ISBN 978-4-9905343-8-7

ISCIIA 2022

The 10th International Symposium on Computational Intelligence and Industrial Applications

Sep. 23-25, 2022, Beijing, China

PROGRAMME

Organizers & Co-organizers:

Co-sponsors:

Publisher: Fuji Technology Press Ltd.
Printed in China, 2022

Welcome to ISCIIA 2022

The 10th International Symposium on Computational Intelligence and Industrial Applications (ISCIIA 2022) will be held from Sep. 23 to Sep. 25, 2022 in Beijing, China. On behalf of the organizing committee of ISCIIA, we would like to express our warmest welcome to the all participants.

During the past years, under kind concerns from the researchers and scientists, ISCIIA has been actively developing their domestic and international scientific and technical exchanges, which is influential and considerable especially in the Asia area.

Due to the COVID-19 pandemic, ISCIIA 2022 will be held online and/or offline (for attendees in China), which makes ISCIIA 2022 very special. However, ISCIIA 2022 with the great support of many researchers and scholars continuously contributes to the development of advanced computational intelligence and information technology as well as their various applications. It has no suspicion that the exchanges about computational intelligence, information technology, and their applications are quite favorable not only for the universities but also for the close relationship between industry and academy.

Dear friends, ISCIIA 2022 closely relies on your support, while the development of computational intelligence also ties up our participation. ISCIIA 2022 is an important occasion that could give a general comment of the recent years' global science and technology, and we can also expect to see that ISCIIA 2022 will indicate us the future development directions. May we join together to contribute more to develop computational intelligence, information technology and their applications, to advance both the theory and application for endeavor to create the brilliant future.

Thanks again for your attendance to ISCIIA 2022.

From

					
Kaoru Hirota	Dawei Shi	Eri Sato-Shimokawara	Sijie Yin	Xiangyuan Zeng	Liqun Han
Founding Chair	Organized Committee Chairs				Cooperation Chair

					
Huifang Li	Zhiyang Jia	Qing Wang	Yuan Li	Shuai Shao	Rongli Li
Publicity Chairs			Local Affairs		Secretary

and all other organizing committee members.

Greetings from General Chairs



Bin Xin



Yasufumi Takama

We would like to thank the honorary chair, Prof. Kaoru Hirota, for his great support of BIT to organize the symposium, even under the severe impact of the new coronavirus epidemic. On behalf of the Beijing Institute of Technology and Beijing Association of Automation, it is our great pleasure to welcome you to the 10th International Symposium on Computational Intelligence and Industrial Applications (ISCIIA 2022) which will be held from Sep. 23 to Sep. 25, 2022 in Beijing, China.

The highlights of ISCIIA 2022 include 7 keynotes by oversea top-notch researchers – Francesco Bullo, Panos M. Pardalos, Naoyuki Kubota, Yang Shi, Jinglu Hu, Massimo Tistarelli, and Katsuhiro Honda; 2 keynotes by Chinese top-notch researchers – Tong Zhou and Long Cheng; and about 14 sessions on different aspects of computational intelligence, intelligent informatics and their applications.

Apart from the technical programs, on-site participants are also cordially invited to attend various social events, such as welcome reception, banquet, round table discussion, etc. As the symposium will be held at the end of September, the weather in the duration will be very nice and you can enjoy beautiful scenes of Beijing comfortably.

We sincerely thank all keynote speakers, the authors, reviewers, members of the organizing committee, and volunteers for your great support of ISCIIA 2022. Wish every participant enjoy a lot from ISCIIA 2022.

Greetings from Advisory Board



Yaping Dai



Toshio Fukuda

The great success of ISCIIA has been witnessed by the previous 9 times of successful holding. ISCIIA provides a very good opportunity to exchange ideas among researchers and scholars who are dedicated to computational intelligence, intelligent informatics and their applications. They are getting more and more influential and considerable especially in the Asia area.

We believe that this time, the 10th ISCIIA, with the great effort of the organizing committee and the contribution of all authors and presenters, would be an excellent occasion for exchanging academic ideas and developing and promoting friendships. Thank you for your contribution to ISCIIA 2022. We hope that ISCIIA 2022 would be a wonderful memory to you.

Greetings from Beijing Association of Automation



Qunxiong Zhu



Yuan Xu

On behalf of Beijing Association of Automation, we are pleased to organize the 10th International Symposium on Computational Intelligence and Industrial Applications (ISCIIA 2022) with Beijing Institute of Technology. We need to express our sincere welcome to all attendees of ISCIIA2022 and we hope our collaboration can make you enjoy a pleasant trip to Beijing.

First of all, we would like to express our sincere gratitude to everyone who made contributions and various support to this symposium, especially the team of BIT who has done hard work which makes this great event possible. We would provide our continuous support with the growth of this event as well as the growth of our association.

As co-organizer of this great event, we would also like to thank all sponsors. Your support to this symposium adds the value of this symposium and help to promote this event as a platform for academic exchange.

Besides, we would also like to give our special thanks to Fuji Technology Press for their continuous great support to our past conferences and this symposium.

And we welcome the members of Beijing Association of Automation, for your attendance and continuous support to this symposium.

We hope that this symposium will be successful and fruitful with all your great efforts and time.

Thank you again for your cooperation and participation for ISCIIA 2022.

Greetings from Program Committee Chairs


Hongbin Ma


Jinhua She


Kewei Chen


Fangyan Dong

On behalf of the program committee of the 10th International Symposium on Computational Intelligence and Industrial Applications (ISCIIA 2022), we would like to express our gratitude to all those who submitted research papers and to volunteer reviewers who took on hard reviewing work for the symposium. Undoubtedly, their great efforts and contributions are critical for the success of the symposium.

We received full submissions from over 30 research institutions. Each submitted paper has been reviewed by at least two reviewers in terms of originality, importance, presentation, English usage, and overall quality. The program committee has finally accepted 78 submissions. And some selected excellent papers will be published in the special issue of the Journal of Advanced Computational Intelligence and Intelligent Informatics, which is indexed by ESCI/SCOPUS/EI. The technical program includes 11 general sessions and 3 organized sessions that cover a broad range of topics related to computational intelligence and industry applications.

We hope that the symposium will provide a great opportunity for exchanging research activities and fostering research collaboration in the future.

Thank you again for your cooperation and participation for ISCIIA 2022.

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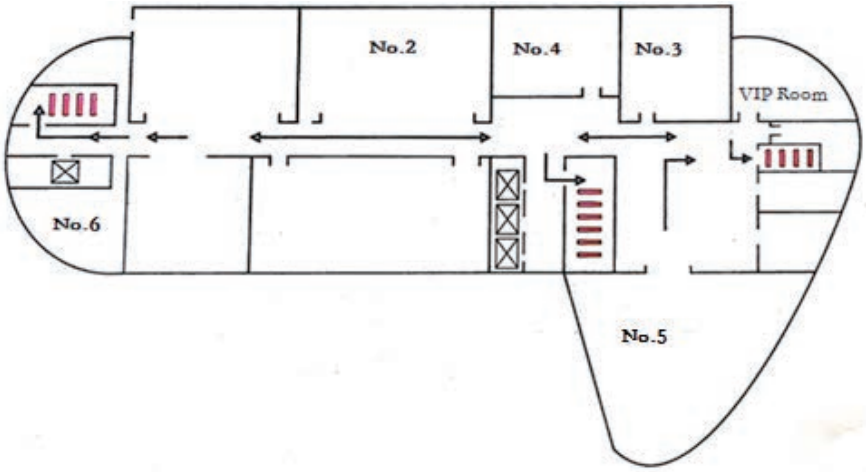
Conference Venue

The 10th International Symposium on Computational Intelligence and Industrial Applications (ISCIIA 2022) will be held at Education Exchange Building of Beijing Institute of Technology.

Address: No.66-1, West Beisanhuan Road, Haidian District, Beijing, China

(理工国际教育交流大厦，苏州桥地铁站 C 出口 350 米)

☞☞ Parallel sessions to be held are at the 3rd Floor



Photos of Meeting Rooms



Meeting Room 2



Meeting Room 3



Meeting Room 4



Meeting Room 5



Meeting Room 6

☞☞ Special sessions to be held are at the 2nd Floor

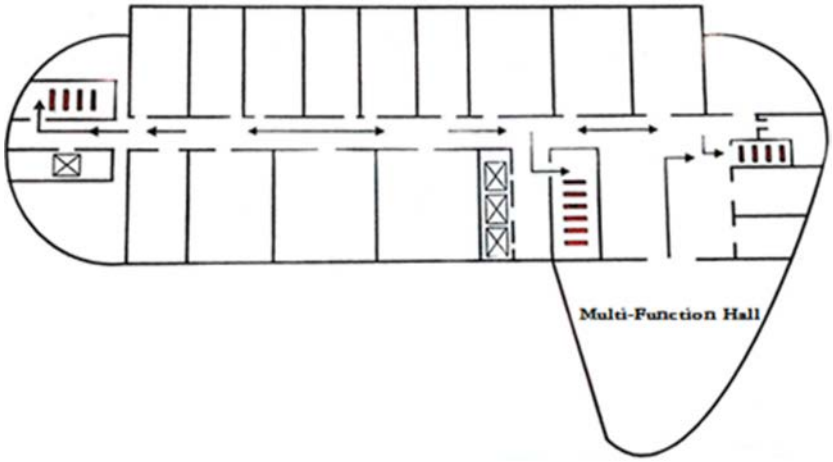


Photo of Multi-Function Hall



Program at a Glance

Sep. 23 (Fri.)		
9:00-9:20	**Opening Ceremony**	**Meeting Room 2**
9:30-10:10	**Keynote Speech 1** Speaker: Yang SHI	**Meeting Room 2**
10:10-10:50	**Keynote Speech 2** Speaker: Jinglu HU	**Meeting Room 2**
11:00-11:40	**Keynote Speech 3** Speaker: Tong ZHOU	**Meeting Room 2**
11:40-14:00	Lunch	
14:00-14:40	**Keynote Speech 4** Speaker: Francesco BULLO	**Meeting Room 2**
14:40-15:20	**Keynote Speech 5** Speaker: Panos M. PARDALOS	**Meeting Room 2**
15:30-16:10	**Keynote Speech 6** Speaker: Long CHENG	**Meeting Room 2**
16:20-17:00	**Keynote Speech 7** Speaker: Massimo TISTARELLI	**Meeting Room 2**
Sep. 24 (Sat.)		
9:00-10:30	**Parallel Session A** A1, A2, A3, A4, A5	**Meeting Room 2, 3, 4, 5, 6**
10:40-12:10	**Parallel Session B** B1, B2, B3, B4, B5	**Meeting Room 2, 3, 4, 5, 6**
12:10-14:00	Lunch	
14:00-15:30	**Parallel Session C** C1, C2, C3, C4	**Meeting Room 2, 3, 4, 5**
15:40-16:20	**Keynote Speech 8** Speaker: Katsuhiro HONDA	**Meeting Room 5**
16:20-17:00	**Keynote Speech 9** Speaker: Naoyuki KUBOTA	**Meeting Room 5**
17:10-17:40	**Closing Ceremony**	**Meeting Room 2**

Program in Detail

Sep. 23 (Fri.)

9:00-9:20	**Opening Ceremony**	**Meeting Room 2**
9:30-10:10	**Keynote Speech 1** Chair: Jinhua SHE	**Meeting Room 2**
	An Integrated Model Predictive Control (MPC) Framework for Autonomous Intelligent Systems Yang SHI University of Victoria	
10:10-10:50	**Keynote Speech 2** Chair: Dai YAPING	**Meeting Room 2**
	Semi-Supervised Classification Based on Laplacian Support Vector Machine with Quasi-Linear Kernel Jinglu HU Waseda University	
11:00-11:40	**Keynote Speech 3** Chair: Hongbin MA	**Meeting Room 2**
	Structure Identifiability of Networked Dynamic Systems and Beyond Tong ZHOU Tsinghua University	
11:40-14:00	**Lunch**	
14:00-14:40	**Keynote Speech 4** Chair: Gang WANG	**Meeting Room 2**
	Perspectives on Contraction Theory and Neural Networks Francesco BULLO University of California, Santa Barbara	
14:40-15:20	**Keynote Speech 5** Chair: Bin XIN	**Meeting Room 2**
	Computational Approaches for Solving Systems of Nonlinear Equations Panos M. PARDALOS University of Florida	
15:30-16:10	**Keynote Speech 6** Chair: Bin XIN	**Meeting Room 2**
	Recent Advances on Hand Rehabilitation Robots for Post-Stroke Patients Long CHENG Chinese Academy of Sciences	
16:20-17:00	**Keynote Speech 7** Chair: Hongbin MA	**Meeting Room 2**
	Forensic Biometrics: Bridging Technology with Forensic Science Massimo TISTARELLI Università Di Sassari	

Sep. 24 (Sat.)

9:00-10:30	**Parallel Session A**	**(5 sessions)**
9:00-10:30	***A1: Intelligent Control*** Chair: Yanjun HE and Xiaohua WANG	**Meeting Room 2**
A1-1 9:00-9:15	**Adaptive Dynamic Neural Network Intelligent Control of a Nonlinear DC Motor Drive System** Xiaohua WANG	

A1-2 9:15-9:30	**Frequency Separation Based Adaptive Feedforward Control for Rejecting Wideband Vibration with Application to Hard Disk Drives** Jinwen PAN, Zhi CHEN, Qing GAO, Yong WANG, and Roberto HOROWITZ	
A1-3 9:30-9:45	**Mean-Square Stabilization for a Class of Networked Multi-Rate Sampled-Data Systems** Weiwei MA and Yanjun HE	
A1-4 9:45-10:00	**UAV Multi-Target Tracking Based on the Principle of Information Concentration** Renshuo CHENG, Hongbin MA, Jingxiang MA, and Ying JIN	
9:00-10:30	***A2: Image Processing and Deep Learning*** Chair: Fangyan DONG and Sijie YIN	**Meeting Room 3**
A2-1 9:00-9:15	**Research on Semantic Representation Based on Syntactic Dependency Structure and Type** Qiao KANG, Can ZENG, Pengfei HU, Fangyan DONG, and Kewei CHEN	
A2-2 9:15-9:30	**Classifying the Machine Components: A Case of Deep Feature Fusion Classification Model** Amina BATOOL, Yaping DAI, Hongbin MA, and Sijie YIN	
A2-3 9:30-9:45	**A Method for Improving the Diversity of Movie Recommendation with Knowledge Graph** Wen-Kai MA, Yuan WEN, and Xia HOU	
A2-4 9:45-10:00	**Identification and Classification of Wheat Quality Grading Based on Deep Learning** Zhaohui ZHANG, Zengyang ZUO, Zhi LI, Tianyao ZHANG, and Xiaoyan ZHAO	
A2-5 10:00-10:15	**Detection of Public Chair Uncivilized Lying Behavior Based on YOLOv5** Liu-Ying ZHOU, Dong WEI, Yi-Bing RAN, Chen-Xi LIU, Si-Yue FU, and Zhi-Yi REN	
9:00-10:30	***A3: Perception and Recognition*** Chair: Xiaoyan ZHAO and Yuan LI	**Meeting Room 4**
A3-1 9:00-9:15	**Human Motion Capture Based on Sparse Inertial Sensor** Huailiang XIA, Xiaoyan ZHAO, Yan CHEN, and Zhaohui ZHANG	
A3-2 9:15-9:30	**Copyright Protection Method of Big Data Based on Color Image Watermark** Yabin XU, Minling ZHU, and Bin SHI	
A3-3 9:30-9:45	**A Dangerous Behavior Identification System for Public Monitoring** Renkai HOU, Yaping DAI, and Shuai SHAO	
A3-4 9:45-10:00	**Object Recognition and Search Based on Machine Vision** Junjie CHEN and Yuan LI	
9:00-10:30	***A4: Planning and Scheduling*** Chair: Shuai SHAO and Yulong DING	**Meeting Room 5**
A4-1 9:00-9:15	**Adaptive RBF Neural Network Sliding Model Control for Path Tracking of DP Vessel** Yixi YANG, Bin XIN, Yang LI, and Jian WEI	
A4-2 9:15-9:30	**Sampling Transformation Based Path Planning for Messenger UAV in Urban Environment Messenger** Benxiang WANG, Bin XIN, Yulong DING, and Yang LI	
A4-3 9:30-9:45	**Efficiently Solving Multi-Stage Dynamic Weapon Target Assignment Problem by a Knowledge-Based Heuristic** Weijie MA, Bin XIN, Yujue WANG, Hanzhong ZHANG, and Yang LI	
A4-4 9:45-10:00	**Obstacle Avoidance and Path Planning of Intelligent Robots Based on Optimized A* and DWA Algorithms** Zhenjiang HU, Ying JIN, Hongbin MA, and Tao FU	
A4-5 10:00-10:15	**Task Allocation of Multi-Robot Cooperative Coverage Based on Circular Coding Genetic Algorithm** Bin XIN, Heng WANG, and Ming LI	
9:00-10:30	***A5: Intelligent Prediction Methods*** Chair: Kai MA and Yabin XU	**Meeting Room 6**

