its accuracy is affected by various error sources and noises. Among them, the deterministic error can be eliminated by calibration. However, random error is difficult to be evaluated due to its uncertainty, so random error has a great negative impact on the accuracy of gyroscope. Therefore, in order to improve the precision of gyroscope, it is necessary to compensate the random error. This paper proposes a compensation method for random error of gyroscopes based on support vector machine (SVM) and beetle antennae search (BAS) algorithm. Firstly, the original time series data of random error is processed in groups by a slide window, and then the SVM model is trained by using the original data of random error. The two key parameters in SVM are optimized by BAS algorithm. Finally, The trained SVM model is used to predict the gyroscopes random error data, and the prediction results are used to complete the compensation of gyroscopes data. Experimental results show the effectiveness of the proposed scheme, and the compensation accuracy is better than the traditional autoregressive integrated moving average (ARIMA) method.
15:15-15:30 **AR2099**	Graph Kernel based Clusterhead Selection Algorithm in Internet of Things Hongwei Luo, Wanyi Feng, Baolin Sun, Ying Song **Presenter:** Baolin Sun, Wuhan International Trade University, Hubei University of Economics, China **Abstract**: The Internet of Things (IoT) is easy to deploy, dynamic and applicable, and has attracted extensive attention from researchers. Clustering is one of the effective methods to measure the performance of IoT with different attributes. In this paper, we propose a Graph Kernel based Clusterhead selection Algorithm in IoT (GKCA). The key idea of GKCA algorithm is to find the clustering scheme in the process of cluster head selection mechanism. The performance of GKCA algorithm, such as average end-to-end delay, packet delivery ratio, was experimentally studied by using network simulation (NS2) software. Experiments show that the GKCA has a good performance advantage in dynamic IoT.
15:30-15:45 **AR2037**	DRMS: Dim-light Robust Monocular Simultaneous Localization and Mapping Qirui Gu, Peiqi liu, Jinjia Zhou, Xiao Peng, Yimeng Zhang **Presenter:** Qirui Gu, Hosei University, Japan **Abstract**: Lighting conditions are critical to the performance of visual SLAM system. Especially, challenge still remains for adopting visual SLAM in dim-light environment since it's difficult to detect enough valid feature points. To address this issue, we propose DRMS (Dim-light Robust Monocular SLAM), a new method combining image preprocessing, which includes linear transformation and CLAHE, with the Monocular SLAM system. After applying the linear transformation and CLAHE, the brightness and contrast of the images would be significantly increased, and adequate feature points

	would be detected. Moreover, we use optical flow algorithm to track the features in order to reduce computation complexity. The performance of our method is validated both on public dataset and real-world experiment. The results show that our proposal is more reliable and of higher accuracy in dim-light conditions than other existing work.
15:45-16:00 **AR2078**	Reliable Network Search based on Evolutionary Algorithm Wei Wang, Liqiang Zhu **Presenter:** Wei Wang, Beijing Jiaotong University **Abstract**: In this paper, we propose a neural architecture compression method based on network search to design a light-weight model for the network compression. The reasonable search method is designed based on evolutionary algorithm and search space for searching the efficient neural architecture, called EANet. The experimental results on several benchmarks datasets show that the performance of the EANet is better and the storage space is smaller. Besides, the light-weight SSD variant detection network based on EANet is applied to a railway intelligent surveillance system, which achieves the practical application based on the CNN model.