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DTR 2024

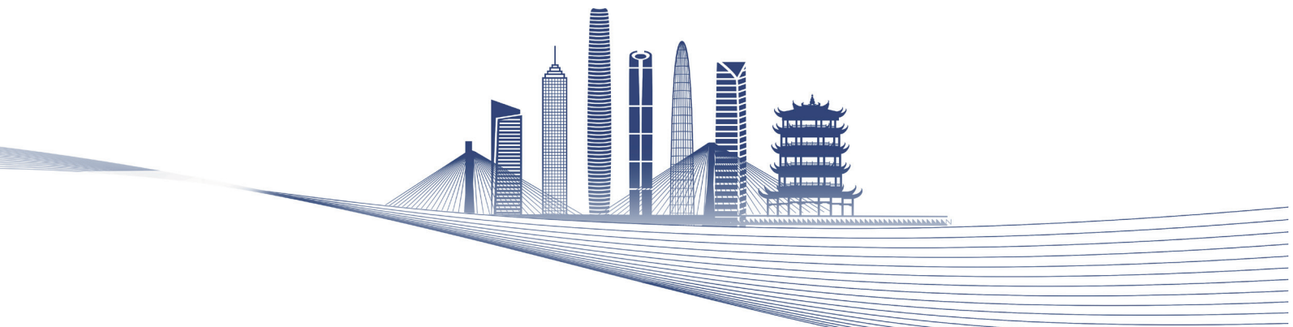
2024 IEEE International Conference on Digital Twins and Parallel Intelligence

Final Program

Wuhan · China
2024.10.18—2024.10.20

DTR 2024

2024 IEEE International Conference on
Digital Twins and Parallel Intelligence



Contents

Welcome Message

Welcome to the 4th IEEE International Conference on Digital Twins and Parallel Intelligence (IEEE DTPI 2024)!

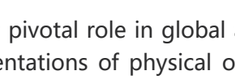
We are delighted to bring together academic and industrial experts worldwide to discuss advancements in Digital Twins and Parallel Intelligence, as well as broader topics, including industrial Internet, intelligent transportation, smart energy, robotics, intelligent manufacturing, smart healthcare, and spectrum management. DTPI 2024 also provides an opportunity to reconnect with colleagues and make new connections.

Digital Twin and Parallel Intelligence technologies have recently played a pivotal role in global advancements in intelligent systems. These technologies provide virtual representations of physical objects or processes, offering efficient, low-cost channels for real-time observation, computation, and prediction. Many critical challenges can be addressed through these virtual-reality interactions. We are pleased to host a series of sessions spotlighting cutting-edge research in these fields.

The conference will take place from October 18th to 20th, 2024, in Wuhan, China, in a "Hybrid Distributed Conference (HDC)" format, including several online sessions. DTPI 2024 is hosted by the IEEE Wuhan Section, IEEE Council on RFID, the Chinese Association of Automation, the Association of Global Intelligent Science and Technology, and the Beijing Huairou Academy of Parallel Sensing. We would like to express our sincere gratitude to the Technical Program Committee Chairs: Jun Jason Zhang of Wuhan University, Long Chen of Waytous Inc.; the Publication Chairs: Lingxi Li of Indiana University-Purdue University Indianapolis, David Wenzhong Gao of University of Denver; the Local Arrangement Chair: Peidong Xu of Wuhan University; and the Financial Chairs: Tianlu Gao of Wuhan University and IEEE Wuhan Section, Haibin Ma of Chinese Association of Automation. And we extend our thanks to all the members of these committees for their hard work and dedication.

We are also grateful to an outstanding group of opening address and keynote speakers who will share their insights on the DTPI topic: Welcome Speech by Professor Xuzhu Dong of Wuhan University; IEEE CRFID James C. Maxwell Leture by Professor David Cebon of University of Cambridge; Keynote Speeches by Professor Derong Liu of Southern University of Science and Technology; Professor Atton-Okine of the University of Maryland; and Professor Yisheng Lv of Chinese Academy of Sciences Institute of Automation. We hope you enjoy IEEE DTPI 2024!

Sincerely,



Fei-Yue Wang

Conference Organizations

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CRFID IEEE Council on RFID

AGIST Association of Global Intelligent Science and Technology

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Important Information

Time: 2024.10.18-2024.10.20

Venue: Offline meetings will be held locally at B1 Qiushi Hall (Lecture Hall), New Library of Wuhan University.

Address: B1 Qiushi Hall (Lecture Hall), New Library, Wuhan University, 299 Bayi Road, Wuchang District, Wuhan, Hubei, P.R. China
(Campus map of Wuhan University and the location labeling of the DTPI 2024 conference venue):

Contacting the Organizing Committee

- Ping Song
  +86 17765965606
  +853 68915606
- Xiaoxiao Yu
  xiaoxiao.yu@qaii.ac.cn

Transportation and Venue Location

Arriving in Wuhan:

1. Access by Wuhan Tianhe International Airport:

1.1 By taxi: it takes about 1 hour by taxi.

1.2 By subway: take Subway Line 2 from Airport Station,and get off at Jiedaokou Station, then walking to the venue. The total travel time is approximately 96 minutes.

2. Access by Wuhan Train Station:

2.1 By taxi: it takes about 30 minutes by taxi.

2.2 By subway: take Subway Line 2 from Train Station,change to and Subway Line 8 at Yuejiazui Station,then get off at Xiaohongshan Station, then walking to the venue. The total travel time is approximately 60 minutes.

Accommodation

	Hotel	Rank	Recommended Transportation	Access to Venue	Reference Price(RMB)
1	True Go Hotel	★★☆☆☆	by taxi	15 mins. by taxi	280-450
2	Hanting Hotel	★★☆☆☆	by taxi, by foot	12 mins. by taxi ; 30mins. by foot	300-350
3	Kamil Hotel(Wuhan Guanggu Plaza)	★★☆☆☆	by taxi	15 mins. by taxi	330-630
4	Sheraton Hampton(Zhongnan Jiedaokou)	★★★☆☆	by taxi	18 mins. by taxi	400-1000
5	Holiday Inn(Wuhan Guanggu)	★★★★☆	by taxi	23 mins. by taxi	420-650
6	Ji Hotel(Jiedaokou Subway Station)	★★★☆☆	by taxi, by foot	11 mins. by taxi ; 25 mins. by foot	450-550
7	Fairfield Hotel By Marriott	★★★☆☆	by taxi	13 mins. by taxi	470-1300
8	Atuor S Hotel(Chuhehanjie)	★★★☆☆	by taxi	15 mins. by taxi	600-920
9	Atuor Hotel(Jiedaokou Luojiashan)	★★★☆☆	by taxi, by foot	9 mins. by taxi ; 30 mins. by foot	640-1098
10	Wuhan Donghu Hotel	★★★★★	by taxi	17 mins. by taxi	3580-4900

Program at a Glance

Oct. 18th, 2024		
Time	**Schedule**	**Location**
13:30-18:00	Oral Session	Faculty of Engineering Teaching Building A
Oct. 19th, 2024		
08:00-09:20	Registration	Wuhan University Library
09:30-11:40	Opening Ceremony &Keynote Speeches	Wuhan University Library
12:00-13:30	Buffet	Wuhan Univerisity Luojia Shanzhuang Restaurant
13:00-16:30	Oral sessions	School of Electrical Engineering
13:30-16:30	Oral sessions	Faculty of Engineering Teaching Building A
14:30-18:00	Award Presentations	Wuhan University Library
18:30-20:00	Conference Banquet	Wuhan Univerisity Luojia Shanzhuang Restaurant
Oct. 20th, 2024		
09:30-11:10	Keynote Speeches	Wuhan University Library
11:00-11:30	Poster session	Wuhan University Library
12:00-13:30	Buffet	Wuhan Univerisity Luojia Shanzhuang Restaurant
13:30-16:30	Oral sessions	School of Electrical Engineering
13:30-18:00	Oral sessions	Faculty of Engineering Teaching Building A

Technical Program

Oct. 19th, 2024			
Time	**Schedule**	**Hornored Guests**	**Location**
08:00-9:20	Registration		Qiushi Hall (Lecture Hall) Wuhan University Library
09:30-09:35	Opening Ceremony		
09:35-9:45	Welcome Speech	Prof. Fei-Yue Wang, Institute of Automation, Chinese Academy of Sciences	
09:45-09:50	Welcome Speech	Prof. Xuzhu Dong, Wuhan University	
09:50-09:55	Welcome Speech	Prof. Jun Zhang, Wuhan University	
9:55-10:00	Welcome Speech	Prof. Long Chen, Waytous Inc.	
10:00-10:40	IEEE CRFID James C. Maxwell Lecture	Prof. David Cebon, University of Cambridge	
10:40-10:50	Q&A Session		
10:50-11:30	Theory and Applications of Parallel Control	Prof. Derong Liu, Southern University of Science and Technology	
11:30-11:40	Q&A Session		
12:00-13:30	Buffet		Wuhan Univerisity Luojia Shanzhuang Restaurant

Technical Program

Oct. 19th, 2024			
Time	**Schedule**	**Hornored Guests**	**Location**
14:30-15:00	Best Paper Award Presentation: User Linguistic Style Awareness and Interest-Driven Conversational Recommender Systems		Qiushi Hall (Lecture Hall) Wuhan University Library
15:00-15:30	Outstanding Award Presentation: Virtual Image Generation: Bridging Reality and Virtuality for Long-Tail Traffic Scenes		
15:30-15:40	Coffee Break		
15:40-16:10	Best Student Paper Award Preesntation: Explainable Multi-task Learning for Improved Land Use Classification in Planetary Health Monitoring		
16:10-16:40	Outstanding Student Paper Award Preesntation: A Two-Stage Genetic Algorithm based Task Allocation Approach for Dependency-aware Spatial Crowdsourcing		
16:40-17:10	Best Application Award Presentation 1: HIPFL: A Hierarchical Incentive-Based Personalized Federated Learning		
17:10-17:40	Best Application Award Presentation 2: Source-Load Co-Optimization Scheduling of Power Systems Considering Extreme Scenarios		
17:40-18:00	Free Discussion		
18:30-20:00	Buffet		Wuhan Univerisity Luojia Shanzhuang Restaurant

Oct. 20th, 2024			
Time	**Schedule**	**Hornored Guests**	**Location**
9:30-10:10	Graphical Probabilistic Models Key to Digital Twins Analysis and Implementation	Prof. Attoh-Okine, The University of Maryland	Qiushi Hall (Lecture Hall) Wuhan University Library
10:10-10:20	Q&A Session		
10:20-11:00	Big Data and AI for Parallel Transportation Systems	Prof .Yisheng Lv, Institute of Automation, Chinese Academy of Sciences	
11:00-11:10	Q&A Session		
11:10-11:20	Coffee Break		
11:20-11:30	Poster Presentation and Free Discussion		

Welcome Sessions

Welcome Speech 1

Oct. 19th 9:35-9:45

Fei-Yue Wang, Institute of Automation, Chinese Academy of Sciences

Fei-Yue Wang (S'87–M'89–SM'94–F'03) received his Ph.D. degree in computer and systems engineering from the Rensselaer Polytechnic Institute, Troy, NY, USA, in 1990. He joined The University of Arizona in 1990 and became a Professor and the Director of the Robotics and Automation Laboratory and the Program in Advanced Research for Complex Systems. In 1999, he founded the Intelligent Control and Systems Engineering Center at the Institute of Automation, Chinese Academy of Sciences (CAS), Beijing, China, under the support of the Outstanding Chinese Talents Program from the State Planning Council, and in 2002, was appointed as the Director of the Key Laboratory of Complex Systems and Intelligence Science, CAS, and Vice President of Institute of Automation, CAS in 2006. In 2011, he became the State Specially Appointed Expert and the Founding Director of the State Key Laboratory for Management and Control of Complex Systems. Dr. Wang has been the Chief Judge of Intelligent Vehicles Future Challenge (IVFC) since 2009 and Director of China Intelligent Vehicles Proving Center (IVPC) at Changshu since 2015. Currently, he is the Director of Intel's International Collaborative Research Institute on Parallel Driving with CAS and Tsinghua University.

His current research focuses on methods and applications for parallel intelligence, social computing, and knowledge automation. He is a Fellow of INCOSE, IFAC, ASME, and AAAS. In 2007, he received the National Prize in Natural Sciences of China, numerous best papers awards from IEEE Transactions, and became an Outstanding Scientist of ACM for his work in intelligent control and social computing. He received the IEEE ITS Outstanding Application and Research Awards in 2009, 2011, and 2015, respectively, the IEEE SMC Norbert Wiener Award in 2014, and became the IFAC Pavel J. Nowacki Distinguished Lecturer in 2024.

Since 1997, he has been serving as the General or Program Chair of over 30 IEEE, INFORMS, IFAC, ACM, and ASME conferences. He was the President of the IEEE ITS Society from 2005 to 2007, the IEEE Council of RFID from 2019 to 2024, the Chinese Association for Science and Technology, USA, in 2005, the American Zhu Kezhen Education Foundation from 2007 to 2008, the Vice President of the ACM China Council from 2010 to 2011, the Vice President and the Secretary General of the Chinese Association of Automation from 2008-2018. He was the Founding Editor-in-Chief (EiC) of the International Journal of Intelligent Control and Systems from 1995 to 2000, IEEE ITS Magazine from 2006 to 2007, IEEE/CAA JOURNAL OF AUTOMATICA SINICA from 2014-2017, China's Journal of Command and Control from 2015-2024, and China's Journal of Intelligent Science and Technology from 2019 to 2024. He was the EiC of the IEEE Intelligent Systems from 2009 to 2012, IEEE TRANSACTIONS on Intelligent Transportation Systems from 2009 to 2016, IEEE TRANSACTIONS ON COMPUTATIONAL Social Systems from 2017 to 2020. Currently, he is the President of CAA's Supervision Council and Vice President of IEEE Systems, Man, and Cybernetics Society.

Welcome Sessions

Welcome Speech 2

Oct. 19th 9:45-9:50

Xuzhu Dong, Wuhan University

BioSketch of Xuzhu Dong
Xuzhu Dong was born in Jailing, Shanxi, China, in 1970. He received the Ph.D. degree from the Virginia Tech University, VA, USA, and Tsinghua University, Beijing, China, of Electrical Engineering in 2002.,He is currently a Professor with Wuhan University, Wuhan, China, where his major research interest focuses on high-voltage insulation and calculation of high voltage.

Welcome Speech 3

Oct. 19th 9:50-9:55

Jun Jason Zhang, Wuhan University

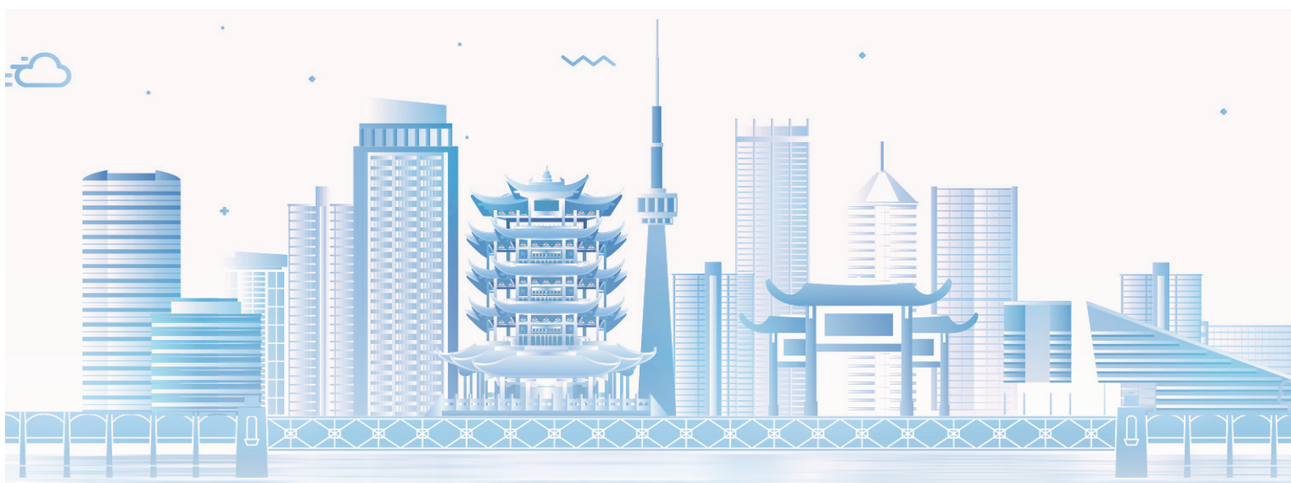
Prof. Jun Jason Zhang received his B.E. and M.E. degrees in Electrical Engineering from Huazhong University of Science and Technology, Wuhan, China, in 2003 and 2005, respectively, and his Ph.D. in Electrical Engineering from Arizona State University, U.S.A., in 2008. From 2011, he was an Assistant Professor and then tenured Associate Professor in Electrical and Computer Engineering at the University of Denver. Currently, he is a Professor at the School of Electrical Engineering and Automation, Wuhan University. He authored/co-authored over 200 peer-reviewed publications. He is Associate Editor of IEEE Transactions on Computational Social Systems, Associate Editor of Acta Automatica Sinica, and Associate Editor of IEEE/CAA Journal of Automatica Sinica. His research expertise is in the areas of signal processing, big data, artificial intelligence, Blockchain, and their applications in complex and intelligent systems. He has been Deputy Secretary of the Chinese Association of Automation (CAA) on International Relations and Collaborations since 2018. He was Vice President of IEEE Council on Radio-Frequency Identification (CRFID) on Technical Activities from 2020 to 2021, and he currently is CRFID's Associate VP on Finance.

Welcome Speech 4

Oct. 19th 9:55-10:00

Long Chen, Waytous Inc.