A5-1 9:00-9:15	**Cooperative Control of Rotating Inverted Pendulum Based on Fuzzy Control** Yujue WANG, Weining MAO, Bin XIN, Qing WANG, and Jian WEI	
A5-2 9:15-9:30	**Decentralized Task Assignment Based on Information Fusion in Communication-Constrained Environments** Zihao CHEN, Juan LI, Jing XIONG, Jie LI, Chang LIU, Jinkun LIN, Ziwei XIN, and Yiliang LI	
A5-3 9:30-9:45	**Air Conditioning Load Prediction Based on HRD-TCN Model** Ning HE, Liqiang LIU, Danlei CHU, Cheng QIAN, and Shang LI	
A5-4 9:45-10:00	**Resilient Self-Triggered Model Predictive Control Strategy Against Replay Attack** Ning HE, Shixuan LIN, Kai MA, and Shuoji CHEN	
A5-5 10:00-10:15	**Research on Network Public Opinion Situation Awareness** Yabin XU, Minling ZHU, and Ran LIANG	
10:40-12:10	**Parallel Session B**	**(5 sessions)**
10:40-12:10	***B1: Intelligent Industry*** Chair: Tianyao ZHANG and Yi LYU	**Meeting Room 2**
B1-1 10:40-10:55	**A Review of Research Methods on PLI Robots** Jingzhe HE, Hao CHEN, and Yifan LU	
B1-2 10:55-11:10	**Synchronization of Positive Networks with Impulsive Control Under False Data Deception Attacks** Kai ZHOU, Yijun ZHANG, and Zhiqiang CHEN	
B1-3 11:10-11:25	**Thickness Determination of Plastic Products Using Continuous Wave Terahertz Frequency-Domain Spectroscopy** Tianyao ZHANG, Boyang LI, Xiaoyan ZHAO, and Zhaohui ZHANG	
B1-4 11:25-11:40	**Label Design and Identification in High Temperature Logistics Based on Concave Coding and DeepLabV3+ Model** Xiaoyan ZHAO, Pengfei ZHAO, Yuguo YIN, Luqi TAO, and Zhaohui ZHANG	
10:40-12:10	***B2: Human-Computer Interaction*** Chair: Zhentao LIU and Kemeng HAN	**Meeting Room 3**
B2-1 10:40-10:55	**A Laser Pointer Trajectory Recognition Method for Human-Computer Interaction** Chong LI, Bin XIN, and Qing WANG	
B2-2 10:55-11:10	**Analysis of Player Engagement with Eye Tracking in Game-Based Training** Kemeng HAN	
B2-3 11:10-11:25	**Speaker Detection Based on Attention Mechanism** Haozhen SONG, Mintao DONG, Kewei CHEN, and Fangyan DONG	
B2-4 11:25-11:40	**Speaker Tracking Method Based on Audio-Visual Bimodal Fusion and its Application to Mobile Robot** Hao-Yan ZHANG, Qi-Feng SHI, Long-Bo ZHANG, and Zhen-Tao LIU	
10:40-12:10	***B3: Multi-agent System and Intelligent Transport*** Chair: Shuxin DING and Jia ZHANG	**Meeting Room 4**
B3-1 10:40-10:55	**Adaptive Cruise Control Optimized for Multi-Objective** Salvador N. Obama OYANA and Jun LI	
B3-2 10:55-11:10	**Traffic Flow Detection Based on Improved YOLOX and DeepSORT** Zewen DU, Ying JIN, Hongbin MA, and Ping LIU	
B3-3 11:10-11:25	**A Decision-Making Method of Multimodal Fusion Based on Deep Reinforcement Learning for Highway Autonomous Driving** Ping LIU, Hongbin MA, Ying JIN, Yazhe DING, Bin CAO, and Zewen DU	
B3-4 11:25-11:40	**A Mixed Encoding Genetic Algorithm for Train Platforming Rescheduling Under Train Delays** Shuxin DING, Tao ZHANG, Rongsheng WANG, Yanhao SUN, Xiaozhao ZHOU, and Chen CHEN	
B3-5 11:40-11:55	**A Joint Task Allocation Method for Heterogeneous Multi-Agent Based on Distributed Auction Algorithm** Jia ZHANG, Xin DU, and Bin XIN	

10:40-12:10	***B4: Machine Learning and Application-1***	**Meeting Room 5**
	Chair: Linxiu CHEN and Zhen CHEN	
B4-1 10:40-10:55	**Mutation-Based Group Teaching Optimization Algorithm for Scheduling Cloud Workflows with Deadline Constraints** Jiwei MENG, Guanghao XU, Bing CHEN, Huifang LI, Lingguo CUI, and Senchun CHAI	
B4-2 10:55-11:10	**Identifying Stroke Types Using Machine Learning Method Based on Multi-Channel Frequency Domain Electromagnetic Signals** Shang GAO and Guohun ZHU	
B4-3 11:10-11:25	**Monotonic Feature Extraction for Equipment Remaining Life Prediction Using Dynamic Time Warping** Xiaotong WU, Ningyun LU, and Jianhua LYU	
B4-4 11:25-11:40	**A Review of Knowledge Graph Research in Military Domain** Xudong GUO, Linxiu CHEN, Yuan LI, Qinglin WANG, and Weili GUAN	
B4-5 11:40-11:55	**Control Strategy and Optimization of the Indoor Ski Simulator** Hao SHI, Zhen CHEN, Ning DONG, Qing FEI, Xiaolan YAO, and Wanshuai HU	
10:40-12:10	***B5: Machine Learning and Application-2***	**Meeting Room 6**
	Chair: Huifang LI and Qing WANG	
B5-1 10:40-10:55	**Assessment of Cognitive Functioning System Based on Computer Graphics Technology** Yu Qi ZHANG and Naoyuki KUBOTA	
B5-2 10:55-11:10	**Comparative Study on Estimating the External Torque of Flexible Robot Driven by Series Elastic Actuators** Shenghong LIU, Gao WANG, Ning LIU, and Feiyan MIN	
B5-3 11:10-11:25	**Experimental Comparison of SNR and RSSI for LoRa-ESL Based on Machine Clustering and Arithmetic Distribution** Malak Abid Ali KHAN, Hongbin MA, Syed Muhammad AAMIR, and Cekderi Anil BARIS	
B5-4 11:25-11:40	**An Arithmetic Sequence Method for Counting Ordered Pillboxes** Maofan CHENG, Hongbin MA, and Ying JIN	
12:10-14:00	**Lunch**	
14:00-15:30	**Parallel Session C**	**(4 sessions)**
14:00-15:30	***C1: Explainable User Modeling and Applications***	**Meeting Room 2**
	Chair: Kazushi OKAMOTO and Shinichi YOSHIDA	
C1-1 14:00-14:15	**Streamflow Prediction Using Cascaded-ANFIS Algorithm in Kelani River, Sri Lanka** Namal RATHNAYAKE, Upaka RATHNAYAKE, Tuan Linh DANG, and Yukinobu HOSHINO	
C1-2 14:15-14:30	**A Comparative Study of Statistical Models and Univariate and Multivariate RNN for Forecasting the Number of COVID-19 Cases** Naoki DOHI, Namal RATHNAYAKE, and Yukinobu HOSHINO	
C1-3 14:30-14:45	**Proposal of Personal Value-Based User Modeling Without Attribute Evaluation** Kaichi NIHIRA, Hiroki SHIBATA, and Yasufumi TAKAMA	
C1-4 14:45-15:00	**Proposal of Generation of Rating Matrix Based on Rational Behaviors of Users** Kenshin MORIYOSHI, Hiroki SHIBATA, and Yasufumi TAKAMA	
C1-5 15:00-15:15	**Vulnerability in Impression Based Strategy Against Bribery Behavior** Takuya OTOGURO, Kazushi OKAMOTO, and Atsushi SHIBATA	
C1-6 15:15-15:30	**Müller-Lyer Illusion Is Replicated by Higher Layer of Pre-Trained Deep Neural Network for Object Recognition** Hongtao ZHANG, Zhen LI, and Shinichi YOSHIDA	
C1-7 15:30-15:45	**Image Classification of MRI for Alzheimer's Disease Using Two Deep Neural Networks and Their Explainability** Boyue SONG and Shinichi YOSHIDA	
14:00-15:30	***C2: AI-Enabled Robots for Smarter Inclusive Society***	**Meeting Room 3**
	Chair: Eri SATO-SHIMOKAWARA and Yasuhisa HIRATA	

C2-1 14:00-14:15	**Trust Towards the Robot with the Presence and Absence of Confidence** Youdi LI, Yasufumi TAKAMA, Eri SATO-SHIMOKAWARA, and Toru YAMAGUCHI	
C2-2 14:15-14:30	**Toward Construction of Handwritten Indus Signs Dataset** Sujata SAINI, Hiroki SHIBATA, and Yasufumi TAKAMA	
C2-3 14:30-14:45	**Proposal of Dynamic Generation of Subordinate Clusters Based on Bayesian Information Criterion for Must-Link Constrained K-Means** Shota SHIMIZU, Shun SAKAYAUCHI, Hiroki SHIBATA, and Yasufumi TAKAMA	
C2-4 14:45-15:00	**Design of a Demonstration Space, the "Living Lab," for Monitoring Daily Activities in the Older Adult and the Assessment of Assistive Technologies** Kenji KATO, Tatsuya YOSHIMI, Daiki SHIMOTORI, Keita AIMOTO, Naoki ITOH, Kohei OKABE, Naoyuki KUBOTA, Yasuhisa HIRATA, and Izumi KONDO	
C2-5 15:00-15:15	**Consideration of Strategy for Selecting Probing Items in Interactive Recommendation** Yasufumi TAKAMA, Mingman XU, and Hiroki SHIBATA	
14:00-15:30	***C3: Intelligent Technologies and Applications for Industrial Alarm Systems*** Chair: Jiandong WANG and Wenkai HU	**Meeting Room 4**
C3-1 14:00-14:15	**Joint Design of Alarm Deadbands and Delay Timers to Reduce the Number of Nuisance Alarms** Jiandong WANG and Poku GYASI	
C3-2 14:15-14:30	**Alarm Floods Management by Extracting Structure Features** Chang TIAN and Chunhui ZHAO	
C3-3 14:30-14:45	**Pattern Mining for Prediction and Suppression of Industrial Alarm Floods** Wenkai HU	
C3-4 14:45-15:00	**Research on Correlation of Alarm Data of Refining and Chemical Plant Based on Optimized CBOW Method** Jinqiu HU, Qin CHEN, and Zhenqiang WEI	
C3-5 15:00-15:15	**Multiple Root-Cause Alarm Flood Classification with Weighted Dissimilarity Indices** Jing ZHOU, Jun SHANG, and Tongwen CHEN	
C3-6 15:15-15:30	**Assessment of Alarm Systems for Mixture Processes and Intermittent Faults** Mohsen ASAADI, Iman IZADI, Amin HASSANZADEH, and Fan YANG	
14:00-15:30	***C4: Robot Control Technology*** Chair: Feiyan MIN and Juan LI	**Meeting Room 5**
C4-1 14:00-14:15	**Identification of Autonomous Underwater Vehicles Model Based on Recursive Least Square with Bounded-Gain Forgetting** Yingying SHE, Gao WANG, and Feiyan MIN	
C4-2 14:15-14:30	**Collision Monitoring of Manipulators Based on Variational Mode Decomposition** Yingying SHE, Gao WANG, and Feiyan MIN	
C4-3 14:30-14:45	**Task-Driven Rule-Based Algorithm with Mode-Switching for UAV Swarms in Bounded Areas** Ziwei XIN, Juan LI, Chang LIU, Jie LI, Zihao CHEN, and Yiliang LI	
C4-4 14:45-15:00	**Embedded Design of Automatic Pesticide Spraying Robot Control System** Ahamed MUSTAK, Hongbin MA, Lepeng SONG, and Ying JIN	
C4-5 15:00-15:15	**Fault-Tolerant Control for Manipulator Under Actuator Fault with Output Constraint** Yong HU, Fengjuan XU, Yun LI, Yaobing LI, Jianlei GAO, and Tianyu GONG	
15:40-16:20	**Keynote Speech 8** Chair: Yasufumi TAKAMA	**Meeting Room 5**
	Algorithm of Fuzzy Clustering and Application to Local Data Analysis Katsuhiro HONDA Osaka Metropolitan University	
16:20-17:00	**Keynote Speech 9** Chair: Hongbin MA	**Meeting Room 5**

	Computational Intelligence for Multiscopic Topological Twin Naoyuki KUBOTA Tokyo Metropolitan University	
17:10-17:40	**Closing Ceremony**	**Meeting Room 2**

Keynote Speech

Keynote Speech 1

9:30-10:10, Sep. 23, Meeting Room 2

Yang SHI

University of Victoria



An Integrated Model Predictive Control (MPC) Framework for Autonomous Intelligent Systems

Abstract: Autonomous intelligent systems, which lie at the intersection of unmanned systems, robotics, systems and control, multi-agent systems, networked and distributed systems, machine learning, etc. Autonomous intelligent systems are equipped with abilities such as sensing and perception, data processing and information fusion, intelligent decision making, autonomous control, learning and adaption, communications and computation, thus can achieve a high level of autonomy to perform missions without human intervention or can naturally interact and collaborate with humans and/or environment. The fundamental control theory and methods in autonomous intelligent systems are of central importance in orchestrating all related functions. Autonomous control and intelligence can be applied to various systems, e.g., aerial vehicles, marine vehicles, ground robots, space exploration, energy and power systems, transportation and smart city, intelligent agriculture, smart manufacturing, smart health care systems, Internet of Things, etc. Model predictive control (MPC) is a promising paradigm for high-performance and cost-effective control of autonomous intelligent systems. This talk will firstly summarize the major application requirements and challenges to innovate in designing, implementing, deploying and operating autonomous intelligent systems. Further, the robust MPC and distributed MPC design framework will be presented. Finally, the application of MPC algorithms to various autonomous intelligent systems will be illustrated.

BIO: Prof. Yang Shi received his B.Sc. and Ph.D. degrees in mechanical engineering and automatic control from Northwestern Polytechnical University, Xi'an, China, in 1994 and 1998, respectively, and the Ph.D. degree in electrical and computer engineering from the University of Alberta, Edmonton, AB, Canada, in 2005. From 2005 to 2009, he was an Assistant Professor and Associate Professor in the Department of Mechanical Engineering, University of Saskatchewan, Saskatoon, SK, Canada. In 2009, he joined the University of Victoria, and now he is a Professor in the Department of Mechanical Engineering, University of Victoria, Victoria, BC, Canada. His current research interests include networked and distributed systems, model predictive control (MPC), cyber-physical systems (CPS), robotics and mechatronics, navigation and control of autonomous systems (AUV and UAV), and energy system applications.

Prof. Shi received the University of Saskatchewan Student Union Teaching Excellence Award in 2007, and the Faculty of Engineering Teaching Excellence Award in 2012 at the University of Victoria (UVic). He is the recipient of the JSPS Invitation Fellowship (short-term) in 2013, the UVic Craigdarroch Silver Medal for Excellence in Research in 2015, the 2017 IEEE Transactions on Fuzzy Systems Outstanding Paper Award, the Humboldt Research Fellowship for Experienced Researchers in 2018. He is a member of the IEEE IES Administrative Committee and the IES Fellow Evaluation Committee during 2017-2019; he is the Chair of IEEE IES Technical Committee on Industrial Cyber-Physical Systems. Currently, he is Co-Editor-in-Chief for IEEE Transactions on Industrial Electronics; he also serves as Associate Editor for Automatica, IEEE Transactions on Automatic Control, IEEE Transactions on Cybernetics, etc. He is General Chair of the 2019 International Symposium on Industrial Electronics (ISIE) and the 2021 International Conference on Industrial Cyber-Physical Systems (ICPS).

He is a Fellow of IEEE, ASME, CSME, and Engineering Institute of Canada (EIC), and a registered Professional Engineer in British Columbia, Canada.

Keynote Speech 2

10:10-10:50, Sep. 23, Meeting Room 2

Jinglu HU

Waseda University



Semi-Supervised Classification Based on Laplacian Support Vector Machine with Quasi-Linear Kernel

Abstract: In this talk, we first introduce a semi-supervised classification algorithm based on Laplacian support vector machine (SVM) with a quasi-linear kernel. The algorithm consists of two steps. In the first step, it composes a quasi-linear kernel through implementing a piecewise linear model based on neural networks. In the second step, the piecewise linear model is further optimized by a Laplacian SVM algorithm using the quasi-linear kernel function. In both steps, it effectively leverages a small amount of labeled and a large amount of unlabeled data so as to achieve good classification performance. Then we introduce an application of the algorithm to construct a semi-supervised classifier for parasite image classification, by including a semi-supervised feature extractor based on deep CNN using contrastive learning.

