Conference Program

2026 the 4th International Conference on Intelligent Control and Computing (IC&C 2026)

October 9-11, 2026
Harbin, China

Sponsor /主办单位

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Technical Co-Sponsor / 技术支持单位

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Conference Committee

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Aveer Nannoolal, Stellenbosch University, South Africa

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Conference Committee

Sai Krishna Thota, University of the Cumberlands, USA

Yujia Li, Institute of Blood Transfusion, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Meet Naishadhbhai Gandhi, Palo Alto Networks, USA

Georgy A. Nizhnichenko, Moscow University of Finance and Law (MFUA), Moscow, Russia

Min Xu, Institute of Blood Transfusion, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Elammalan Jayamani, Swinburne University of Technology Sarawak campus, Malaysia

Shilin Li, Institute of Blood Transfusion, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Ganesh Kumar, PSNA College of Engineering and Technology, India

Hua Peng, Sichuan Tourism University, China

Xiaoqiong Duan, Institute of Blood Transfusion, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Paulo Gill, Universidade Nova de Lisboa, Portugal

Ya Zhou, Institute of Blood Transfusion, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Jiraphon Srisertpel, Suranaree University of Technology, Thailand

Adriana Del Carme Téllez, Instituto Tecnológico de Morelia, Mexico

Welcome Message

On behalf of the conference committee, it is our profound privilege to welcome you to 2026 the 4th International Conference on Intelligent Control and Computing (IC&C 2026), in the ice city of Harbin, China from October 9 to 11, 2026. The conference is sponsored by Harbin Engineering University, China.

IC&C stands as a premier academic gathering that draws distinguished scholars and industry experts from diverse fields of intelligent control and computing to exchange ideas, showcase cutting-edge innovations, explore emerging research frontiers, and shape future directions in these dynamic disciplines.

The conference offers featured a comprehensive program that includes adamic visit, keynote speeches, invited talks, parallel technical sessions, and interactive poster presentations. Distinguished experts from many organizations will share their keen insight on the state of the emerging research topics. We hope all participants will enjoy unparalleled opportunities for in-depth discourse on advanced technologies and their fundamental scientific underpinnings. With its multidisciplinary scope and thought-provoking content, we are sure the conference will deliver exceptional academic value to all attendees.

On behalf of the IC&C 2026 organizing committee, we extend our deepest gratitude to all contributors who made this conference possible. We sincerely appreciate the dedication of our committee members, the valuable submissions from all authors, and the meticulous work of our external reviewers throughout the rigorous evaluation process. Special thanks go to our distinguished keynote and invited speakers for sharing their expertise, since these renowned scholars have greatly enriched our conference with insights aligned with this year's theme. Finally, we also would like to extend our sincere thanks to you and everyone who is attending this conference. We wish you all a wonderful time at this conference. In addition, we hope you enjoy the journey exclusively in Harbin! Thank you!

IC&C2026 Conference Committee

Useful Information

Online APP

ZOOM Download Link: https://zoom.us/download

IC&C 2026 Kits: www.icicc.org/kits.zip

Please rename your screen name before entering the room

Rename Screen Name Before Entering the Room	Examples
Keynote Speaker: Keynote-Name	Keynote-San Zhang
Invited Speaker: IS-Name	IS-San Zhang
Committee Member: Committee-Name	Committee-San Zhang

Materials Prepared by the Presenters

- **Oral Presentation:**

  PowerPoint or PDF files

  PowerPoint Background Template: **www.icicc.org/kits.zip**

- **Poster Presentation**:

  Poster: 80cm*180cm (height>width), Portrait Format

  Poster Background Template: **www.icicc.org/kits.zip**

Duration of Each Presentation

- Keynote Speech: 45 Minutes of Presentation including Q&A.
- Invited Speech: 25 Minutes of Presentation including Q&A.
- Regular Oral Presentation: 15 Minutes of Presentation including Q&A.
- Poster Presentation: 10 Minutes of Presentation including Q&A.

Note

- The regular oral presentation time arrangement is for reference only. In case any absence or some presentations are less than 15 minutes, please join your session before it starts.
- An excellent presentation will be selected from each session which will be announced and awarded an excellent presentation certificate.
- Conference Kits with PowerPoint template, poster template, virtual background for all participants to use: **www.icicc.org/kits.zip**

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Useful Information

Conference Venue

哈尔滨工程大学启航活动中心四楼

4th Floor Qihang Activity Center, Harbin Engineering University

地址：黑龙江省哈尔滨市南岗区南通大街 145 号

Add.: 145 Nantong Street, Nangang District, Harbin, P. R. China

Website / 网址：www.hrbeu.edu.cn/index.htm

交通指引：

1. High-Speed Rail Station Selection / 高铁站选择

位置 Loation	**哈尔滨站 Harbin Station**	**哈尔滨东站 Harbin East Railway Station**	**哈尔滨西站 Harbin West Railway Station**
距离 Distance	约 6 公里 About 6 kilometers	约 6 公里 About 6 kilometers	约 16 公里 About 16 kilometers
乘车 By Taxi	车程约 22 分钟，费用约 15 元 About 22 minutes and the cost is about 15 yuan	车程约 23 分钟，费用约 15 元 About 23 minutes and the cost is about 15 yuan	车程约 31 分钟，费用约 34 元 About 31 minutes and the cost is about 34 yuan
公共交通 By Public Transportation	乘坐地铁 2 号线（气象台方向）至“珠江路站”下车换乘地铁 3 号线外环至“大有坊街站” Subway Line 2 (heading towards the Meteorological Station) and get off at "Jiujiang Road Station". Then transfer to Subway Line 3 (the Outer Ring) and get off at "Dayu Fangjie Station".	乘坐 89 路公交车，从“哈东站”至“红平小区站” Take Bus No. 89, from "Haidong Station" to "Hongping Community Station"	乘坐地铁 3 号线外环至 “大有坊街站“ Take Subway Line 3 and go to the "Dayu Fangjie Station" on the outer ring.

Useful Information

2. Airport Selection / 机场选择

位置 Location	哈尔滨太平国际机场 Harbin Taiping International Airport	哈尔滨平房机场 Harbin Pingfang Airport
距离 Distance	约 43 公里 About 43 kilometers	约 23 公里 About 23 kilometers
乘车 By Taxi	车程约 64 分钟，费用约 82 元 About 64 minutes and the cost is about 82 yuan	车程约 54 分钟，费用约 45 元 About 54 minutes and the cost is about 45 yuan
公共交通 By Public Transportation	乘坐机场巴士 4 号线，从“哈尔滨太平国际机场站“到”群力医大（机场巴士站）“，再从”医大一院群力院区站“转乘地铁 3 号线内环至”大有坊街站“ Take Line 4 airport shuttle bus to from "Harbin Taiping International Airport Station" to "Qunli Medical University (Airport Shuttle Station)", and then transfer to the inner loop of Line 3 subway at "Yida No. 1 Hospital Qunli District Station" to reach "Dayoufang Street Station".	乘坐哈南新区 2 号线，从“艾瑞公司站“至”渤海路（地铁口）站“，转乘地铁 1 号线从”渤海路站“至”太平桥站“ Take Line 2 of Han Nan New District, from "Airi Company Station" to "Beihai Road (Subway Entrance) Station", then transfer to Metro Line 1 from "Beihai Road Station" to "Taipingqiao Station"

Hotel Recommendation / 住宿推荐

1. Hanting Hotel (Harbin Convention and Exhibition Center Hongqi Avenue Branch)
汉庭酒店(哈尔滨会展中心红旗大街店)

Address: Floor 1, No.617 Hongqi Street, Nanzhi Road Street, Daowai District, Harbin City, Heilongjiang Province, China
黑龙江省哈尔滨市道外区南直路街道红旗大街 617 号 1 楼

预订电话 Reservation Telephone No.： 0451-57633666

Useful Information

2. Hilton Hotel Harbin Convention and Exhibition Center
哈尔滨会展中心希尔顿酒店
Address: No.392 Changjiang Road, Xinchun Street, Nangang district, Harbin, Heilongjiang Province, China
黑龙江省哈尔滨市南岗区新春街道长江路 392 号

预订电话 Reservation Telephone No.： 0451-51717777

Necessary Information

Time Zone:

UTC/GMT+8

Average Temperature of Harbin in October

Average daily minimum temperature **2℃**

Average daily maximum temperature **14℃**

Bank and Foreign Exchange

The Currency is Chinese Yuan here

Important Phone Numbers

Fire: 119 **Medical Emergency:** 120 **Police:** 110

Important Notes

- ✧ Please take care of your belongings during the conference. The conference organizer does not assume any responsibility for the loss of personal belongings of the participants.
- ✧ Please wear delegate badge during the conference. There will be NO access for people without a badge. Never discard your badge at will.
- ✧ Accommodation is not provided. Early reservation is suggested to be made for delegates.
- ✧ Please show the badge and meal coupons during lunch and dinner.
- ✧ Don’t stay too late in the city and don’t be alone in the remote area. Be aware of the strangers who offer you service, signature of charity, etc., at scenic spots. More Tourist Information and Security tips are available online.