Long Chen received the Ph.D. degree from Wuhan University, Wuhan, China, in 2013. He is currently a Professor with the State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China. He is the cofound of Waytous and rector of QAII. Prof. Chen has contributed more than 100 publications in his research interests. His research interests include parallel intelligence, autonomous driving, robotics, and artificial intelligence. He was an Associate Editor for the IEEE Transaction on Intelligent Transportation Systems, IEEE/CAA Journal of Automatica Sinica, IEEE Transaction on Intelligent Vehicle and IEEE Technical Committee on Cyber-Physical Systems.



Plenary Sessions

IEEE CRFID James C. Maxwell Presentation

Oct. 19th 10:00-10:40

David Cebon, University of Cambridge

David Cebon received the B.E. degree in mechanical engineering from the University of Melbourne, Parkville, VIC, Australia, in 1980, and the Ph.D. degree in engineering from the University of Cambridge, Cambridge, U.K., in 1985. Since 1985, he has been with the Department of Engineering, University of Cambridge, where he is currently a Professor of mechanical engineering. He is a fellow of the Royal Academy of Engineering. He is also the Director of the Centre for Sustainable Road Freight and the Cambridge Vehicle Dynamics Consortium. He also leads the research theme energy, transport, and urban infrastructure with the Department of Engineering, University of Cambridge. His research interests include mechanical, civil, materials, and energy aspects of road transport engineering.

Presentation title: Improving heavy goods vehicle safety, productivity and sustainability

Presentation abstract: Heavy goods vehicles are essential to modern urbanized society: transporting food and everything needed to support city life; removing waste and providing all goods and materials needed for industry to function. However, heavy goods vehicles have complex dynamics. They can have multiple coupled vehicle units with high centres of mass and nonlinear suspensions. They generate large motions, high dynamic tire forces and damaging interactions with roads and bridges. They have a multitude of safety challenges, including roll-over, jack-knife, poor emergency stopping performance due to their pneumatic brakes, poor maneuverability and challenging interactions with vulnerable road users. Their carbon emissions are high and difficult to abate and their non exhaust emissions due to tire and brake wear have detrimental impacts on human health and the environment. This presentation will discuss four decades of research into the dynamics of heavy goods vehicles: aimed at improving their safety, productivity and environmental impact.

Keynote Speech 1

Oct.19th 10:50-11:30

Prof. Derong Liu, Southern University of Science and Technology

Derong Liu received the PhD degree in electrical engineering from the University of Notre Dame, USA, in 1994. He became a Full Professor of Electrical and Computer Engineering and of Computer Science at the University of Illinois Chicago in 2006. He was selected for the "100 Talents Program" by the Chinese Academy of Sciences in 2008, and he served as the Associate Director of The State Key Laboratory of Management and Control for Complex Systems at the Institute of Automation, from 2010 to 2016. He is currently a chair professor at Southern University of Science and Technology, Shenzhen, China. He has published 13 books. He received the International Neural Network Society's Dennis Gabor Award in 2018 and the IEEE CIS Neural Network Pioneer Award in 2022. He has been named a highly cited researcher by Clarivate since 2017. He was the Editor-in-Chief of the IEEE Transactions on Neural Networks and Learning Systems from 2010 to 2015. He is the Editor-in-Chief of Artificial Intelligence Review (Springer). He is a Fellow of the IEEE, a Fellow of the International Neural Network Society, a Fellow of the International Association of Pattern Recognition, and a Member of Academia Europaea (The Academy of Europe).

Presentation title: Theory and Applications of Parallel Control

Presentation abstract: As modern industrial and manufacturing systems get more and more complex, it becomes difficult to model and analyze them. On one hand, existing methods are not efficient enough in handling complexity at such a scale. On the other hand, vast amount of data are being produced everyday by industrial processes. It is desireable to have methods that can handle complex systems and the vast amount of data. In this lecture, a new mechanism will be introduced for intelligent control of real-world large scale and complex problems using the concept of parallel control and management based on the ACP approach. Neural networks, fuzzy logic and other methods in computat.

Plenary Sessions

Keynote Speech 2

Oct.20th 9:30-10:10

Attoh-Okine, The University of Maryland

Dr. Nii O. Attoh-Okine, Ph.D., P.E., F. ASCE, Snr. Member IEEE, Professor and **Chair of Civil and Environmental Engineering, University of Maryland,** College Park, Maryland. He also served as the Interim Academic Director of the University of Delaware Cybersecurity Initiative. He has authored two books that define the direction of research across disciplines: a) Resilience Engineering: Models and Analysis [Cambridge Press 2016] and b) Big Data and Differential Privacy in Railway Track Engineering [John Wiley 2017]. He was an early pioneer of machine learning and artificial engineering in railway engineering. Dr. Attoh-Okine has supervised several Ph.D. researchers in the area of ML/AI in Railway Engineering. Also, a leader in cyber application in Railway Operations and Engineering. He is a founding associate editor for the ASCE/ASME Journal of Risk and Uncertainty Analysis. He has served as an Associate Editor on ASCE Journals: a) ASCE Journal of Infrastructure Systems; b) ASCE Journal of Computing; c) ASCE Journal of Bridge Engineering; d) ASCE Journal of Pipeline Systems Engineering and Practice. Attoh-Okine is also the Director of the Digital and Cyber Center in Railway Engineering and Operations.

Presentation title: Graphical Probability Models Key to Digital Twins Analysis and Implementation

Presentation abstract: Probabilistic graphical models are critical in the digital twin formulation, analysis, and implementation. Within the context of critical infrastructure systems, the digital twins represent the flow of information among connected platforms. The digital twin can run "what-if" scenarios, predict and prevent failures, provide early alerts of anomalies, and conduct predictive analysis. The strength of a digital twin is the interconnectivity of data and models. With all the current research in critical infrastructure systems, a central missing element is the appropriate selection and use of graphical models, which govern the information and data exchange between the physical and the virtual model. The graphical model encodes the two connections between the physical and the virtual. Various probabilistic graphical models, including Bayesian networks, Belief Function Networks, Valuation Networks, and Influence Diagram Networks, will be examined. The merit of these networks within the digital twin application will be presented.

Keynote Speech 3

Oct.20th 10:20-11:10

Yisheng Lv, Institute of Automation, Chinese Academy of Sciences

Yisheng Lv is a professor at the State Key Laboratory for Management and Control of Complex Systems, Institute of Automation, Chinese Academy of Sciences, Beijing, China. He is also with the University of the Chinese Academy of Sciences, Beijing. His research interests include artificial intelligence for transportation, intelligent vehicles, and parallel traffic management and control systems.

Presentation title: Big Data and AI for Parallel Transportation Systems

Presentation abstract: This talk starts by deconstructing complex urban traffic systems through the lens of Cyber-Physical Social Systems (CPSS), revisiting key challenges in intelligent traffic management and control. Then, it delivers some of our recent research of data-driven and AI for parallel transortaiton systems. Finally, this talk provides a perspective on large transportation models for traffic mangement and control.

Award Presentations

Oct. 19th, 2024 **14:30-15:00**

Best Paper Award Presentation: User Linguistic Style Awareness and Interest-Driven Conversational Recommender Systems

Authors: Hongkai Du,Haozhou Li,Qinke Peng,Laiyi Fu

Affiliation: Xi'an Jiaotong University

Abstract: Generation-based conversational recommender systems (CRSs) are tailored to individual user needs, employing cutting-edge text generation techniques for generating contextually relevant and fluent responses. Nevertheless, current CRSs, including advanced general language models like ChatGPT, often overlook the subtle differences in users' linguistic styles and the evolving nature of their interests, which leads to a tendency for uniform responses at the onset of dialogues and unnecessarily prolonged interaction cycles. To overcome these challenges, our approach leverages user historical data and information from similar user profiles to more accurately capture the user linguistic feature within dialogue subtasks. We introduce an innovative multi-factor cross-attention mechanism, specifically designed for the efficient integration of diverse quantitative relationships. In the recommendation subtask, our strategy involves the intuitive representation of user interest migration trajectories and the stereotype. This not only allows for a more granular understanding of the trajectory of user interests but also alleviates data sparsity for new users. Our proposed framework, User Linguistic Style Awareness and Interest-Driven CRSs (LSAID), has undergone extensive testing on well-established CRS datasets such as ReDial and INSPIRED. The empirical results underscore LSAID' s effectiveness, showcasing its state-of-the-art performance. Our code will be released at http://github.com/zhizhaixingchen/LSAID.

Oct. 19th, 2024 **15:00-15:30**

Outstanding Award Presentation: Virtual Image Generation: Bridging Reality and Virtuality for Long-Tail Traffic Scenes

Authors: Feibing Xu,Hui Zhang,Xiaohua Suo,Yidong Li

Affiliation: Beijing Jiaotong University, College of Computer Science and Technology

Abstract: Although visual perception algorithms have made significant progress in most normal scenes, it is still challenging for autonomous driving systems to accurately perceive long-tail scenes that occur less frequently, which can lead to serious traffic safety issues. However, existing open-source datasets do not systematically collect sufficient long-tail scenes. To fill this gap, we propose a pipeline for designing large-scale, diverse long-tail traffic scenes and generating virtual datasets based on the parallel vision approach. A virtual dataset named Vir-LTTS (virtual long-tail traffic scenes) is built, comprising various scenes such as extreme weather conditions, adverse lighting conditions, traffic accidents, unique forms of traffic objects, and blurry images caused by camera defects. We investigate the potential of training models using the Vir-LTTS dataset in long-tail traffic scenes. Experimental results show that pre-training with Vir-LTTS significantly improves the performance of visual models in long-tail traffic scenes.

Award Presentations

Oct. 19th, 2024 **15:40-16:10**

Best Student Paper Award Preesntation: Explainable Multi-task Learning for Improved Land Use Classification in Planetary Health Monitoring

Authors: Rafal Krzysiak,Andrew Amavizca,YangQuan Chen

Affiliation: University of California Merced

Abstract: This paper introduces an innovative approach towards the development of a better understanding of planetary health monitoring techniques. Utilizing hyperspectral satellite imagery from the EuroSAT dataset, we focus on improving land use classification via multi-task learning with indice mapping, particularly emphasizing the Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), and Normalized Difference Water Index (NDWI) indices. Our approach employs explainable multi-task learning, integrating AI techniques such as GradCAM, SmoothGrad and saliency mapping to enhance model interpretability and provide valuable insights into the model’ s environmental perception. Our model achieves a high classification accuracy of 90%, demonstrating low inaccuracy in indice prediction and mapping, thereby ensuring precise assessment of land use. The incorporation of XAI techniques aids in providing a deeper understanding of the model’ s decision-making process, highlighting influential regions and features which provide valuable insight into the predictions. These results underscore the effectiveness of our approach in accurately classifying land use and assessing vegetation health and water content, contributing to improved environmental management and decision-making. This work promotes sustainable practices and advances in the field of planetary health monitoring through the use of explainable and reliable AI-driven methods.

Oct. 19th, 2024 **16:10-16:40**

Outstanding Student Paper Award Preesntation: A Two-Stage Genetic Algorithm based Task Allocation Approach for Dependency-aware Spatial Crowdsourcing

Authors: Yunkai Dai,Yong Zhao,Bin Chen,Wei Duan

Affiliation: National University of Defense Technology

Abstract: The widespread use of smart devices and efficient wireless network transmission has fostered the development of crowdsourcing systems, providing vast data for the advancement of digital twins and parallel intelligence. This paper proposes a two-stage genetic algorithm to optimize the allocation of complex tasks in spatial crowdsourcing systems by dividing tasks into subtasks with dependency relationships and employing iterative optimization stages. Experimental results validate the effectiveness of the proposed algorithms.

Award Presentations

Oct. 19th, 2024 **16:40-17:10**

Best Application Award Presentation 1: HIPFL: A Hierarchical Incentive-Based Personalized Federated Learning

Authors: Yuru Liu,Zhicheng Bao,Weishan Zhang,Shentao Yao,Hongwei Zhao,Zhen Zhang,Yifan Miao

Affiliation: China University of Petroleum East China

Abstract: Federated learning is a distributed collaborative training approach that aims to balance model performance and privacy. In this distributed environment, clients with high-quality data can be incentivized to participate more in the training, thus improving the performance of federated learning. But if this process performs in a Non-IID environment, the value of the model is an important metric to determine the level of client participation. Therefore, an effective evaluation mechanism is needed. However, when each client evaluates values, there will be a risk of privacy leakage which will prevent the client from actively participating in the session. To solve these challenges, in this paper, we propose hierarchical incentive-based personalized federated learning (HIPFL) based on privacy model value evaluation and reverse weight updating. This method aims to achieve secure, fair and personalized federated incentivization. Through extensive experiments on three Non-IID datasets, the HIPFL improves the average accuracy by 8.54% compared to existing four federated learning incentivization methods and effectively resists attacks from malicious nodes. Compared with existing models that use encryption for value evaluation, the HIPFL has an average accuracy improvement of 13.53%.

Oct. 19th, 2024 **17:10-17:40**

Best Application Award Presentation 2: Source-Load Co-Optimization Scheduling of Power Systems Considering Extreme Scenarios

Authors: Chen Min

Affiliation: South China University of Technology

Abstract: With the increasing penetration of wind power in the power system, the randomness and variability of wind power bring about power balancing difficulties, which makes the stable operation of the power system and the realization of efficient wind energy consumption a major challenge. Flexible resources are introduced to participate in scheduling to increase wind power consumption through the cooperative optimization and effective integration of different resources, and a battery storage adjustable model considering battery life loss and an electrolytic aluminum load adjustable model are established. In order to reduce the impact of wind power uncertainty, a source-load co- optimization scheduling model considering Extreme Scenarios is proposed. The risk cost and comprehensive cost of wind power under a given confidence level are defined. In order to minimize the comprehensive cost, an optimization method for extreme scenarios is proposed to achieve the comprehensive optimization of the model in terms of robustness and economy. The simulation results prove that the proposed model has obvious cost advantages over the traditional scheduling model, and is effective in smoothing the peak-valley difference and improving the wind power consumption.

Schedule of Sessions

Time	Session Name	Chairs	Location
Oct. 18th			
13:30-18:00	DTPI in Power Generation and Energy Systems	Feng Yin, Peng Hou, Wei Zhang, Zhejiang Baima Lake Laboratory Co., Ltd. Lin Gao, Lin Wang, Xi'an Thermal Power Research Institute Co., Ltd. Xiaojie Lin, Zhejiang University	Faculty of Engineering Teaching BuildingA 2nd Floor A111
Oct. 19th			
13:00-14:30	Blockchain and Knowledge Automation	Rui Qin, Institute of Automation, Chinese Academy of Sciences Yong Yan, State Grid Zhejiang Electric Power Co., Ltd. Research Institute	School of Electrical Engineering Meeting Room 2
13:30-17:00	Smart Ecology	Yuntao Ma, China Agricultural University Mengzhen Kang, Institute of Automation, Chinese Academy of Sciences	Faculty of Engineering Teaching BuildingA 2nd Floor A110
13:30-15:00	Communications Techniques based on Parallel Intelligence	Shuangshuang Han, University of Science and Technology Beijing Jun Hou, Chang' an University	Faculty of Engineering Teaching Building A 2nd Floor A111
	Blockchain Intelligence	Peng Zhu, Nanjing University of Science and Technology Juanjuan Li, Institute of Automation, Chinese Academy of Sciences	School of Electrical Engineering Meeting Room 3
15:00-16:30	Multi-modal Collaborative Perception and Cognitive Computing	Hui Zhang, Beijing Jiaotong University Yan Wang, The HongKong Polytechnic University	School of Electrical Engineering Meeting Room 2 VOOV Meeting Number (腾讯会议)：998-651-007
	Vehicular Communications in Parallel Networks	Shuangshuang Han, University of Science and Technology Beijing Jun Hou, Chang'an University	Faculty of Engineering Teaching BuildingA 2nd Floor A111

Time	Session Name	Chairs	Location
Oct. 20th			
13:30-15:00	Smart Manufacturing and Services in DTPI	Lefei Li, Tsinghua University	Faculty of Engineering Teaching Building A 2nd Floor A114 VOOV Meeting Numberr (腾讯会议)：231-103-073
	Artificial Transportation Systems and Simulations	Fenghua Zhu, Institute of Automation, Chinese Academy of Sciences Chunlin Shang, Ludong University	School of Electrical Engineering Meeting Room 4
	Parallel Human Resource Management in CPSS	Tao Wang ,National University of Defense Technology	Faculty of Engineering Teaching Building A 2nd Floor A111
13:30-15:00	Parallel Transportation Systems	Yonglin Tian, Institute of Automation, Chinese Academy of Sciences	VOOV Meeting Numberr (腾讯会议)：670-562-994
15:00-16:30	Embodied Intelligence and Parallel Vehicles	Tianyu Shen, Beijing University of Chemical Technology Jinlin Sun, Jiangsu University	School of Electrical Engineering Meeting Room 2 VOOV Meeting Numberr (腾讯会议)：174-880-844
	Advanced Technologies in Smart Energy Systems	Peidong Xu, Wuhan University Yuxin Dai, Wuhan University	Faculty of Engineering Teaching Building A 2nd Floor A115
	New Power Systems and Hierarchical Clusters	Xiaodong Zheng South China University of Technology	Faculty of Engineering Teaching Building A 2nd Floor A111
16:30-18:00	The Application of Frontier Technologies in the Operation of Energy Industrial Systems	Huajian Fang, China Nuclear Power Operation Technology Corporation, Ltd Shiqi Liu, China Southern Power Grid Co., Ltd Yin Yao, Shanghai University of Electric Power	Faculty of Engineering Teaching Building A 2nd Floor A115
	Smart Grid Control and Optimization	Jinghua Zhou, North China University of Technology	Faculty of Engineering Teaching Building A 2nd Floor A111
	Foreigner Session-Theory and Development of DTPI	Xiaolong Liang, Institute of Automation, Chinese Academy of Sciences	ONLINE

Schedule of Sessions

DTPI 2024 Oct. 18th Session Schedule

Session Name	DTPI in Power Generation & Energy Systems
Date and Time	Oct. 18, 2024, 13:30-18:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A, 2nd Floor, A111

Chairs

Lin Gao
Xi' an Thermal Power Research Institute Co., Ltd.