BIO: Prof. Jinglu Hu received a M.Sci degree in Electronic Engineering from Sun Yat-Sen University, Guangzhou, China in 1986, and a Ph.D degree in Computer Science and System Engineering from Kyushu Institute of Technology, Iizuka, Japan in 1997. From 1986 to 1988, he worked as a Research Associate and from 1988 to 1993 a Lecturer at Sun Yat-Sen University. From 1997 to 2003, he worked as a Research Associate at Kyushu University. From 2003 to 2008, he worked as an Associate Professor and since April 2008, he has been a Professor at Graduate School of Information, Production and Systems of Waseda University. His research interests include Computational Intelligence and its applications to system modeling and identification, bioinformatics, time series prediction, financial analysis, data mining and so on. Dr. Hu has published more than 180 journal papers indexed by SCI or EI and 140 prominent conference papers. Dr. Hu is a member of IEEE, IEEJ, SICE and IEICE.

Keynote Speech 3

11:00-11:40, Sep. 23, Meeting Room 2

Tong ZHOU

Tsinghua University



Structure Identifiability of Networked Dynamic Systems and Beyond

Abstract: Networked dynamic systems (NDS) have been attracting research attentions for a long time. With technology developments, especially those in communications and computers, the scale of an NDS becomes larger and larger. Moreover, some new issues also arise, such as attack prevention, random communication delay/failure, etc. In addition, recent marvelous success in artificial intelligence greatly stimulates constructions of artificial NDSs with a huge number of nodes. On the other hand, some classic problems including revealing the structure of an NDS from measurements, computationally efficient conditions for NDS controllability/observability verifications, etc., still remain challenging. In this talk, a model is introduced for a large scale NDS in which subsystems are connected through their internal outputs in an arbitrary way, and subsystems may have distinctive dynamics. A matrix rank based necessary and sufficient condition is given for the global identifiability of subsystem interactions, which leads to several conclusions about NDS structure identifiability when there is some a priori information. This matrix also leads to an explicit description for the set of subsystem interactions that can not be distinguished from experiment data only. Importance of "structure identifiability degree" is also revealed through numerical simulations, with a discussion on its influences on model prediction capabilities and system performances.

BIO: Prof. Zhou received the B.S. and M.S. degrees from the University of Electronic Science and Technology of China, China, in 1984 and 1989, respectively, another M.S. degree from Kanazawa University, Japan, in 1991, and the Ph.D. degree from Osaka University, Japan, in 1994. After visiting several universities in The Netherlands, Japan and China, he joined Tsinghua University, Beijing, China, in 1999, where he is currently a Professor of control theory and control engineering. His current research interests include networked dynamic systems, distributed/robust estimation and control, system identification and their applications to real-world problems in molecular cell biology and communication systems. Dr. Zhou was a recipient of the First-Class Natural Science Prize in 2020 from the Chinese Association of Automation (CAA), a recipient of the First-Class Natural Science Prize in 2003 from the Ministry of Education, China, and a recipient of the National Outstanding Youth Foundation of China in 2006. He has served as an Associate Editor of the IEEE TRANSACTIONS ON AUTOMATIC CONTROL, and is now on the editorial board of

AUTOMATICA. He is an IEEE Fellow and a CAA Fellow.

Keynote Speech 4

14:00-14:40, Sep. 23, Meeting Room 2

Francesco BULLO

University of California, Santa Barbara



Perspectives on Contraction Theory and Neural Networks

Abstract: Basic questions in dynamical neuroscience and machine learning motivate the study of the stability, robustness, entrainment, and computational efficiency properties of neural network models. I will present some elements of a comprehensive contraction theory for neural networks. Using nonEuclidean norms I will review recent advances in analyzing and training a class of recurrent/implicit models. JOINT WORK WITH: Alexander Davydov, Saber Jafarpour, Anton Proskurnikov

BIO: Prof. Francesco Bullo is a Professor with the Mechanical Engineering Department and the Center for Control, Dynamical Systems and Computation at the University of California, Santa Barbara. He was previously associated with the University of Padova (Laurea degree in Electrical Engineering, 1994), the California Institute of Technology (Ph. D. degree in Control and Dynamical Systems, 1999), and the University of Illinois. He served on the editorial boards of IEEE, SIAM, and ESAIM journals, as the IEEE CSS President and as the SIAG CST Chair. His research interests focus on contraction theory, network systems and distributed control with application to robotic coordination, power grids and social networks. He is the coauthor of "Geometric Control of Mechanical Systems" (Springer, 2004), "Distributed Control of Robotic Networks" (Princeton, 2009), and "Lectures on Network Systems" (Kindle Direct Publishing, 2022, v1.6). He received best paper awards for his work in IEEE Control Systems, Automatica, SIAM Journal on Control and Optimization, IEEE Transactions on Circuits and Systems, and IEEE Transactions on Control of Network Systems. He is a Fellow of IEEE, IFAC, and SIAM.

Keynote Speech 5

14:40-15:20, Sep. 23, Meeting Room 2

Panos M. PARDALOS

University of Florida



Computational Approaches for Solving Systems of Nonlinear Equations

Abstract: Finding one or more solutions to a system of nonlinear equations (SNE) is a computationally hard problem with many applications in sciences, engineering, machine learning and artificial intelligence. First, we will briefly discuss classical approaches for addressing (SNE). Then, we will discuss the various ways that a SNE can be transformed into an optimization problem, and we will introduce techniques that can be utilized to search for solutions to the global optimization problem that arises when the most common reformulation is performed. In addition, we will present computational results using different heuristics.

BIO: Prof. Panos Pardalos received his PhD (Computes and Information Sciences) from the University of Minnesota. He is a Distinguished Professor in the Department of Industrial and Systems Engineering at the University of Florida, and an affiliated faculty of Biomedical Engineering and Computer Science & Information & Engineering departments. He is the director of the Center for Applied Optimization. In addition, he is the academic advisor of the laboratory on networks and applications at the Higher School of Economics, Moscow (funded by a mega grant in 2011).

Panos Pardalos is a world-renowned leader in Global Optimization, Mathematical Modeling, Energy Systems, Financial Applications, and Data Sciences. He is a Fellow of AAAS, AAIA, AIMBE, EUROPT, and INFORMS and was awarded the 2013 Constantin Caratheodory Prize of the International Society of Global Optimization. In addition, Panos Pardalos has been awarded the 2013 EURO Gold Medal prize and a prestigious Humboldt Research Award (2018-2019).

Panos Pardalos is also a Member of several Academies of Sciences, and he holds several honorary PhD degrees and affiliations. He is the Founding Editor of Optimization Letters, Energy Systems, and Co-Founder of the International Journal of Global Optimization, Computational Management Science, and Springer Nature Operations Research Forum. He has published over 500 journal papers, and edited/authored over 200 books. He is one of the most cited authors and has graduated 70 PhD students so far. Details can be found in www.ise.ufl.edu/pardalos.

Keynote Speech 6

15:30-16:10, Sep. 23, Meeting Room 2

Long CHENG

Chinese Academy of Sciences



Recent Advances on Hand Rehabilitation Robots for Post-Stroke Patients

Abstract: Post-stroke patients pay most attention to the upper-/lower-limb rehabilitation and neglect the rehabilitation training of the hand. However, hand is the most important execution organ of human beings, which plays a critical role in daily lives. Meanwhile, the area charging the hand motor in the human's brain is large. Therefore, the study on the hand rehabilitation robot can help the function recovery of patients' hands and improve their brain plasticity, which is valuable theoretically and practically. This talk is going to introduce the mechanism design and optimization techniques of the motion-compatible hand rehabilitation robot to ensure the comfortable and safe use of the robot. In addition, some novel impedance control algorithms are presented to realize the passive/active rehabilitation training.

BIO: Prof. Long Cheng received the B.S. (Hons.) degree in control engineering from Nankai University, Tianjin, China, in 2004, and the Ph.D. (Hons.) degree in control theory and control engineering from the Institute of Automation, Chinese Academy of Sciences, Beijing, China, in 2009. He is currently a Full Professor with the Institute of Automation, Chinese Academy of Sciences. He is also an adjunct Professor with University of Chinese Academy of Sciences. He has published over 100 technical papers in peer-refereed journals and prestigious conference proceedings. He was a recipient of the IEEE Transactions on Neural Networks Outstanding Paper Award from IEEE Computational Intelligence Society, the Aharon Katzir Young Investigator Award from International Neural Network Society and the Young Researcher Award from Asian Pacific Neural Network Society. He is taking the role of Chair of IEEE Computational Intelligence Society Beijing Chapter (2022); the Associate Vice President of IEEE Systems, Man, and Cybernetics Society (2022). He is currently serving as an Associate Editor/Editorial Board Member of IEEE Transactions on Cybernetics, IEEE Transactions on Automation Science and Engineering, Science China Technological Sciences, and Acta Automatica Sinica. His current research interests include the rehabilitation robot, intelligent control and neural networks.

Keynote Speech 7

16:20-17:00, Sep. 23, Meeting Room 2

Massimo TISTARELLI

Università Di Sassari



Forensic Biometrics: Bridging Technology with Forensic Science

Abstract: In the last decades, digital technologies have been applied in forensic investigations only to a limited extent of their possibilities. A number of factors have hindered the wider adoption of these technologies to operational scenarios. However, there has been a number of successful applications where digital biometric technologies were crucial to support investigation and to provide evidence in court. Given the great potential of biometric technologies for objective and quantitative evidence evaluation, it would be desirable to see a wider deployment of these technologies, in a standardized manner, among police forces and forensic institutes. In this talk, the actual state of the art in forensic biometric systems will be briefly reviewed, trying to identify the outbreaks and pitfalls of current technologies. Despite of their impressive performance, some recent biometric technologies when applied to forensic evaluation demonstrated sometimes to be lacking under some respect. Other technologies will need adaptations to be ready for the forensic field. We postulate that there is a challenge to be faced with more advanced tools and testing on operational data. This will require a joint effort involving stakeholders and scientists from multiple disciplines as well as a greater involvement of forensic institutes and police forensic science departments.

BIO: Massimo Tistarelli received the Phd in Computer Science and Robotics in 1991 from the University of Genoa. He is Full Professor in Computer Science (with tenure) and director of the Computer Vision Laboratory at the University of Sassari, Italy. Since 1986 he has been involved as project coordinator and task manager in several projects on computer vision and biometrics funded by the European Community. Since 1994 he has been the director of the Computer Vision Laboratory at the Department of Communication, Computer and Systems Science of the University of Genoa, and now at the University of Sassari, leading several National and European projects on computer vision applications and image-based biometrics.

Prof. Tistarelli is a founding member of the Biosecure Foundation, which includes all major European research centers working in biometrics. His main research interests cover biological and artificial vision (particularly in the area of recognition, three-dimensional reconstruction and dynamic scene analysis), pattern recognition, biometrics, visual sensors, robotic navigation and visuo-motor coordination. He is one of the world-recognized leading researchers in

the area of biometrics, especially in the field of face recognition and multimodal fusion. He is coauthor of more than 150 scientific papers in peer reviewed books, conferences and international journals. He is the principal editor for the Springer books “Handbook of Remote Biometrics” and “Handbook of Biometrics for Forensic Science”. Prof. Tistarelli organized and chaired several world-recognized several scientific events and conferences in the area of Computer Vision and Biometrics, and he has been associate editor for several scientific journals including IEEE Transactions on PAMI, IET Biometrics, Image and Vision Computing and Pattern Recognition Letters. Since 2003 he is the founding director for the Int.l Summer School on Biometrics (now at the 19th edition – http://biometrics.uniss.it). He served as vice president of the IEEE Biometrics Council, first vice president of the IAPR and chair of the IAPR Fellow committee. He is a Fellow member of the IAPR and Senior member of the IEEE.

Keynote Speech 8

15:40-16:20, Sep. 24, Meeting Room 5

Katsuhiro HONDA

Osaka Metropolitan University



Algorithm of Fuzzy Clustering and Application to Local Data Analysis

Abstract: Fuzzy clustering is a basic technique for unsupervised classification and is utilized in summarization of intrinsic data structures. In this talk, the theoretical characteristics of several fuzzy clustering algorithms induced from Fuzzy c-Means (FCM) are reviewed. Then, some of their applications to local data analysis are introduced. By replacing the prototypical centroids of FCM with least-square-type modeling, the basic data modeling is extended to local data analysis, which is the hybrid of data space partition and local area modeling. When we hybridize non-negative matrix factorization (NMF) with fuzzy clustering, we can achieve simultaneous estimation of multiple decomposition models, which is available in such applications as seasonal effect analysis in Environmental Data Analysis.

BIO: Prof. Katsuhiro Honda received the B.E., M.E. and D.Eng. Degrees in industrial engineering from Osaka Prefecture University, Osaka, Japan, in 1997, 1999 and 2004, respectively. From 1999 to 2021, he was a Research Associate, Assistant Professor, Associate Professor and Professor at Osaka Prefecture University. Since 2022, he has been a Professor at Graduate School of Informatics, Osaka Metropolitan University. His research interests include hybrid techniques of fuzzy clustering and multivariate analysis, data mining with fuzzy data analysis and neural networks. He has published over 90 papers in refereed journals and has presented over 200 papers in refereed international conferences. He received the best paper awards at FUZZ-IEEE 2008, SCIS&ISIS 2016 and SICE2021, publication award and paper awards from Japan Society for Fuzzy Theory and Intelligent Informatics (SOFT) in 2010 and 2002, 2011 and 2012, respectively. He has been an executive board member of SOFT since 2017.

Keynote Speech 9

16:20-17:00, Sep. 24, Meeting Room 5

Naoyuki KUBOTA

Tokyo Metropolitan University



Computational Intelligence for Multiscopic Topological Twin

Abstract: Cyber-Physical System, Digital Transformation, and Digital Twin have been discussed based on the integration of information, intelligence, communication, and robot technologies in various research fields. In order to simulate a real-world phenomenon in the cyber world, we often have to extract features and structures from given or measured big data based on topology. Therefore, we proposed the concept of topological twin. The aim of topological twin is to (1) extract topological structures hidden implicitly in the real world, (2) reproduce them explicitly in the cyber world, and (3) simulate and analyze the real world in the cyber world. The topological twin plays the important role in extracting and connecting structures hidden in real world from the mutliscopic point of view. In this talk, we discuss the concept of topological twin in robotics in order to bridge the cyber-physical gap from the multiscopic point of view. First, we introduce the concept of multiscopic topological twin, and next, various types of topological mapping methods, unsupervised learning methods, and graph-based methods. One of them is Growing Neural Gas (GNG) that can dynamically change the topological structure composed of nodes and edges. One important advantage of GNG is in the incremental learning capability of nodes and edges according to a target data distribution, but the computational cost of standard GNG is very expensive. Therefore, we proposed a method of multi-scale batch-learning GNG called Fast GNG. Next, we show the comparison result of Fast GNG with other methods. Furthermore, we show several experimental results of robot partners and mobility support robots. Finally, we discuss the applicability and future direction of multiscopic topological twin in robotics.

BIO: Prof. Kubota is currently a Professor in the Department of Mechanical Systems Engineering, the Graduate School of Systems Design, and Director of Community-centric System Research Center, Tokyo Metropolitan University, Japan. He graduated from Osaka Kyoiku University in 1992, received the M.E. degree from Hokkaido University in 1994, and received the D.E. from Nagoya University, Nagoya, Japan, in 1997. He was an Assistant Professor and Lecturer at the Department of Mechanical Engineering, Osaka Institute of Technology, Japan, from 1997 to 2000. In 2000, he joined the Department of Human and Artificial Intelligence Systems, the School of Engineering, Fukui University, Japan, as an Associate Professor. He joined the Department of Mechanical Engineering, the Graduate School of Engineering, Tokyo Metropolitan University, Japan, as an Associate Professor in 2004. He was an Associate Professor from 2005 to

2012, and a Professor from 2012 at the Graduate School of Systems Design, Tokyo Metropolitan University, Japan. He was a Visiting Professor at University of Portsmouth, UK, in 2007 and 2009, and was an Invited Visiting Professor at Seoul National University from 2009 to 2012, and others. His current interests are in the fields of topological mapping, coevolutionary computation, spiking neural networks, perception-based robotics, robot partners, and informationally structured space. He has published more than 500 refereed journal and conference papers in the above research fields. He received the Best Paper Award of IEEE IECON 1996, IEEE CIRA 1997, MHS 2011, WAC 2012, HSI 2016, and so on. He was an associate editor of the IEEE Transactions on Fuzzy Systems from 1999 to 2010, the IEEE CIS Intelligent Systems Applications Technical Committee, Robotics Task Force Chair from 2007 to 2014, IEEE Systems, Man, and Cybernetics Society, Japan Chapter Chair from 2018 to 2021, Vice Director, Tokyo Biomarker Innovation Research Association, Japan since 2020, and others.