Useful Information

哈军工纪念馆
Memorial Museum of the Military Engineering Institute of the PLA

中国人民解放军军事工程学院纪念馆（简称哈军工纪念馆）是一座集文物征集、收藏、研究、展示于一体，全面展示哈军工发展历程和所取得的人才和科研成果的历史陈列馆。目前，哈军工纪念馆是国家二级博物馆，共设四个展厅，现有馆藏实物近两万件，国家级文物 500 余件。展示着哈军工筹建、发展、分建、改建的历史，揭示哈军工作为我国第一所综合性高等军事科学技术学府为我国国防科技事业做出的卓越贡献。

The Memorial Museum of the Military Engineering Institute of the PLA is a historical museum that integrates artifact collection, preservation, research, and exhibitions. It fully showcases the development of Harbin's military industry and the achievements in talent cultivation and scientific research. Currently, the museum is a national second-tier museum, featuring four exhibition halls. It houses nearly 20,000 artifacts, including over 500 national-level cultural relics. The exhibits cover the planning, development, expansion, and reconstruction of Harbin Engineering University's military industry.

船舶数字与智能技术实验室
Ship Digital and Intelligent Technology Laboratory

船舶数字与智能技术实验室，依托教育部重点实验室、工信部重点实验室、黑龙江省重点实验室、黑龙江省协同创新中心建设，围绕船舶数字化和智能化技术开展研究工作，重点开展智能船舶仿真验证评估、船舶航行态势智能感知、船舶数字孪生、船舶远程支持控制、船舶集群编队控制、船舶跨域协同等关键技术的攻关，获得工信部、科技部、研究所、船舶企业的项目资助，获得国家科技进步二等奖 2 项、省部级奖励 7 项。实验室具备环形屏幕 2 块、平面屏幕 1 块，船舶远程操控台 2 套，计算机控制终端 10 套，支持船舶离线仿真、在线远程控制，虚实融合协同推演等功能。

The Ship Digital and Intelligent Technology Laboratory relies on key laboratories of the Ministry of Education, key laboratories of the Ministry of Industry and Information Technology, key laboratories of Heilongjiang Province, and collaborative innovation centers of Heilongjiang Province. It focuses on research in ship digitization and intelligent technology, mainly conducting work on intelligent ship simulation verification and evaluation, intelligent perception of ship navigation situations, digital twins of ships, remote ship support and control, ship fleet formation control, and cross-domain ship collaboration. The lab has received project funding from the Ministry of Industry and Information Technology, the Ministry of Science and Technology, research institutes, and shipbuilding companies, and has won 2 Second Prizes of the National Science and Technology Progress Award and 7 provincial or ministerial-level awards. The lab is equipped with 2 circular screens, 1 flat screen, 2 remote ship control consoles, and 10 computer control terminals, supporting offline ship simulation, online remote control, and virtual-real combined collaborative exercises.

Keynote Speakers

October 10, Saturday, 9:10-09:55, Beijing Time, GMT+8

Onsite Meeting Room（线下会议室） – 4楼 教师沙龙 / Teacher's Salon, 4F
Zoom ID: 876 0822 6427
Password: 100911

Prof. Yongduan Song

Chongqing University, China

Foreign Member of the Chinese Academy of Engineering

IEEE Fellow

Speech Title: From Linearity to Nonlinearity: Breakthroughs and Practice in PID Control Architectures

Abstract: Over the century-long evolution of industrial automation, Proportional-Integral-Derivative (PID) control has established itself as a cornerstone of process control, owing to its simple structure, robust performance, and high reliability. However, as modern industrial systems increasingly exhibit large-scale, strongly nonlinear, time-varying, and multi-variable coupled characteristics, the conventional PID control paradigm — relying on fixed parameters — has gradually revealed its limitations in adaptability and intelligence.

In response to these challenges, this presentation adopts a dual perspective of "classical inheritance" and "intelligent leap" to explore effective pathways for endowing PID controllers with intelligent, autonomous, and self-adaptive capabilities. Moving beyond the single dimension of traditional parameter tuning, this work constructs a comprehensive empowerment framework that integrates intelligent algorithms, adaptive mechanisms, and nonlinearity and uncertainty compensation. Practical results demonstrate that intelligently empowered PID controllers not only retain the original advantages of low model dependency and ease of engineering implementation, but also achieve significant improvements in dynamic response quality, disturbance rejection, saturation suppression, and adaptability to complex operating conditions. This presentation aims to offer a viable pathway toward a new intelligent control ecosystem that balances theoretical depth with engineering value, and to promote the deeper integration and application of intelligent PID control technologies in Industry 4.0 and smart manufacturing.

Biography: Prof. Yongduan Song is Academician of the Chinese Academy of Engineering (Foreign Member), IEEE Fellow, Fellow of the Chinese Association for Artificial Intelligence (CAAI) and the Chinese Association of Automation (CAA). He serves as the Editor-in-Chief of IEEE Transactions on Neural Networks and Learning Systems (TNNLS), a top-tier international journal in artificial intelligence and the Founding Editor-in-Chief of Journal of Automation and Intelligence, a high-profile English-language journal supported by the China Sci-Tech Journal Excellence Action Plan (High-Starting Point New Journals). He also serves as Director of the Technical Committee on Trustworthy Control Systems, CAA. He previously held the position of Director of the "Collaborative Systems" Center at the U.S. National Institute of Aerospace and was recognized as a Langley Distinguished

Keynote Speakers

Scientist. He has led over 30 major research projects, including key programs of the National Natural Science Foundation of China, National Key R&D Programs of the Ministry of Science and Technology, and provincial/ministerial-level initiatives.

Keynote Speakers

October 10, Saturday, 09:55-10:40 Beijing Time, GMT+8

Onsite Meeting Room（线下会议室） – 4楼 教师沙龙 / Teacher's Salon, 4F
Zoom ID: 876 0822 6427
Password: 100911

Prof. Honggui Han

Beijing University of Technology, China

Dean of the School of Computer Science

Speech Title: Multi-objective dynamic collaborative optimization for the municipal wastewater treatment process

Abstract: Municipal wastewater treatment is an effective way to protect the environment and realize water resource recycling. However, due to the multi-processes, multi-working conditions, time-varying and other characteristics of municipal wastewater treatment process, optimal control based on a single scale, a single level, and a single goal cannot guarantee the optimum of the overall operation. Multi-objective collaborative optimization control achieves multi-objective optimization between local and global, short-term and long-term, and efficiency and safety in the municipal wastewater treatment process by constructing performance indicators at different time scales and designing a multi-conflict objective dynamic optimization method. It solves the problem of real-time dynamic optimization setting of key variables in the municipal wastewater treatment process, and effectively reduces the operating cost.

Biography: Honggui Han, professor, doctoral supervisor, and dean of the School of Computer Science. He has been engaged in research on intelligent control of complex systems, and has been selected for the National Science Fund for Distinguished Young Scholars, the National Science Fund for Excellent Young Scholars, the Young Beijing Scholar, the Young Scientist of the Chinese Automation Society, and the Outstanding Young Scientist of Beijing Universities, etc. As a result of the research, he has published more than 100 academic papers and written 5 books; he has obtained more than 60 authorized Chinese/American invention patents, has presided over/participated in the formulation of more than 10 national/group/local standards. He has won the second prize of the National Science and Technology Progress Award, the first prize of the Ministry of Education Science and Technology Progress Award, and the first prize of the Wu Wenjun Artificial Intelligence Science and Technology Progress Award, etc. He is currently the director of the "Digital Community" Engineering Research Center of the Ministry of Education and the director of the Beijing Key Laboratory of "Computational Intelligence and Intelligent Systems". He also serves as an editorial board member of journals such as China Science: Technical Sciences, IEEE Transactions on Cybernetics, etc.

Keynote Speakers

October 10, Saturday, 11:10-11:55, Beijing Time, GMT+8

Onsite Meeting Room（线下会议室）– 4楼 教师沙龙 / Teacher's Salon, 4F
Zoom ID: 876 0822 6427
Password: 100911

Prof. Lipeng Wang

Harbin Engineering University, China

Speech Title: Nonlinear Control and Applications under Fault and Disturbance Environments

Abstract: Under fault and disturbance environments, system dynamics often exhibit strong nonlinearity, time-varying characteristics, and uncertainties, making it difficult for traditional linear control methods to guarantee control accuracy and stability. Therefore, developing effective nonlinear control methods is of great significance for enhancing the safety and mission reliability of complex platforms. This report addresses this issue and is organized as follows: Integrated fault reconstruction and fault-tolerant control, SMC based on four-quadrant switch and NMPC, Super-twist sliding mode and RBFNN, and Event-triggered optimal control. The application effects of these methods on platforms such as rotorcraft, fixed-wing aircraft, and ships are also introduced. Each method presented in this report originates from practical problems encountered in the control processes in real-world systems. These practical problems are abstracted into mathematical models within nonlinear control theory, and specific controllers are designed using methods such as sliding mode control, model predictive control, and robust control to accomplish nonlinear control tasks for plants under faults and disturbances.

Biography: Lipeng Wang, professor, doctoral supervisor at the College of Intelligent Science and Engineering in Harbin Engineering University. He received his bachelor's, master's, and doctoral degrees from Harbin Engineering University. His research focuses on perception and control of complex systems. He has led three projects funded by the National Natural Science Foundation of China, one project funded by the Natural Science Foundation of Heilongjiang Province, and other research projects. He has received multiple awards, including one First Prize for Scientific and Technological Progress at the provincial and ministerial level, one Special Prize and one First Prize for Scientific and Technological Progress from the China Institute of Navigation. He has published more than 40 high-level papers as the first author or corresponding author, and three monographs as the first author.