Lin Wang
Xi' an Thermal Power Research Institute Co., Ltd.

Session Presenters

Transfer learning-based multi-fidelity modeling method for multimode process monitoring

Baoyu Zhu, Southeast University

Presentation Abstract: Data-driven modeling techniques have been widely applied in industrial systems for process monitoring. However, these models heavily rely on data accuracy and completeness. Challenges emerge when the mode characteristics of the system alter due to equipment deterioration (such as heat exchanger fouling, component wear, catalyst deactivation) or after maintenance activities (like cleaning, repair, replacement, etc.). Data collected from the old mode (before the mode change) no longer accurately reflects the characteristics of the new mode (after the mode change). This presents a significant challenge for multimode process modeling, as the new mode model cannot directly utilize old mode data when there is insufficient training data for the new mode. To address this issue, we propose a novel transfer learning-based multi-fidelity modeling (TL-MFM) method. The key innovation of this method lies in its fusion of limited high-fidelity data from the new mode with sufficient low-fidelity data from the old mode to construct a robust monitoring model. By leveraging a model transfer framework that optimizes the transfer of relevant information across fidelity levels, the TL-MFM method enhances the adaptability of the monitoring model. The effectiveness of the TL-MFM method is validated through a case study on a real-world condenser in a steam turbine generator set.

A Hybrid Modeling Approach Integrating First-principles with Data for Nonlinear Process Monitoring

Yijia Zhang, Southeast University

Presentation Abstract: Fault monitoring plays a crucial role in modern industrial systems. Timely and accurate monitoring is essential to mitigate economic losses and protect life safety. Traditional data-driven methods, such as auto-encoder (AE) and variational auto-encoder (VAE), are widely utilized in nonlinear process monitoring due to their simplicity and efficiency. However, the interpretability and generalization capabilities of data-driven models are constrained by the absence of physical knowledge. To address this limitation, we have developed a physics-informed variational auto-encoder (PI-VAE) method in this study. This method incorporates physical mechanism information into the model's loss function through equality constraints. The results obtained from applying the PI-VAE method to a 1000MW ultra-supercritical coal-fired power plant demonstrate its exceptional capability in fault monitoring. By integrating reliable physical data with the VAE model, the model ensures enhanced stability and improved generalization.

Simulation Modeling Analysis of Light Oil Treatment Station Based on Aspen Plus

Shimeng Lu, Zhejiang University

Presentation Abstract: In the context of carbon neutrality, oilfield enterprises have the difficult task of increasing the rate at which clean energy is utilized, enhancing electrification, decreasing the unit consumption of production energy, and lowering the carbon emission intensity. This paper examines a simulation model for the low-carbon transformation of a light oil treatment station. Firstly, the process and energy-consuming equipment of the light oil treatment station are examined. Next, a simulation model of the light oil treatment station is constructed using Aspen Plus. Relevant calculations are made for the power and heat consumption. Finally, some suggestions for the multi-energy complementary system of the light oil treatment station are proposed. This model can serve as a guide for oilfield companies looking to reduce their energy consumption and carbon emission levels.

Schedule of Sessions

Chairs

Feng Yin
Zhejiang Baima Lake Laboratory Co. Ltd.

Wei Zhang
Zhejiang Baima Lake Laboratory Co. Ltd.

Session Presenters

A Tensor Train based Multi-channel Fault Signal De-noising Method for Wind Turbine Generators

Keren Li, Beijing Institute of Technology

Presentation Abstract: With the continuous development of sensors and information collection related technologies, there are more and more types of data, and the amount of data of the same type is getting larger and larger. For mechanical components such as fan rotating gears, the use of a single sensor for fault diagnosis has limitations, and it is impossible to fully and simultaneously perform auxiliary fault diagnosis on gears, bearings and other components on each shaft. However, the use of multi-channel sensors can solve this problem well, but in actual engineering applications, there is noise interference when multi-channel sensors perform joint fault diagnosis, and it is impossible to accurately extract the fault characteristics of rotating machinery. This paper proposes a feature extraction method based on tensor train fused signal (TTFS) as a means of addressing noise interference in rotating machinery signals within wind farms. Initially, our focus is on data collection, during which we analyse data in tensor format across three dimensions: time, frequency, and channel. In order to emphasise the use of tensor train decomposition, we introduce a tensor reconstruction method with adaptive filter truncation. Subsequently, the continuous wavelet transform (CWT) method is employed to establish tensor data representation across these dimensions. Subsequently, the proposed adaptive filtering truncation tensor reconstruction method is employed to reconstruct the tensor by combining the aforementioned matrices. Finally, the continuous wavelet inverse transform is applied to the reconstructed tensor in order to obtain time-domain signals from different channels. The efficacy of the proposed method is demonstrated through experimental signals, which illustrate the advantages of the method and the improved convergence speed of the objective function.

Rolling Bearing Fault Classification based on CEEMDAN-Transforme

Jing Liang, Zhejiang University of Technology

Presentation Abstract: Rolling bearings are critical components in rotating mechanical equipment. They are usually prone to frequent faults due to prolonged operation at high speeds under complex and variable working conditions. This paper proposes a fault classification method to enhance the system's safety and reliability. Firstly, Complete Ensemble Empirical Mode Decomposition with Adaptive Noise (CEEMDAN) method is utilized to extract vibration features from signals, effectively eliminating the interference of white noise during signal analysis. Subsequently, the extracted features are input into a Transformer model for fault classification, while an internal multi-head attention mechanism of the Transformer model is leveraged to capture both global dependencies and local patterns within input sequences for further optimizing feature extraction and representation. Finally, experimental results demonstrate that the proposed fault classification method achieves a higher accuracy.

A Data-driven Digital Model for Remaining Useful Life Prediction of Aero-engines

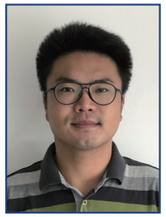
Jiayue Lou, Zhejiang University

Presentation Abstract: In this work, a data-driven framework based on digital model is proposed to predict the remaining useful life (RUL) of aero-engines. An encoder-decoder structure is applied to generate a hidden representation of the degradation status of aero-engines. The digital model achieves high similarity between real sensor data and the virtual sensor data generated by the digital model.

Schedule of Sessions

Chairs

Xiaojie Lin
Zhejiang University



Peng Hou
Zhejiang Baima Lake Laboratory Co. Ltd.

Session Presenters

Investigation of Carbon Emission Flow Modeling Methods for Integrated Electricity and Heat System

Meng Yuan, Zhejiang University

Presentation Abstract: In the context of global carbon peaking and carbon neutrality, the low-carbon development of integrated energy systems is critically important. Carbon emission flow (CEF) model can track and identify the flow paths and transformation processes of carbon emissions within energy systems, serving as an efficient tool for carbon evaluation. However, the application of CEF modeling methods in integrated electricity and heat systems remains underdeveloped, particularly lacking computational paradigms for district heating networks with multiple loops and multiple heat sources. This study investigates energy flow based CEF modeling theory and conducts a case analysis, focusing on an integrated energy system composed of a 6-node power network and an 8-node district heating network coupled together. Based on the CEF calculation results, the node with the highest carbon emissions in the power system is Load 2 (79.9 tCO2/h), while the node with the lowest carbon emission intensity is Load 3 (0.447 tCO2/MWh). In the heating system, carbon emissions due to network losses account for 19.3% of the total emissions. There are five different carbon emission intensities across all nodes, and carbon emission intensities of supply and return water nodes are not necessarily equal. The node with the highest carbon emissions is Load 1 (7.87 tCO2/h), while the node with the lowest carbon emission intensity is Load 3 (0.358 tCO2/MWh). Based on the CEF model, guiding recommendations can be provided for low-carbon transformation and allocation of carbon emission responsibilities within the energy system.

Electric and Heat Load Forecasting of Integrated Energy System

Zhiqiang Guo, North China Electric Power University

Presentation Abstract: Accurate load forecasting is essential for optimizing the operation and energy management of integrated energy system (IES). This study proposes a novel approach that combines digital twin (DT) with Transformer for accurate multiple loads forecasting of IES. The proposed model demonstrates high accuracy and can closely track the changes in actual load values.

A Two-layer Optimal Planning Method for Integrated Energy Systems based on Reinforcement Learning

Kaiyuan Chen, Zhejiang University

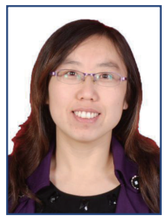
Presentation Abstract: With the continuous development of new energy technologies, regional integrated energy system (RIES) is seen as an energy utilization model with great potential. Given that the RIES encompasses various forms of energy subsystems, the model exhibits high dimensionality, posing significant challenges for joint planning and scheduling. Based on this, this paper proposes a two-layer planning optimization method based on reinforcement learning. The upper layer model using deep deterministic policy gradient (DDPG) algorithm to find the optimal capacity configuration by continuously interacting with the environment. The lower layer model uses the annual electricity, heat, and cooling loads and the equipment capacity solved by the upper layer as inputs for optimal scheduling of typical days. The scheduling cost calculated by the lower layer is fed back to the upper layer as part of the environmental return, thereby optimizing the capacity configuration. The case test results verify the effectiveness of the proposed model and method.

Schedule of Sessions

DTPI 2024 Oct. 19th Session Schedule

Session Name	Blockchain and Knowledge
Date and Time	Oct. 19, 2024, 13:00-14:30 GTM+8
Meeting ADD	School of Electrical Engineering Meeting Room 2

Chairs



Rui Qin
Institute of Automation, Chinese Academy of Sciences

Yong Yan
State Grid Zhejiang Electric Power Co., Ltd. Research Institute

Session Presenters

Construction of Online Freight Platform Based on Blockchain Technology

Shuai Wang, Financial Technology Research Institute, Industrial Bank Co., Ltd.

Presentation Abstract: There are pain points in the current online freight industry, e.g., poor transparency, lack of protection for drivers' rights, etc. In this report, we propose a novel framework of online freight platform based on blockchain technology. The proposed platform makes full use of the technical characteristics of blockchain and smart contracts to realize trusted certificaiton of online freight information and multi-dimensional verification of order status. Besides, we use e-CNY to achieve the penetration payment of shipping fee, which can realize the transparency, fairness and security of transactions, thereby protects the interests of all parties involved in online freight industry.

Security Evaluation of RIS-Aided V2X Communication Systems in L3ow-Speed Scenarios

Yongqiang Bai, School of Computer and Communication Engineering, University of Science and Technology Beijing

Presentation Abstract: The security of vehicle-to-everything (V2X) communication systems is of critical importance for intelligent transportation systems. This paper discusses the use of reconfigurable intelligent surface (RIS) technology to enhance the security of V2X systems in the presence of interference from potential eavesdropper. By precisely controlling the RIS, the enhancement of the legitimate user's signal and the interference of the eavesdropper's signal are achieved, which effectively improves the communication confidentiality. High-quality suboptimal solutions are obtained by utilizing alternate optimization and semidefinite relaxation techniques. The simulation results clearly demonstrate that the proposed scheme can markedly enhance the secure communication rate. In addition, the influence of factors such as base station transmit power, user position and RIS element number on the secrecy rate is analyzed, which provides a reference for the further optimization of the security evaluation of the V2X system.

RIS-UAV Assisted Marine Communication Based on Deep Neural Network Training

Tianrui Zhang, School of Computer and Communication Engineering, University of Science and Technology Beijing

Presentation Abstract: With the reconfigurable intelligent surface (RIS) and unmanned aerial vehicle (UAV) becoming increasingly prevalent in everyday human activities, RIS-UAV assisted wireless communication system helps to extend transmission distance and improve communication quality. However, most of the scenarios about RIS-UAV applications are on land. At the same time, how to jointly optimize the communication link between the UAV equipped with RIS and the communication link between the base station (BS) and the vessel is challenging. In order to solve the above problems, this paper proposes a RIS-UAV assisted marine communication system, and training the beamforming matrix, transmitter and receiver weights implemented by deep neural networks (DNN) to maximize the performance of the system. The simulation results show that the marine wireless communication system based on RIS-UAV achieves lower bit error rate (BER) than the conventional UAV relay communication system. Furthermore, based on parallel intelligence theory, more reasonable intelligent decision-making and prediction are expected be obtained for marine communications in the future.

Schedule of Sessions

Session Presenters

A DAOs-Based Publishing System for Advancing Open Access

Siji Ma, Faculty of Innovation Engineering, Macau University of Science and Technology

Presentation Abstract: The development of the scientific publishing system has remarkably enhanced global accessibility to research findings and substantially increased the visibility and dissemination of academic publications. However, significant challenges still exist in effectively safeguarding the intellectual property rights of contributors, such as the unauthorized usage of materials, the complexity of enforcing intellectual property rights across various legal jurisdictions, and high instances of plagiarism and content misuse. Additionally, financial barriers related to open access may restrict the participation of economically disadvantaged researchers, potentially biasing scientific records towards more affluent research initiatives. To address these issues, a novel decentralized framework is formulated to ensure truly open access. This framework leverages blockchain for immutable record-keeping and clear attribution of authorship, to prevent unauthorized usage and plagiarism. Besides, it also utilizes a copyright-sharing model based on decentralized autonomous organizations and operations (DAOs), where smart contracts automatically enforce copyright and access policies to ensure fair compensation for authors and researchers. Furthermore, the copyright sharing model based on non-fungible tokens (NFT) and gradual ownership optimization (GOO) mechanism is proposed to ensure fair and accurate recognition and compensation for scholarly contributions.

Optimization of Cultivated Land Use Structure in Small Watershed Based on Tabu Search Algorithm

Shuifeng Zhang, Nanjing Police University

Presentation Abstract: The paper constructed a multi-objective decision-making system based on the "land-water-economy" relationship perspective that can simultaneously address multiple issues and goals in small watershed. This paper proposes a Single Flip Tabu Search algorithm for the optimization of land use structure in only a few select areas within the comprehensive management of soil and water conservation in the Pei watershed. Additionally, by integrating the algorithm with watershed hydrological models and economic benefit evaluation models, a multi-objective function for comprehensive watershed management was established, aiming to minimize sediment, nitrogen, and phosphorus production while maximizing economic benefits. The improved metaheuristic algorithm was used to optimize the agricultural land structure in the small watershed, yielding the optimal comprehensive management plan at the small watershed scale. The Single Flip Tabu Search algorithm was applied to optimize land use in 12 cells within a localized area of the small watershed, demonstrating that optimization of a few select areas can be considered separately in the decision-making process. The algorithm achieves seamless integration of automatic updating, analysis, and optimization of land use structure during iterations and successfully obtains the optimal solution from a large number of alternative agricultural land use structures with particularly high time efficiency. Overall, the proposed approach effectively controls the negative environmental impacts of crop planting while considering economic benefits, aiding managers in making efficient scientific decisions for digital comprehensive management of small watershed.

DTPI 2024 Oct. 19th Session Schedule

Session Name	Smart Ecology
Date and Time	Oct. 19, 2024, 13:30-17:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching BuildingA 2nd Floor A110

Chairs

Yuntao Ma
China Agricultural University

Mengzhen Kang
Institute of Automation, Chinese Academy of Sciences

Session Presenters

Application of remote sensing technology in rice breeding and modern agriculture

Xianting Wu, Wuhan University

Presentation Abstract: One of the challenge for Modern Agriculture is how to continuously guarantee increment of food production to feed increasing population, especially in climate changing and less vibrant soil conditions.Therefore, searching for eurytopic crop varieties which could be productive stably under variable environmental conditions are becoming an urgent pressure in crop breeding. However, to screening for such proper varieties means a larger genetic population are needed for proper mutation screening and identification, indicating that high-throughput and sensitive screening for agricultural phenotypes and larger field precise managements are required as assistant for breeding purpose. Besides, growth and developmental models for particular crops should also be constructed to meet the needs for sensors identification and live analysis. Our group are focusing on the following aspects in rice: 1) build the rice growth models by Unmanned Aerial Vehicle Multispectral Imagery in field with hundreds or thousands of different rice varieties; 2) detect the tractable excellent agricultural traits, such as higher nitrogen use efficiency (NUE), by sensors and 3) develop effective and reliable high-throughput methods to assisting the selection of the high NUE breeding phenotype in rice.

Schedule of Sessions

Session Presenters

Linking FvBC to Greenlab in cross-scale prediction in coping with maize high plant density

Youhong Song, Jiangxi Agricultural University and The University of Queensland

Presentation Abstract: Linking the existing FSPM, e.g., GreenLab, with a biochemistry model is an effective tool to identify strategies in boosting canopy light use efficiency for tolerating high plant density in maize. The GreenLab model can precisely simulate plant growth and development. Here we report a module in GreenLab that can simulate canopy photosynthesis and biomass accumulation replaced by integrating the FvBC-C4 model with the Sunlit-Shaded two-leaf mode.We thus achieved across-scale modelling from the molecular level to the canopy level, enable to guide photosynthetic manipulation at the biochemical level and thus harness its consequence on crop productivity for coping with high plant density.

IHUP: An integrated high-throughput universal phenotyping software platform to accelerate unmanned aerial vehicle based field plant phenotypic data extraction and analysis

Jian Zhang, Huazhong Agricultural University

Presentation Abstract: With the threshold for crop growth data collection having been markedly decreased by sensor miniaturization and cost reduction, unmanned aerial vehicle (UAV)-based low-altitude remote sensing has shown remarkable advantages in field phenotyping experiments. However, the requirement of interdisciplinary knowledge and the complexity of the workflow have seriously hindered researchers from extracting plot-level phenotypic data from multisource and multitemporal UAV images. To address these challenges, we developed the Integrated High-Throughput Universal Phenotyping (IHUP) software as a data producer and study accelerator that included 4 functional modules: preprocessing, data extraction, data management, and data analysis. Data extraction and analysis requiring complex and multidisciplinary knowledge were simplified through integrated and automated processing. Within a graphical user interface, users can compute image feature information, structural traits, and vegetation indices (VIs), which are indicators of morphological and biochemical traits, in an integrated and high-throughput manner. To fulfill data requirements for different crops, extraction methods such as VI calculation formulae can be customized. To demonstrate and test the composition and performance of the software, we conducted case-related rice drought phenotype monitoring experiments. In combination with a rice leaf rolling score predictive model, leaf rolling score, plant height, VIs, fresh weight, and drought weight were efficiently extracted from multiphase continuous monitoring data. Despite the significant impact of image processing during plot clipping on processing efficiency, the software can extract traits from approximately 500 plots/min in most application cases. The software offers a user-friendly graphical user interface and interfaces for customizing or integrating various feature extraction algorithms, thereby significantly reducing barriers for nonexperts. It holds the promise of significantly accelerating data production in UAV phenotyping experiments.