General (A1): Intelligent Control
9:00-10:30, Sep. 24, 2022, Meeting Room 2

A1-1 9:00-9:15

Adaptive Dynamic Neural Network Intelligent Control of a Nonlinear DC Motor Drive System

Xiaohua WANG

Technology, Siemens Ltd., China

Abstract: Nonlinear, parameter variations and external load disturbance are widespread in a DC motor drive system. The PID controller has poor self-regulation and adaptivity and robustness. In this paper, A model-following adaptive control approach based on the neural networks is proposed for the speed control of a nonlinear motor drive system with high stick slip and Coulomb friction and the compensation of the nonlinearities. Two neural networks formulate the identification and control approaches. A Wiener-type neural network (WNN) is proposed to identify the motor system, which formulates the Wiener model with a linear dynamic block in cascade with a nonlinear static gain. A feedforward neural network is proposed to formulate the PID controller, termed as PID-type neural network (PIDNN). In this way, the WNN is used as a motor system identifier to recognize the output of motor servo system and provide Jacobian identification information for PID controller in real-time, which realize self-adjusting and self-adaptive control of motor servo system. Based on MATLAB/Simulink simulation, Wiener-type dynamic neural network intelligent control strategy of motor servo system effectiveness is verified. The results obtained confirm the excellent disturbance rejection and tracking performance properties of the system.

Keywords: Nonlinear DC Motor System, Dynamic Neural Networks, System Identification, Intelligent Control, Friction Compensation

A1-2 9:15-9:30

Frequency Separation Based Adaptive Feedforward Control for Rejecting Wideband Vibration with Application to Hard Disk Drives

Jinwen PAN[1,2], Zhi CHEN[3], Qing GAO[4], Yong WANG[2], and Roberto HOROWITZ[3]

[1]Guangzhou Dorabot Inc., China, [2]University of Science and Technology of China, China, [3]University of California, Berkeley, USA, [4]Beihang University, China

Abstract: In this paper, a frequency separation based adaptive feedforward control algorithm is developed with the ability to identify the plant and do compensation region by region. In this algorithm, the accelerometer signal is filtered by a series of uniformly distributed bandpass filters to generate a bunch of subband signals which are mutually exclusive in spectrum. In each subband, the corresponding subband signal acts as the feedforward signal and only the frequency response of system in that region needs to be identified, thus a pretty low order model can be expected to have efficient compensation. Starting from the first region, the feedforward control parameters are learned simultaneously with the low order plant model in the same region and then moves to the next region until all the regions are performed.

Keywords: Vibration Rejection, Adaptive Feedforward Control, Spectrum Partition

General (A1): Intelligent Control
9:00-10:30, Sep. 24, 2022, Meeting Room 2

A1-3 9:30-9:45

Mean-Square Stabilization for a Class of Networked Multi-Rate Sampled-Data Systems

Weiwei MA[1] and Yanjun HE[2]

[1]School of Applied Mathematics, Shanxi University of Finance and Economics, China, [2]School of Public Finance and Economics, Shanxi University of Finance and Economics, China

Abstract: This work investigates the modelling and $H\infty$ control problem for a class of networked control systems with uncertainties and external disturbances, where the system state variables are divided and sampled by multiple groups of sensors with different sampling periods, i.e., multi-rate sampled-data systems. The multi-rate sampled data are transmitted over multiple networked channels with different network constraint parameters, such as different packet dropout rates and network-induced delays. Based on received asynchronous sampled data, a multi-rate state-feedback controller is introduced. To formulate the complex effects of the multi-rate sampling, network-induced delays, and statistic packet dropout, a new integral inequality is developed and utilized to construct a Lyapunov-like functional. Then the mean square stability criterion and control design method are given under a prescribed $H\infty$ performance level. Finally, the validity of the proposal result is testified by a vehicle active suspension system.

Keywords: Networked Control Systems, Multi-Rate Sampling, Statistic Effects, Integral Inequalities

A1-4 9:45-10:00

UAV Multi-Target Tracking Based on the Principle of Information Concentration

Renshuo CHENG, Hongbin MA, Jingxiang MA, and Ying JIN

Beijing Institute of Technology, China

Abstract: At present, unmanned aerial vehicle (UAV) target tracking technology mainly focuses on single target tracking, rather than single UAV tracking multiple targets. Based on the principle of information concentration and numerical calculation, a new trajectory prediction algorithm for UAV tracking is proposed in order to improve the execution efficiency of target tracking. The principle of information concentration which uses the set of tracking objects and numerical calculation method are used to determine the current position information of UAV. Considering the real motion form of UAV, Kalman filter algorithm is used to smooth the tracking position information, which improves the robustness of the algorithm. In addition, since the complexity of the algorithm is not affected by the number of tracking targets, the new multi-target tracking algorithm can be applied to the engineering background with more targets

Keywords: Target Tracking, Information Concentration, Multi-Circle Intersection, UAV, Kalman Filter

General (A2): Image Processing and Deep Learning

9:00-10:30, Sep. 24, 2022, Meeting Room 3

A2-1 9:00-9:15

Research on Semantic Representation Based on Syntactic Dependency Structure and Type

Qiao KANG, Can ZENG, Pengfei HU, Fangyan DONG, and Kewei CHEN

Faculty of Mechanical Engineering & Mechanics, Ningbo University, China

Abstract: Long short-term memory (LSTM) has become the state-of-the-art for modeling semantic similarity computation. However, it cannot fully encode hierarchical syntactic dependencies and cannot identify differences in meaning caused by changes in the semantic roles of words or phrases. Therefore, a new relative syntactic distance dependency type long short-term memory (RSD-DT-LSTM) neural model is proposed in this paper. This model modifies the gating mechanism in Dependency type long short-term memory (DT-LSTM) with relative syntactic distance and provides a transformed gate to more directly model syntactic structure. Make sentence structure dependencies and dependency types embed sentence meanings into dense vectors. The RSD-DT-LSTM model was used to perform semantic similarity scoring experiments on the SICK dataset and the MRPC dataset. The Pearson correlation coefficient obtained by the model on the SICK dataset is very close to the DT-LSTM model. The mean square error (MSE) between the actual similarity score y and the predicted score y ^ ' is 0.1% better than the DT-LSTM model. In the MRPC dataset, its accuracy is 0.9% better than that of DT-LSTM. And its recall is 0.3% better than that of DT-LSTM model.

Keywords: Semantic Similarity, LSTM, Relative Syntactic Distance

A2-2 9:15-9:30

Classifying the Machine Components: A Case of Deep Feature Fusion Classification Model

Amina BATOOL, Yaping DAI, Hongbin MA, and Sijie YIN

School of Automation, Beijing Institute of Technology, China

Abstract: Automatic components classification is inevitable for industrial and logistics applications in the contemporary digital world. How to classify different machine components (such as bolt, nut, locatingpin and washers) automatically by computer is a challenging task for image-based object recognition and classification. Despite varying shapes and classes, components are difficult to distinguish when they appear identical in many ways – particularly in images. For solving the task, a case of Deep Feature Fusion Classification Model (DFFCM) is proposed in this article, which is designed through a convolutional neural network combined with Adaboost classifier. By DFFCM, the extracted multi-layered features (containing precise information emanated from image edges) are fused through the direct fusion method to differentiate similar images and used as input to the ensemble Adaboost classifier for classification. Resultantly, DFFCM has achieved the highest accuracy with 99.34% compared with CNN and One-Shot Learning models.

Keywords: Objective Identification in Image, Multi-Layer Features Fusion, Machine Components Classification, Convolutional Neural Networks

A2-3 9:30-9:45

A Method for Improving the Diversity of Movie Recommendation with Knowledge Graph

Wen-Kai MA, Yuan WEN, and Xia HOU

Computer School, Beijing Information Science and Technology University, China

Abstract: This paper proposes a diversity enhancement method with knowledge graph for improving the diversity of recommendation lists in movie recommendation systems. Firstly, this method uses the IMDb movie dataset to build a knowledge graph of movie-character and movie-company relationships, and expands the fine-grained connectivity between movie entities through 20 relationships. Secondly, this paper proposes an aggregation algorithm to improve the diversity feature expression of movies in the knowledge graph module, and the outputs are embedded into the recommendation module as auxiliary information. Finally, the multi-layer perceptron is used to mine the deep expression of user and movie features. Considering the important impact of movie category on the diversity of recommendation list, this paper improved the calculation method of diversity. The experimental results show that on the MovieLens and Netflix dataset, the proposed method greatly improves the diversity while ensuring the accuracy.

Keywords: Movie Recommendation, Diversity, Knowledge Graph

A2-4 9:45-10:00

Identification and Classification of Wheat Quality Grading Based on Deep Learning

Zhaohui ZHANG[1,2], Zengyang ZUO[2], Zhi LI[3], Tianyao ZHANG[1], and Xiaoyan ZHAO[1,2]

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Abstract: China is one of the world's largest producers of wheat. Because of its storability, wheat has become one of the country's three largest grain reserves. However, the detection methods of wheat quality are mainly manual detection. There are many problems with this identification and classification method. Initially, different identification personnel will produce different identification results. Secondly, the identification process is long, the identification personnel are prone to visual fatigue. Finally, the identification takes a lot of time and money, and the classification results are difficult to reproduce. Based on the above background, this paper designs a wheat unsound kernel identification method based on YOLO algorithm. Image acquisition is carried out with sound kernel, injured kernel, broken kernel, sprouted kernel, spotted kernel, and foreign material in wheat kernels. And image data enhancement methods such as image cropping, rotation, scaling, and segmentation are used to determine the number of data sets expanded. The deep learning recognition model is used to identify wheat quality categories. The wheat quality detection experiment of YOLOv5 recognition model is realized, and the performance indicators of the model are evaluated. The recognition results show that the overall recognition rate of YOLOv5 for wheat is about 93%. And the detection can be completed quickly. The average accuracy of YOLOv5 is evaluated. The experimental results show that YOLOv5 is more suitable for the recognition of unsound wheat kernels.

Keywords: Wheat, Unsound Kernels, Deep Learning, YOLOv5

General (A2): Image Processing and Deep Learning

9:00-10:30, Sep. 24, 2022, Meeting Room 3

A2-5 10:00-10:15

Detection of Public Chair Uncivilized Lying Behavior Based on YOLOv5

Liu-Ying ZHOU[1,2], Dong WEI[1,2], Yi-Bing RAN[3], Chen-Xi LIU[1,2], Si-Yue FU[1,2], and Zhi-Yi REN[1,2]

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Abstract: To monitor and manage the uncivilized lying behavior of the urban public chair, this paper studies the urban public chair lying behavior image recognition algorithm based on YOLOv5. At present, the object studied in the field of object detection is a single object, but for the uncivilized lying behavior of the urban public chair, the object to be measured is composed of the chair and the human posture combined, so its characteristics will be more complex. To accurately identify the uncivilized lying behavior of urban public chairs, this paper designs various dataset classification schemes according to the feature differences among various combined objects, and tests them using the YOLOv5x object detection algorithm. The experimental results show that the best performance index mAP is 97.38%, and the overall average recall rate (Recall) is 95.51%, which can effectively realize the detection and identification of uncivilized lying public chair behavior.

Keywords: Uncivilized Lying Behavior of Urban Public Chairs, Deep Learning, Object Detection, YOLOv5x, Image Processing

General (A3): Perception and Recognition
9:00-10:30, Sep. 24, 2022, Meeting Room 4

A3-1 9:00-9:15

Human Motion Capture Based on Sparse Inertial Sensor

Huailiang XIA[2], Xiaoyan ZHAO[1,2], Yan CHEN[1], and Zhaohui ZHANG[1,2,3]

[1]School of Automation and Electrical Engineering, University of Science and Technology Beijing, China, [2]Shunde Graduate School, University of Science and Technology Beijing, China, [3]Beijing Engineering Research Center of Industrial Spectrum Imaging, University of Science and Technology Beijing, China

Abstract: In recent years, human motion capture has a broad market prospect, widely used in film and television animation production, human-computer interaction, virtual reality, sports training, medical rehabilitation and other interdisciplinary disciplines. Unlike the regular motion of mechanical objects, the movement of the human body is complex, changeable and unpredictable, and has a flexibility and variety that no mechanical object has. Therefore, at present, the capture, recognition and reproduction of human posture have become a research hotspot. Body motion capture usually requires placing sensor markers above and below the joint to calculate joint angles, but this will lead to a large number of body sensors, affecting the performer's normal movements. Using the method of deep learning can reduce the number of sensors, but it requires a large number of training datasets and sufficient computing resources. In this paper, we propose a new deep learning-based approach, which learns data-driven time priors, merges past and future inertial sensor information into superimposed input vectors, which are then fed back to shallow neural networks to estimate human movements. Six inertial measurement unit (IMU) sensors were used to estimate human motion.

Keywords: Parameterization, LSTM, Deep Learning, Motion Capture

A3-2 9:15-9:30

Copyright Protection Method of Big Data Based on Color Image Watermark

Yabin XU, Minling ZHU, and Bin SHI

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Abstract: Data watermarking technology is an effective means of copyright protection of big data. In order to embed more real, reliable and practical watermarking information, the method of embedding color image watermarking information to protect big data intellectual property is presented. Firstly, based on JPEG image coding standard algorithm, the color image is compressed without affecting the image quality, and the embedded watermark information is reduced. Then, the watermark is embedded in two dimensions: data tuple and attribute. Finally, under the constraint of data usability, the lowest bit of watermark embedding is calculated and the data is changed to complete the watermark bit embedding. Experimental results show that the proposed method can extract color image watermarking information under different attack conditions. The robustness of watermark is high, and the comprehensive effect of data watermark is better than that of existing methods.

Keywords: Big Data, Data Watermarking, Copyright Protection, JPEG Image Encoding

General (A3): Perception and Recognition
9:00-10:30, Sep. 24, 2022, Meeting Room 4

A3-3 9:30-9:45

A Dangerous Behavior Identification System for Public Monitoring

Renkai HOU, Yaping DAI, and Shuai SHAO

Beijing Institute of Technology, China

Abstract: At the present stage, the identification of dangerous behaviors in public places mostly relies on manual work, which is subjective and has low identification efficiency. This thesis proposes an automatic identification method for dangerous behaviors in public places, which analyzes human behavior and speech emotion through deep learning network and then performed multimodal information fusion. Based on the fusion results, people can judge the emotional atmosphere of the crowd and make early warning and alarm for possible dangerous behaviors. Experiments show that the algorithm adopted in this paper can accurately identify dangerous behaviors and has great application value.

Keywords: Human Behavior Recognition, Speech Emotion Recognition, Multimodal Fusion, Deep Learning

A3-4 9:45-10:00

Object Recognition and Search Based on Machine Vision

Junjie CHEN and Yuan LI

Beijing Institute of Technology, China

Abstract: The loss of personal belongings often occurs in daily life. This paper studies the object recognition algorithm and its implementation on the mobile terminal. Two offline-based mobile terminal object recognition apps are developed, which can realize real-time object recognition without network, and has good privacy security. In this paper, the object recognition function is realized based on SIFT and YOLOX respectively. The transplantation of these two methods on the mobile terminal is realized and two apps are developed based on Android system. The developed android app was tested through some pictures collected in the surrounding living environment or downloaded from the network. The test results realized the function of real-time object detection, and achieved a prediction accuracy of more than 90% based on the deep learning method.

Keywords: Object Recognition, Android System, SIFT, YOLOX, NCNN

General (A4): Planning and Scheduling
9:00-10:30, Sep. 24, 2022, Meeting Room 5

A4-1 9:00-9:15

Adaptive RBF Neural Network Sliding Model Control for Path Tracking of DP Vessel

Yixi YANG[1,2], Bin XIN[1,2], Yang LI[3], and Jian WEI[4]

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Abstract: With external environmental disturbances and model uncertainties, a path tracking control method for Dynamic Positioning (DP) vessel is proposed. It addressed the problem of the accuracy of path tracking and improved the convergence rate of errors. First, a 3-degree of freedom horizontal motion model is established. Then, considering input saturation, an adaptive radial basis function neural network (RBFNN) sliding mode controller is designed to realize the tracking of desired path, and detailed stability proof illustrates that all errors are bounded. At last, a series of simulations verify the accuracy and validity of the proposed control strategy.

Keywords: Path Tracking, RBF, Sliding Mode Control, Dynamic Positioning, Model Uncertainties

A4-2 9:15-9:30

Sampling Transformation Based Path Planning for Messenger UAV in Urban Environment Messenger

Benxiang WANG[1], Bin XIN[1], Yulong DING[2], and Yang LI[3]

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Abstract: In recent years, unmanned platforms are considered to be an important part of the Internet of Things system. However, in the face of communication-limited special tasks such as large-scale logistics and multi-obstacle urban warfare, information isolation will greatly affect the efficiency of the system. In this case, indirect communication between unmanned platforms can be realize by the mobile relay of messenger UAV. This paper mainly introduces a path planning scheme of messenger UAV in urban environment, aiming at minimizing the cost time to access all mobile UGVs (unmanned ground vehicles). The paper models this problem as a special dynamic generalized traveling salesman problem (DGTSP), and proposes a sampling transformation algorithm. The algorithm discretizes the paths of UGVs through a sampling mechanism, and effectively transforms the problem into asymmetric traveling salesman problem (ATSP) by using motion relationship. Finally, the effectiveness of the algorithm is verified by computational experiments with instances of different sizes.