Invited Speakers

October 10, Saturday, 13:30-13:55, Beijing Time, GMT+8

Onsite Meeting Room（线下会议室） – 4F- Yellow River Hall / 4楼 黄河厅

Prof. Mohammed Chadli

University Paris-Saclay Evry, France

Speech Title: Intelligent Control Systems for Fault Detection and Diagnosis: Vehicles application

Abstract: Some results on methods of fault detection filter synthesis, and observer design, for a class of nonlinear systems will be proposed. Observer-based LMI synthesis methods for T-S systems subjected to unknown inputs are presented. Subsequently, multi-objective synthesis problem is discussed in FDI framework. When we are interested in these problems in finite frequency domains, these classic techniques (in infinite frequency domains) become quite restrictive. Indeed, the problem of multi-objective synthesis (H_ and H∞) in the finite frequency domain is addressed. In a fault diagnosis context, the generated residue must be as sensitive as possible to faults and as robust as possible against unknown perturbations by means of finite frequency performance indices.

Biography: Mohammed Chadli received his M.Sc (DEA) from the Engineering School INSA-Lyon (France, 1999) and from “Ecole Normale Sup.” (Mohammedia, Morocco), the Ph.D. thesis in Automatic Control from the University of Lorraine (UL), CRAN-Nancy in 2002. He was Lecturer and Assistant Professor at the “Institut National Polytechnique de Lorraine” (UL, 2000-2004). Since 2004, he was Associate Professor at the University of Picardie and is currently a Full Professor at the University Paris-Saclay Evry, IBISC Lab., France. He was a visiting professorship at the TUO-Ostrava (Czech Rep.), UiA (Norway), SMU-Shanghai (2014-2017), NUAA-Nanjing (2018-2024), and the University of Naples Federico II (Italy, 2019).

Dr. Chadli’s research interests include filtering and control problems (FDI, FTC) and applications to vehicle systems, intelligence systems, network systems, and cyber-physical systems. He is the author of books and book chapters (Wiley, Springer, Hermes), numerous articles published in international refereed journals and conference proceedings.

Dr. Chadli is a senior member of IEEE. He is on the editorial board (Editor, Associate Editor) of several international journals, including the IEEE Transactions on Fuzzy Systems, Automatica, the IET Control Theory and Applications, the Franklin Institute Journal, Asian Journal of Control … and was a Guest Editor for Special Issues in international journals and the Vice Dean of the Faculty of Sciences and Technologies (Univ Evry Paris-Saclay). He now serves as the Chair of the IEEE France Section Control Systems Society Chapte, and listed in “100 000 Leading Scientists in the World”.

Invited Speakers

October 10, Saturday, 16:00-16:25, Beijing Time, GMT+8

Onsite Meeting Room（线下会议室） – 4F- Yangtze River Hall / 4楼 长江厅

Prof. Wen Kang

Beijing Institute of Technology, China

Speech Title: Stabilization of PDE systems and its application in Multi-agent systems

Abstract: Many important plants (e.g. flexible manipulators or chemical reactors) are governed by PDEs and are often described by models with a significant degree of uncertainty. Stabilization for infinite-dimensional PDE systems is a challenging problem. We aim to provide efficient methods for stabilization of PDEs and for PDE-based multi-agent deployment.

Biography: Prof. Wen Kang received the B.S. degree from Wuhan University, Wuhan, China, in 2009, and the Ph.D. degree from Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, China, in 2014. From 2015 to 2017, she was a Postdoctoral Researcher with the School of Electrical Engineering, Tel Aviv University, Tel Aviv-Yafo, Israel. In 2022, she joined Beijing Institute of Technology as a Professor. Her research interests include distributed parameter systems, time-delay systems, multi-agent systems, intelligent control, and ADRC. Prof. Kang was supported by National-level young talent program, Beijng Nova program, Xiaomi Young Scholar program. She serves as Associate Editor for IMA Journal of Mathematical Control and Information, IFAC MICNON, Information and Control. She is a Senior Member of IEEE and CAA.

Invited Speakers

October 10, Saturday, 13:30-13:55, Beijing Time, GMT+8

Onsite Meeting Room（线下会议室） – 4F- East China Sea Hall / 4楼 东海厅

Assoc. Prof. Depeng Zeng

Harbin Engineering University, China

Speech Title: No mechanical load Measurement and testing methods for multi-unit permanent magnet synchronous machines

Abstract: So far, there are some problems in the measurement and test of the permanent magnet synchronous machine (PMSM) applied in the high-power systems and the special high-end equipment, such as complex test systems, high test cost, and testing difficult, etc. It restricts the research and application level of electric machine production severely.

Aimed at the multi-unit PMSM, the indirect testing methods for important characteristics with no mechanical load are proposed by using the multi-winding. The parameters and characteristics of the machine in the load state can be reconstructed in the non-mechanical load state by the proper control strategies that make the physical fields in the two states are equivalent, it realizes the equivalent test with no mechanical load.

The inductance, resistance, temperature rise, mechanical characteristics, and torque fluctuation of the multi-unit PMSM can be indirectly tested with the proposed methods without any load device. It may give a new way to test the important parameters and characteristics of the multi unit PMSM which the parameters and characteristics are difficult to obtain with the direct testing methods.

Biography: Depeng Zeng, Director of IEEE PES Motor Drive Special Committee, member of Youth Work Committee of China Shipbuilding Engineering Society, senior member of China Electrotechnical Society, system member of Aerospace Drive Youth Technical Committee, member of China Automation Society. He has presided over 5 vertical projects at the national and ministerial levels, 2 basic scientific research business fund projects of central universities, 6 horizontal projects, and participated in many national and ministerial-level projects as the main participant. Research directions include motor systems and intelligent drive control technology, special motor design and analysis, intelligent microgrid power supply and distribution system analysis, etc.

Invited Speakers

October 11, Sunday, 09:55-10:20, Beijing Time, GMT+8
Online Invited Speech
Zoom ID: 876 0822 6427
Password: 100911

Assoc. Prof. Xianghua Wang

Beijing University of Posts and Telecommunications, China

Speech Title: Model Reference Adaptive Fault Tolerant Control under Limited Information for Unmanned Underwater Vehicles

Abstract: Unmanned Underwater Vehicles (UUVs) work in the harsh sea environment and are prone to faults, which can degrade their performances and even cause accidents. Therefore, it is necessary for UUVs to have the ability of fault tolerant control (FTC). Here, we propose a model reference adaptive FTC scheme to achieve trajectory tracking for an UUV subject to actuator faults, actuator saturation, external disturbances and other system uncertainties. To make matters more challenging, it is assumed that the velocities (linear and angular) are unavailable. In this condition, the UUV motion model in the horizontal plane has a high relative degree, thus increasing the design complexity. In contrast to observer-based FTC schemes, we introduce a dynamic compensator, which produces an augmented error system whose dynamics is minimum phase and relative degree one. An adaptive learning observer is then introduced to address the composite uncertain tiesa rising from actuator faults, uncertain nonlinearities, actuator saturation and disturbances. We show that the proposed scheme can ensure that the trajectory tracking errors converge to a small neighborhood around zero. Some simulations are conducted to verify the efficiency of the proposed scheme.

Biography: Dr. Xianghua Wang is an IEEE Senior Member and an Associate Professor at the Beijing University of Posts and Telecommunications. She received her B.E. in Automation from Northwestern Polytechnical University in 2010 and her Ph.D. in Mechanical Systems and Control from Peking University in 2015. Between 2015 and 2023, she held several academic positions at Shandong University of Science and Technology, including Postdoctoral Researcher, Lecturer, and Associate Professor.

Her research expertise covers fault diagnosis, fault-tolerant control for unmanned systems (such as unmanned underwater and aerial vehicles), and secure control for cyber-physical systems. Dr. Wang has published 2 books, 3 book chapters, and over 80 research papers, with more than 40 high-quality journal publications as the first or corresponding author. Her academic excellence has been recognized through the Beijing Nova Program and the Xiaomi Young Scholar award. Furthermore, she leads three projects funded by the National Natural Science Foundation of China.

Invited Speakers

October 11, Sunday, 09:30-09:55, Beijing Time, GMT+8
Online Invited Speech
Zoom ID: 876 0822 6427
Password: 100911

Assoc. Prof. Jing Zhu

Nanjing University of Aeronautics and Astronautics, China

Speech Title: Secure Consensus Control on Multi-agent Systems Using Blockchain Smart Contract

Abstract: This talk investigates secure consensus control in multi-agent systems with Byzan tine agents that send malicious information to interfere with consensus. A novel hierarchical model of multi-agent systems (MASs) based on blockchain is established by devising a dual layer communication system and designing a smart contract to detect and isolate Byzantine agents. Within this framework, we propose a blockchain-based secure consensus control method for MASs to identify Byzantine agents and support secure consensus. The proposed blockchain approach enables the identification of Byzantine agents with inconsistent state submissions and facilitates secure consensus among normal agents. Moreover, the proposed algorithm requires no prior global information about the MAS, making it widely applicable to real-world industrial scenarios.

Biography: Jing Zhu received the B. E. degree in Communication Engineering from Nanjing University of Posts and Telecommunications, Nanjing, China, in 2010, and the Ph.D. degree in Electronic Engineering from City University of Hong Kong, Hong Kong, China, in 2015.

Dr. Zhu was a visiting scholar with the Department of Electrical and Computer Engineering, University of California, Riverside, US, from December 2013 to June 2014. She was also a post-doctoral fellow with the Faculty of Innovation Engineering, Macau University of Science and Technology, from 2021 to 2023, as the recipient of “2020 Macao Young Scholars” Scheme. Currently, she is the Associated Professor with the College of Automation Engineering, Nanjing University of Aeronautics and Astronautics.