Remote sensing of quality traits in cereal and arable production systems

Zhenhai Li, Shandong University of Science and Technology

Presentation Abstract: Cereal is an essential source of calories and protein for the global population. Accurately predicting cereal quality before harvest is highly desirable in order to optimise management for farmers, grading harvest and categorised storage for enterprises, future trading prices, and policy planning. The use of remote sensing data with extensive spatial coverage demonstrates some potential in predicting crop quality traits. Many studies have also proposed models and methods for predicting such traits based on multi-platform remote sensing data. In this paper, the key quality traits that are of interest to producers and consumers are introduced. The literature related to grain quality prediction was analyzed in detail, and a review was conducted on remote sensing platforms, commonly used methods, potential gaps, and future trends in crop quality prediction. This review recommends new research directions that go beyond the traditional methods and discusses grain quality retrieval and the associated challenges from the perspective of remote sensing data.

Artificial intelligence assists in plant phenotyping research

Yuntao Ma, China Agricultural University

Presentation Abstract: "Whether using conventional breeding methods or genetic engineering technology for breeding, it is necessary to quickly screen out the plant phenotype from a large number of samples. This urgently requires high-throughput plant phenotype extraction methods. This report mainly discusses the research progress and development of artificial intelligence in field plant phenotypes from the perspectives of 'Where are the difficulties in field phenotypes?', 'How can multi-source sensors assist in breeding material screening?', and 'How can plant 3D simulation models be combined with phenotypes?'. Based on the research work of our team, we will discusses the application of artificial intelligence in field surveys of plant phenotyping from 2D to 3D, from consumer grade drones with RGB cameras to drones equipped with multispectral, hyperspectral, and LiDAR sensors.

Schedule of Sessions

DTPI 2024 Oct. 19th Session Schedule

Session Name	Communications Techniques based on Parallel Intelligence
Date and Time	Oct. 19, 2024, 13:30-15:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A111

Chairs

Shuangshuang Han
University of Science and Technology Beijing

Jun Hou
Chang' an University

Session Presenters

Comparison of Different Vehicles with Electronic Control System Based on Regulatory Tests

Ziwen Zhang, CATARC Automotive Test 3Center (Guangzhou) Co.,Ltd

Presentation Abstract: Electronic stability control system makes driving more safe under extreme lateral movement conditions. To study the performance under certain regulatory tests, based on UN R140 and FMVSS 126, sine with dwell tests are conducted on four subjects that are a sport car, a normal car, a SUV and a van. An appropirate test methology is established and results of the peak yaw rate and the lateral displacement are investigated. All the results meet the regulatory requirements. The mass and the height of centre gravity of the vehicle are shown to affect the performance under tests according to the comparison.

Fatigue EEG signal detection based on Ensemble learning

Jie Chen, University of Science and Technology Beijing

Presentation Abstract: In recent years, researchers have proposed a variety of machine learning and deep learning-based techniques to process EEG signals, such as support vector machines, deep learning algorithms, and graph neural networks (GNNs). Particularly, graph neural networks can effectively learn the spatial connectivity relationships between different channels in EEG signals, thereby enhancing the accuracy and robustness of fatigue driving detection.

This paper introduces an integrated architecture that combines an information-enhanced network (IENet) with a graph convolutional network (GCN) to augment feature extraction capabilities and improve model classification performance. Through preprocessing EEG data and computing brain connectivity metrics, we trained the graph neural network and validated the method's superior performance in fatigue driving detection. This research introduces novel methods and concepts aimed at advancing road traffic safety, particularly in mitigating the risks associated with fatigued driving.

VR-Recon: Visual Refiner for Fine-Grained Human Reconstruction

Xiaoyan Zhang, College of Computer Science and Software Engineering, Shen Zhen University

Presentation Abstract: To reconstruct 3D human figures with fine-grained details from sparse views, we propose a novel framework called VR-Recon. The proposed system incorporates a Multi-Scale Geometric (MSG) feature extractor and a viewpoint refiner, which together enhance the extraction and fusion of geometric features from multi-view inputs. The framework employs a consistent cosine loss and cascaded view-space geometric loss to ensure accurate reconstruction of intricate details. Experimental results demonstrate that VR-Recon surpasses state-of-the-art methods in capturing fine geometric details and robust performance in 3D human reconstruction tasks.

Schedule of Sessions

Session Presenters

Enteromorpha prolifera detection in complex scenarios based on YOLOv8

Yanjun Zhu, University of Science and Technology Beijing

Presentation Abstract: As a key player in the regulation of the global ecosystem, the oceans and seas, with their vast space and abundant resources, are of vital importance. However, in recent years, with the development of economy, the frequency of marine pollution has risen, especially the large-scale outbreak of seagrass has brought serious impacts on marine ecology and economic activities. The monitoring and prevention of seagrass disaster has become a common concern for scholars and managers. Traditional ground survey methods are inefficient, so the use of advanced target detection technology has become one of the solutions. In recent years, YOLO, as an advanced target detection algorithm, has performed well in various image recognition tasks, but specific comparative studies in seashore moss detection are still relatively few. In this study, we address the problem of seashore detection by comparing their performances in YOLOv5 and YOLOv8 accuracy and detection speed through label transformation and model training on the FIO-EP seashore dataset. The experimental results show that YOLOv8's recognition accuracy is 4% higher than YOLOv5, and its detection speed is also 0.03 seconds faster. This indicates that YOLOv8 outperforms YOLOv5 in both accuracy and detection speed. This study not only validates the application potential of the YOLO series in monitoring seaweed but also provides valuable references for future related research. This study not only verifies the potential application of YOLO series in seashore monitoring, but also provides a valuable reference for future related research.

Channel estimation for OFDM Systems based on RMSGAN

Jiacheng Li, Chang' an University

Presentation Abstract: In this paper, a residual multi-scale generative adversarial network (RMSGAN) is introduced for orthogonal frequency division multiplexing (OFDM) systems, which conducts feature extraction via multi-scale feature fusion and local residual connections, rendering it suitable for OFDM channel estimation.In addition, the proposed channel estimation method achieves generalization for different pilot insertion methods through custom deconvolution layers. Simulation experiments reveal that in multipath fading channels, the RMSGAN-based channel estimation algorithm outperforms several existing image superresolution-based channel estimation algorithms with regard to the mean square error (MSE) evaluation metric. Furthermore, it achieves comparable performance to the linear minimum mean square error (LMMSE) algorithm.

DTPI 2024 Oct. 19th Session Schedule

Session Name	Blockchain Intelligence
Date and Time	Oct. 19, 2024, 13:30-15:00 GTM+8
Meeting ADD	School of Electrical Engineering Meeting Room 3

Chairs

Peng Zhu
Nanjing University of Science and Technology

Juanjuan Li
Institute of Automation, Chinese Academy of Sciences

ACP-based Dynamic Incentive Mechanism for Information Sharing in DAO

Tengchao Zhang, Macau University of Science and Technology

Presentation Abstract: As a new paradigm in the Web3 era, Decentralized Autonomous Organizations (DAOs) not only embodie the spirit of decentralization and collective governance, but also are the forefront of promoting community-led innovation. However, DAOs face challenges in sustainable growth and scalability in community governance, which are closely related to the income distribution model and member participation. Therefore, the Artificial systems, Computational experiments, Parallel execution (ACP) approach is applied to optimize the contribution evaluation and incentive feedback of member behavior through parallel governance and decision-making methods, so as to improve the intelligence of the DAO incentive mechanism. On this basis, the long short-term memory network (LSTM) and combinatorial game theory are used to conduct experimental verification on information sharing within the community. The experimental results show that our proposed method can not only achieve a high degree of information sharing in the community faster than other methods, but also has the ability of autonomous dynamic adjustment. It is of great significance and value to the community governance research and scenario implementation of DAOs.

Schedule of Sessions

Session Presenters

Quadratic Funding in Blockchain-Based DAO: Empirical Analysis and Future Prospects

Fei Lin, Macau University of Science and Technology

Presentation Abstract: This paper provides an in-depth analysis of the application of the Quadratic Funding (QF) mechanism in blockchain-based Decentralized Autonomous Organizations (DAOs) of the QF mechanism. Then, the empirical analysis on the influence of QF on promoting project funding is examined, taking the first round of BNB funding on the DoraHacks platform as the exemplar. The focus has been put on its performance on community voting and fund allocation as well as its real-world impact. Finally, based on the analysis results, the paper proposes improvements to the QF mechanism and presents forward-looking strategies for applying Large Language Models (LLMs) in decentralized decision-making. These insights provide valuable perspectives for understanding and optimizing Decentralized Finance (DeFi).

Exploring Parallel Blockchains: From Related Concepts to Application Scenarios

Ziyi Zhang, Nanjing University of Science and Technology

Presentation Abstract: This paper examines the foundational ideas and architectures of the parallel blockchain, highlighting the possible uses in intelligent transportation, smart healthcare, the IoT and financial transaction. The research also supplements the relevant concepts of DAO and explores the application of these technologies in intricate CPSS contexts. Parallel blockchain solves the shortcomings brought about by the absence of effective modeling and experimental techniques in traditional blockchain by integrating virtual and real systems and using a bidirectional guidance approach to test and optimize real systems. The paper concludes by summarizing recent research findings and talking about the potential for parallel blockchain applications in increasingly complex systems that span multiple domains in the future.

Exploring the Future of Quantum Computing-Enabled Blockchain Development: A Survey

Zhijian Li, Nanjing University of Science and Technology

Presentation Abstract: This presentation explores the convergence of quantum computing and blockchain technology, addressing the current limitations of blockchain systems in security and performance. We will examine the latest research advancements in quantum blockchain, including key technologies, applications of quantum cryptography, and the design of quantum-enhanced consensus mechanisms. The report will also discuss potential solutions to scientific challenges and provide attendees with cutting-edge insights into how quantum blockchain can fundamentally resolve existing pain points and support the development of secure and efficient distributed value systems.

Digital Twin Technology and Applications in the Medical Field:Bridging the Virtual for Precision Medicine

Siyi Chen, Nanjing University of Science and Technology

Presentation Abstract: Digital twin technology serves as a virtual bridge between physical entities and their digital models, showing significant promise in medicine. This paper outlines its fundamental elements and technical architecture, highlighting key technologies like modeling, simulation, and artificial intelligence. It explores applications in real-time data monitoring, diagnostic assistance, and medical device development, while addressing challenges such as data privacy and technological maturity. Proposed solutions aim to enhance digital twins' role in advancing precision medicine and fostering intelligent, personalized healthcare, ultimately benefiting public health.

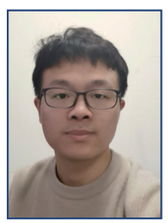
Schedule of Sessions

DTPI 2024 Oct. 19th Session Schedule

Session Name	Multi-modal Collaborative Perception and Cognitive Computing
Date and Time	Oct. 19, 2024, 15:00-16:30 GTM+8
Meeting ADD	School of Electrical Engineering Meeting Room 2 VOOV Meeting Number（腾讯会议）：998-651-007

Chairs

Hui Zhang
Beijing Jiaotong University



Yan Wang
The Hongkong Polytechnic University

Session Presenters

C-V2X Resource Allocation and Power Control for Cooperative Perception Through Game Theory

Juan Li, Beijing University of Posts and Telecommunications

Presentation Abstract: In view of the bottleneck of vehicle sensor perception, collaborative perception can be used to share data to expand the range of perception in the environment of vehicle networking. To save resources, spectrum multiplexing is required in Vehicleto-Vehicle (V2V) communication. The power adjustment of a communication link sharing the same spectrum will cause wireless interference to other related links, affecting the transmission efficiency of other communication links, and affecting the satisfaction of cooperative perception. Aiming at the C-V2X resource scheduling problem of vehicle-road cooperative sensing, this paper uses game theory to build an alliance, and carries out power control during the scheduling of wireless communication resources to ensure on-demand transmission while reducing interference to other links, so as to maximize the total data transmission volume of all V2V direct links. Extensive experiments show that compared with random alliance optimization algorithm, greedy alliance optimization algorithm and constant power game-theoretic alliance algorithm, the proposed algorithm achieves better efficiency.

Virtual Image Generation: Bridging Reality and Virtuality for Long-Tail Traffic Scenes

Feibing Xu, School of Computer Science and Technology, Beijing Jiaotong University

Presentation Abstract: Although visual perception algorithms have made significant progress in most normal scenes, it is still challenging for autonomous driving systems to accurately perceive long-tail scenes that occur less frequently, which can lead to serious traffic safety issues. However, existing open-source datasets do not systematically collect sufficient long-tail scenes. To fill this gap, we propose a pipeline for designing large-scale, diverse long-tail traffic scenes and generating virtual datasets based on the parallel vision approach. A virtual dataset named Vir-LTTS (virtual long-tail traffic scenes) is built, comprising various scenes such as extreme weather conditions, adverse lighting conditions, traffic accidents, unique forms of traffic objects, and blurry images caused by camera defects. We investigate the potential of training models using the Vir-LTTS dataset in long-tail traffic scenes. Experimental results show that pre-training with VirLTTS significantly improves the performance of visual models in long-tail traffic scenes.

YOLO-Point: Effective Key Points Detection for Optimal Break Points on Vehicle Windows

Wei Zhang, Information Science Academy, China Electronics Technology Group Corporation

Presentation Abstract: The optimal break points detection of vehicle windows is of great significance for various safety and emergency response scenarios, such as unmanned rescue operations and accidental vehicle lock-ins. Identifying the best locations to break a vehicle window can significantly reduce the time and effort required to gain entry, while minimizing potential injury or damage to the vehicle's occupants. Unfortunately, there is currently a lack of comprehensive datasets specifically focused on the optimal break points of vehicle windows. This absence of available data hampers the advancement of research and development in this area. Given this, this study establishes a novel dataset, named "VeBp", dedicated to the optimal break points on vehicle windows. This dataset provides comprehensive images and labels that can be used by researchers and engineers to develop and test new methodologies and technologies for efficient window breakage. Additionally, inspired by the design principle of YOLO, an effective key points detection model named "YOLO-Point" is proposed for accurately identifying the optimal break points on vehicle windows. Extensive experiments were conducted to validate the effectiveness and performance of the proposed model on the newly established dataset. The results demonstrate that the proposed model not only achieves high accuracy but also operates efficiently, making it a practical solution for real-world applications in emergency scenarios and beyond.

Schedule of Sessions

Session Presenters

AUKF-Based Collision Avoidance of Autonomous Vehicles Considering Measurement Noise Uncertainty

Ting Meng, The Hong Kong Polytechnic University

Presentation Abstract: Advanced driver assistance systems, such as active collision avoidance systems, improve vehicle safety by planning paths to avoid obstacles in dangerous conditions. Active collision avoidance systems typically determine whether to perform path planning depending on the relative distance and the speed of the preceding vehicle, and these signals can be obtained by radar. In previous studies, it is assumed that the sensor measurement noise is known and the radar information is simply processed and fed to the active collision avoidance system. However, the uncertainty of the measurement noise may lead to premature lane changes that reduce traffic efficiency or rear-end accidents that occur when lanes are changed too late. To address these problems, an adaptive unscented Kalman filtering (AUKF) algorithm is proposed to obtain accurate relative distance and velocity of preceding vehicles. Next, this information is fed to the decision module to determine whether to perform path planning or not. Finally, designing a path based on the seventh-order polynomial to accomplish active collision avoidance. Simulation results show that AUKF can improve sensor measurement accuracy and autonomous vehicles can successfully avoid obstacles.

A Spatiotemporal Probabilistic Graphical Model based on Adaptive Expectation-Maximization Attention for Individual Trajectory Reconstruction Considering Incomplete observations

Xuan Sun, Beijing Jiaotong University

Presentation Abstract: High-precision spatiotemporal trajectory inference is very important for generating a complete passenger travel process with high fidelity. However, due to the lack of travel observations, it is difficult to accurately infer effective information based only on the Automatic Fare Collection (AFC) data and Automatic Vehicle Location (AVL) data. To address this problem, this study proposes a data and knowledge-driven method (STPGM-AEMA), which includes three steps: first, through data mining and combinatorial enumeration, a set of potential passenger boarding train candidate solutions and travel time candidate solutions with a one-to-one mapping relationship is obtained; secondly, by introducing global latent variables representing candidate value of individual egress time and local latent variables representing the distribution of egress time, a spatiotemporal probabilistic graphical model (STPGM) for train reasoning is constructed to simulate the spatiotemporal dependency between the states of all passengers and the system state; then, considering the non-random missing characteristic of the passenger egress time state, an attention mechanism enhanced expectation maximization algorithm (AEMA) is proposed to realize the inference of the egress state value and the boarding train ID in the individual trajectory, and a random simulation strategy is used to complete the individual trajectory reconstruction process. Finally, the effectiveness of the proposed method is verified by using AFC, AVL and actual individual trajectory tracking(ITT) data of typical OD pairs. The results show that in a small sample training scenario, the STPGM-AEMA method proposed in this paper improves the accuracy of individual trajectory inference by 15% and the consistency by 20%.