Keywords: Path Planning, Messenger Mechanism, Urban Environment, Traveling Salesman Problem

General (A4): Planning and Scheduling
9:00-10:30, Sep. 24, 2022, Meeting Room 5

A4-3 9:30-9:45

Efficiently Solving Multi-Stage Dynamic Weapon Target Assignment Problem by a Knowledge-Based Heuristic

Weijie MA[1], Bin XIN[2], Yujue WANG[2], Hanzhong ZHANG[3], and Yang LI[3]

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Abstract: Based on the dynamic weapon target assignment problem (DWTA), this paper is devoted to solving the real-time and dynamically changing requirements of air defense operations. Taking maximizing the elimination of the enemy's threat as the objective function, a new DWTA model is established, which makes multi-stage decision making for the enemy's target according to the battlefield situation at different times and simulates the entire dynamic combat process. The decision-making process regarding different enemy targets is processed in parallel, the survival state of defender combat resources is considered, and the DWTA decision is making from the global battlefield situation at different times. A knowledge-based heuristic algorithm is proposed to solve the problem. In order to test the performance of the proposed heuristic algorithm, this paper selects the KM (Kuhn-Munkres) algorithm for finding the optimal matching of weighted bipartite graphs as the comparison algorithm and selects multiple evaluation indicators to evaluate the performance of the two algorithms. The experimental results show that the algorithm proposed in this paper is better than the KM algorithm in the solution quality of most cases.

Keywords: Dynamic Weapon Target Assignment, Fuzzy Systems, Knowledge-Based Heuristic Algorithm, Air Defense Operations

A4-4 9:45-10:00

Obstacle Avoidance and Path Planning of Intelligent Robots Based on Optimized A* and DWA Algorithms

Zhenjiang HU, Ying JIN, Hongbin MA, and Tao FU

Beijing Institute of Technology, China

Abstract: Typically, mobile robots work in an environment that is not fully known, such as wilderness, where they need to move from a specified starting point to a desired location. The traditional A* algorithm is based on Dijkstra algorithm to increase the heuristic function (Euclidean distance between the end point), which greatly reduces the number of grids included while obtaining the optimal path. However, in the search process, the number of traversed grids is still large and the planned path is not smooth. In the view of the above problems, the Euclidean distance in the heuristic function is changed to the diagonal distance and the Manhattan distance, and different weights are given. The Bezier curve is used for smoothing. Finally, the optimized A* algorithm is combined with the DWA algorithm to quickly reach the destination while bypassing the obstacles.

Keywords: Mobile Robot, Path Planning, A* Algorithm, Heuristic Function, Optimized A* Algorithm, DWA Algorithm

General (A4): Planning and Scheduling
9:00-10:30, Sep. 24, 2022, Meeting Room 5

A4-5 10:00-10:15

Task Allocation of Multi-Robot Cooperative Coverage Based on Circular Coding Genetic Algorithm

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Abstract: Aiming at the problem of multi-robot cooperative area coverage, this paper adopts genetic algorithm based on circular coding to complete the allocation of robot coverage area. In this paper, the given map is divided into rectangular regions and merged into several areas to be allocated. The genetic algorithm with circular coding method is used to complete the coverage task allocation of these areas. Combined with the result of task allocation, this paper designs a navigation point set for each robot. Robots will cover the whole target area by passing through these navigation points in sequence. This paper compares the state-of-the-art algorithm and demonstrates that the algorithm used in this paper has advantages in the balance of task allocation. By running the task allocation algorithm in different situations, it is verified that the task allocation algorithm has situation scalability. This paper also carries out simulation verification on the Gazebo simulation platform which is under the Robot Operating System (ROS).

Keywords: Task Allocation, Genetic Algorithm, Area Coverage, Multi-Robot

General (A5): Intelligent Prediction Methods
9:00-10:30, Sep. 24, 2022, Meeting Room 6

A5-1 9:00-9:15

Cooperative Control of Rotating Inverted Pendulum Based on Fuzzy Control

Yujue WANG, Weining MAO, Bin XIN, Qing WANG, and Jian WEI

School of Automation, Beijing Institute of Technology, China

Abstract: The rotating inverted pendulum is a nonlinear, multivariate, strongly coupled unstable system, and its study can effectively reflect many typical problems in control. In this paper, a parameter self-tuning fuzzy controller is proposed to achieve intelligent control of a single rotating inverted pendulum. Particle swarm optimization is used to adjust its structural parameters, and simulation experiments are given to show that the system can achieve stability with the designed parametric self-tuning fuzzy controller, and the control performance is better than that of the conventional fuzzy controller. On the other hand, the leader-follower control strategy is used to realize the cooperative control of multiple rotating inverted pendulums. Two Qube-Servo2 rotating inverted pendulums are used for the cooperative pendulum starting and stabilization experiments, and the effectiveness of the proposed cooperative control strategy is verified.

Keywords: Particle Swarm Optimization, Parameter Self-Tuning, Fuzzy Control, Cooperative Control

A5-2 9:15-9:30

Decentralized Task Assignment Based on Information Fusion in Communication-Constrained Environments

Zihao CHEN, Juan LI, Jing XIONG, Jie LI, Chang LIU, Jinkun LIN, Ziwei XIN, and Yiliang LI

Beijing Institute of Technology, China

Abstract: In communication-constrained environments, the wireless communication quality of unmanned aerial vehicle (UAV) swarms is unstable. This paper proposes an information fusion strategy (IFS) based on information integrity and authenticity for the task assignment problem in communication-constrained environments. The proposed IFS is embedded into the classical sequential and G-Prim decentralized task assignment algorithms, and the two improved variants with the proposed IFS are denoted as Seq-IFS and G-Prim-IFS, respectively. The Gilbert-Elliott (G-E) model, which can model burst errors and bandwidth saturation, is adopted to describe unreliable communication channels. A series of test instances with different swarm sizes and different levels of communication channel reliability are used to compare the performances of Seq-IFS and G-Prim-IFS with their original forms. Numerical experimental results demonstrate that the Seq-IFS and the G-Prim-IFS outperform their original versions significantly in the majority of test instances, especially in cases with low communication channel reliability.

Keywords: Task Assignment, Communication-Constrained Environments, Information Fusion, Information Integrity, Information Authenticity, Gilbert-Elliott Model

General (A5): Intelligent Prediction Methods
9:00-10:30, Sep. 24, 2022, Meeting Room 6

A5-3 9:30-9:45

Air Conditioning Load Prediction Based on HRD-TCN Model

Ning HE[1], Liqiang LIU[1], Danlei CHU[2], Cheng QIAN[1], and Shang LI[1]

[1]Xi'an University of Architecture and Technology, China, [2]Optimal Process Control Techonlogies Co., Ltd, China

Abstract: Accurate air conditioning load prediction is of great importance for building energy management. This paper presents a hybrid data decomposition method (HRD) combined with temporal convolutional network (TCN) for air conditioning load prediction. First, the original data are decomposed using HRD to extract its linear features and frequency domain features. Then, the extracted significant features are input to TCN for predicting the next day's air conditioning load. Finally, the real values of the next day's air conditioning load are added to the training set, which are decomposed and predicted again to form a rolling mechanism. The experimental results show that the proposed method has excellent prediction performance.

Keywords: Air Conditioning Load Prediction, Hybrid Data Decomposition Method, Temporal Convolutional Network, Rolling Mechanism

A5-4 9:45-10:00

Resilient Self-Triggered Model Predictive Control Strategy Against Replay Attack

Ning HE, Shixuan LIN, Kai MA, and Shuoji CHEN

School of Mechanical and Electrical Engineering, Xi'an University of Architecture and Technology, China

Abstract: In this paper, contrapose cyber-physical system (CPS), a resilient control strategy based on input sample reconstruction is proposed to solve the security problem of self-triggered model predictive control (STMPC) in the presence of malicious replay attacks. Firstly, a novel replay attack model is established by considering the STMPC non-periodic sampling features. Secondly, by analyzing the characteristics of established replay attack model, an input reconstruction mechanism based on key data is designed, which ensures that even if the optimal control sample is attacked, the controlled system can still generate feasible control samples to preserve the system. In addition, closed-loop stability of the system under replay attacks is strictly demonstrated. Finally, the effectiveness of the developed resilient control mechanism is verified by a robotic system.

Keywords: Cyber-Physical System, Replay Attack, Self-Triggered Model Predictive Control, Input Sample Reconstruction

General (A5): Intelligent Prediction Methods
9:00-10:30, Sep. 24, 2022, Meeting Room 6

A5-5 10:00-10:15

Research on Network Public Opinion Situation Awareness

Yabin XU, Minling ZHU, and Ran LIANG

School of Computer, Beijing Information Science &Technology University, China

Abstract: In order to perceive the development of network public opinion effectively and provide technical support for the supervision of network public opinion, the incremental prediction model GG-ICP of information dissemination is constructed by integrating the structural and temporal characteristics of social networks. Firstly, the GCN is combined with the GRU to learn the dynamic network structure information and timing information together. Then, the time decay function is improved to more effectively reflect the value decay of public opinion information with the passage of time. By coupling the spatial and temporal characteristics, the historical and edge information can be captured more reasonably to improve the prediction accuracy of the model, and then make a scientific prediction of the increment of information forwarding. The results of comparison experiments on real datasets show that, the prediction accuracy of the information dissemination model proposed in this paper is significantly improved compared with the existing models.

Keywords: Online Public Opinion, Situational Awareness, Information Cascade, Temporal Characteristics

General (B1): Intelligent Industry
10:40-12:10, Sep. 24, 2022, Meeting Room 2

B1-1 10:40-10:55

A Review of Research Methods on PLI Robots

Jingzhe HE[1], Hao CHEN[2], and Yifan LU[3]

[1]College of IoT Engineering, Faculty of Informatics, Hohai University, China, [2]College of Mechanical and Electrical Engineering, Hohai University, China, [3]Business School of Hohai University, China.

Abstract: This paper mainly introduces a common power line inspection (PLI) robot model, and introduces several main solutions to the model, that is, to prove that its motion equation can converge to a given constant.

Keywords: PLI Robot, PID Controller, PSO Algorithm, Linearization, First-Order Euler Discrete Method

B1-2 10:55-11:10

Synchronization of Positive Networks with Impulsive Control Under False Data Deception Attacks

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School of Automation, Nanjing University of Science and Technology, China.

Abstract: The aim of this paper is to investigate the synchronization of a network, which consists of a set of positive systems. The false data deception attacks are involved in the communication channels which will destroy the data completeness of the considered network. Distinguished from general networks, the condition retaining positivity of the interconnected positive systems is firstly considered. Considering constraints on the positivity of the systems, a distributed impulsive control approach is proposed to solve the synchronization issue of the network. A data detector is designed as well in the sensor. By rigorous mathematical analysis, a sufficient condition for the mean-square bounded synchronization of continuous-time positive systems is provided. Finally, the effectiveness of main results is illustrated by a specific numerical example.

Keywords: Bounded Synchronization, Positive Systems, False Data Deception Attacks, Impulsive Controller, Data Detector

General (B1): Intelligent Industry
10:40-12:10, Sep. 24, 2022, Meeting Room 2

B1-3 11:10-11:25

Thickness Determination of Plastic Products Using Continuous Wave Terahertz Frequency-Domain Spectroscopy

Tianyao ZHANG, Boyang LI, Xiaoyan ZHAO, and Zhaohui ZHANG

School of Automation and Electrical Engineering, University of Science and Technology Beijing, China, Beijing Engineering Research Center of Industrial Spectrum Imaging, University of Science and Technology Beijing, China

Abstract: In this paper, a novel method for thickness determination of plastic products using continuous wave (CW) THz frequency-domain spectroscopy is proposed. This method begins with the refractive index measurement of target material over THz frequencies. The optimal frequency band with high SNR and minimum water vapor affection is then selected for thickness prediction. For samples with unknown thickness, the THz wave's optical path is initially reconstructed from the phase delay of the recorded data. The calibrated refractive index is then applied to calculate the physical thickness of the sample. The proposed method is exemplified by the widely used plastic material Teflon. The thicknesses predicted by THzFDS measurements are coincided with conventional caliper measurements perfectly.

Keywords: Terahertz Waves, Non-Destructive Inspection, Plastic Industry, Thickness Determination

B1-4 11:25-11:40

Label Design and Identification in High Temperature Logistics Based on Concave Coding and DeepLabV3+ Model

Xiaoyan ZHAO[1,2], Pengfei ZHAO[2], Yuguo YIN[3], Luqi TAO[1], and Zhaohui ZHANG[1,2]

[1]School of Automation and Electrical Engineering, University of Science and Technology Beijing, China, [2]Shunde Graduate School, University of Science and Technology Beijing, China, [3]Shandong Start Measurement and Control Equipment Co., Ltd, China

Abstract: With the development of the Internet of Things, the logistics tracking technology at normal temperature has been quite mature, but there are few tracking methods for products in the high-temperature production process. The main difficulties include that the label materials cannot withstand high temperature for a long time, and the detection devices are vulnerable to environmental impact. This paper takes the logistics tracking of carbon anode for aluminum electrolysis as the application background to carry out specific research. This paper designs a high temperature resistant label, that is, printing concave coding on the surfaces of the anode carbon blocks, which ensures the integrity of labels in high temperature environment without affecting product performance. There is no obvious color distinction between the coding area and the background, so the direct recognition is not effective. Therefore, based on DeepLabV3+ model, MobileNetV2 and Xception are selected as the backbone network to semantically segment the concave coding in order to realize the effective segmentation of the coding area and background, and lay the foundation for the subsequent recognition of the concave coding. The experimental results show that the DeepLabV3+ model based on MobileNetV2 is superior, with MIoU of 95.45% and MPA of 97.38%. In summary, the scheme is feasible and provides a new idea for the development of high-temperature logistics tracking technology in smart manufacturing.

Keywords: Semantic Segmentation, DeepLabV3+, High Temperature Logistics

General (B2): Human-Computer Interaction
10:40-12:10, Sep. 24, 2022, Meeting Room 3

B2-1 10:40-10:55

A Laser Pointer Trajectory Recognition Method for Human-Computer Interaction

Chong LI, Bin XIN, and Qing WANG

School of Automation, Beijing Institute of Technology, China

Abstract: In the mainstream teaching equipment, because the laser pointer is limited by distance and has a relatively single function, it cannot meet the needs of classroom teaching; in order to facilitate teaching, this paper designs a human-computer interaction oriented laser pointer trajectory recognition method, and proposes a hybrid algorithm that combines the traditional light spot recognition algorithm, it can ensure the real-time update of the background image, at the same time accurately identify the tiny moving target; the improved BP neural network algorithm is proposed for trajectory recognition, which gives full play to the nonlinear fitting ability of the neural network. Compared with the previous trajectory recognition methods, the advantages and characteristics of this method are: the characteristics of the light spot and its background can be trained before use, which ensures the adaptability of the whole system; also, it can continuously identify different trajectories, after arranging and combining them, the laser pointer can be used to realize more complex functions, which is convenient for the speaker's operation. Therefore, it provides efficiency as well as scalability for us. Finally, after experimental verification, the accuracy rate of this method is as high as 95% when using an infrared laser pointer and normal light conditions, which proves the feasibility and robustness of the method.

Keywords: Human-Computer Interaction, Laser Pointer, Trajectory Recognition, Neural Network

B2-2 10:55-11:10

Analysis of Player Engagement with Eye Tracking in Game-Based Training

Kemeng HAN

University of Toronto, Canada

Abstract: Human factor engineering (HFE) concentrates on designs that take human characteristics into account, aiming at providing leisure and reaction, maximizing human capabilities, improving human's quality of life and so on. In this field, game-based training is an essential method. Combining passive content with interactive games, users can stay engaged with certain level, which is significantly affected by game difficulty level. Hence, it is crucial to establish the relationship between game difficulty level and player engagement level. To this end, in this paper, an example hooking game is developed based on Field Programmable Gate Array (FPGA) and simulated successfully on an online simulation platform, which makes it possible to construct an offline embedded system for the purpose of investigating player engagement. Eye-tracking methodology was adopted as an objective way to track participants' reaction, which is hard to capture by typical observation method. User performance and eye-tracking heatmaps of the user interface are analyzed, which reveals that game difficulty is a key factor of player engagement level.