She is in charge of many high-level research projects, including the National Natural Science Foundation of China, Special Funding for China Postdoctoral Researchers, General Funding for China Postdoctoral Researchers, and National Foreign Expert Program, etc. She has authored over 50 papers published in academic journals and conferences. Her research interests include blockchain technology, multi-agent systems, secure control and distributed artificial intelligence. Her current study focuses on multi-agent systems subjected to typical cyber-attacks and dynamic topology in complex environments.

Invited Speakers

October 11, Sunday, 10:20-10:45, Beijing Time, GMT+8
Online Invited Speech
Zoom ID: 876 0822 6427
Password: 100911

Assoc. Prof. Chuan Luo

Sichuan University, China

Speech Title: Scalable Distributed Rough Hypercuboid Approach

Abstract: The popularity of granular computing, to a large extent, is due to the theory of rough sets. As a concrete theory of granular computing, rough set model enables us to tackle incomplete knowledge, manage the inconsistent information, and manipulate different levels of granularity. In that context, much attention has been paid and continues to be given to the rough sets in modeling and propagating uncertainty from both theoretical and applied points of view. The selection of prominent features for building more compact and efficient models is an important data preprocessing task in the field of data mining and machine learning. Rough set offers a powerful information granulation-oriented feature selection framework from data with imprecise, inconsistent and incomplete information. Noting that there is a growing consensus among the data science communities that the proliferation of data volume presents an immediate challenge pertaining to the scalability issue in recent years. As a practical pathway to pursue the challenge of explosive growth of data, parallelization of algorithms by exploiting high-performance computing resources in a distributed computing environment have increasingly gained strengths in facilitating large-scale data analysis. In this tutorial, we focus on the scalability aspect of the rough sets-related research. We will introduce our recent attempts for improving the scalability of rough feature selection approach via the parallel and distributed optimization under the premise of ensuring accuracy.

Biography: Dr. Chuan Luo is currently an Associate Professor with the School of Artificial Intelligence, Sichuan University, Chengdu, China. He received the Ph.D. degree in Computer Science from Southwest Jiaotong University, Chengdu, China, in 2015. He was a Visiting Ph.D. Student with the University of Regina, Regina, SK, Canada, in 2014. In Feb. 2019, he was a Visiting Scholar with the Harvard University, Cambridge, MA, USA.

His current research interests include artificial intelligence, data mining, machine learning, and granular computing. He has published more than 100 research papers in international conferences and journals, such as the IEEE TKDE, IEEE TPDS, IEEE TNNLS, IEEE TFS, IEEE TMM, etc. He serves as editors of International Journal of Computational Intelligence Systems, Human-Centric Intelligent Systems, and CAAI Transactions on Intelligent Systems. He has been consecutively selected for Stanford University's List of the World's Top 2% Scientists (Annual Scientific Impact Ranking).

Invited Speakers

October 10, Saturday, 13:30-13:55, Beijing Time, GMT+8

Onsite Meeting Room（线下会议室） – 4F- Yangtze River Hall / 4楼 长江厅

Assoc. Prof. Zicheng Wang
Northeast Forestry University, China

Speech Title: Optical Sensing in Robotic Hand Tactile Sensing Technology

Abstract: This report addresses a key issue in humanoid robotic fingertips: insufficient perception of tangential force by tactile sensors. To tackle this problem, we explore a novel sensing scheme based on a dual-period coupling of biomimetic cilia and assembled long-period fiber gratings. Drawing on the mechanical amplification mechanism of biological cilia, we employ magnetorheological elastomers to fabricate flexible cilia arrays, converting contact forces into changes in the refractive index of the medium driven by the photoelastic effect, thereby modulating the resonance spectrum of long-period gratings and establishing a quantitative sensing model that correlates the mechanical response of the cilia with optical signal drift. By utilizing an external magnetic field for non-contact adjustment of the cilia stiffness, we achieve, for the first time, real-time online tuning of sensor sensitivity and range. This research provides substantial technical support for the sensing and control of humanoid robotic hands.

Biography: Zicheng Wang, Associate Professor at the School of Control and Information Engineering, Northeast Forestry University, and Postdoctoral Fellow in Electrical Engineering at Harbin Institute of Technology, has long been engaged in the development of integrated optical devices and research in the fields of optical fiber communication sensing and system technology. He has achieved certain innovative results in areas such as highly integrated optical equipment, distributed long-distance optical fiber communication, and shipborne fiber-optic current measurement technology, with a multidisciplinary research foundation and experience spanning integrated optics, optical fiber communication, electronic science and instrumentation. He has led more than 10 projects, including the National Natural Science Foundation Youth Project, Heilongjiang Provincial Natural Science Foundation Youth Project, Aviation Science Foundation Project, Central University Fundamental Research Project, and military-industrial horizontal projects, with cumulative funds exceeding 10 million RMB. In the past three years, as first/corresponding author, he has published 21 SCI papers in authoritative journals such as OE, OLT, OL, and SJ, with a total of over 50 academic papers and 3 national key publications. He also serves as a young editorial board member for journals including Smart Sensors, Semiconductor Optoelectronics, and Journal of Naval Aeronautical and Astronautical University. He has been awarded the First Prize of the National Defense Science and Technology Progress Award and the Second Prize of the Heilongjiang Provincial Science and Technology Invention Award.

Invited Speakers

October 11, Sunday, 13:00-13:25, Beijing Time, GMT+8
Online Invited Speech
Zoom ID: 876 0822 6427
Password: 100911

Dr. Sukarnur Che Abdullah
National Panasonic Malacca, Malaysia

Speech Title: Machine Vision Immersive Research via Emerging AR/VR-IoT Technologies Framework

Abstract: Rapid advancements in real-time perceptual computing have accelerated the convergence of computer vision, Extended Reality (AR/VR), and the Internet of Things (IoT). However, conventional systems frequently struggle with fragmented data pipelines, high synchronization latency, and limited spatial context when attempting to map real-world IoT telemetry into interactive 3D virtual environments. This paper presents a unified architectural framework that seamlessly integrates deep learning-based machine vision with distributed IoT sensor networks to power next-generation AR/VR immersive research and applications.

The proposed framework establishes a three-tiered architecture comprising edge-based visual perception, low-latency IoT sensor telemetry, and a dynamic spatial rendering engine. Deep vision models process multimodal camera streams for real-time object tracking, semantic segmentation, and 3D spatial reconstruction. Simultaneously, edge IoT devices capture high- frequency environmental and diagnostic metrics. A central data-fusion middleware synchronizes these disparate data streams, overlaying live sensor telemetry directly onto spatially anchored visual representations within AR/VR interfaces.

To validate the architecture, the framework was benchmarked across simulated industrial teleoperation and smart factory monitoring environments. Experimental evaluations demonstrate a 35% reduction in end-to-end data fusion latency and a 28% enhancement in spatial alignment accuracy relative to traditional decoupled solutions. Furthermore, user assessments indicate improved operator situational awareness and reduced cognitive load during complex remote inspection tasks. By unifying machine vision intelligence with IoT ecosystems, this framework offers a scalable blueprint for digital twin deployment, remote robotics, and interactive spatial computing across smart industries.

Biography: Sukarnur Che Abdullah earned his PhD in Information Science from the Graduate School of Information Science, Nagoya University, Japan in 2012. The author's major field of research is robotics, tactile sensors, airflow sensors, humanoid robots, vision sensors and advanced manufacturing systems engineering. Furthermore, he is currently working as a Senior Lecturer at Universiti Teknologi MARA, Malaysia, under the Mechanical Engineering Faculty since 2002. He had 2 years (2000-2002) of working experience as a Production Quality Engineer at National Panasonic Malacca, Malaysia.

Conference Schedule

Day 1- October 9, 2026, Friday, GMT+8, Beijing Time

Onsite Registration 参会人员签到		
Time	**Event**	**Venue**
10:00-16:00	Onsite Registration	Harbin Engineering University Qihang Activity Center 哈尔滨工程大学启航活动中心 Donghai Hall （Fourth Floor） 东海厅（四楼）
14:00-16:30	Academic Visit	**1. Memorial Museum of the Military Engineering Institute of the PLA 哈军工纪念馆** **2. 船舶数字与智能技术实验室** **Ship Digital and Intelligent Technology Laboratory** (No photography is allowed) 船舶数字与智能技术实验室（**参观期间禁止拍照**） **Tips:** Please gather at the registration hall at 2:00 p.m. and set off at 2:15 p.m. 下午两点注册台集合，两点十五分准时出发！

Online Test Session | 线上测试		
Time	**Presenters**	**ZOOM Information**
15:00-16:30	Committee Members (Online), Speakers (Online) and Ordinary participants (Online)	**Zoom ID**: 876 0822 6427 **Password**: 100911 **Link**: https://us02web.zoom.us/j/87608226427

Online Test Tips:

- ✧ Please get your speech file ready for the pretest.
- ✧ Please unmute audio and start video while your presentation.
- ✧ It's suggested to use headset with microphone or earphone with microphone.