DTPI 2024 Oct. 19th Session Schedule

Session Name	Vehicular Communications in Parallel Networks
Date and Time	Oct. 19, 2024, 15:00-16:30 GTM+8
Meeting ADD	Faculty of Engineering Teaching BuildingA 2nd Floor A111

Chairs

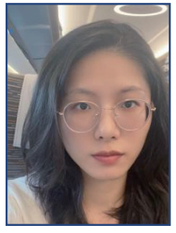
Shuangshuang Han
University of Science and Technology Beijing

Jun Hou
The Hongkong Polytechnic University

Session Presenters

Analysis of Driver Drowsiness and Attention Warning System

Dandan Cai, CATARC Automotive Test Center(Guangzhou)Co.,Ltd



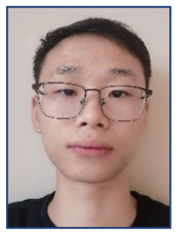
Presentation Abstract: This article is based on the requirements and testing methods for vehicle driver drowsiness and attention warning (DDAW) systems in Regulation (EU) 2021/1341. Firstly, the hazards of fatigue driving and its potential hazardous consequences were introduced, and the importance of preventing fatigue driving is analyzed. Secondly, by introducing testing equipment, KSS drowsiness level, driver training methods, road test pass requirements, and human-machine interaction warning requirements, the overall testing process and detailed requirements are analyzed, and laying a foundation for subsequent research and certification testing of DDAW systems.

Schedule of Sessions

Session Presenters

Classification and detection of EEG data for tired driving based on Mamba Framework

Xiaohui Chen, University of Science and Technology Beijing



Presentation Abstract: Fatigue driving is an important factor that causes frequent traffic accidents. The fatigue driving pre-detection system is a research direction at present. Compared to the driving habits of different people, EEG signals can show physiological consistency, and it is a major challenge to mine the characteristics of driver fatigue from the multi-channel EEG data. In this paper, based on Mamba framework, CNN feature extraction module is selected to realize coupling, and a CNN-Mamba model is constructed and applied to EEG fatigue driving detection task.

In this paper, we selected a fatigue driving dataset published in 2019, which contains 30 channels of EEG data from 11 subjects. The results show that the average accuracy of the model is 72.25% in the cross-subject EEG classification of 11 subjects, which is significantly improved compared with other advanced methods, and the recognition accuracy performance is improved by 8.93% compared with EEGNet.

Performance analysis in wireless-powered cooperative cognitive radio vehicular network

Yang Zhang, School of Information Engineering，Chang' an University

Presentation Abstract: An overlay cognitive radio network is investigated in this paper, which permits two wireless-powered secondary vehicles to communicate bidirectionally. Primary communication is achieved through direct link and relay cooperation from secondary vehicles. Herein, a hybrid simultaneous wireless information and power transfer (SWIPT) strategy is proposed, which can apply power-splitting and time-switching protocols adaptively. Specifically, selection combining is executed at primary receiver to obtain signals, and amplify-and-forward operation is performed at secondary vehicles. To explore performance of the proposed strategy in the vehicular network, exact outage probability expressions are derived under Nakagami-m fading as well as total energy efficiency. Simulations are presented to highlight impact of critical parameters on system performance.

Analyzing Public Disputation of Autonomous Driving Technology: A Study Based on Data Mining

Lehao Lv, University of Science and Technology Beijing

Presentation Abstract: With the rapid development of autonomous driving technology, public's opinion of this technology shows diversification and complexity. The discussion about autonomous driving online has a large quantity and diverse perspectives, which causes the traditional data analysis methods hard to catch and understand the whole spectrum of these data. This paper explores how to use text mining techniques effectively, especially the Latent Dirichlet Allocation (LDA) model, to analyze and understand people's attitude and viewpoint towards autonomous driving technology. By calculating the perplexity, coherence, Jensen-Shannon (JS) divergence and other related parameter indicators of the LDA model, striving to obtain the text mining model with best performance, in order to get valuable information faster and more efficiently.

DTPI 2024 Oct. 20th Session Schedule

Session Name	Smart Manufacturing and Services in DTPI
Date and Time	Oct. 20, 2024, 13:30-15:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A114 VOOV Meeting Numberr（腾讯会议）：231-103-073

Chair

Lefei Li
Department of
Industrial Engineering,
Tsinghua University

Schedule of Sessions

Session Presenters

Enhancing Resilience of Parallel Intelligent Systems

Zheng Jing, Department of Industrial Engineering, Tsinghua University

Presentation Abstract: As globalization continues to intensify, the frequency of natural disasters increases, and system complexity and interdependencies grow, systems need to develop stronger abilities to withstand such uncertainties and recover from disruptions, which is known as resilience. Accordingly, research on system resilience has gained increasing attention as a critical branch of systems engineering. Traditional resilience studies do not fully apply to more complex and intelligent systems, including parallel intelligent systems. Therefore, we propose a new resilience assessment framework suitable for parallel intelligent systems and various complex systems. Furthermore, as technology advances, nodes within systems are gradually acquiring autonomous capabilities. We believe this presents a significant opportunity for systems to address "unknown unknowns." Our research examines the performance of systems with varying degrees of autonomy when facing attacks. Finally, we summarize the five key strategies that need to be considered to enhance the resilience of parallel intelligent systems: robustness, flexibility, visibility, responsiveness, and autonomy.

Chinese Academy of Sciences Institute of Automation

Zhijian Yue, University of Science and Technology Beijing

Presentation Abstract: With the development of continuous fiber-reinforced composites (CFRCs) 3D printing technology, accurately detecting fiber path defects is crucial for ensuring product quality. However, existing methods face challenges such as insufficient training data and the complexity of fiber path structures, which impact detection accuracy. To address this, we propose a YOLOv7 object detection model combined with a Squeeze-and-Excitation (SE) attention mechanism for precise detection of fiber path defects in CFRCs. By introducing the SE mechanism, we enhance the model's ability to perceive key features. Experimental results show that this model achieves an average accuracy of 93.9% in detecting fiber path defects, representing a 10.7% improvement over models without the attention mechanism. This outcome validates the effectiveness and practicality of the proposed method, providing new insights for defect detection in CFRCs 3D printing technology.

Design and Implementation of a Web-based Collaborative Manufacturing System Based on Knowledge Graph

Zhijian Yue, University of Science and Technology Beijing

Presentation Abstract: Collaborative manufacturing is central to agile, intelligent, and cloud-based manufacturing paradigms. This paper presents the design and implementation of a web-based collaborative manufacturing system based on a knowledge graph (KG). The system achieves the full spectrum of knowledge extraction, fusion, and reasoning across the industrial chain, thereby enhancing efficiency and reducing operational costs. The proposed system constructs an industrial chain KG and multi-agent systems, offering comprehensive digital services across the manufacturing value chain. It supports the integration of business processes, data, and standard information for enterprise groups, presenting collaborative manufacturing data of the industrial chain in real-time visualization. The paper further discusses a method for real-time perception of anomalies in the collaborative manufacturing process, utilizing expert knowledge and data-driven insights to construct an operational risk KG. The system's architecture, workflow, and functional design are detailed, along with application cases in visual dynamic management. The conclusion underscores the system's potential to improve supply-demand chain management and operational efficiency in collaborative manufacturing.

Parallel Theory-Based Risk Assessment for Networked Manufacturing Systems

Fan Yang, Shandong Jiaotong University

Presentation Abstract: The increasing applications of robots and other automated machines into intelligent manufacturing poses great requirement of timely risk evaluation and recognition, which is critical to the stable operation of a factory. However, only a little previous work is centered on this problem. In this paper, we present a close-loop manufacturing situation management framework base on parallel theory to address the challenge of risk recognition in real time. A graph illustrates the relationships between various factors in networked manufacturing, followed by the introduction of corresponding risk measurement indices. And then the fuzzy analytic hierarchy process (FAHP) method is applied to assess the risk of the manufacturing. The factor with the maximum risk is selected out with max-max algorithmic operators and is input into the real system for checking out. The innovation of this paper lie in the proposition of a real time risk analytic framework for operational streamlines base on parallel theory and the integration of network graph with FAHP method for risk evaluation. The numerical testing results show that the model is valid, and its corresponding evaluation method can quickly recognize the highest risk occurred in the manufacturing. The risk evaluation framework and method can be generalized to other networked and complex systems, e.g., transportation system.

Schedule of Sessions

DTPI 2024 Oct. 20th Session Schedule

Session Name	Artificial Transportation Systems and Simulations (ATSS)
Date and Time	Dec. 20, 2024, 13:30 -15:00 GTM+8
Meeting ADD	School of Electrical Engineering Meeting Room 4

Chairs

Fenghua Zhu
Institute of Automation, Chinese Academy of Sciences

Chunlin Shang
Ludong University

Session Presenters

Simple-FPN: An Image Anomaly Detection and Localization Network based on SimpleNet and Feature Pyramid

Yiming Zhao, Harbin Institute of Technology

Presentation Abstract: We propose a neural network that is simple to understand, easy to implement and deploy, called Simple-FPN. This network is mainly used to detect and locate anomaly in images. The neural network mainly includes the following four parts: (1) a feature extraction part, including a pre-trained feature extraction network and a corresponding feature pyramid structure, (2) a pre-adaptation part, which maps the features obtained by feature extraction to the feature distribution space formed by target image set, (3) an anomaly feature generator adding Gaussian noise to the extracted features, and (4) the anomaly discriminator part is used to distinguish anomaly and normal features. The anomaly feature generator needs to be included during training, but is not required during inference. The design of this neural network mainly relies on three assumptions: (1) mapping common features in the non-target environment to the target environment helps avoid deviations in data distribution, (2) generating anomaly features in the feature domain is more efficient than in the image space, (3) features at different scales in the image can be more effectively extracted through feature pyramid. Simple-FPN has better performance than some previous methods. In the data set MVTec AD, Simple- FPN's AUROC can reach an average of 99.4%. In addition, Simple-FPN's inference speed can reach 89 FPS when tested on a 4060 GPU (only calculating inference time). Simple-FPN has excellent performance among many other anomaly detection networks.

An Autonomous Driving Decision Making Method with Maximum Entropy Objective and Safety Constraints

Junyou Shang, Xi' an Jiaotong University

Presentation Abstract: At present, the algorithm based on reinforcement learning has shown advantages over the rule-based algorithm in the field of building autonomous driving decision-making model, which has great potential and application prospects in the field of autonomous driving. However, reinforcement learning based algorithms often have disadvantages such as low learning efficiency, poor safety, and sensitivity to hyperparameters. To solve this problem, based on the Soft Actor-Critic algorithm with maximum entropy objective, the safety rule constraint is introduced to adjust the action sampling probability in the training phase, and the autonomous driving decision-making model under the conditions of 3 actions and 5 actions is trained and tested. It was compared with the value-based ssafety constraint algorithm and the rule-based safety constraint algorithm using DQN algorithm. The results show that the proposed algorithm is superior to the compared algorithms in terms of safety and training efficiency, and the algorithm based on SAC and safety constraints can improve the safety and learning efficiency of reinforcement learning algorithms.

Design and Implementation of a Web-based Collaborative Manufacturing System Based on Knowledge Graph

Hongwei Zhao, China University of Petroleum (East China)

Presentation Abstract: Contrastive Language-Image Pre-training (CLIP) can not be directly applied in re-identification (ReID) tasks because multiple images may be associated with the same ID description in a batch, which is not applicable for instance contrastive learning in CLIP and brings performance degradation.

Additionally, ReID data involves sensitive personal information. Data security and privacy protection mechanism is necessary for model training with multi-party ReID data.
Federated learning facilitates collaborative training across multiple parties while preserving data privacy. However, when data is non-independent and non-identically distributed (non-IID), the performance of some clients may decrease. To address these challenges, a Personalized Fuzzy Federated Prompt Tuning method (PFFPT) is proposed in this paper for ReID. PFFPT constructs ID-specific learnable prompt tokens at each client, while the global server performs fuzzy federated clustering and dynamic weight aggregation based on local visual feature embeddings. Furthermore, an ID-contrastive Loss is proposed in local client training to tackle the ID-image matching issue. Comprehensive experiments were conducted on two vehicle ReID datasets and eight person ReID datasets. Compared to the traditional FedAVG, PFFPT achieved Rank-1 improvements of more than 10.87 and 10.48 on person ReID and vehicle ReID tasks, respectively, which demonstrates the effectiveness of the proposed method.

Schedule of Sessions

Session Presenters

Optimization of Path for Small Shunting Trains in Railway Hubs Based on Improved Simulated Annealing Algorithm

Shuguang Yang, Shandong Jiaotong University and Institute of Automation, Chinese Academy of Sciences

Presentation Abstract: Small shunting trains are a type of operational car serving within railway hubs. It primary function, which is to provide temporary transportation services for freight cars originating from non-direct transfer trains and local freight trains, constitutes their core operational duty. This paper explores the optimization problem of the operating path for small shunting trains in railway hubs. Firstly, an optimization model is established to minimize the operational costs of locomotive scheduling and car operations, considering constraints such as train running time, pick-up and delivery operation time, station operation capacity, and line traffic capacity. Secondly, a simulated annealing algorithm with constraint relaxation and multi-objective function handling is employed to solve the problem. Experimental results validate the effectiveness of the proposed method in significantly reducing overall operational costs.

DTPI 2024 Oct. 20th Session Schedule

Session Name	Parallel Human Resource Management in CPSS
Date and Time	Oct. 20, 2024, 13:30-15:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A111

Chair

Tao Wang
College of Systems Engineering,
National University of
Defense Technology

Session Presenters

Recognition of Retained Secretions in Central-Airway for Adult Patients Receiving Mechanical Ventilation

Shuai Wang, School of Engineering Medicine, Advanced Innovation Center for Biomedical Engineering, Beihang University

Presentation Abstract: In critical care settings, mechanical ventilation is a common practice employed to support patients. Retained secretions commonly affect the effectiveness of mechanical ventilation, and there is currently no autonomous recognition method available. This study proposes an autonomous recognition method based on deep learning to analyze respiratory sounds for effective recognition of retained secretions. Initially, binary classification was performed to detect the presence or absence of secretions, achieving a notable accuracy of 91.5% and a precision of 89.5%. Based on these promising results, the study progressed to a more detailed ternary classification to provide further analysis of suction requirements, categorizing requirements as "no suction required", "suction monitoring required", and "suction required". Experiments conducted on 1,512 seconds of respiratory sound data demonstrated the efficacy of the binary classification, but also highlighted the challenges in the ternary classification. This study demonstrates the potential of deep learning techniques in augmenting critical care, promising significant improvements in patient management and care outcomes.

Spatial Feature and Mish Loss Function Enhanced YOLOv8n for Efficient Volleyball Detection

Jintao Pei, School of Railway Transportation,Shandong Jiaotong University

Presentation Abstract: To address the challenge of inaccurate volleyball height detection and localization due to complex environments and low image resolution during volleyball bobble assessments, a refined detection algorithm, YOLOv8n-SPD, is proposed. This algorithm enhances the YOLOv8n model by incorporating several key improvements. Firstly, a meticulously labeled dataset of volleyball bobble images is created. The algorithm integrates a Spatial Depth Convolution module (SPDConv), which preprocesses images prior to their entry into the neural network. By eliminating the maxpooling layer, redundant pixel information is reduced. Secondly, the activation function Mish is employed instead of SiLU to diminish the interdependence of parameters and enhance the adaptability of the network. Additionally, the DIoU replaces the original CIoU loss function, aiming to better align the predicted and actual bounding boxes. Experimental results show that YOLOv8n-SPD improves the mAP@0.5 metric from 99.3% to 99.4% and the mAP@0.5-0.95 metric from 86.5% to 87.6%, with an increase in GFLOPS from 8.1 to 11.5. This algorithm not only enhances accuracy but also improves real-time performance and stability in complex scenarios. Index Terms—Target

Schedule of Sessions

Session Presenters

Agent-Based Integrated Intelligent Parallel Scheduling System for Station Area

Yibo Mi, School of Transportation, Fujian University of Technology

Presentation Abstract: In order to improve the intelligence and integration level of railway technical operation station and enhance the optimal allocation and efffcient scheduling of station resources, an intelligent scheduling system is built based on the artiffcial system, computational experiment, parallel execution (ACP) method. It compiles data, empirical and mechanism, and its data compilation method supports the normal operation of the intelligent scheduling system. The artiffcial scheduling system is constructed by introducing multi-agent modeling, and the controllable factors and random disturbance factors under different scheduling scenarios are considered in the calculation experiment. The system is managed and controlled by constructing the railway transportation operation in parallel execution. Finally, the simulation experiment of station area scheduling has been completed, and its results demonstrate that it can not only improve the overall operation efffciency of the railway technical station, but also further enhance the overall operation efffciency of the station area.

Navigating the Education-Employment Nexus: A Decades-Long Analysis of Occupational Mobility

Shan Huang, College of Systems Engineering, National University of Defense Technology

Presentation Abstract: This study investigates the intricate link between educational attainment and patterns of occupational mobility from 1980 to 2010. By analyzing 1720 occupations, it identifies four key trends in educational requirements across industries: upward, fluctuating upward, stable, and downward. Applying K-means clustering, six occupation categories are defined, reflecting variations in education levels and practitioner populations. The research underscores the consistent yet adaptable nature of the job market, highlighting education's pivotal role in shaping career paths and the necessity for ongoing skill adaptation. Findings offer crucial implications for talent management strategies in the evolving knowledge economy.

The revolutionary impact of AIGC on human resources

Yuanhan Xie, College of Systems Engineering, National University of Defense Technology

Presentation Abstract: The remarkable progress in the field of generative artificial intelligence represented by ChatGPT has made the concept of human resources vague once again. This paper attempts to explore the fundamental impact of AIGC (Artificial Intelligence Generated Content) on the basic concept and attributes of human resources, starting from the development and basic attributes of the concept of human resources. Based on Karl Popper's theory of the three worlds, it explores the essence and development of the concept of human resources in different worlds and different times. It proposes possible concepts, forms, and development trends of human resources in Cyber-Physical-Social Systems (CPSS), and conducts an in-depth analysis of the impact of the emergence of AIGC on the characteristic attributes of human resources. This paper believes that the development of AIGC will have a fundamental impact on the basic concept and characteristics of human resources, and may change the concept of human resources itself.