Keywords: Human Factor Engineering, Engagement Level, Game-Based Training, Eye-Tracking, FPGA, Embedded System

General (B2): Human-Computer Interaction
10:40-12:10, Sep. 24, 2022, Meeting Room 3

B2-3 11:10-11:25

Speaker Detection Based on Attention Mechanism

Haozhen SONG, Mintao DONG, Kewei CHEN, and Fangyan DONG

Faculty of Mechanical Engineering & Mechanics, Ningbo University, China

Abstract: Speaker detection is a necessary pre-processing step for speech recognition and its downstream applications. Unimodal design architectures are currently widely used, but still have limitations in specific environments. Recent research has shown that bimodal fusion learning of audio and visual is a promising solution to the speaker detection task. Thus, in this paper, a bimodal model SdNet is proposed to implement speaker detection by introducing a cross-attention mechanism. Moreover, in order to optimize the different feature sizes caused by different attention levels at different locations of the network, a large number of residual connections are used to map to higher dimensional spaces. After the model is built, the largest AVA-Speech dataset is used for training, the mean average precision (mAP) reaches 80.1%, which is a certain improvement compared with the previously published models, and the experimental results show that the method can improve the accuracy of speaker recognition.

Keywords: Speaker Detection, Multi Model, ResNet, Vision Transformer

B2-4 11:25-11:40

Speaker Tracking Method Based on Audio-Visual Bimodal Fusion and its Application to Mobile Robot

Hao-Yan ZHANG[1,2,3], Qi-Feng SHI[1,2,3], Long-Bo ZHANG[1,2,3], and Zhen-Tao LIU[1,2,3]

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Abstract: Initiative service is one of the key research directions of the new generation of service robots. It is important to track human automatically for initiative service in human-robot interaction. To solve the problems of low precision and poor anti-interference capability of only using single-modal (audio or visual information), a speaker localization and tracking method based on audio-visual bimodal fusion is proposed. Firstly, the azimuth of speaker is obtained based on time difference of arrival (TDOA) using microphone array and face detection based on AdaBoost algorithm is carried out using camera. Frame rate tracker and spatial coordinate fusion are used to obtain the location of speaker. Secondly, path planning according to the preset tracking mode is designed, by which the azimuth and distance between the robot and the speaker is maintained in a limited range. To simulate different situations, different angle and distance for speaker tracking were set. Finally, a mobile robot is driven to follow the planned path by the real-time control system using STM32, and information from the microphone array and the camera are collected by Raspberry Pi. The proposed method was tested by setting 16 different sets of azimuth and distance data (the speaker moves slowly in the experimental place). Experimental results demonstrate that the running trajectory of the mobile robot is close to the ideal preset trajectory, which ensures effective tracking of the target speaker.

Keywords: Speaker Tracking, Audio-Visual Bimodal, Information Fusion, Mobile Robot

General (B3): Multi-agent System and Intelligent Transport
10:40-12:10, Sep. 24, 2022, Meeting Room 4

B3-1 10:40-10:55

Adaptive Cruise Control Optimized for Multi-Objective

Salvador N. Obama OYANA and Jun LI

Department of Automation, University of Science and Technology of China, China

Abstract: With the great objective of improving the adaptive cruise control (ACC) system, in terms of safety between the vehicles that travel the route, both the ego car and the lead car, energy-saving, and driver comfort, we analyze these terms as restrictions system control for them, we analyze our system from the driving data of a real vehicle. A hierarchical control architecture is adopted, and the top controller is designed based on Model Predictive Control (MPC). The numerical simulation shows that the proposed MPC controller considerably reduces the energy consumption of the ACC system if we compare it with the energy consumption in cruise control (CC) system and the comfort under the premise of guaranteeing the performance and the inter-vehicular distance between the two vehicles is also quite stable.

Keywords: Adaptive Cruise Control, Multi-Objective Control, Model Predictive Control

B3-2 10:55-11:10

Traffic Flow Detection Based on Improved YOLOX and DeepSORT

Zewen DU, Ying JIN, Hongbin MA, and Ping LIU

School of Automation, Beijing Institute of Technology, China

Abstract: Aiming at the shortcomings of low detection rate, low tracking accuracy and poor robustness in traditional traffic flow detection algorithms in surveillance video, we introduce a traffic flow detection method, which divides the traffic flow detection task into three modules, including vehicle detection, vehicle tracking and vehicle counting. Firstly, the improved YOLOX model is used to detect the vehicles in a single frame image. Secondly, the DeepSORT algorithm is used to track the detected vehicles. Finally, the two-way traffic flow statistics are completed by the improved virtual coil method. In order to make full use of the feature information of different scales, we use the ASFF module to perform adaptive feature fusion on the output feature maps of different scales. In addition, the convolutional attention modules are also used in the detection algorithm to improve the classification and localization performance of the network. Through experimental tests, the traffic flow detection method proposed in this paper has achieved high accuracy and adaptability in a series of traffic surveillance videos under different weather and different perspectives.

Keywords: Vehicle Detection, Vehicle Tracking, Traffic Flow Detection, YOLOX, DeepSORT

General (B3): Multi-agent System and Intelligent Transport
10:40-12:10, Sep. 24, 2022, Meeting Room 4

B3-3 11:10-11:25

A Decision-Making Method of Multimodal Fusion Based on Deep Reinforcement Learning for Highway Autonomous Driving

Ping LIU, Hongbin MA, Ying JIN, Yazhe DING, Bin CAO, and Zewen DU

School of Automation, Beijing Institute of Technology, China

Abstract: This paper focuses on deep reinforcement learning-based decision-making and planning methods for autonomous vehicles to drive on dynamic highways in a high-speed, comfortable, and safe manner. Due to the highly dynamic and complex road environment, the ability to make decisions and plan autonomously as humans has always been a challenging topic for autonomous vehicles. Different from the previous only taking dynamic traffic state as input, a multimodal fusion method is designed in this paper to enrich the input feature information, and the longitudinal acceleration (or deceleration) and lateral rotation angle are used for the output of the decision-making model. The total decision reward for the highway autonomous driving problem is designed into three parts, namely, the non-collision reward, the high-speed driving reward, and the successful-to-destination reward. During the experiment, the training and testing parameters of the decision-making model are set according to the driving parameters of the real highway. The experimental results show that the method accelerates the rapid convergence of the decision-making model by fusing the multi-modal data in the high-speed driving environment, and can make reasonable decisions autonomously in the high-speed environment.

Keywords: Autonomous Driving, Dynamic Environment, Decision Making, Deep Reinforcement Learning, Multimodal Fusion

B3-4 11:25-11:40

A Mixed Encoding Genetic Algorithm for Train Platforming Rescheduling Under Train Delays

Shuxin DING[1,2], Tao ZHANG[1,2], Rongsheng WANG[1,2,3], Yanhao SUN[1,2], Xiaozhao ZHOU[1,2], and Chen CHEN[4,5]

[1]Signal and Communication Research Institute, China Academy of Railway Sciences Corporation Limited, China, [2]Train Operation Control Laboratory for High-Speed Railway, National Engineering Research Center of System Technology for High-Speed Railway and Urban Rail Transit, China, [3]Postgraduate Department, China Academy of Railway Sciences, China, [4]School of Automation, Beijing Institute of Technology, China, [5]Key Laboratory of Intelligent Control and Decision of Complex Systems, Beijing Institute of Technology, China

Abstract: To improve the operational efficiency of the high-speed railway station with emergencies, a train platforming rescheduling problem (TPRP) at a high-speed railway station is proposed in this paper. The TPRP problem addresses the adjustment of train track assignment and train arrival/departure time under train arrival delays. A mixed-integer nonlinear programming model is proposed to minimize the weighted sum of total train delays and rescheduling costs. A mixed encoding genetic algorithm (GA) is proposed. The individual of the GA is represented as the platform track assignment and train departure priority, which is a mixed encoding scheme with integer and permutation. The individual is decoded to a feasible platform track assignment and arrival/departure time of trains using a rule-based method for conflict resolution in platform tracks and arrival/departure route. Experimental results demonstrate the superiority of the mixed encoding GA in solving the proposed problem compared with other algorithms.

Keywords: High-Speed Railway, Train Platforming Rescheduling, Conflict Resolution, Genetic Algorithm, Mixed Encoding

B3-5 11:40-11:55

A Joint Task Allocation Method for Heterogeneous Multi-Agent Based on Distributed Auction Algorithm

Jia ZHANG, Xin DU, and Bin XIN

Beijing Institute of Technology, China

Abstract: The coordination between sensor resources and firepower resources is one of the key factors to improve the operational efficiency of modern war. The paper establishes a mathematical model for the typical heterogeneous multi-agent joint task allocation problem of sensor-weapon-target joint task allocation. Considering the bias of different agents to different tasks, the paper combines the marginal utility theory in economics with the auction algorithm, and proposes a distributed joint auction algorithm that can quickly and effectively generate task schemes. Simulation results show that the method can get 90% performance effect by consuming less than 10% of the calculation time of the centralized algorithm and get a better allocation scheme. It is more suitable for task scenarios with large task scale, high computing time requirements and unstable communication topology.

Keywords: Sensor-Weapon-Target Assignment (SWTA), Heterogeneous Agent Allocation, Distributed Joint Auction Algorithm, AnyLogic Simulation

General (B4): Machine Learning and Application-1

10:40-12:10, Sep. 24, 2022, Meeting Room 5

B4-1 10:40-10:55

Mutation-Based Group Teaching Optimization Algorithm for Scheduling Cloud Workflows with Deadline Constraints

Jiwei MENG, Guanghao XU, Bing CHEN, Huifang LI, Lingguo CUI, and Senchun CHAI

School of Automation, Beijing Institute of Technology, China

Abstract: Cloud computing shows great potential in dealing with immense amounts of data, which satisfies users' demand for high performance computing capability. The elasticity of the cloud and the heterogeneity of virtual machines provisioned provide a cost-effective deploying environment for executing user applications. How to manage and schedule these applications in order to guarantee users' QoS requirements and improve resource utilization, is still a great challenge. In this paper, we design a Group Teaching Optimization Algorithm (GTOA)-based workflow scheduler to minimize the workflow execution cost under deadline constraints. To improve the global search ability and avoid falling into local optima, we introduce a mutation strategy into the original GTOA and propose a Mutation-based GTOA, i.e., M-GTOA. A set of experiments are conducted to verify its effectiveness and experimental results show that M-GTOA outperforms GTOA in success rate and cost optimization. Compared with GA, PSO and OSAM, M-GTOA achieves better optimization performance in most cases, especially for Montage and Sipht workflows.

Keywords: Group Teaching Optimization Algorithm, Workflow Scheduling, Cloud Computing, Meta-Heuristic Algorithms

B4-2 10:55-11:10

Identifying Stroke Types Using Machine Learning Method Based on Multi-Channel Frequency Domain Electromagnetic Signals

Shang GAO and Guohun ZHU

The University of Queensland, Australia

Abstract: Stroke is an emergency and requires treatment within 3-6 hours. Therefore, rapid diagnosis of stroke subtypes is very important for timely clinical intervention. This study assesses four traditional machine learning methods with frequency domain features to classify stroke subtypes based on multichannel electromagnetic signals. Firstly, redundant data are removed from 256 channels scattering signals on each subject. Then 16 frequency domain features are extracted by a principle component analysis (PCA) method. Finally, features are forwarded into four classifiers to be built and used for stroke type prediction. The results indicate that the logistic regression classifier achieves better results than K-nearest neighbour, XGBoost and MLP neural network methods, achieving the highest accuracy (98%) while retaining one feature on each channel.

Keywords: Stroke, PCA, Machine Learning, Antenna Array, Classification, Frequency Domain

General (B4): Machine Learning and Application-1
10:40-12:10, Sep. 24, 2022, Meeting Room 5

B4-3 11:10-11:25

Monotonic Feature Extraction for Equipment Remaining Life Prediction Using Dynamic Time Warping

Xiaotong WU[1], Ningyun LU[1], and Jianhua LYU[2]

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Abstract: This paper proposes a method to screen out monotonic features for equipment remaining life prediction (RUL) using Dynamic Time Warping (DTW). First, Spearman correlation coefficient is used to pre-screen the original features to build a candidate feature set. Second, trend sequences are constructed from the diagonal regions of DTW cost matrix and they have the same height and width as the feature sequences. Then, the similarity index between the candidate features and the trend sequences is calculated, the features with high similarity are screened out since they have strong correlation with the trend sequences, and all screen-out features form a "core" feature set. Finally, these core features are input to a Long Short Term Memory (LSTM) neural network model to predict the RUL. Experimental verification is carried out using a real-world dataset for low-voltage circuit breakers, and the results show that the features screened out by the proposed method are effective for accurate RUL prediction.

Keywords: Monotonic Feature Extraction, Remaining Useful Life (RUL) Prediction, Dynamic Time Warping (DTW)

B4-4 11:25-11:40

A Review of Knowledge Graph Research in Military Domain

Xudong GUO[1], Linxiu CHEN[2], Yuan LI[1], Qinglin WANG[1], and Weili GUAN[2]

[1]Beijing Institute of Technology, China, [2]Science and Technology on Complex System Control and Intelligent Agent Cooperation Laboratory, China

Abstract: With the development of information technology as well as the continuous improvement of military informatization level, the complex and changing battlefield situation put forward a huge challenge on the military's massive data processing capability. This paper presents the technical framework related to the construction of knowledge graph in military field, summarizes different aspects of the application of knowledge graph in military field, and reveals the directions for improvement in view of the current situation of the application of knowledge graph in military field

Keywords: Military Domain, Knowledge Graph, Ontology

General (B4): Machine Learning and Application-1

10:40-12:10, Sep. 24, 2022, Meeting Room 5

B4-5 11:40-11:55

Control Strategy and Optimization of the Indoor Ski Simulator

Hao SHI, Zhen CHEN, Ning DONG, Qing FEI, Xiaolan YAO, and Wanshuai HU

School of Automation, Beijing Institute of Technology, China

Abstract: This paper is based on a self-developed indoor ski simulator for ski training and entertainment, which can simulate slalom and combine it with virtual scenes to allow skiers to have a more realistic skiing experience. Firstly, the model of the skiing movement is analyzed, and the nonlinear control strategy of the motor velocity of the ski simulator is proposed. For the relative lag between the virtual scenes and the current skier's position, we use a neural network to make predictions and use a sparrow search algorithm (SSA) to optimize neural network weights and thresholds. The simulation and experimental results indicate that this method can effectively predict.

Keywords: Simulated Ski Platform, Nonlinear Function, Neural Network, Sparrow Search Algorithm

General (B5): Machine Learning and Application-2

10:40-12:10, Sep. 24, 2022, Meeting Room 6

B5-1 10:40-10:55

Assessment of Cognitive Functioning System Based on Computer Graphics Technology

Yu Qi ZHANG and Naoyuki KUBOTA

Tokyo Metropolitan University, Japan

Abstract: Early detection of cognitive impairment is crucial for dementia prevention. We aim to assess those at risk of dementia's cognitive functioning system. We developed a computer graphics-based short-term memory and attention test system that utilizes a spot-the-difference task. The system can recognize the position and information of particular things in photographs and then substitutes the original object with a photo of a comparable entity. The system may effectively produce several spot-the-difference task pictures, decreasing the repetitiveness and tediousness of studies. Furthermore, it allows for remote, real-time judgment and helps healthcare professionals provide better telemedicine services. The findings revealed that the proposed strategies were effective.

Keywords: Medical-Industrial Alliance, Assessment of Cognitive Functioning, Spot-The-Difference Task, Object Recognition, Intelligent Graphics Processing

B5-2 10:55-11:10

Comparative Study on Estimating the External Torque of Flexible Robot Driven by Series Elastic Actuators

Shenghong LIU, Gao WANG, Ning LIU, and Feiyan MIN

School of Information Science and Technology, Jinan University, China

Abstract: Accurate and fast estimation of external torque applied to the robot body directly determines the final performance of force control for flexible robot driven by series elastic actuators. The external torque estimation based on dynamics model requires the state information of robot link side, including angle, angular velocity and angular acceleration. Due to the noise and uncertainty of angular acceleration signal obtained by discrete differentiation of the angle, most methods of external torque estimation take the method of avoiding acceleration calculation. In this paper, an extended Kalman filter (EKF) algorithm is used to fuse the information of the photoelectric encoder and accelerometer to obtain the accurate link side angular acceleration signal, which is used to directly estimate (DE) the external torque based on the dynamic model. The results show that the momentum observer (MOB) has the same effect as reaction torque observer (RTOB), and the direct estimation method of precise acceleration signal has high accuracy and wide band. Also, the experiments in turn demonstrate the accuracy of the angular acceleration signal obtained by the EKF fusion.