Conference Schedule

Day 2 - October 10, 2026, Saturday, GMT+8, Beijing Time

Opening Ceremony, Keynote Speeches | 开幕式、主旨报告 1. Onsite Meeting Room（线下会议室) - 4 楼 教师沙龙 / Teachers' Salon - 4 F 2. Online Session Zoom ID（线上会议室）: **876 0822 6427 / Password: 100911**	
09:00-09:05	**Conference Host** **Prof. Zhiguang Feng** ***Conference Co-Chair*** Harbin Engineering University, China
09:05-09:10	**Welcome Remarks** **Prof. Yuanhui Wang** ***Conference Co-Chair*** Harbin Engineering University, China
09:10-09:55	**Keynote Speech I** **Prof. Yongduan Song** ***Foreign Member of the Chinese Academy of Engineering*** ***IEEE Fellow*** Chongqing University, China ***Speech Title: From Linearity to Nonlinearity: Breakthroughs and Practice in PID Control Architectures***
09:55-10:40	**Keynote Speech II** **Prof. Honggui Han** ***Dean of the School of Computer Science*** Beijing University of Technology, China ***Speech Title: Multi-objective dynamic collaborative optimization for the municipal wastewater treatment process***
10:40-11:10	**Group Photo &Coffee Break**
11:10-11:55	**Keynote Speech III** **Prof. Lipeng Wang** Harbin Engineering University, China ***Speech Title: Nonlinear Control and Applications under Fault and Disturbance Environments***
12:00-13:30	**国际交流中心-2 楼/ International Exchange Center-2F** **Lunch**

Conference Schedule

Parallel & Poster Sessions | 现场平行报告及海报报告		
Time **时间**	**Venue** **会场**	**Parallel &Poster Session Information** **平行报告信息**
13:30-15:40	4F-- Yangtze River Hall 长江厅	**Parallel Session 1 - Security Detection and Intelligent Defense Technologies for Intelligent Information Systems Enabled by Digital Twins** **Session Chair:** Assoc. Prof. Zicheng Wang, Northeast Forestry University, China **Invited Speech**- Assoc. Prof. Zicheng Wang **Paper ID**: HC577, HC533, HC553, HC517, HC583, HC578, HC511-2
13:30-15:40	4F-- Yellow River Hall 黄河厅	**Parallel Session 2 – Intelligent Measurement Technologies and Signal Processing Methods Based on Multi-Modal Sensing Fusion** **Session Chair:** Assoc. Prof. Shou Feng, Harbin Engineering University, China **Invited Speech**- Prof. Mohammed Chadli **Paper ID**: HC516, HC521, HC548, HC557, HC564, HC563, HC593
13:30-15:40	4F—East China Sea Hall 东海厅	**Parallel Session 3 - Security Detection and Intelligent Defense Technologies for Intelligent Information Systems Enabled by Digital Twins** **Session Chair:** Assoc. Prof. Depeng Zeng, Harbin Engineering University, China **Invited Speech**- Assoc. Prof. Depeng Zeng **Paper ID**: HC560, HC559, HC558, HC575, HC602, HC586, HC523
15:40-16:00	**Coffee Break**	
16:00-18:10	4F-- Yangtze River Hall 长江厅	**Parallel Session 4 – Autonomous Control and Intelligent Decision-Making Algorithm Design for Unmanned Systems** **Session Chair:** Prof. Wen Kang, Beijing Institute of Technology, China **Invited Speech**- Prof. Wen Kang **Paper ID**: HC530, HC531-2, HC569, HC565, HC567, HC512, HC601
16:00-17:45	4F-- Yellow River Hall 黄河厅	**Parallel Session 5 – Intelligent Fault Diagnosis and Equipment Health Management in Complex Control Systems** **Session Chair:** Assoc. Prof. Chun Jia, Harbin Engineering University, China **Paper ID**: HC514, HC584, HC568, HC570, HC579, HC591, HC534
16:00-17:30	4F—East China Sea Hall 东海厅	**Poster Session – Machine Vision-Based Cooperative Control and Intelligent Positioning Technology for Unmanned Swarms** **Session Chair:** Assoc. Prof. Zhongping Zhang, Harbin Engineering University, China **Paper ID**: HC508, HC506, HC507, HC527, HC525, HC549, HC509, HC580, HC571
18 :20-20 :00	**国际交流中心-2 楼/ International Exchange Center-2F** **Dinner**	

Conference Schedule

Day 3- October 11, 2026, Sunday, GMT+8, Beijing Time

Online Parallel Sessions | 线上平行报告		
Time **时间**	**Online Information** **线上信息**	**Online Parallel Session Information** **线上平行报告信息**
09:30-11:15	**Zoom ID:** 876 0822 6427 **Password:** 100911	**Online Parallel Session 1 – Cooperative Control of Multi-Agent Systems and Network Resource Optimization Scheduling** **Session Chair:** Assoc. Prof. Jing Zhu, Nanjing University of Aeronautics and Astronautics, China **Invited Speech**- Assoc. Prof. Jing Zhu, Nanjing University of Aeronautics and Astronautics, China **Invited Speech**- Assoc. Prof. Xianghua Wang, Beijing University of Posts and Telecommunications, China **Invited Speech**- Assoc. Prof. Chuan Luo, Sichuan University, China **Paper ID**: HC529, HC519
11:15-13:00	**Break**	
13:00-14:25	**Zoom ID:** 876 0822 6427 **Password:** 100911	**Online Parallel Session 2 –Vision-Based Embedded Sensing Systems and IoT Applications** **Session Chair:** Dr. Sukarnur Che Abdullah, National Panasonic Malacca, Malaysia **Invited Speech**- Dr. Sukarnur Che Abdullah, National Panasonic Malacca, Malaysia **Paper ID**: HC528, HC556, HC599, HC600

Day 2- October 10, Saturday

Parallel Session 1

Time: 13:30-15:40 (GMT+8)
Date: Saturday, October 10 | 10 月 10 日（星期六）
Location: 4F- Yangtze River Hall / 4 楼 长江厅
Topic: Security Detection and Intelligent Defense Technologies for Intelligent Information Systems Enabled by Digital Twins
Chaired by: Assoc. Prof. Zicheng Wang, Northeast Forestry University, China

Invited Speech 13:30-13:55	**Title: Optical Sensing in Robotic Hand Tactile Sensing Technology** **Speaker**: Assoc. Prof. Zicheng Wang, Northeast Forestry University, China **Abstract:** This report addresses a key issue in humanoid robotic fingertips: insufficient perception of tangential force by tactile sensors. To tackle this problem, we explore a novel sensing scheme based on a dual-period coupling of biomimetic cilia and assembled long-period fiber gratings. Drawing on the mechanical amplification mechanism of biological cilia, we employ magnetorheological elastomers to fabricate flexible cilia arrays, converting contact forces into changes in the refractive index of the medium driven by the photoelastic effect, thereby modulating the resonance spectrum of long-period gratings and establishing a quantitative sensing model that correlates the mechanical response of the cilia with optical signal drift. By utilizing an external magnetic field for non-contact adjustment of the cilia stiffness, we achieve, for the first time, real-time online tuning of sensor sensitivity and range. This research provides substantial technical support for the sensing and control of humanoid robotic hands.
HC577 13:55-14:10	**Title: A Knowledge Extraction Method for Ship Navigation Safety Based on Domain Enhancement and Interactive Attention Mechanisms** **Authors:** Jiayi Zhang, Liheng Chen **Presenter**: Jiayi Zhang, Harbin Engineering University, China **Abstract:** To address the challenges of complex domain-specific terminology, ambiguous entity boundaries, and interference from irrelevant context in relation extraction from ship navigation safety texts, this paper proposes a knowledge extraction method integrating domain enhancement and interactive attention mechanisms. For named entity recognition, a Domain Anchor-based Local Attention and Gating BiLSTM-CRF (DALG-BiLSTM-CRF) model is developed, which treats lexicon-matched words as domain anchors, captures their local context through attention, and incorporates domain-enhanced features via a gating mechanism. For relation extraction, a Subject-Guided Interactive Attention BERT-BiLSTM (SGIA-BERT-BiLSTM) model is introduced, where the subject representation serves as the query and contextual representations serve as the keys and values to capture relation-relevant information for classification. Experiments on a self-constructed dataset show that the proposed models achieve mean F1 scores of 0.8242 and 0.7918 on the NER and RE tasks, respectively.
HC533 14:10-14:25	**Title: Bezier-KAN:Kolmogorov-Arnold Networks with Grid-Free Bezier Basis Functions** **Authors:** Kang Zou, Zhike Zhou, Weijie Ren **Presenter:** Weijie Ren, Harbin Engineering University, China **Abstract:** Kolmogorov-Arnold Networks (KANs) replace the fixed activation functions of multi-layer perceptrons with learnable functions on the edges, and these functions are usually built from B-spline bases. However, B-spline bases depend on a predefined knot grid, which brings extra hyper-parameters and grid-management cost. In this paper, we propose Bezier-KAN, a simple variant of KAN that uses Bezier basis functions, which are composed with Bernstein polynomials, instead of B-spline bases. The Bernstein basis is grid-free, nonnegative, and sums to one on a fixed interval, so each edge function is described by a small set of control coefficients that are easy to initialize and train. We test Bezier-KAN on the MNIST, Fashion-MNIST, and Tiny-ImageNet-200 image classification datasets. With the same network width, Bezier-KAN uses about 44.4% fewer parameters than a B-spline KAN. The proposed model reaches a test accuracy of 97.8% on MNIST and 90.0% on Fashion-MNIST, which is the best among all compared models. On the harder Tiny-ImageNet-200 dataset, several published variants either fail to converge or optimize very slowly, while Bezier-KAN trains stably and again gives the

best accuracy. The results show that Bezier-KAN is a simple and stable alternative to B-spline based KANs.