DTPI 2024 Oct. 20th Session Schedule

Session Name	Parallel Transportation Systems
Date and Time	Oct. 20, 2024, 13:30-15:00 GTM+8
Meeting ADD	VOOV Meeting Numberr（腾讯会议）：670-562-994

Chair

Yonglin Tian
Institute of Automation,
Chinese Academy of Sciences

Schedule of Sessions

Session Presenters

Text Semantic Analysis and Intelligent Interaction in Parallel Dispatching Systems for Technical Station

Yuantao Jiao, Beijing Jiaotong University

Presentation Abstract: Technical station dispatching system plays an important role in cargo operation, but due to the large number of dispatching systems and complex operation, dispatchers rely on manual experience to complete the task, and many scenarios cannot be applied in the real system. Therefore, this paper utilizes the data-driven form to establish a parallel dispatching system for technical stations, semantically analyzes text data rich in dispatcher experience, completes the Computational Experiments on the textual semantic data in the artificial dispatching system,and synchronizes the Parallel Execution of data interaction with the real dispatching system.

Metaverses for Parallel Transportation: From General 3D Traffic Environment Construction to Virtual-Real I2TS Management and Control

Hao Ma, Anhui University

Presentation Abstract: This article explores how metaverse technology integrates with Intelligent Transportation Systems (ITS), utilizing Generative Artificial Intelligence (GAI), such as diffusion models, to construct virtual-real interactive traffic scenarios, thereby enhancing the efficiency of traffic management and control (M&C). The paper reviews the evolution of traffic modeling tools and proposes new methods to address the challenges of social diversity and uncertainty in mixed traffic environments.

Performance analysis in wireless-powered cooperative cognitive radio vehicular network

Yang Zhang, School of Information Engineering，Chang’an University

Presentation Abstract: An overlay cognitive radio network is investigated in this paper, which permits two wireless-powered secondary vehicles to communicate bidirectionally. Primary communication is achieved through direct link and relay cooperation from secondary vehicles. Herein, a hybrid simultaneous wireless information and power transfer (SWIPT) strategy is proposed, which can apply power-splitting and time-switching protocols adaptively. Specifically, selection combining is executed at primary receiver to obtain signals, and amplify-and-forward operation is performed at secondary vehicles. To explore performance of the proposed strategy in the vehicular network, exact outage probability expressions are derived under Nakagami-m fading as well as total energy efficiency. Simulations are presented to highlight impact of critical parameters on system performance.

ACP-based Parallel Multi-Sensor Optimization Configuration System for Intelligent Vehicles

Min Zhou, School of Automation and Intelligence Beijing Jiaotong University

Presentation Abstract: Perception technology plays a significant role in ensuring driving safety and other aspects. However, achieving the optimal configuration of multi-source sensors is a complex problem when designing an intelligent vehicle perception system. In this paper, the ACP method (artificial system, computational experiments, and parallel execution) is introduced to address the problem of optimally configuring multi-source sensors in intelligent vehicles. Firstly, an artificial system is constructed to simulate the effects of different scenarios on the performance of sensing sensors. Secondly, the configuration method for different sensing sensors, under the condition of maximum coverage of the sensing area, is determined through computational experiments. This includes determining the number of installations, positions, and directions. Finally, dynamic optimization of the configuration scheme is achieved through parallel execution, resulting in an optimal configuration scheme of multi-source sensors for intelligent vehicles that meets the requirements of different scenarios. Additionally, this paper generates a multi-sensor configuration scheme through computational experiments based on a hypothetical car model. The effectiveness of the parallel optimal configuration method proposed in this paper is verified by evaluating the coverage of the perception area under various scenarios.

Schedule of Sessions

DTPI 2024 Oct. 20th Session Schedule

Session Name	Embodied Intelligence and Parallel Vehicles
Date and Time	Oct. 20, 2024, 15:00 -16:30 GTM+8
Meeting ADD	School of Electrical Engineering Meeting Room 2 VOOV Meeting Numberr（腾讯会议）：174-880-844

Chairs

Tianyu Shen
College of Information Science and Technology, Beijing University of Chemical Technology

Jinlin Sun
School of Electrical and Information Engineering, Jiangsu University

Session Presenters

Embodied Intelligent Driving: Key Technologies and Applications

Yadong Wang, Beijing University of Chemical Technology

Presentation Abstract: Embodied intelligence emphasizes direct interaction between machines and the physical world, enabling intelligent agents to exhibit intelligent behaviors and autonomous evolution through the interplay of the brain, body, and environment. This paper discusses key technologies involved in embodied intelligent driving, based on the core requirements of embodied intelligence and autonomous driving, focusing on two core aspects: embodied perception and execution, and embodied learning and evolution. The development status and existing issues of these technologies are analyzed. Additionally, the paper elaborates on datasets and practical system applications related to embodied intelligent driving. Subsequently, it presents reflections and prospects for this field, considering the significant role and application potential of parallel robot, aiming to promote the application of embodied intelligent driving in highly dynamic real-world scenes.

LoT-nuScenes: A Virtual Long-Tail Scenario Dataset for Parallel Vision and Parallel Vehicles

Yang Mi, Beijing University of Chemical Technology

Presentation Abstract: Autonomous driving systems rely on massive amounts of high-quality data, and the long-tail problem is a major challenge for their development. The long-tail problem involves a large number of rare, special, or complex driving scenarios, which are difficult to be comprehensively covered by traditional data collection methods. But the long-tail scenarios can be reduced to simulation software to create diverse and controllable driving environments. In this paper, we construct accident scenarios under different states in the Carla simulator, which includes six types of motor vehicle accidents, one type of pedestrian accidents and combines three extreme weathers, three time periods and five types of locations. At the same time, we collect accident events in the format of the nuScenes dataset, equipped with multi-sensors and 360° field-of-view. This dataset not only fills the gap of accident scenario data and achieves long-tailed normalized distribution, but also provides resources for target detection and tracking task testing and validation of autonomous driving systems.

Optimal Control-Based Dynamic Obstacle Avoidance and Path Tracking for Unmanned Agricultural Vehicles

Chuanhao Sun, Jiangsu University

Presentation Abstract: Path tracking and obstacle avoidance are challenging problems for autonomous vehicles moving in unknown environments. This paper presents a nonlinear model predictive control strategy for unmanned agricultural vehicles (UAVs), ensuring accurate path tracking while efficiently avoiding static and moving obstacles, as well as road boundaries. Compared to existing works, a new obstacle avoidance constraint is proposed to better delineate obstacle contours. The above constraints are incorporated into the optimal control problem. At the same time, a nonlinear optimization algorithm is used to deal with multiple constraints. The simulation outcomes confirm that the suggested method is highly effective for UAVs, ensuring accurate path tracking and proficient obstacle avoidance of both stationary and moving types.

Schedule of Sessions

Session Presenters

OARegNet: Online Adaptive Point Cloud Registration for Embodied Intelligent Driving

Jinying Zhang, Beijing University of Chemical Technology

Presentation Abstract: Embodied intelligent driving involves autonomous systems interacting with and adapting to real-world environments through integrated sensing and cognitive processes, enhancing vehicle efficiency and adaptability. A crucial aspect of this is V2X technology, enabling vehicle-infrastructure collaboration and playing a key role in intelligent transportation. Multisensor data registration is essential for V2X data fusion and utilization. However, the initial registration accuracy of V2X point clouds is not satisfactory, with manual methods being time-consuming and inefficient. Current challenges in online V2X point cloud registration stem from differences in point cloud density, occlusions, and changing overlaps. Research in this area is limited. In this paper, OARegNet, a new online V2X point cloud registration network, is proposed to address the aforementioned challenges. Two core modules are introduced to deal with the issues. In the keypoint extraction layer, an adaptive density learning module is used to extract accurate keypoints from vehicles' and infrastructures' point clouds despite significant density differences and occlusions. Moreover, in the coarse registration network, an adaptive feature fusion module is introduced that utilizes a multi-head attention mechanism to learn rich point cloud information and estimate reliable point correspondences from point clouds with varying degrees of overlaps. Experiments are conducted on the DAIR-V2X dataset and a 95.19% recall rate is achieved, a 4.89% improvement over HRegNet, demonstrating the method's effectiveness in online V2X point cloud registration.

DTPI 2024 Oct. 20th Session Schedule

Session Name	Advanced Technologies in Smart Energy Systems
Date and Time	Oct. 20, 2024, 15:00 -16:30 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A115

Chairs

Peidong Xu
School of Electrical Engineering and Automation,
Wuhan University

Yuxin Dai
School of Electrical Engineering and Automation,
Wuhan University

A compound Control Technology for The Current Loop of Shunt Active Power Filters

Ruogu Zhang, China University of Petroleum, Beijing

Presentation Abstract: This report introduces a digital control strategy for the current loop of three-phase three-wire parallel active power filters (SAPFs).The control strategy is a composite control method based on a digital PI controller and a digital repetitive controller, in which the repetitive controller improves the steady-state performance and the PI controller improves the dynamic performance. The report will also describe the impact of the robustness of the composite control method when there is a large change in the system parameters.

Modeling and Analysis of Load Characteristics for High-Power Electromechanical Actuators

Yi Cai, Beihang University

Presentation Abstract: To address the issue of inaccurate modeling in onboard electro-hydrostatic actuator (EHA) systems, particularly the neglecting of the impact of motor driver input filtering circuits and parasitic line parameters on system input current, a comprehensive mathematical model for the EHA load and onboard generation system is developed. This model incorporates feedforward control based on position error compensation to ensure precise tracking of the reference signal by the actuator. Under step input position conditions, the input current waveform and DC bus voltage fluctuations are analyzed. The developed model enables accurate assessment of the impact of high-power actuators like EHA on the aircraft power supply system, providing a basis for optimizing dynamic performance.

Application of LLM Techniques for Data Insights in DHP

Huajian Fang, China Nuclear Power Operation Technology Corporation, Ltd.

Presentation Abstract: With the rapid development of China's nuclear power industry, data insights plays an increasingly crucial role in enhancing the safety and operational efficiency of nuclear power plants. Traditional data analysis methods face challenges in handling massive, complex, and heterogeneous industrial data from multiple sources. The emergence of large model technology offers new solutions for industrial data insights. This article proposes a digital intelligent platform architecture for nuclear power large model and thoroughly explores its applications in the nuclear power industry. The architecture includes data layer, model layer, analysis layer, and application layer, responsible respectively for data collection, storage, processing, analysis, and application. Finally, based on the architecture proposed in this article, prototypes for applications such as nuclear power industry report table generation and intelligent analysis assistant for patrol inspection data were developed, with a view towards future development directions.

Schedule of Sessions

Session Presenters

Research on Auxiliary Control Strategy for Large-scale Power Grid Based on Deep Reinforcement Learning

Shiqi Liu, China Southern Power Grid Co., Ltd

Presentation Abstract: Large-scale power grid sections often exceed their limits due to the participation of power generation units in the frequency regulation auxiliary service market. To address this issue, this paper proposes an auxiliary control strategy for large-scale power grid sections based on deep reinforcement learning. The Deep Deterministic Policy Gradient (DDPG) algorithm is applied to construct an intelligent agent for power grid section control, providing real-time control strategies in complex power grid environments, while considering both the safety and economy of power grid operations. On this basis, a two-stage optimization strategy considering sensitivity is proposed. In cases where the section limit cannot be eliminated through real-time control, the optimal market intervention plan is provided for operators to eliminate the section limit. Finally, case studies are designed to verify the effectiveness of real-time control strategies and market intervention plans. Under different types of section limits caused by power generation units participating in the market, the method proposed in this paper reduces the clearing price by an average of 1.2% and the average adjustment amount by 37.6% compared to the current rules, effectively improving the system's economy.

Research on Active Power Corrective Control of the Power System Based on Deep Reinforcement Learning Model

Ke Zhang, China Three Gorges Wuhan Science and Technology Innovation Park

Presentation Abstract: The application of artificial intelligence (AI) technology in active power corrective control (APCC) within power systems can significantly enhance decision-making efficiency, high-dimensional data processing capability, and the intelligence level of the power grid. By establishing mechanisms for safety operation decision support analysis and autonomous knowledge learning, AI can improve the power grid's response speed and handling efficiency for abnormal and accident situations, thereby reducing the workload of manual dispatching. Advanced digital technologies such as AI will play a crucial role in APCC. Deep reinforcement learning, as an emerging AI technology, has been gaining widespread attention. This paper combines the perception capabilities of deep learning with the decision-making abilities of reinforcement learning to propose a competitive Dueling Double Deep Q-network (D3QN) model. Furthermore, it introduces an APCC method for power systems based on the D3QN model. When faced with "N-1" faults, source-load fluctuations, and other situations, this method can re-distribute the active power among the various generator units in the system, effectively eliminating the transmission line overload issues.

DTPI 2024 Oct. 20th Session Schedule

Session Name	New Power Systems and Hierarchical Clusters
Date and Time	Oct. 20, 2024, 15:30 -16:30 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A111

Chair

Xiaodong Zheng
South China University of Technology

Distributed Optimal control method of reactive voltage for high proportion photovoltaic low-voltage distribution network

Xingyun Li, Tianjin University

Presentation Abstract: Firstly, the background of the research is introduced: the high proportion of photovoltaic grid-connected causes frequent voltage overstep and network loss increase. Next, the paper introduces the multi-time scale optimization framework: a two-stage reactive power optimization method based on improved whale algorithm for photovoltaic distribution networks, and introduces its objective function and constraints. Then, the improved whale optimization algorithm proposed by us is introduced: the improved whale algorithm based on adaptive social learning and wavelet mutation is solved, the adaptive social learning strategy is adopted to enhance the diversity of the population, and the wavelet function is used to enhance the ability of the algorithm to jump out of the local optimization, and the calculation accuracy of the algorithm is improved. Finally, an example analysis based on improved IEEE-33 node system is presented.

Schedule of Sessions

Session Presenters

Operation and Control of the New Power Systems Based on Hierarchical Clusters

Bifei Tan, Wuyi University

Presentation Abstract: This work proposes the three-layer network (energy network, information network, value network) architecture and overall research design of the new hierarchical cluster power systems. At the energy network level, the technical characteristics and patterns of the new hierarchical cluster power systems are proposed, and China's current relevant policy support is introduced. At the information network level, after introducing the problem of distributed sensing and information fusion in the new power systems, the focus is put on the application of swarm intelligence and cooperative control theories and technologies (especially the frequency control problem). At the value network level, new transaction mechanisms and business models such as distributed resource peer-to-peer transactions and virtual power plants are introduced. Finally, the frontier research directions of new power systems are discussed from the perspective of complex system theories based on multidisciplinary research.

Day-ahead Optimized Scheduling of Wind Power Systems Incorporating Carbon Trading

ZhaoHang Zhang, South China University of Technology

Presentation Abstract: Presents an optimized dispatch model for wind power integrated power systems considering carbon trading mechanisms. Under the premise of ensuring stable power system operation, it constructs a dynamic optimized dispatch model that considers wind power costs and introduces carbon trading costs to further investigate the impact of wind power integration on grid operation. The Latin Hypercube Sampling method is used to simulate wind power uncertainty, clearly defining backup compensation costs for insufficient wind output and wind curtailment costs for excess output. Finally, the model is validated using an IEEE-30 bus system, demonstrating improved wind power utilization and reduced system carbon emissions.

Source-Load Co-Optimization Scheduling of Power Systems Considering Extreme Scenarios

Min Chen, South China University of Technology

Presentation Abstract: With the increasing penetration of wind power in the power system, the randomness and variability of wind power bring about power balancing difficulties, which makes the stable operation of the power system and the realization of efficient wind energy consumption a major challenge. Flexible resources are introduced to participate in scheduling to increase wind power consumption through the cooperative optimization and effective integration of different resources, and a battery storage adjustable model considering battery life loss and an electrolytic aluminum load adjustable model are established. In order to reduce the impact of wind power uncertainty, a source-load co- optimization scheduling model considering Extreme Scenarios is proposed. The risk cost and comprehensive cost of wind power under a given confidence level are defined. In order to minimize the comprehensive cost, an optimization method for extreme scenarios is proposed to achieve the comprehensive optimization of the model in terms of robustness and economy. The simulation results prove that the proposed model has obvious cost advantages over the traditional scheduling model, and is effective in smoothing the peak-valley difference and improving the wind power consumption.

DTPI 2024 Oct. 20th Session Schedule

Session Name	The Application of Frontier Technologies in the Operation of Energy Industrial Systems
Date and Time	Oct. 20, 2024, 16:30 -18:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A115

Chairs

Huajian Fang
China Nuclear Power Operation Technology Corporation, Ltd

Shiqi Liu
China Southern Power Grid Co., Ltd

Yin Yao
Shanghai University of Electric Power

Schedule of Sessions

Session Presenters

System Partitioning Primary Frequency Regulation Capability Evaluation Based on DBSCAN Clustering

Yin Yao, Shanghai University of Electric Power

Presentation Abstract: The high proportion of new energy sources and large-capacity DC feeds have led to a continuous weakening of system inertia support and primary frequency regulation capabilities. This has highlighted the temporal and spatial dispersion of system frequency response. This dispersion introduces certain errors in evaluating primary frequency regulation capabilities, resulting in unnecessary economic losses for units participating in frequency response and significantly reducing their initiative. To mitigate the impact of frequency dispersion on the primary frequency regulation capability of units, this paper proposes a system partitioning method based on the DBSCAN clustering algorithm. Firstly, to effectively reduce the impact of frequency response dispersion, the DBSCAN clustering algorithm is introduced to partition the power system, with the optimal partitioning results evaluated using the DB index. Then, sensitivity analysis is used to perform disturbance analysis on nodes within each region to determine the optimal frequency measurement point. Finally, a partial regional system of the East China Power Grid is established in the PSD-BPA simulation software to verify the effectiveness of the proposed method. Simulation results show that this method can effectively reduce the impact of frequency dispersion on primary frequency regulation assessment results, making the evaluation more accurate and reliable.

A New-generation Nuclear Power Industrial Internet Platform Based on Cloud-Edge-Terminal Network Architecture

Lan Yang, China Nuclear Power Operation Technology Corporation, Ltd.