Keywords: Force Estimation, Momentum Observer, Reaction Torque Observer, Accelerometer Calibration, Extended Kalman Filter

General (B5): Machine Learning and Application-2
10:40-12:10, Sep. 24, 2022, Meeting Room 6

B5-3 11:10-11:25

Experimental Comparison of SNR and RSSI for LoRa-ESL Based on Machine Clustering and Arithmetic Distribution

Malak Abid Ali KHAN, Hongbin MA, Syed Muhammad AAMIR, and Cekderi Anil BARIS
School of Automation, Beijing Institute of Technology, China

Abstract: LoRa lacks the sensing capabilities of channel status. Received signal strength indicator (RSSI) decreases due to collision, interference, and near-far effect while for signal-to-noise ratio (SNR), the packets are rejected by decreasing the transmission power (TP) at a higher spreading factor (SF). To overcome these challenges in the case of electric shelf label (ESL) to minimize the dependency on retransmission and acknowledgment, the end devices (EDs) are allocated around gateways (GWs) based on machine clustering with dynamic SF for SNR while dynamic TP for RSSI. The experimental results determined that the RSSI approach is more dominant than SNR because of determining the exact locality of the ED that diminished the capture effect. Arithmetic distribution of EDs for various GWs in different clusters helps to minify the near-far effect. The resultant received power (RP) at each cluster is higher for most of the connected EDs than the threshold RP.

Keywords: RSSI, SNR, ESL, Machine Clustering, Arithmetic Distribution

B5-4 11:25-11:40

An Arithmetic Sequence Method for Counting Ordered Pillboxes

Maofan CHENG[1], Hongbin MA[2], and Ying JIN[3]
[2]Beijing Institute of Technology, China, [3]Beijing Institute of Technology, China

Abstract: It is often necessary to count pillboxes in the medical and health care industry. However, there are many challenges in the counting process, such as complex patterns on the surface of the pillboxes, surface reflection, etc. It is difficult to achieve satisfactory results using existing methods, such as object detection and image segmentation. In this paper, a simple and novel method for arithmetic sequence algorithm based on deep learning and traditional image processing technology fusion is proposed, which can effectively and efficiently count ordered pillboxes. Firstly, we use one deep-learning-based real-time instance segmentation model to segment the pillbox image, and secondly use the arithmetic sequence algorithm we proposed to count the pillboxes. The method requires little computation overhead to obtain an accurate result. Our experiment shows that the algorithm we proposed is effective, efficient, with counting accuracy up to 99.89 % in our dataset.

Keywords: Instance Segmentation, Objects Counting, Arithmetic Algorithm

Organized (C1): Explainable User Modeling and Applications
14:00-15:30, Sep. 24, 2022, Meeting Room 2

C1-1 14:00-14:15

Streamflow Prediction Using Cascaded-ANFIS Algorithm in Kelani River, Sri Lanka

Namal RATHNAYAKE[1], Upaka RATHNAYAKE[2], Tuan Linh DANG[3], and Yukinobu HOSHINO[1]

[1]Kochi University of Technology, Japan, [2]Department of Civil Engineering, Faculty of Engineering, Sri Lanka Institute of Information Technology, Sri Lanka, [3]School of Information and Communications Technology, Hanoi University of Science and Technology, Vietnam

Abstract: Sri Lanka is rich in rainfall throughout the entire year, and river overflow incidents occur continuously. Heavy rainfall and poor infrastructure management cause the runoff of rivers. Therefore, this study proposes an accurate rainfall-runoff prediction model development using the Cascaded-ANFIS algorithm. The performance of the proposed method is compared with five algorithms, namely, Linear Regression, Lasso Regression, Ridge Regression, Gated Recurrent Unit, and Long Short-Term Memory. Moreover, the evaluation was done using six parameters: correlation coefficient, root mean squared error, percent bias, Nash-Sutcliffe Efficiency, and Kling-Gupta Efficiency. The proposed algorithm shows 0.9139, 1.15×10^{-10}, 0.2100, 0.8351, and 0.8776 results, respectively. The results indicate that the Cascaded-ANFIS algorithm outperforms other algorithms in every aspect.

Keywords: Cascaded-ANFIS, Regression, GRU, LSTM, RNN, Flood Forecasting

C1-2 14:15-14:30

A Comparative Study of Statistical Models and Univariate and Multivariate RNN for Forecasting the Number of COVID-19 Cases

Naoki DOHI, Namal RATHNAYAKE, and Yukinobu HOSHINO

Kochi University of Technology, Japan

Abstract: This study forecast COVID-19 cases in Japan to assist in decisions. There are statistical and machine learning models for forecasting time series. Traditionally, Statistical models are used in this field, and many machine learning models are recently adopted. Therefore, both models are needed to be compared for forecasting COVID-19 cases. Auto-Regressive Integrated Moving Average (ARIMA) and Recurrent neural network (RNN) are compared by Akaike information criterion (AIC) and Root Mean Square Error (RMSE). Results show that RNN (with vector inputs and outputs) was better than statistical models. Specifically, the RMSE of RNN is 47 and that of ARIMA is 103.

Keywords: Statistical Model, SARIMA, Machine Learning, Deep Learning, RNN, Time Series Forecasting, COVID-19, Novel Corona Virus

Organized (C1): Explainable User Modeling and Applications
14:00-15:30, Sep. 24, 2022, Meeting Room 2

C1-3 14:30-14:45

Proposal of Personal Value-Based User Modeling Without Attribute Evaluation

Kaichi NIHIRA, Hiroki SHIBATA, and Yasufumi TAKAMA

Graduate School of System Design, Tokyo Metropolitan University, Japan

Abstract: This paper proposes a personal values modeling method that does not require attribute ratings. The proposed method is applied to memory-based collaborative filtering (CF) to demonstrate its effectiveness. Personal values modeling using rate matching rate (RMRate) has been proposed, which needs an evaluation of each item attributes in addition to the rating value to items. Therefore, it cannot be used when the evaluation of item attributes is not available. To obtain personal values model of users only from a rating matrix, this paper defines user's personal values as their tendency to select popular/unpopular items. Five attributes are proposed for modeling user's personal values, of which effectiveness is evaluated in combination with user-based CF. Experimental results with three datasets show the proposed method can achieve higher precision and recall than conventional user-based CF.

Keywords: Recommendation, Personal Values, Collaborative Filtering

C1-4 14:45-15:00

Proposal of Generation of Rating Matrix Based on Rational Behaviors of Users

Kenshin MORIYOSHI, Hiroki SHIBATA, and Yasufumi TAKAMA

Tokyo Metropolitan University, Japan

Abstract: This paper proposes a method to generate an artificial rating matrix based on user's rational behavior, with the aim of generating a large-scale rating matrix at low cost. Collaborative filtering is one of the major techniques for recommender systems, which is widely used because it can recommend items using only a history of ratings given to the items by users [1]. However, collaborative filtering has some problems such as the cold-start problem [2] and the sparsity problem [3], both of which are caused by the shortage of ratings in a database (rating matrix). This problem is particularly serious for services that have just started operation or do not have a large number of users. The proposed method generates a rating matrix with no missing values using users' rating probabilities, which are obtained from the distribution of their actual ratings. The final synthetic rating matrix is generated after adjusting its sparsity by introducing missing values. The validity of the proposed method is evaluated by comparing the synthetic data in terms of the similarity of the distribution of several statistics with that of the real data. Synthetic data are generated by the proposed method and generated based on regular but meaningless behavior.

Keywords: Recommendation, Synthetic Data, Long-Tail

Organized (C1): Explainable User Modeling and Applications
14:00-15:30, Sep. 24, 2022, Meeting Room 2

C1-5 15:00-15:15

Vulnerability in Impression Based Strategy Against Bribery Behavior

Takuya OTOGURO[1], Kazushi OKAMOTO[1], and Atsushi SHIBATA[2]

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Abstract: Electronic marketplaces have adopted centralized reputation systems that aggregate the ratings given by reviewers. This type of systems is used to express the overall evaluation of the products or sellers. Malicious sellers or users may manipulate the ratings to build false evaluations using these systems. Therefore, approaches to maintain high robustness against such attacks and to correctly evaluate products or sellers are being devised. Simultaneously, new types of reputation attacks are increasing. This study shows that an impression-based defensive strategy is vulnerable against a bribery behavior in which a seller offers bribes to and demands excellent evaluations from reviewers who have made transactions. The results of experiment suggest that this strategy fails to identify approximately half or more of the dishonest sellers under the ratio of bribe-giving manipulators and bribed ratings exceed by 80% and 30% respectively.

Keywords: Bribery Behavior, Centralized Reputation System, Impression Based Strategy, Reputation Attack

C1-6 15:15-15:30

Müller-Lyer Illusion Is Replicated by Higher Layer of Pre-Trained Deep Neural Network for Object Recognition

Hongtao ZHANG[1], Zhen LI[2], and Shinichi YOSHIDA[1]

[1]School of Information, Kochi University of Technology, Japan, [2]Department of Psychology, the University of Hong Kong, Hong Kong, China

Abstract: Deep neural networks (DNNs) are commonly used in neuroscience research, however comparing neural networks to human perception remains challenging. With the development of the disciplinary intersection of deep learning and neuroscience, researchers have begun to use deep neural networks (DNNs) and human behavioral perception to assess the relevance of DNNs to brain neural networks. Here, we explore the similarity between DNNs and human visual perception through the well-known Müller-Lyer illusion. Specifically, by presenting the classical visual illusory stimuli, we compared representation by VGG-19 and ResNet-101 with human perception. Results indicated that similar to human visual perception, Müller-Lyer illusion is also shown in DNNs. Also, we further find that DNNs exhibit low physicalperceptual bias but present similar judgments in analogy with the layers of human perceptual hierarchy.

Keywords: Deep Neural Networks, Illusions, Müller-Lyer Illusion, Visual Perception, Deep Learning

Organized (C1): Explainable User Modeling and Applications
14:00-15:30, Sep. 24, 2022, Meeting Room 2

C1-7 15:30-15:45

Image Classification of MRI for Alzheimer's Disease Using Two Deep Neural Networks and Their Explainability

Boyue SONG and Shinichi YOSHIDA

[1]Graduate School of Engineering, Kochi University of Technology, Japan, [2]School of Information, Kochi University of Technology, Japan

Abstract: Currently, many studies have realized the automatic classification of various neurological diseases with a synergy of raw fMRI data and convolutional neural networks (CNNs). However, CNN model has been criticized for its uninterpretability as a black box, which can greatly affect the credibility of the model, especially in the field of clinical diagnosis. In this paper, we used two modified CNNs to classify different stages of Alzheimer's disease (AD) and applied Gradientsweighted Class Activation Mapping (Grad-CAM) on these models to explain them. However, the images of Grad-CAM didn't highlight different regions of the brains according to the stages of AD as expected. Instead, the highlighted regions appeared randomly, which indicated the models didn't effectively extract useful higher-level features for the different stages of AD. Instead, specific lower-level features of the patients' brain might become the basis for classification.

Keywords: Alzheimer's Disease, Convolutional Neural Networks, Clinical Functional Magnetic Resonance Imaging, Gradients-Weighted Class Activation Mapping, Visual Explanation

Organized (C2): AI-Enabled Robots for Smarter Inclusive Society
14:00-15:30, Sep. 24, 2022, Meeting Room 3

C2-1 14:00-14:15

Trust Towards the Robot with the Presence and Absence of Confidence

Youdi LI, Yasufumi TAKAMA, Eri SATO-SHIMOKAWARA, and Toru YAMAGUCHI

Tokyo Metropolitan University, Japan

Abstract: With the increasing presence of social robots in various circumstances, there is a great need to adapt robots' behaviors to the needs of the individuals they interact with. Expression of confidence is one important capability in either interpersonal or human-robot interaction. In this study, volunteer subjects engaged in 2 phases involving a social robot Kebbi. In the Perceptive Phase, participants watched several videos showing the robot's confident or unconfident expressions with different settings to pinpoint the factors of confidence expression including voice, motion, and response time. In the Game Phase, participants finished four sections of a treasure hunt game with support from the robot. In this phase, the robot gave hints while showing different combinations of confident/unconfident utterances and non-verbal information to explore how the robot's expressions consisting of verbal and non-verbal factors affect people's trust. Results have shown that both verbal and non-verbal factors are essential for people's estimation of the degree of the robot's confidence and participants tended to evaluate the robot with non-verbal information as more trusting and are more likely to trust the robot again after mistakes. This study provides insights into how advanced social features, like confidence, can be used to improve human-robot interaction.

Keywords: Expression of Confidence, Trust Towards Robot, Human-Robot Interaction

C2-2 14:15-14:30

Toward Construction of Handwritten Indus Signs Dataset

Sujata SAINI, Hiroki SHIBATA, and Yasufumi TAKAMA

School of System Design, Tokyo Metropolitan University, Japan

Abstract: Indus script is a writing system developed in the Indus civilization. Despite so many attempts over the years, it is still undeciphered. The decipherment of the Indus sign has yet to be resolved due to a lack of knowledge and limited data available. The demand for the large volume of datasets has increased recently with the hope of applying the state-of-the-art machine learning algorithms. The aim of the paper is to construct the dataset of the top 10 frequently appeared Indus signs found in multiple sites in the Indus civilization. As the number of images of actual Indus signs available is limited, a dataset is constructed by asking people to draw the Indus signs referring to the actual images. The handwritten images of Indus signs are collected from 36 participants with a web application. To examine the quality and characteristics of the constructed dataset from the viewpoint of machine learning, the dataset is used to train Convolutional Neural Networks (CNN) with the Tensorflow. The result shows the obtained model achieved 93% classification accuracy.

Keywords: Indus Sign Dataset, Image Classification, Dataset Creation

Organized (C2): AI-Enabled Robots for Smarter Inclusive Society
14:00-15:30, Sep. 24, 2022, Meeting Room 3

C2-3 14:30-14:45

Proposal of Dynamic Generation of Subordinate Clusters Based on Bayesian Information Criterion for Must-Link Constrained K-Means

Shota SHIMIZU, Shun SAKAYAUCHI, Hiroki SHIBATA, and Yasufumi TAKAMA

School of System Design, Tokyo Metropolitan University, Japan

Abstract: This paper proposes a constrained K-means clustering method that dynamically generates subordinate clusters based on Bayesian Information Criterion. COP K-means, which considers a pair-wise constraints in partition-based clustering, have difficulty handling the case that a Must-link is given to instances located far away from each other. To address this problem, the proposed method generates subordinate clusters that have a Must-link to a master cluster during a clustering process. The final clustering result is obtained by merging the subordinate clusters. In addition, this paper proposes to determine whether to generate subordinate clusters or not based on the Bayesian Information Criterion. This paper evaluates the effectiveness of the proposed method with synthetic datasets.

Keywords: Clustering, Constrained Clustering, Bayesian Information Criterion (BIC)

C2-4 14:45-15:00

Design of a Demonstration Space, the "Living Lab," for Monitoring Daily Activities in the Older Adult and the Assessment of Assistive Technologies

Kenji KATO[1], Tatsuya YOSHIMI[1], Daiki SHIMOTORI[2], Keita AIMOTO[3], Naoki ITOH[3], Kohei OKABE[4], Naoyuki KUBOTA[5], Yasuhisa HIRATA[6], and Izumi KONDO[7]

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Abstract: In this study, we designed and constructed a demonstration space, Living Lab, with specifications that can simulate daily life in a typical house or small nursing home. The basic concept is to provide a living space equipped with an entrance, living room, dining room, kitchen, bathroom and restroom within which the typical daily activities of an elderly individual can be evaluated. To safeguard against falls, the living space contains a suspension system. The size of the restroom and bathroom can be changed as required to simulate either the home or the nursing home environment. The Living Lab can also be used for training as part of a rehabilitation program prior to discharge from hospital, and also serves as a safe place to demonstrate new nursing-care devices and robots as they are developed.

Keywords: Life Space, Life Scenario, Suspension Device, Outdoor Activity, Motion Analysis

Organized (C2): AI-Enabled Robots for Smarter Inclusive Society
14:00-15:30, Sep. 24, 2022, Meeting Room 3

C2-5 15:00-15:15

Consideration of Strategy for Selecting Probing Items in Interactive Recommendation

Yasufumi TAKAMA, Mingman XU, and Hiroki SHIBATA

Graduate School of System Design, Tokyo Metropolitan University, Japan

Abstract: This paper discusses a strategy to determine probing item. The definition of probing item is provided in the paper: the probing item is an item by showing it to a user the system can obtain effective feedback for further recommendation. This paper compares several strategies for determining probing items. Probing items are presented to users especially at their Signup process to obtain their feedback, from which initial user profiles are constructed. Therefore, how to determine probing items are critical for designing recommender systems. This paper reports the results of comparing several strategies by simulating user behaviors using real dataset.