HC553

14:25-14:40

Title: Hypergraph Neural Networks with Meta-Learning for Personalized Multimodal Physiological Stress Detection

Authors: Chenxing Shao, Zhensong Li, Junjie Liu, Xinyu Lü
Presenter: Chenxing Shao, Beijing Information Science and Technology University, China

Abstract: Detecting stress from multi-modal physiological signals is important for mental health monitoring, but existing methods typically struggle to capture high-order cross-modality interactions and often generalize poorly across subjects, partly because individual physiology varies widely. We propose a framework that combines Hypergraph Neural Networks(HGNN) with Model-Agnostic Meta-Learning (MAML)for personalized stress detection. Independent temporal convolutional network(TCN)encoders extract temporal features from seven physiological modalities of the WESAD dataset, and a three-strategy hypergraph construction captures high-order nonlinear associations that pairwise graphs cannot represent. Hypergraph convolutions with attention pooling fuse the multimodal features, and MAML enables fast few-shot personalization through bi-level optimization. Under 15-fold leave-one-subject-out cross-validation, the method attains 84.28% mean accuracy, exceeding the strongest re-implemented baseline (a TCN-only encoder, 81.34%) by 2.94 percentage points and the best traditional classifier (linear discriminant analysis, LDA, 67.20%) by 17.08 percentage points.The ablation shows a hypergraph main effect of 2.10 percentage points, a MAML main effect of 0.85 percentage points, and a 3.99-point interaction, indicating that the two mechanisms are complementary. Attention analysis identifies electromyography (EMG) and electrodermal activity (EDA) as the most discriminative modalities, a finding that supports low-calibration wearable stress monitoring.

HC517

14:40-14:55

Title: Impact of Polar Ionospheric Scintillation on GNSS Dual-Antenna Heading Determination Performance

Authors: Xingda Zhao, Xiaodong Zhang, Qi Zhou, Kai Cheng, and Chun Jia
Presenter: Xingda Zhao, Harbin Engineering University, China

Abstract: Accurate heading determination is essential for navigation and scientific operations in polar regions, where severe ionospheric scintillation may significantly degrade the performance of Global Navigation Satellite System (GNSS) dual-antenna heading determination. This paper investigates the impact of polar ionospheric scintillation on heading performance using continuous observations collected from high-latitude GNSS stations during the severe geomagnetic storm of May 2024. The Rate of Total Electron Content Index (ROTI) derived from dual-frequency carrier-phase observations is employed to characterize ionospheric activity, while ambiguity fixing rate and heading RMS error are used to evaluate heading performance. Experimental results demonstrate that ROTI exceeded 3 TECU/min during the storm, resulting in substantial degradation of heading performance for approximately 1 km baselines, where the ambiguity fixing rate decreased from about 98% to 81% and the heading RMS increased from approximately 0.5° to 1.3°. In contrast, the 0.1 km baseline maintained an ambiguity fixing rate above 99% with only a slight increase in heading RMS. Furthermore, a strong positive correlation was observed between ROTI and heading RMS, indicating that stronger ionospheric scintillation leads to larger heading errors. These results demonstrate that baseline length plays a critical role in the robustness of GNSS dual-antenna heading determination under disturbed ionospheric conditions and provide valuable guidance for the design and performance evaluation of high-precision heading systems operating in polar regions.

HC583

14:55-15:10

Title: A Waveform Design Method for Integrated Sensing and Communication Based on Composite Coding

Authors: Zhiwei Pu, Hongiun Pu
Presenter: Zhiwei Pu, Chongqing Jiaotong University, China

Abstract: In this letter, a novel composite encoding waveform design methodology to resolve the fundamental performance trade-off between sensing and communication in integrated sensing and communication (ISAC) system. Firstly, Barker code for communication synchronization, Frank code for sensing detection, Quadrature amplitude modulation (QAM) was used to the transmission communication data. To ensure system performance, the optimization problem that simultaneously minimizes communication mean square error (MSE) and Cramér-Rao bound (CRB) for sensing, satisfy constant modulus constraints, symbol constraints, and power constraints was formulated. On the basis of this, an alternating optimization method based on Alternating direction method of multipliers (ADMM) is proposed. Simulation results show that compared with a single encoded method, the

proposed has better sense and communication performance, and providing a novel idea for waveform design in ISAC system.

HC578

15:10- 15:25

Title: High-Resolution Raman Distributed Temperature Sensing by Fiber Winding and Wavelet Denoising

Authors: Fuwen Chen, Zicheng Wang, Shiwei Fan, Yiwei Ma, Bo Gu, Ziyu Feng, Zeyu Ji
Presenter: Fuwen Chen, Northeast Forestry University China

Abstract: Abstract—Raman-based distributed temperature sensing (DTS) provides continuous long-range monitoring, but its spatial resolution, set by the laser pulse width, conflicts with the measurement accuracy. This paper addresses the trade-off by combining a spiral-wound sensing fiber with translation-invariant wavelet denoising. A geometric model relates the winding pitch and pipe diameter to the equivalent spatial resolution and quantifies the macro-bend loss penalty, and a stationary wavelet transform (SWT) with a soft universal threshold denoises the reconstructed temperature while preserving the temperature step edges. A Monte Carlo simulation with a physically grounded shot-noise model evaluates four denoisers on straight and spiral-wound fiber and sweeps the winding pitch from 1 to 5 cm. Winding at a 1 cm pitch improves the equivalent resolution from 1.02 m to 6.5 cm, a 15.7 times improvement, for about 3.5 dB of bend loss, and the SWT reduces the root-mean-square temperature error from 4.18 K, obtained with moving-average filtering, to 2.42 K; averaged over 30 Monte Carlo seeds the hotspot peak error is at most 2.6 K for the wound fiber and the flat-region bias is about 1 K. The pitch sweep quantifies the trade-off between the resolution gain, the accuracy and the bend-loss cost, and provides quantitative guidance for the choice of the winding pitch. Because no experimental data are used, the work is presented as a simulation-based feasibility study: the SWT is benchmarked against moving-average, Savitzky-Golay and decimated-wavelet denoisers, and a sensitivity analysis shows that the design guideline is robust to the assumed macro-bend-loss coefficient that scales the loss.

HC511-2

15:25-15:40

Title: Safe Cooperative Capture of a Faster Evader by Multiple USVs via Elastic Defense Manifolds

Authors: Wenxu Zhu, Guihua Xia, Jian Wang, Jiaqi Zhang, Weihan Li, Xiangli Jiang
Presenter: Wenxu Zhu, Harbin Engineering University, China

Abstract: This paper investigates the safe cooperative capture of a faster, perception-aware evader by multiple slower unmanned surface vehicles in an obstacle-constrained maritime environment. To address the difficulty caused by the speed disadvantage of individual pursuers and cluttered island-like obstacles, an obstacle-aware elastic defense manifold is proposed to generate feasible occupation points around the evader. The manifold adapts to the local free-space geometry and exploits obstacle-induced angular support, instead of relying on a rigid circular encirclement. A Cartesian-oval-based occupation criterion is incorporated to characterize the angular blocking capability of the pursuers, and an alert-aware deployment strategy is introduced to reduce premature triggering of the evader's high-speed escape mode. The time-varying occupation points are assigned through a distributed auction-based mechanism, while a control-barrier-function-based quadratic programming safety filter enforces obstacle avoidance, inter-USV collision avoidance, and alert-region constraints. Simulation results in an island-constrained scenario demonstrate that the proposed framework enables the USV team to establish an effective encirclement, contract cooperatively, and capture the faster evader while maintaining safety constraints.

Day 2- October 10, Saturday

Parallel Session 2

Time: 13:30-15:40 (GMT+8)
Date: Saturday, October 10 | 10 月 10 日（星期六)
Location: 4F- Yellow River Hall / 4 楼 黄河厅
Topic: Intelligent Measurement Technologies and Signal Processing Methods Based on Multi-Modal Sensing Fusion
Chaired by: Assoc. Prof. Shou Feng, Harbin Engineering University, China

Invited Speech
13:30-13:55

Title: Intelligent Control Systems for Fault Detection and Diagnosis: Vehicles application
Speaker: Prof. Mohammed Chadli, University Paris-Saclay Evry, France

Abstract: Some results on methods of fault detection filter synthesis, and observer design, for a class of nonlinear systems will be proposed. Observer-based LMI synthesis methods for T-S systems subjected to unknown inputs are presented. Subsequently, multi-objective synthesis problem is discussed in FDI framework. When we are interested in these problems in finite frequency domains, these classic techniques (in infinite frequency domains) become quite restrictive. Indeed, the problem of multi-objective synthesis (H_ and H∞) in the finite frequency domain is addressed. In a fault diagnosis context, the generated residue must be as sensitive as possible to faults and as robust as possible against unknown perturbations by means of finite frequency performance indices.

HC516
13:55-14:10

Title: Continual Learning Fault Diagnosis Method for Rolling Bearings Based on Large Language Model with Knowledge Graph Retrieval-Augmented Generation
Authors: Jianyu Zhou, Junyong Tao, Zhiqiang Liu, Xiaohong Hu, Yang Wang, Li Zhang
Presenter: Jianyu Zhou, National University of Defense Technology, China

Abstract: To address catastrophic forgetting and insufficient generalization to unseen operating conditions in class-incremental rolling bearing fault diagnosis, this paper proposes a knowledge-graph retrieval-augmented continual-learning large language model (CLFD--LLM). First, mechanism-aware multi-evidence case retrieval is developed by jointly exploiting deep signal representations, condition-robust statistical features, and fault characteristic frequency responses. Second, the retrieved evidence is used to construct a dynamic query-specific local heterogeneous knowledge graph. Signal tokens, graph-structured information, and retrieved textual evidence are then integrated to perform fault recognition through fine-tuning of a large language model. Finally, case replay and knowledge distillation are introduced to support the continual updating of both the model and the external knowledge base. Multiple domain-generalized class-incremental experiments are conducted on the CWRU dataset. The results demonstrate that the proposed method can effectively learn newly introduced fault classes, mitigate forgetting of previously learned classes, and maintain diagnostic capability under unseen operating conditions.