Presentation Abstract: To address the major challenges in the development of the nuclear power industrial internet—prominent industry barriers, inconsistent data standards, and high security and control risks, this paper proposes a solution guided by application needs. Leveraging new-generation technologies such as big data, edge computing, and artificial intelligence, we design a nuclear power industrial internet platform architecture that supports the development, operation, maintenance, and continuous upgrading of China's nuclear power industrial information systems. Firstly, the overall architecture of the nuclear power industrial internet cloud-edge-terminal network is designed. This architecture ad dresses issues related to data, model, and application coordination within the platform by overcoming technological barriers such as multi-source heterogeneous data access, distributed data storage, and real-time intelligent computing through edge-cloud collaboration. It achieves the virtualization and containerization of edge nodes, network, and storage resources, meeting the requirements for elastic resource scheduling and cluster management. Subsequently, a layered security protection architecture is designed to address the platform's security and privacy issues. Finally, the application of emerging technologies within the nuclear power platform is summarized and discussed, providing insights and prospects for future developments.

Construction progress and prospect of China's nuclear power industry Internet platform

Minmin Cheng, China Nuclear Power Operation Technology Corporation, Ltd.

Presentation Abstract: With the development of industry 4.0 and digital technology, as a new infrastructure of the fourth industrial revolution, industrial Internet has become an important technology to realize the digital transformation of industry. Compared with other energy sources, nuclear power has higher requirements in terms of safety and energy efficiency. Therefore, it is necessary to clarify the construction situation of China's nuclear power industry Internet platform and the shortcomings of digital transformation, so as to improve the energy efficiency and core competitiveness of nuclear power enterprises. Firstly, this paper sorts out the architecture, technical characteristics and main applications of China's nuclear power industrial Internet platform (DHP), and then compares the DHP platform with existing industrial Internet platforms in China from five aspects of application technology, main functions, application scenarios, data storage and service, and security system, and focuses on the model management technology. Secondly, the use of foreign industrial Internet platform components and tools is compared. Finally, according to the above research conclusions, the shortcomings of the construction of China's nuclear power industry Internet platform are found and the improvement scheme is put forward.

Application of the BeiDou Navigation Satellite System in Nuclear Emergency Response

Min Li, China Nuclear Power Operation Technology Corporation, Ltd.

Presentation Abstract: Against the backdrop of global energy structure transformation and nuclear technology innovation, the safe operation of nuclear power plants, especially the effectiveness of nuclear emergency response, has become a critical issue in nuclear energy applications. The BeiDou Navigation Satellite System (BDS), as China's independently developed global satellite navigation system, demonstrates significant potential in the field of nuclear emergency response. This paper first discusses the prospects of BDS applications in nuclear emergency response and proposes BDS-based technical solutions. Next, it analyzes the basic framework and key technologies of BDS applications in this field, including indoor-outdoor integrated positioning technology and dynamic path planning technology. Finally, specific implementation schemes for the BDS in nuclear emergency response are proposed to ensure rapid and accurate evacuation and resource allocation in emergency situations, minimizing the impact of nuclear accidents.

Schedule of Sessions

DTPI 2024 Oct. 20th Session Schedule

Session Name	Smart Grid Control and Optimization
Date and Time	Oct. 20, 2024, 16:30 -18:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A111

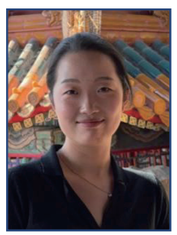
Chair

Jinghua Zhou
North China University
of Technology

Session Presenters

Suppression of Current Harmonics in Grid-Connected Inverter Using Equivalent Odd Proportional Multi-Resonant Controller

Shasha Chen, North China University of Technology



Presentation Abstract: The current harmonics will seriously degrade the power quality of injected current in the gird connected inverter. The proportional resonant (PR) control as effective method can selectively suppress current harmonics at a certain frequency. However, proportional multi-resonant controllers (PMR) will greatly increase the structure complexity and calculation burden. In this paper, an equivalent odd proportional multi-resonant (OPMR) control based on repetitive control (RC) is proposed. Compared with PMR control, the proposed controller is simpler in structure, and multiple odd harmonics can be inhibited simultaneously. What's more, a complete equivalent mathematical relationship between PMR and OPMR is presented. The validity of proposed method is proved by simulation and experimental results.

Research on Energy Optimization Scheduling Methods for Systems with Multiple Microgrids in Urban Areas

Jinxuan Guo, North China University of Technology

Presentation Abstract: Energy optimization scheduling for urban systems with multiple microgrid integrations can ensure the reliability of power supply, achieve optimal energy allocation and utilization, and reduce the overall costs of the multi-microgrid system. This paper proposes an energy optimization scheduling method based on a bi-level optimization model using a CPLEX+PSO hybrid algorithm. Day-ahead scheduling is conducted based on predicted wind and solar load data. Using CPLEX to solve the upper and lower-level functions as a baseline, an evaluation function is introduced to select the optimal particles in the particle swarm algorithm, resulting in the optimal solution for the energy allocation scheme of the multi-microgrid system.

Power Balance Strategy based on Ordery Electricity Consumption with Demand Response

Kunyu Yu, North China University of Technology

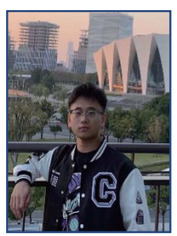
Presentation Abstract: Power balance strategy is more critical than before to the reliability and safety of the new grid with a growing penetration of intermittent renewable energy. A comprehensive methodology based on orderly electricity consumption (OEC) and demand response (DR) is proposed in this work to deal with power tight balance and power deficiency. First, DR is employed to improve the load profile by guidance of electricity price. Then, orderly consumption power (OCP) is determined and allocated over the subsystems according the load sizes and types. Furthermore, subsystem OCPs, including power shifting, averting and rationing are specified. At last, reliability assessment is implemented to review the practicability of the power balance strategy. The effect of the proposed methodology is verified by case studies.

Schedule of Sessions

Session Presenters

Short-term photovoltaic power generation prediction based on VMD-IGWO-LSTM

Lei Tian, North China University of Technology



Presentation Abstract: In order to improve the prediction accuracy of photovoltaic power generation, a short-term photovoltaic power generation prediction method based on variational mode decomposition (VMD) and improved grey wolf optimization algorithm (IGWO) to optimize long short term memory (LSTM) neural network is proposed. The multi-dimensional photovoltaic feature data is decomposed into several intrinsic modes and residual components of different frequencies by VMD algorithm to reduce the non-stationarity of the original sequence; IGWO is used to globally optimize the hyperparameters of LSTM neural network, and the IGWO-LSTM combination model under different modal sequence components is established. The simulation results show that the constructed VMD-IGWO-LSTM combination model has better prediction effect than the conventional short-term photovoltaic power generation prediction model.

HMP-LLM: Human Mobility Prediction Based on Pre-trained Large Language Models

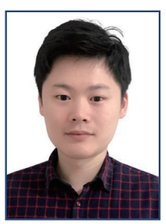
Xiaofei Zhong, Zhejiang University

Presentation Abstract: Human mobility prediction is fundamental to designing intelligent cities and forecasting how people move during disasters and health emergencies, specifically in emergency responses. However, the existing method for human mobility prediction is mainly designed for normal scenarios and is incapable of handling the case of a pandemic. The COVID-19 pandemic has presented challenges over the past few years: the powerful pandemic has a fundamental and long-lasting influence on mobility, which is hard to model. Inspired by recent progress in the Large Language Model, we present the Human Mobility Prediction-Large Language Model (HMP-LLM), which utilizes LLMs with understanding and reasoning abilities to do human mobility prediction tasks. Especially to adapt LLMs to intervened time series prediction, we propose the following critical designs: 1) Seasonal Decompose. 2) Two-stage Prompts Designing. We convert the input data into textual prototypes so LLMs can understand it, then we use two-stage prompts to guide the language model in reasoning. Extensive experiments on real-world datasets confirm the superiority of HMP-LLM over existing methods. Besides, due to the zero-shot nature and the expansibility of our two-stage design, HMP-LLM is expected to be used in other public safety incidents.

DTPI 2024 Oct. 20th Session Schedule

Session Name	Foreigner Session-Theory and Development of DTPI
Date and Time	Oct. 20, 2024, 16:30 -18:00 GTM+8
Meeting ADD	Faculty of Engineering Teaching Building A 2nd Floor A115

Chair



XiaoLong Liang
Institute of Automation,
Chinese Academy of Sciences

Self-Optimizing Control: An Old Idea Towards Digital Twins and Parallel Intelligence (DTPI)

Justus Nwoke, University of California, Merced

Presentation Abstract: The concept of self-optimizing control(SOC) can be classified as a type of learning control (LC) where a system is designed to adjust itself automatically to control an arbitrary dynamic process. Classic feedback control techniques and traditional optimal control techniques are also capable of automatically adjusting a system to a desired target but only if all the a priori information about the controlled process (plant environment) is known and can be described deterministically. Hence, learning control techniques becomes essential for systems where the a priori knowledge is unknown or incompletely known. Given this challenge, researchers through out the years and across discipline have developed and refined two possible approaches to address this challenge. One approach which is more conservative involves using the available known information to design the controller with anacceptable margin of error based on the designer's experience. The other approach which is akin to learning control involves designing a controller which is capable of estimating the unknown information during its operation and determining an optimal control action based on the estimated information. In this work, we present the different classes of learning control which inspired the concept of self-optimizing control and the trend towards digital twin and parallel intelligence to improve system knowledge acquisition for better control.

Schedule of Sessions

Session Presenters

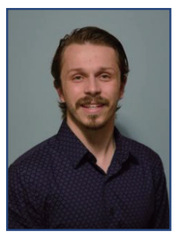
Fractional Order Dynamic Mode Decomposition

Shiang Cao, Dept. of Mechanical Engineering, University of California-Merced

Presentation Abstract: This study extends the dynamic mode decomposition (DMD) framework to fractional order DMD, enabling it to handle systems characterized by fractional dynamics. Traditional DMD is based on integer-order differential equations, which can be insufficient for capturing the dynamics of fractional-order systems. In this work, we incorporated fractional order dynamics into the DMD framework. Instead of using exponential functions, the eigen-decomposition of the approximated coefficient matrix was used to determine the parameters of the Mittag-Leffler functions, which were then employed to reconstruct the system's dynamics. Simulation results demonstrate that the fractional order DMD can effectively capture the dynamics of fractional order systems. Additionally, the proposed framework remains applicable to integer order systems as well.

Explainable Multi-task Learning for Improved Land Use Classification in Planetary Health Monitoring

Rafal Krzysiak, Dept. of Mechanical Engineering, University of California-Merced



Presentation Abstract: This paper introduces an innovative approach towards the development of a better understanding of planetary health monitoring techniques. Utilizing hyperspectral satellite imagery from the EuroSAT dataset, we focus on improving land use classification via multi-task learning with indice mapping, particularly emphasizing the Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), and Normalized Difference Water Index (NDWI) indices. Our approach employs explainable multi-task learning, integrating AI techniques such as GradCAM, SmoothGrad and saliency mapping to enhance model interpretability and provide valuable insights into the model's environmental perception. Our model achieves a high classification accuracy of 90%, demonstrating low inaccuracy in indice prediction and mapping, thereby ensuring precise assessment of land use. The incorporation of XAI techniques aids in providing a deeper understanding of the model's decision-making process, highlighting influential regions and features which provide valuable insight into the predictions.
These results underscore the effectiveness of our approach in accurately classifying land use and assessing vegetation health and water content, contributing to improved environmental management and decision-making. This work promotes sustainable practices and advances in the field of planetary health monitoring through the use of explainable and reliable AI-driven methods.

Modeling and Analysis of the Aft Collision Assist Advanced Driver Assistance System

Andrew Rictor, Colorado State University

Presentation Abstract: The Aft Collision Assist (ACA) is an Advanced Driver Assistance System (ADAS) that is integrated into the native systems of the host vehicle. The function of the ACA is to monitor rearward traffic and reengage the distracted driver of an approaching vehicle which it determines has a high potential of rear-ending the host vehicle. This work presents the ACA's digital twin via Simulink and response utilizing real world data for validation. The simulated results of the digital twin system provide a positive proof of concept for future physical prototyping.

A Robust Digital Twin Framework for Coaxial Helicopters: Development, Validation, and Practical Implications

Elham Fakhraian, Faculty of Engineering and Architecture
Universiteit Gent-Department of Industrial Systems
Engineering and Product Design (EA18)

Presentation Abstract: The advancement of Digital Twin (DT) technology, which serves as a digital representation of a physical object, system, or process, enables the simulation of real-world scenarios and enhances decision-making processes. In the aerospace industry, where product development and aircraft operation have substantial costs, using a validated aircraft model offers a cost-effective and safe approach for analyzing diverse attributes. This paper presents the development of a DT for coaxial rotorcraft. The model is demonstrated and validated through a case study of the CoAX600 helicopter and its flight data. The study highlights the importance of validation in ensuring the DT's accuracy and reliability before its practical application in flight scenarios.

Hosts

IEEE Wuhan Section

IEEE Wuhan Section History

Background

The Wuhan Section is part of Region 10, and is represented at the China Council. The Section was formed on 14 February 2007. Wuhan is the capital city of Hubei Province and is the largest city in Central China.

IEEE Wuhan Section History	
Established date	2007-02-14
IEEE Region	10
IEEE Council	China
Geographic region	Wuhan

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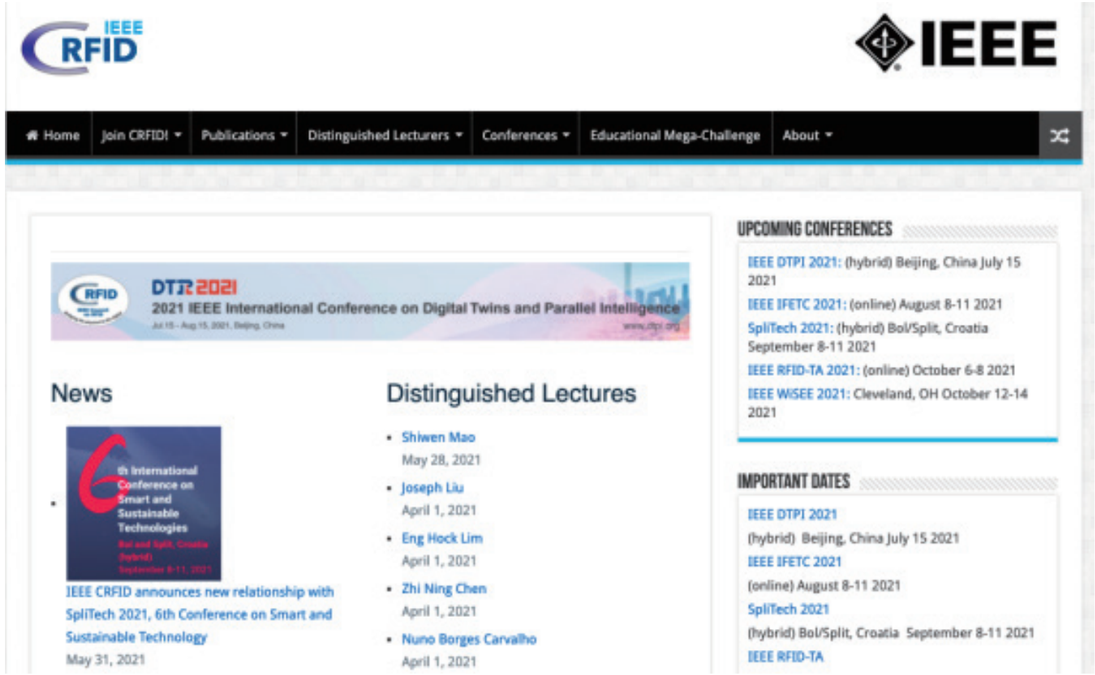
The Wuhan Section is part of Region 10, and is represented at the China Council. The Section was formed on 14 February 2007. Wuhan is the capital city of Hubei Province and is the largest city in Central China.

IEEE CRFID



The IEEE Council on RFID focuses on the theory and practice of matters relating to RFID (radio frequency identification) and RFID-related systems.

Council-sponsored activities provide participants the opportunity to publish and collaborate on research, network with colleagues, stay current on news and events, develop standards, and participate in educational activities. If you would like to hear about these activities and other IEEE Council on RFID programs, simply select "Add Item" and check out for no charge. We welcome your participation!

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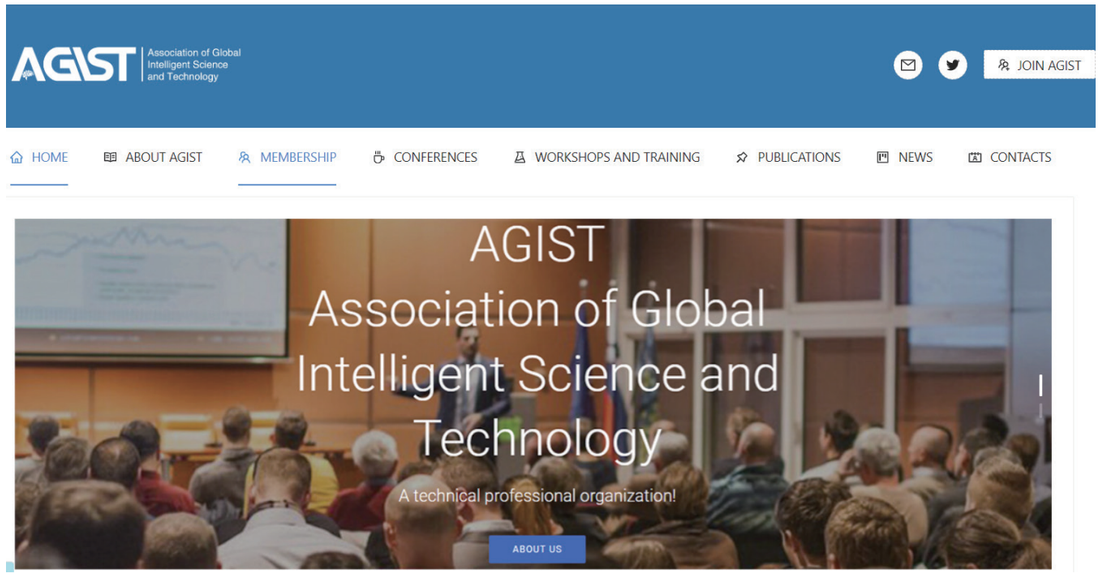
Website: http://www.ieee-rfid.org

Hosts

Chinese Association of Automation

Founded in 1961, the CAA is an important social force to develop automation, information and intelligence science and technology in our country. CAA and its members inspire a scientific community to innovate for a better tomorrow through its over 80,000 individual members, over 300 group members, 64 technical committees, 11 working committees, 53 science popularization and education bases, and 23 service stations for the academy. The CAA has been honored as the Advanced Association for Party Construction of China Association for Science and Technology, the Advanced Collective of the China Association for Science and Technology System, the Outstanding Unit of the National Association for Journal Publishing, and the Outstanding Association for Poverty Alleviation. The CAA has been elected to the Association for Ability Improvement and Reform Project Support of China Association for Science and Technology for many times. In 2021, the CAA was awarded the title of "National Advanced Social Organization" by Ministry of Civil Affairs.