Keywords: Recommender System, Online Recommendation, Cold-Start, Probing Items, Rating Matrix

Organized (C3): Intelligent Technologies and Applications for Industrial Alarm Systems
14:00-15:30, Sep. 24, 2022, Meeting Room 4

C3-1 14:00-14:15

Joint Design of Alarm Deadbands and Delay Timers to Reduce the Number of Nuisance Alarms

Jiandong WANG and Poku GYASI

Shandong University of Science and Technology, China

Abstract: Alarm deadbands and delay timers are widely used in practice to reduce the number of nuisance alarms. This paper proposes a method to jointly design alarm deadbands and delay timers that are connected in a serial or parallel manner. Serial and parallel alarm systems are effective for removing nuisance alarms with different types of nuisance alarms, while alarm deadbands or delay timers alone are suitable only for one type of false alarms. The principle idea is that nuisance alarms with alarm deviations or alarm durations less than a certain threshold can be effectively removed by an alarm deadband or a delay timer. A minimization problem is formulated to design optimal values of the alarm deadband width and delay timer factor. Bayesian estimation approach is exploited to achieve reliable estimates of joint probabilities of alarm deviations and alarm durations. Existing methods are limited to the design of either alarm deadbands or delay timers based on probability density functions of process variables, and to a restrictive assumption that process variables are independent and identically distributed. The proposed method is for the joint design of serially/parallelly-connected alarm deadbands and delay timers; it is based on joint probabilities of alarm deviations and alarm durations, and does not require the restrictive assumption. Numerical and industrial examples are presented to illustrate the proposed method and compare with existing ones.

Keywords: Industrial Alarm Systems, Nuisance Alarms, Alarm Deadbands, Delay Timers

C3-2 14:15-14:30

Alarm Floods Management by Extracting Structure Features

Chang TIAN and Chunhui ZHAO

State Key Laboratory of Industrial Control Technology, College of Control Science and Engineering, Zhejiang University, China

Abstract: Alarm floods indicate specific abnormal episodes, each of which has uniquely causal mechanisms between sources of industrial alarms, ultimately leading to causally dependent alarms. In that regard, online alarm flood classification based on causality differences could provide support for alarm handling, root cause analysis, and predictive maintenance. In this paper, the structure feature of alarm floods is explored for alarm flood classification. The structure feature reflects causal dependencies among alarm variables in alarm flood, achieving desirable discriminate properties for classification due to its interpretable physical meaning. Technically, we develop a probabilistic function that characterizes the alarm data distribution and parametrizes causal dependency probabilities. Instead of solving the parameters by traditional optimization methods, a deep learning model is exploited to generate the parameters and thereby gains the ability to transform an alarm flood to structure features in representation space. Besides, a general classifier is established based on structure features, enabling the online application. Experimental results illustrate the interpretability of structure features and show their effectiveness for alarm floods classification.

Keywords: Alarm Floods Classification, Causal Analysis, Deep Learning

C3-3 14:30-14:45

Pattern Mining for Prediction and Suppression of Industrial Alarm Floods

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Abstract: Alarm floods are among the most difficult issues in industrial alarm monitoring and have been identified as causes of many industrial accidents. During an alarm flood situation, the operator is overwhelmed by a large number of alarms and thus may fail to reorganize critical alarms. As a result, it could be almost impossible to make corrective actions, leading to deterioration of the situation and even causing serious consequences. To handle alarm floods and mitigate their negative influences to process operation, pattern mining has been exploited to extract interesting patterns that are then used for decision supports in alarm monitoring. This abstract mainly introduces the advanced methods and results on pattern mining for prediction and suppression of industrial alarm floods, including similarity analysis, pattern extraction, and real-time matching. Case studies are presented to demonstrate the effectiveness and practicality of these techniques.

Keywords: Alarm Monitoring, Alarm Floods, Pattern Mining, Similarity Analysis

C3-4 14:45-15:00

Research on Correlation of Alarm Data of Refining and Chemical Plant Based on Optimized CBOW Method

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Abstract: As the refining equipment gradually becomes more complex and intelligent, more and more alarm points need to be set in the industrial process. However, the functions of some alarm points are repetitive and unnecessary, and some alarm thresholds are set unreasonably, which will lead to a large number of alarm prompts in a short period of time and interfere with judgment of operator, and brings challenges to the alarm management. Therefore, it is necessary to analyze the alarm log and optimize the alarm management system. In order to process the alarm information more conveniently and quickly, and improve the efficiency of alarm log information analysis. This paper introduces the CBOW model and negative sampling optimization method commonly used in natural language processing to embed the alarm log, embed the alarm information, retain the correlation of the alarm information in time and semantics, calculate the Euclidean distance after the dimensionality reduction of high-dimensional vectors, and obtain the clustering results, which provides help for optimizing the process alarm point setting and alarm threshold setting. Experimental results show that the proposed method can retain the correlation of alarm data in time and semantics, and effectively identify alarms with high correlation.

Keywords: Alarm Management, Word Embedding, Clustering, Correlation Analysis

Organized (C3): Intelligent Technologies and Applications for Industrial Alarm Systems
14:00-15:30, Sep. 24, 2022, Meeting Room 4

C3-5 15:00-15:15

Multiple Root-Cause Alarm Flood Classification with Weighted Dissimilarity Indices

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Abstract: Modern industrial facilities and processes have been becoming increasingly complex since a few decades ago. Massive numbers of sensors, actuators, and controllers can inevitably experience failures and induce alarm floods. Efficient fault detection and isolation (FDI) for these components based on analytical models and historical process/alarm data have attracted extensive research interests. Existing studies on root cause analysis are mostly restricted to the scenario that an alarm flood is caused by a single fault, which can be identified by machine learning and pattern matching algorithms. In real industrial processes, it is not rare that some units fail simultaneously, or more than one fault occurs within a short period of time. Owing to physical inter-connections and coupled material/information flows, a faulty component can sometimes cause its neighbor components to fail. Early isolation of *all* root causes that induce an alarm flood is an important topic. It not only allows field operators to respond quickly to tackle all malfunctioning units, but also is a core requirement for advanced alarm management systems. Motivated by the deficiency identified above, this paper proposes a pattern matching algorithm to achieve multiple root-cause alarm flood classification with weighted dissimilarity indices. For each labeled subset of historical data, a binary signature vector is firstly extracted as the alarm flood template; then a weighting factor is assigned to each unique tag to enhance the importance of relevant alarms and deemphasize irreverent ones. For alarm floods with multiple root causes, a *predict-update* strategy is adopted to fuse the information in historical data. Alarm flood classification is then achieved by comparing the weighted dissimilarity scores of an ongoing alarm flood with each template vector. The effectiveness of the proposed method is verified with simulated data from a Vinyl Acetate Monomer (VAM) plant model.

Keywords: Alarm Flood Template, Dissimilarity Index, Multiple Root Causes, Pattern Matching

C3-6 15:15-15:30

Assessment of Alarm Systems for Mixture Processes and Intermittent Faults

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Abstract: Alarm systems are utilized in the process industries to notify operators and other plant staff of abnormal process conditions or equipment faults. Alarm system, as an essential part of distributed control systems (DCS), assists operators in safely operating the process under normal and abnormal situations. The alarm system must be appropriately constructed to maximize the possibility of safe and efficient operation. Nowadays, advanced industrial monitoring systems such as Supervisory Control and Data Acquisition (SCADA) and Centralized Monitoring System (CMS) are equipped with an enormous number of sensors, thanks to the rapid growth in sensing technologies. As an advantage, the number of alarm tags in a plant grows noticeably and makes it possible to monitor the whole industrial plant with more details. As a drawback, the number of alarms may confuse the operator to originate the faults. Chattering alarms are also another disruptive phenomenon in modern alarm systems. Poor alarm system rationalization is the primary source of the aforementioned issues. As a reason for poor alarm rationalization, the behavior of the faulty process variable is not taken into consideration in alarm system design, and again this will bring many meaningless alarms and no-alarms states to the operator. As an attempt to solve this problem, we tried to propose a model to reflect the behavior of an intermittent fault and utilize it to design alarm systems more specifically to the fault type. The Time-variant Finite Mixture Model is utilized to model the behavior of an Intermittent Fault (IF), which is a fault that alternates between faulty and non-faulty behavior at discrete random intervals. Time-variant finite mixture models could be a helpful tool for modelling complex data collections whose statistical properties change over time. A finite mixture model is a convex combination of two or more probability density (or mass) functions (PDF(PMF)). By combining the properties of the individual PDFs, mixture models are capable of approximating any arbitrary distribution. Our work's contribution is twofold. [For the rest of contents, please refer to the PDF.]

Keywords: Alarm System, Intermittent Faults, Finite Mixture Models, Non-Stationary Process, Averaged Alarm Delay (AAD), False Alarm Rate (FAR), Missed Alarm Rate (MAR)

Organized (C4): Robot Control Technology
14:00-15:30, Sep. 24, 2022, Meeting Room 5

C4-1 14:00-14:15

Identification of Autonomous Underwater Vehicles Model Based on Recursive Least Square with Bounded-Gain Forgetting

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Abstract: The hydrodynamic characteristics of autonomous underwater vehicle (AUV) are complex and vary with the working environment, so it is difficult to establish an accurate mathematical model. To solve this problem, an online estimation method of AUV dynamical model parameters is proposed in this paper, including the establishment of AUV dynamical model based on recursive least square; A bounded gain forgetting estimator is used fast tracking of parameter variation. The proposed algorithm and result are verified by simulation experimental data. The results show that this method has good convergence and adaptability. In particular, the identification results of turning force and torque parameters have high consistency in different identification experiments, indicating that the method can extract the maneuvering characteristics of AUV well, which is helpful to the controller design of AUV. The research in this paper has potential application value to the modeling and control of underwater robot.

Keywords: Autonomous Underwater Vehicle, Recursive Least Square, Bounded Gain Forgetting, Online Parameter Identification

C4-2 14:15-14:30

Collision Monitoring of Manipulators Based on Variational Mode Decomposition

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[1]Wuhan Second Ship Design and Research Institute, China, [2]School of Information Science and Technology, Jinan University, China

Abstract: Collision detection and identification is an important subject for industrial robot research, such as contact location, touching a person or metal, etc. In this paper, a model independent collision detection method is presented, based on the variational mode decomposition of vibration signals generated by collisions. Firstly, the vibration modal features of the manipulator related to collision shock, collision direction and contact position are analysed with dynamic models. Then, the non-stationary vibration symptoms of collisions are extracted with a variational mode decomposition algorithm. The vibration modal symptoms are utilised for the construction and training of the artificial neural network for the collision detection, locating and classification. Finally, the proposed method is validated with both a two-link planar robot. The experimental results show the validity of the collision detection and identification scheme, which can achieve considerable performance.

Keywords: Manipulator, Collision Detection, Variational Mode Decomposition, Neural Network

Organized (C4): Robot Control Technology
14:00-15:30, Sep. 24, 2022, Meeting Room 5

C4-3 14:30-14:45

Task-Driven Rule-Based Algorithm with Mode-Switching for UAV Swarms in Bounded Areas

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Abstract: The decision-making of UAV swarms under restricted environments is very important to exert the swarm effectiveness. On the basis of bio-inspired rule-based (Bio-RB) decision-making algorithms, this paper proposes a task-driven rule-based (Task-RB) decision-making algorithm. A mapping mechanism from behavioral rules to task modes and a probability-based mode-switching strategy are established for search and target attracting tasks. In order to improve the efficiency of performing tasks at regional boundaries, a boundary handling strategy based on the combination of path prediction and virtual agents is proposed. Taking search and target attracting tasks as examples, the Task-RB and Bio-RB algorithms are compared and tested. Simulation results demonstrate the effectiveness and adaptability of the proposed decision-making method to perform the above tasks in bounded areas.

Keywords: UAV Swarm, Adaptive Decision-Making, Task Mode Switching, Boundary Handling

C4-4 14:45-15:00

Embedded Design of Automatic Pesticide Spraying Robot Control System

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Abstract: In agriculture, crops need to apply pesticide spraying flow control precisely to reduce costs, protect the environment, and increase yield production. Although there have several variable control methods for spraying flow control because indirect control flow techniques and having a slow response could cause inaccuracy and mismanagement, also noted that those systems also suffer from complicated design and debugging, etc. In this paper, an embedded design of the fuzzy PID variable spraying control method is adopted. The experimental results show that the overshoot of Proportional–Integral–Derivative (PID) control is 10.76%, and the overshoot of fuzzy PID control is 7.17% which can meet the requirements of an advanced spray control flow system. For further investigation, a novel spray flow control method based on Programmable Logic Control (PLC) is proposed in this paper.

Keywords: Fuzzy PID, MATLAB, PLC, Control System Simulation

Organized (C4): Robot Control Technology
14:00-15:30, Sep. 24, 2022, Meeting Room 5

C4-5 15:00-15:15

Fault-Tolerant Control for Manipulator Under Actuator Fault with Output Constraint

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Abstract: This paper investigates motion control problems of robotic manipulators under the actuator fault. The uncertainty induced by actuator faults brings up great challenges to control method design. Besides, with the consideration of output constraint and disturbance simultaneously, a fault-tolerant control (FTC) scheme, oriented to solve motion control problems is proposed in this paper. The barrier Lyapunov function is employed to deal with output constraint, an extended state observer (ESO) is used to compensate the system perturbation such as parameter uncertainties and external disturbance, and a fault estimation observer (FEO) is designed to compensate the actuator fault. Theoretical results are shown to confirm the output constraints are not violated and all the desired signals in the system are uniformly bounded. The simulation results verify the effectiveness and robustness of the proposed control scheme.

Keywords: Fault-Tolerant Control (FTC), Barrier Lyapunov Function, Output Constraint, Robotic Manipulator

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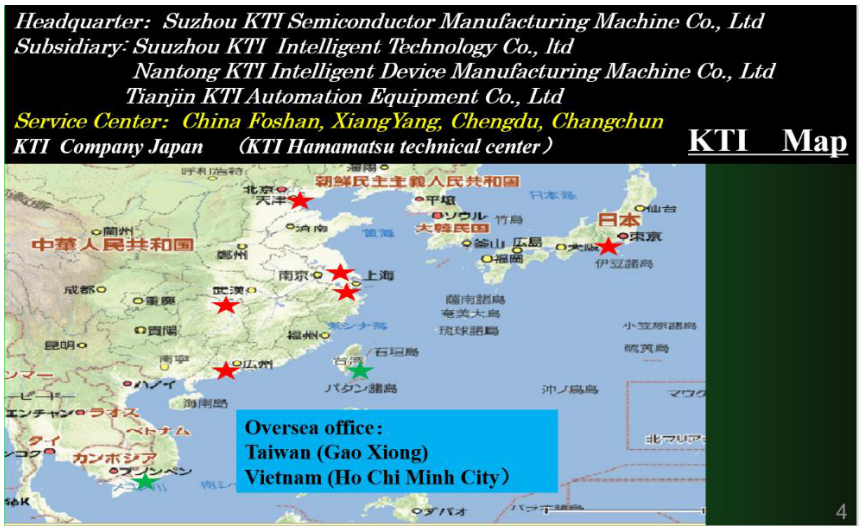
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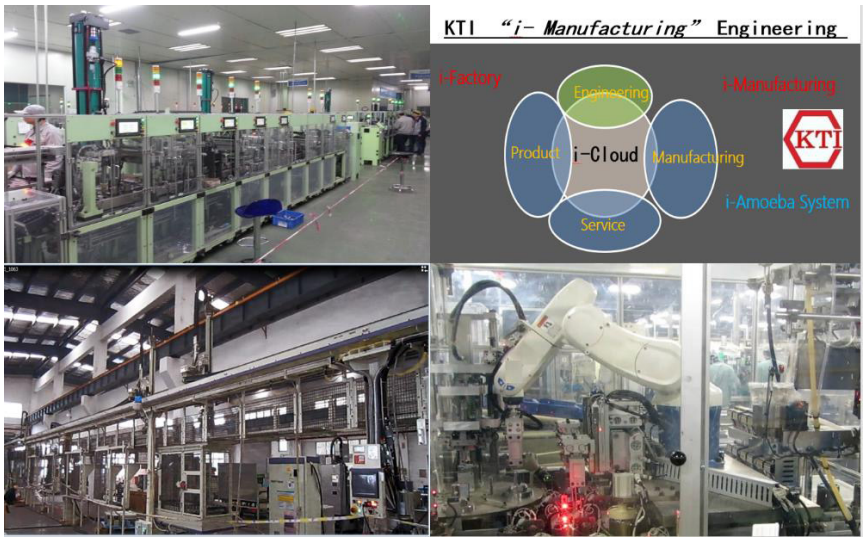
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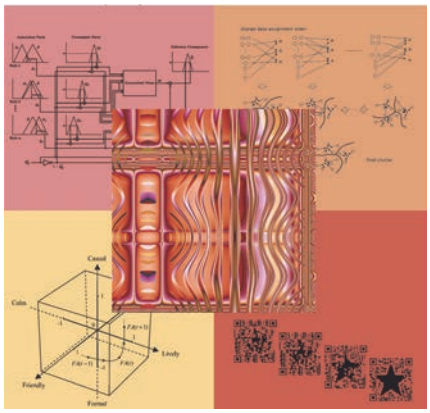
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