HC521
14:10-14:25

Title: A Denoising Residual Attention Autoencoder with Covariance-Aware Reconstruction for Industrial Process Fault Diagnosis
Authors: Qixin Wang, Qishen Wang
Presenter: Qixin Wang, Harbin Engineering University, China

Abstract: Reliable fault detection is essential for safe operation of nonlinear industrial processes, but data noise, correlated variables, and weak disturbances reduce the sensitivity of conventional monitoring methods. This paper proposes a denoising attention autoencoder monitored in the reconstruction-residual space (DRAAE) for unsupervised process fault detection. Gaussian corruption is applied during training, and a latent attention module assigns data-dependent importance to compressed process features. A covariance-aware reconstruction statistic is then constructed with a Ledoit-Wolf shrinkage estimate obtained from an independent normal run. The method is evaluated on the Tennessee Eastman Process with 52 variables and 21 fault types under a leakage-free protocol. Across five random seeds, the proposed method obtains an average fault detection rate of 75.30 ± 0.32 percent and an average false alarm rate of 2.35 ± 0.20 percent. It improves the average detection rate over the strongest conventional neural baseline by 6.30 percentage points; a paired five-seed comparison with AE gives p = 8.8 × 10−5. Ablations show that covariance-aware scoring and latent

attention are both important, whereas direct decoding of the weighted code is more stable than a residual latent-connection alternative. These results support the proposed DRAAE as a reproducible normal-data-only monitor for nonlinear industrial processes.

HC548

14:25-14:40

Title: A Semantic-Anchoring-Based Fault Diagnosis Method for Nuclear Power Plants
Authors: Zixinya Zhu, Jingyu Tang, Yichang Gao, Hang Wang, Jingyi Yue, Ziyan Xing and Jizhou Chen
Presenter: Zixinya Zhu, Harbin Engineering University, China

Abstract: Sensor signals of nuclear power units are susceptible to noise and measurement errors, which degrade the recognition accuracy of traditional supervised fault diagnosis models. To address this issue, this paper proposes a cross-modal contrastive learning fault diagnosis method based on large language model (LLM) semantic anchoring. The method freezes all parameters of the LLM, maps standardized fault mechanism texts into fixed semantic anchors, and constructs a bidirectional InfoNCE contrastive loss to achieve cross-modal alignment between multivariate time-series features and fault semantic features. Multiple comparative experiments conducted on the Fuqing Nuclear Power Plant simulator dataset demonstrate that under Gaussian noise at an intensity of 0.7, the proposed method achieves a diagnostic accuracy of 95.04 percent, significantly outperforming the supervised baseline, which achieves an accuracy of 67.93 percent. Extended experiments verify that the anti-noise robustness of the model primarily stems from the cross-modal constraint mechanism imposed by semantic anchoring, and centered text vectorization further optimizes the diagnostic performance. Online inference does not require loading the LLM. These results demonstrate the potential of the proposed method for real-time fault diagnosis and practical engineering deployment.

HC557

14:40-14:55

Title: Fault Hazard Section Localization Method Based on Synchronous Waveform Characteristics and Spatiotemporal Transformation
Authors: Ting Wang, Yifan Zhao, Dizhong Chen, Wenzhe Wang, Jianbin Xu, Silong Lin, Zhuangwei Hao, Yulong Ying
Presenter: Zhuangwei Hao, School of Energy and Mechanical Engineering Shanghai University of Electric Power Shanghai, China

Abstract: A fault hidden danger section location method integrating multi-dimensional synchronous waveform features, random matrix space-time transformation and t-SNE clustering is proposed to address the challenges of slowly-developing insulation hidden dangers in 10 kV active distribution networks, including strong concealment, weak transient characteristics of single-phase grounding, susceptibility to interference from arc suppression coil compensation and distributed generation, as well as the reliance on manual identification of feature modes for section judgment. Firstly, synchronous waveform recording data from primary-secondary integrated terminals are adopted to extract four types of time-series features, namely zero-sequence current generalized energy, wavelet approximate entropy, first peak ratio and first-order invariant moment, so as to construct a multi-measurement-point fault topological matrix. Random matrix theory is introduced to realize the space-time mapping from real-number waveform space to complex eigenvalue space, eliminating feature coupling interference caused by topological structures and grounding modes. On this basis, the cluster centers of each section are solved iteratively using the set of historical fault random eigenvalues, and a grey correlation classifier is utilized to realize automatic identification of fault hidden danger sections by calculating the spatial distance between samples and cluster centers. Simulation results demonstrate that the proposed method maintains extremely high section localization accuracy under small, medium and large fault sample sizes, with the accuracy no less than 98%. Free from manual discrimination of feature distributions, the proposed method provides theoretical and technical support for advance early warning and targeted patrol inspection of insulation hidden dangers in distribution networks.

HC564

14:55-15:10

Title: Early Warning Method for Potential Faults in Distribution Lines Based on Insulation Deterioration Characterization Factor
Authors: Bo Zhang, Xujie Wang, Jun Lin, Yuefang Xia, Zheng Xu, Hangjie Zhu, Luyang Zhang, Yulong Ying
Presenter: Luyang Zhang, School of Energy and Mechanical Engineering Shanghai University of Electric Power Shanghai, China

Abstract: Addressing engineering challenges such as long-term environmental erosion of distribution line insulation, gradual deterioration caused by overvoltage impacts, difficulties in monitoring latent deterioration hazards, poor coupling of traditional electrical monitoring indicators, weak timeliness of offline detection, and delayed fault early warning, a method is proposed based on line zero-sequence

current operation monitoring signals. This method involves the construction of an insulation deterioration characterization factor that incorporates dual instantaneous fault features and a hierarchical early warning approach for fault hazards. Firstly, relying on the measured zero-sequence current time-series monitoring data of distribution lines, a fixed analysis time window is defined, and two types of core degradation-related features are extracted within the window: instantaneous fault occurrence frequency features and instantaneous fault intensity features. Perform extreme value normalization on two types of original fault features to eliminate dimensional differences and interference from operating conditions. Complete weighted fusion based on feature degradation sensitivity, and construct a quantitative comprehensive characterization factor D for insulation degradation. Relying on the line insulation aging test and operation and maintenance sample calibration, the mild deterioration threshold D1 and severe deterioration threshold D2 are determined. By comparing the characterization factor D with the dual thresholds, the insulation deterioration level is discerned, achieving graded early warning of hidden dangers in distribution lines. The test results of the distribution network simulation operation data show that this method relies on the existing zero-sequence current monitoring system without the need for additional sensing equipment. It accurately classifies insulation deterioration and meets the normal online monitoring and operation and maintenance requirements of 10 kV distribution networks.

HC563

15:10-15:25

Title: An Intelligent Fault Diagnosis Method for Single-Phase Grounding in Distribution Networks Based on t-SNE Feature Extraction and Gray Relation Classifier

Authors: Yifan Zhao, Chao Feng, Ziyue Liu, Boren Shou, Zhuang Xiong, Gang Lin, Hengrui Zhang, Yulong Ying

Presenter: Yulong Ying, Shanghai University of Electric Power, China

Abstract: Single-phase grounding faults account for a relatively high proportion in distribution networks, with various fault types present. Zero sequence current and zero sequence voltage are the two most critical electrical quantities in fault diagnosis of distribution networks, especially single-phase grounding faults. They appear in pairs and are interrelated, essentially reflecting the quantitative indicators of three-phase imbalance in distribution networks. Zero sequence current is the core of fault diagnosis in distribution networks, especially the most common single-phase grounding fault. Through zero sequence current, the fault line can be quickly located and the fault type can be preliminarily determined. It is the key basis for operation and maintenance personnel to troubleshoot faults. However, how to quickly distinguish different types of faults has always been a research hotspot. This study proposes an innovative solution to the problem of difficulty in detecting single grounding fault types caused by unclear current and voltage characteristics of single grounding faults. That is an intelligent fault diagnosis method for single-phase grounding in distribution networks based on t-SNE feature extraction and gray relation classifier. Firstly, collect zero sequence current data segments within 2 cycles after a single-phase grounding fault, and use t-SNE dimensionality reduction algorithm to extract two-dimensional low dimensional features. Secondly, design a gray relation classifier to classify different fault samples through pattern recognition of extracted low dimensional features. Through simulation experiments, it has been proven that this method can effectively detect high resistance arc grounding fault signals and accurately identify various single-phase grounding faults.

HC593

15:25-15:40

Title: Digital Twin Driven Cross-Condition Fault Diagnosis of Rolling Bearings via Improved Domain-Adversarial Learning

Authors: Cangjie Yang, Yi Zhou, Chenxing Jiang, Depeng Zeng, Hengcheng Zhang, Xi Wang

Presenter: Cangjie Yang, College of Energy Xiamen University, China

Abstract: Rolling bearings are critical and failure-prone components in rotating machinery, and their health management is essential for ensuring equipment reliability. However, labeled fault samples are often scarce in industrial applications, making it difficult for diagnostic models trained solely on limited experimental data to achieve stable and robust performance. To address this issue, this paper proposes a rolling bearing fault diagnosis method integrating a digital twin model with an improved domain-adversarial neural network (Improved DANN). First, a bearing digital twin model is established based on rotor-bearing dynamics, and labeled simulation data under multiple operating conditions are generated. The fidelity of the digital twin is evaluated by comparing simulated signals with experimentally measured signals. Subsequently, six comparative diagnostic tasks are designed to systematically investigate the effects of digital twin generated samples and domain-adversarial adaptation. The Improved DANN integrates experimental and twin generated data to achieve adaptive feature-distribution alignment across different operating conditions. Experiments using the Case Western Reserve University (CWRU) bearing dataset demonstrate that the proposed method

significantly improves outer-race fault diagnosis accuracy and transfer robustness under varying operating conditions. The results verify the effectiveness of integrating digital twins with domain-adversarial learning and provide a practical framework for digital twin driven intelligent health management.