Association of Global Intelligent Science and Technology



As a technical professional organization, AGIST is dedicated to advance the scientific understanding of artificial intelligence and its impact on science and technology. AGIST aims to promote research in scientific models, methods and technologies with both solid theoretical development and practical importance. Considering the significance of education to technology advancement, AGIST also aims to improve and empower teaching and training of a diverse science and engineering workforce that is capable of designing and deploying artificial-intelligence-empowered systems, tools and services.

Hosts

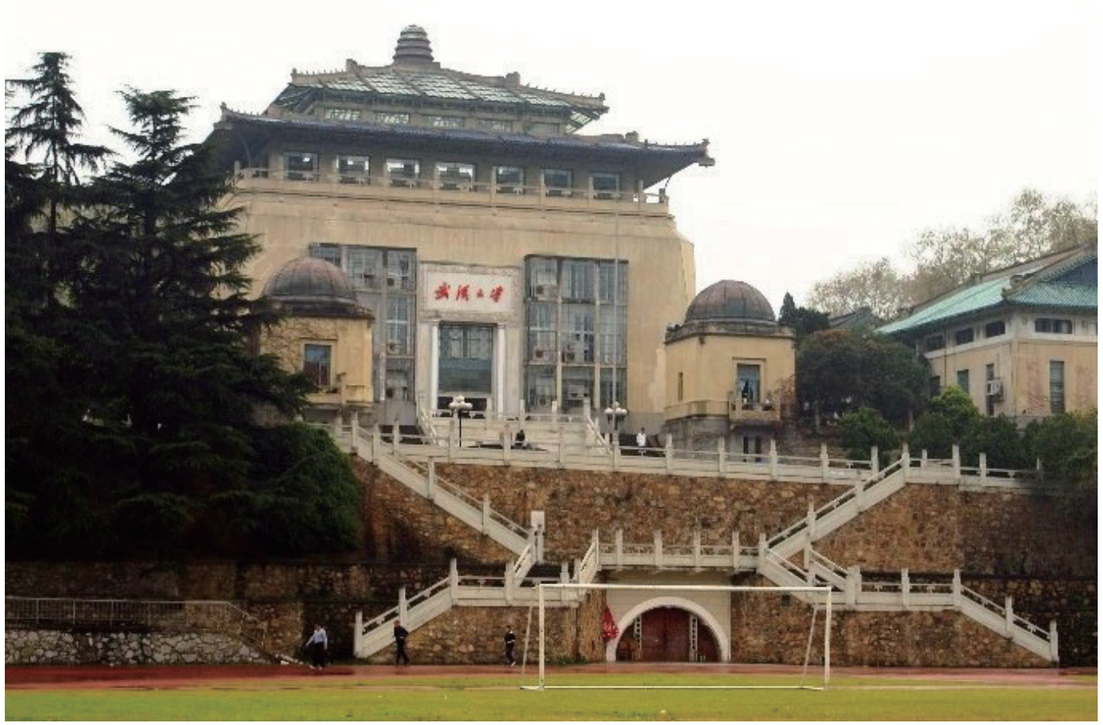
Beijing Huairou Academy of Parallel Sensing

Beijing Huairou Academy of Parallel Sensing (APS) primarily focuses on the sensor and high-end instrument equipment industries in Huairou. APS undertakes activities such as attracting top-tier talent, addressing key technological challenges, developing new products, cultivating and incubating scientific and technological achievements, and investing in projects. It operates under a president-responsible system led by a governing council.

Adhering to the principles of "demand-driven, innovation-driven, industry-research collaboration, and steady advancement," and following the development strategy of "based in Huairou, radiating nationwide, and intelligently connecting to the world," APS leverages cutting-edge technological innovation, technology transfer, and industrial incubation to gather innovative elements in the sensor industry, including technology, talent, capital, and services. It focuses on overcoming key technologies and developing core products in intelligent sensing. APS aims to establish a highland of parallel sensing intelligent technology innovation with core competitiveness and significant international influence, a base for cultivating and incubating emerging industries, an international cooperation and exchange hub, and a talent cultivation center for intelligent sensing.

Co-Organizor

School of Electrical and Automation, Wuhan University



Wuhan University (WHU) is a comprehensive and key national university directly under the administration of the Ministry of Education. It is also one of the "211 Project" and "985 Project"universities with full support in the construction and development from the central and local government of China.

The history of Wuhan University can be traced back to Ziqiang Institute, which was founded in 1893 by Zhang Zhidong, the then governor of Hubei Province and Hunan Province in the late Qing Dynasty. In the process of development and evolution, the institute changed its name several times before it was finally named Wuhan National University in 1928. It is one of the earliest comprehensive national universities in modern China. By the end of 1946, the university had established 6 colleges, the colleges of liberal art, law, sciences, engineering, agriculture and medicine. In 2000, an amalgamation of the former Wuhan University, Wuhan University of Hydraulic and Electric Engineering, Wuhan Technical University of Surveying and Mapping, and Hubei Medical University was announced, which ushered in a new era in its 100-odd years of development.

Sponsor

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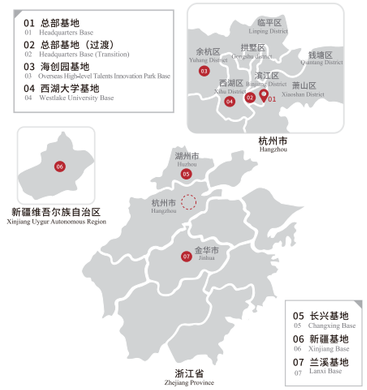
BAIMA LAKE LABORATORY

白马湖实验室（能源与碳中和浙江省实验室）是经浙江省政府批准，由浙江省能源集团有限公司牵头，联合浙江大学、西湖大学共建的新型研发机构。总部基地位于杭州市高新区（滨江）白马湖畔。



The Baima Lake Laboratory (Energy and Carbon Neutral Zhejiang Laboratory) is a new research and development institution approved by the Zhejiang Provincial Government, led by Zhejiang Provincial Energy Group Co., Ltd., and jointly built by Zhejiang University and Westlake University. The headquarters is located on the banks of Baima Lake in High-Tech Zone (Binjiang) of Hangzhou.

- **2022年5月22日，浙江省人民政府发文决定建设白马湖实验室；2022年6月7日，白马湖实验室正式揭牌成立**

  On May 5, 2022, the People's Government of Zhejiang Province issued a document deciding to build the Baima Lake Laboratory.
  On June 7, 2022, the Baima Lake Laboratory was officially established.

- **一总部、多基地：总部基地、总部基地（过渡）、海创园基地、西湖大学基地、长兴基地、新疆基地、兰溪基地**

  One headquarters, multiple bases: Headquarters Base, Headquarters Base (Transition), Overseas High-level Talents Innovation Park Base, Westlake University Base, Changxing Base, Xinjiang Base, Lanxi Base.

- **入选2022年度省级新型研发机构名单、牵头承接国家工信部节能低碳材料生产应用示范平台**

  Baima Lake Laboratory was selected as a provincial-level new research and development institution (2022).
  Baima Lake Laboratory took the lead in undertaking the demonstration platform for the production and application of energy-saving and low-carbon materials by the Ministry of Industry and Information Technology of the People's Republic of China.

- **汇聚了以12位院士为代表的实验室战略与学术咨询委员会**

  The Laboratory Strategy and Academic Advisory Committee has assembled a diverse team, with 12 academicians serving as prominent representatives.

·“139”科研布局·

· “1-3-9” SCIENTIFIC RESEARCH LAYOUT ·

1 个体系 SYSTEM

海-陆协同新型能源体系
A COORDINATED MARINE-TERRESTRIAL NEW ENERGY SYSTEM

3 大研究集群 RESEARCH CLUSTERS

太阳能转换与催化研究集群 SOLAR ENERGY CONVERSION AND CATALYSIS

瞄准太阳能高效转化、催化与利用，集中优势资源重点研究新型太阳能电池、宽光谱光热转化、太阳能燃料催化合成等技术，形成一批拥有自主知识产权的原创性成果，构建太阳能转化与利用技术体系。

Targeting efficient solar energy conversion, catalysis and utilization. Focusing on the research of new solar cells, broad-spectrum solar thermal conversion, solar fuel catalytic synthesis,and other technologies with advantageous resources. The aim is to generate a set of original achievements with independent intellectual property rights and establish a solar energy conversion and utilization technology system.

零碳能源转化与存储 ZERO-CARBON ENERGY CONVERSION AND STORAGE

瞄准现代能源体系储运关键核心技术，围绕零碳能源转化与存储材料、结构及工艺等基础理论和技术原理开展研究，前瞻性开发绿色高效制氢、超高压/深冷氢储运、能量转化与储能等技术，构建形成氢制取、储运、加注全链条的本质安全型氢能技术体系和支撑大规模可再生能源消纳的储能技术体系。

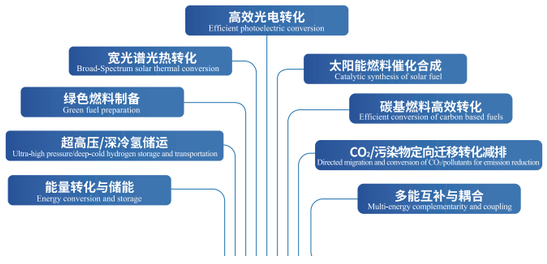
Targeting the key core technologies of modern energy system storage and transportation, research is conducted around the fundamental theories and technological principles of zero-carbon energy conversion and storage materials, structures, and processes. Forward-looking development of green and efficient hydrogen production, ultra-high pressure/deep-cold hydrogen storage and transportation, energy conversion and storage technologies, etc., is undertaken to construct a nature-safe hydrogen energy technology system covering the entire chain of hydrogen production, storage, and refueling, and to support large-scale renewable energy integration through energy storage technology systems.

能源低碳转化与多能互补 LOW-CARBON ENERGY CONVERSION AND MULTI-ENERGY COMPLEMENTARITY

聚焦碳基燃料定向高效转化基础和电、热、冷、气等多能互补转化基础研究，突破碳基燃料高效转化、多能互补与耦合、CO2/污染物定向迁移转化等的新理论、新方法、新技术，实现能源高效利用与减污降碳，破解能源安全保障与绿色低碳转型的挑战。

Focusing on the basic research of directed and efficient conversion of carbon-based fuels and the complementary conversion of multiple energies such as electricity, heat, cold, and gas, breakthroughs are sought in new theories, methods, and technologies for efficient conversion of carbon-based fuels, multi-energy complementarity and coupling, directed migration and conversion of CO2/pollutants, etc. This aims to achieve efficient energy utilization, pollution reduction, and carbon reduction, and to address the challenges of energy security and green low-carbon transformation.

9 大重点方向 KEY DIRECTIONS



·创新成果·

· INNOVATION ACHIEVEMENTS ·

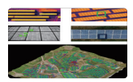
制备绿色甲醇，为杭州亚运会主火炬提供燃料
Produce methanol to provide green fuel for the main torch of the Hangzhou Asian Games

全国首个煤电二氧化碳捕集及矿化利用项目在兰溪电厂应用
The first coal-fired carbon dioxide capture and mineralization utilization project in China has been applied in Lanxi Power Plant

高功能、高安全型镍氢储能电池在枣泉电厂实现一次调频示范应用
Demonstration application of high function and high safety NiMH energy storage batteries in primary frequency regulation at Zaoquan Power Plant

研制了首套自主知识产权的基于氦膨胀制冷的氢液化系统
Developed the first set of independently patented hydrogen liquefaction systems based on helium expansion refrigeration technology

建成耦合燃煤电厂烟气碳捕集和可再生电力制氢工艺的百吨级/年绿色甲醇合成验证平台
Establishment of a Hundred-Ton/Year Green Methanol Synthesis Verification Platform for Coupled Coal-Fired Power Plant Flue Gas Carbon Capture and Renewable Electricity Hydrogen Production Process



光伏电站无人化巡检及故障智能评估技术在十余座光伏电站开展应用验证，规模超500MW
The unmanned inspection and intelligent fault assessment technology for photovoltaic power stations has been applied and verified in more than ten photovoltaic power stations, with a scale over 500MW

全国首台套天然气压差径向透平发电装置在国家管网浙江省天然气长输管网应用
The first set of natural gas pressure difference radial turbine power generation device in China has been applied in the Zhejiang Province's natural gas long-distance transmission network of PipeChina

全国首套船舶尾气高效净化技术/装备在海内外200余艘船舶上应用
The first high-efficiency purification technology/equipment for ship exhaust gas in China has been applied to over 200 ships domestically and abroad

Technical Sponsors

International Federation of Automatic Control (TC 9.1)

IFAC Website

IFAC
INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL

TC 9.1. Economic, Business, and Financial Systems

Dear Friends,

Welcome to the homepage of the IFAC Technical Committee 9.1 on “Economic, Business, and Financial Systems”.

IFAC TC 9.1 focuses on bringing together scientists, engineers, and business professionals to explore theoretical and computational methods and tools for decision and control in economics, finance, and management. As cross-fertilization cutting across disciplinary boundaries is at the core of our activities, we strongly encourage you to be actively engaged in a wide range of technical activities to move our TC forward and bring value to your research and professional development.

Please visit IFAC TC 9.1's website at

http://tc.ifac-control.org/9/1/

for announcements and updates.

I hope you are interested in these topics and I am waiting for your new ideas and proposals to improve our activity.

I am looking for a real cooperation with you being an active contributor of our Technical Committee.

Best Regards

Fei-Yue Wang

Chair, IFAC TC 9.1

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The State Key Laboratory for Management and Control of Complex Systems

Research Departments

State Key Laboratory of Management and Control for Complex Systems

Apr 15, 2020 Author: Print Text Size A A

The State Key Laboratory of Management and Control for Complex Systems (SKL-MCCS) is hosted by the Institute of Automation, Chinese Academy of Science (CASIA). It started as the Key Laboratory for Control of Complex Systems in 1991 and was formally approved to open to the outside as Key Laboratory of Complex Systems Engineering of CAS in 1994. In 2011, MOST of the People's Republic of China officially approved the plan of construction of the SKL-MCCS.

CAS Member DAI Ruwei is the director of academic committee of SKL-MCCS and Prof. WANG Feiyue is the director of SKL-MCCS. Currently, the SKL-MCCS has 70 full-time faculty members, 16 professors, and 5 winners of National Science Fund for Distinguished Young Scholars. What' s more, the SKL-MCCS has more than 200 graduate students and more than 300 floating researchers and engineers. The SKL-MCCS also hosts more than 100 visiting scholars at home and abroad.

The SKL-MCCS mainly focuses on research fields in theory and application of complex systems and intelligent science by using network environment to give a full play of multidisciplinary coordinated advantages. Based on technology of system engineering technology, it aims to solve the problem of modeling, analysis, management and optimization of complex systems in engineering, society, economy and other relative issues through theory and methods of intelligent science. The goal of future development of the SKL-MCCS is to become an internationally well-known organization for scientific research, technical innovation and talents cultivation.

http://www.compsys.ia.ac.cn/EN/index.html

The DAO and DeSci For Intelligent Industries

Establishment

QAll was jointly founded in 2013 as a pioneering research a development institute for Industry 5.0 and Parallel Industries by Chinese Academy of Sciences, Qingdao National High-Tech Industrial Development Zone, and Qingdao Science and Technology Bureau. lt was officially registered as a new type of research organization with independent legal entity in May 2014.

Orgnization

QAll is composed of an Academy for R&D , one enterprise for IP management, one industrial park for incubation, one investment fund for startups, and one open-platform for open-source programs. Currently, QAll' s Academy includes 14 research institutes in the fields of Intelligent Manufacturing, Intelligent Networks, Smart Agriculture, Smart Enterprises, Smart City, Smart Society, Smart Health, Smart Education, Intelligent Logistics, Intelligent Data, Intelligent Systems, Intelligent Services, Parallel Economy, Parallel Control and a Research and Development Center for Intelligent Technology. Since 2014, QAII has launched over 20 related startups, and some have grown into major AI companies in their fields.

DAO and DeSci

QAII' s Academic and Technical Council composes of 21 outstanding academician and experts from both China and abroad. QAII faculty has 258 researchers and developers, including 4 winners of the National Science Fund for Distinguished Young Scholars, 3 winners of National Natural Science Foundation Outstanding Youth Fund, and 4 Editor-in-Chiefs of premier international joumals. QAII' s strength lies in its pioneering effort in creating China's DAO and DeSci for Intelligent Science, Intelligent Technology, and Intelligent Industries, with over 3000 young scientists, researchers, and developers distributed in Mainland China. Currently, QAll has emerged as a new and major force in decentralized and autonomous scientific and technological activities.

Technical Sponsors

Shandong Association for Science and Technology

Qingdao Association for Science and Technology