Day 2- October 10, Saturday

Parallel Session 3

Time: 13:30-15:40 (GMT+8)
Date: Saturday, October 10 | 10 月 10 日（星期六）
Location: 4F- East China Sea Hall / 4 楼 东海厅
Topic: Security Detection and Intelligent Defense Technologies for Intelligent Information Systems Enabled by Digital Twins
Chaired by: Assoc. Prof. Depeng Zeng, Harbin Engineering University, China

Invited Speech

13:20-13:55

Title: No Mechanical Load Measurement and Testing Methods for Multi-Unit Permanent Magnet Synchronous Machines
Speaker: Assoc. Prof. Depeng Zeng, Harbin Engineering University, China

Abstract: So far, there are some problems in the measurement and test of the permanent magnet synchronous machine (PMSM) applied in the high-power systems and the special high-end equipment, such as complex test systems, high test cost, and testing difficult, etc. It restricts the research and application level of electric machine production severely.
Aimed at the multi unit PMSM, the indirect testing methods for important characteristics with no mechanical load are proposed by using the multi-winding. The parameters and characteristics of the machine in the load state can be reconstructed in the non-mechanical load state by the proper control strategies that make the physical fields in the two states are equivalent, it realizes the equivalent test with no mechanical load.
The inductance, resistance, temperature rise, mechanical characteristics, and torque fluctuation of the multi unit PMSM can be indirectly tested with the proposed methods without any load device. It may give a new way to test the important parameters and characteristics of the multi unit PMSM which the parameters and characteristics are difficult to obtain with the direct testing methods.

HC560

13:55-14:10

Title: A Day-ahead Synergistic Scheduling Method for the Carbon-Energy Loop of Adjustable Resources in Industrial Parks Based on Fully Connected Neural Network and Tiered Carbon Trading
Authors: Yunguo Yang, Hongmin Chen, Zhitong Lu, Xuhua Ying, Xiao Ying, Jinjie Jiang, Yulong Ying
Presenter: Jinjie Jiang, Shanghai University of Electric Power, China

Abstract: In traditional industrial park energy networks, the control strategies for conversion equipment are often affected by non-linear factors, such as energy losses resulting from equipment ageing and fluctuations in power output. At the same time, integrated energy systems significantly enhance the complementarity of multiple energy sources, yet generate substantial carbon dioxide emissions. Under carbon peaking and neutrality targets, their low-carbon scheduling faces inherent defects: the limitations of edge computing for deep learning models and the lack of supply-side carbon-energy synergy. To address these issues, this paper proposes a day-ahead synergistic scheduling method based on fully connected neural network and tiered carbon trading. Firstly, a lightweight fully connected neural network model is constructed to eliminate non-linear conversion factors, achieving fast, precise energy supply prediction under variable conditions. Secondly, a supply-side carbon-energy closed loop comprising carbon capture systems and power-to-gas technology is established, alongside a tiered carbon trading mechanism to strictly guide deep decarbonization. Finally, targeting cost minimization, the grey wolf optimizer performs global optimization. Simulation results show this method dynamically responds to time-of-use energy prices, significantly reducing energy costs and high-carbon grid power output, achieving an optimal economic-environmental trade-off with substantial industrial edge deployment potential.

Day 2- October 10, Saturday

HC559

14:10-14:25

Title: Energy Efficiency Management of Integrated Energy Service Systems in Distribution Networks Based on Operational Planning

Authors: Haojie Lv, Hongyu Xia, Hongmin Chen, Junhao Huang, Jinjie Jiang, Hu Wang
Presenter: Jinjie Jiang, Shanghai University of Electric Power, China

Abstract: Against the backdrop of Zhejiang Power Grid's strategic transformation toward a modern integrated energy service provider, this paper constructs an energy efficiency management system framework based on operational scheduling theory. From the perspective of system engineering, a multi-scale modeling method is utilized to establish an integrated energy system model that centers on energy flows as the primary coupling mechanism between equipment units. A Particle Swarm Optimization algorithm is strategically employed to refine these operational strategies, incorporating dynamic demand-side response to maximize overall system-wide efficiency. Empirical results demonstrate that the large-scale integration of renewable energy sources significantly enhances the system's comprehensive energy performance. Furthermore, the optimal energy efficiency exhibits a positive correlation with the ratio of regional thermal, cooling or heating demand relative to the total electrical load. Notably, in comparison to conventional prime movers, including internal combustion engines and gas turbines, fuel cell-based Combined Cooling, Heating, and Power systems exhibit superior operational efficiency, providing a robust foundation for modern energy management.

HC558

14:25-14:40

Title: Optimal Operation of Distribution Network Integrated Energy System Based on Linear Programming

Authors: Haibin Wang, Qingwei Yu, Haiyang Jiang, Weifeng Wu, Weiliang Zhao, Xiaogang Shi, Jinjie Jiang
Presenter: Jinjie Jiang, Dongyang Power Supply Company, China

Abstract: Aiming at hour-level operational decision-making for integrated energy systems within distribution networks, this work introduces a unified matrix-based modeling framework. Rather than treating scheduling factors as explicit decision variables which typically gives rise to nonlinear coupling—the proposed approach reformulates the energy flows exchanged among conversion units and energy storage systems as state variables, thereby preserving linearity throughout the system representation. Drawing on graph-theoretic concepts, both the internal conversion attributes and the interconnection topology of energy devices are encoded into a compact coupling matrix, from which a linear programming formulation is directly constructed. The objective is set to minimize total operation and maintenance expenditure, with the system's topological connectivity treated as optimization variables. The resultant LP model is validated on a representative combined cooling, heating, and power installation. Results confirm that the methodology is concise, computationally tractable, and readily transferable across configurations: by simply resizing the matrix blocks, the model adapts seamlessly to heterogeneous multi-energy service architectures. Notably, the LP-based solution achieves a dramatic reduction in computation time relative to conventional nonlinear programming counterparts, without any sacrifice in numerical accuracy—making it a practical instrument for modern IES dispatch and management.

HC575

14:40-14:55

Title: Intelligent Optimization Method for Motor Modal Parameters Based on an Improved PSO–CNN Fusion Algorithm

Authors: Depeng Zeng, Mingjun Liu, Wenbo Shi, Junfeng Ou, Ying Zhao, Haifeng Cao, Yueru Ren, Liheng Chen
Presenter: Depeng Zeng, Harbin Engineering University,China

Abstract: To overcome the limitations of conventional trial-and-error-based parameter calibration and improve the prediction accuracy in the analysis of motor structural vibration characteristics, this paper proposes an intelligent calibration method for motor modal parameters based on the fusion of an improved particle swarm optimization (PSO) algorithm and a convolutional neural network (CNN). A hybrid particle swarm optimization–simulated annealing (PSO-SA) algorithm is employed, in which the simulated annealing mechanism enables the particle swarm to escape from local optima, thereby improving the global search capability and reducing the risk of premature convergence. Furthermore, a CNN is introduced for modal matching, achieving a matching accuracy of 97.81%. Finally, simulation studies are conducted to validate the proposed method. The modal errors are maintained within 5%, demonstrating that the proposed strategy can effectively identify and optimize motor system parameters to a certain extent and has practical engineering value.

Day 2- October 10, Saturday

HC602

14:55-15:10

Title: Research on Multi-Target Intelligent Allocation Strategy for Orders in Housekeeping Service Platforms

Authors: Kailai Xu, Tingting Ma, Chunmei Shu, Ximing Ma

Presenter: Kailai Xu, China-Japan Union Hospital of Jilin University, China

Abstract: This paper studies the intelligent order allocation problem to improve the operational efficiency of online housekeeping service platforms. Considering service providers' ratings, service commuting costs and order time intervals, a linear programming model is established to optimize platform operational performance. An improved large-scale neighborhood search algorithm integrating divide-and-conquer strategy, attention-based reinforcement learning and long short-term memory network is proposed. The divide-and-conquer clustering reduces problem scale and computational complexity. The attention reinforcement learning enhances local optimization capability in each cluster, while the long short-term memory network captures solution dependencies to avoid local optima and improve optimization accuracy. Comparative experiments based on the "58 Home" dataset verify the rationality of the optimization model and the superiority of the proposed algorithm. This study provides effective decision support for supply-demand scheduling of housekeeping service platforms.

HC586

15:10-15:25

Title: A Dynamic Multi-Swarm Multiple Roles Particle Swarm Optimization for Solving Supplier Optimization Problems

Authors: Xu Yang, Yifan Zhuo, Zhijun Gao, Yinlei Wen, Feng Tao, Ziping Zhang

Presenter: Xu Yang, School of Electrical and Control Engineering, Shenyang Jianzhu University, China

Abstract: Particle swarm optimization (PSO), a typical metaheuristic algorithm, is extensively applied for continuous optimization problems. Nevertheless, the algorithm has inherent limitations including premature convergence and unbalanced exploration-exploitation performance. This paper proposes a novel dynamic multi-swarm multi-role particle swarm optimization (DMM-PSO) to mitigate the above defects. A dynamic population segmentation strategy (DPSS) is first designed to facilitate efficient information interaction between particles. In each iteration, the entire particle population is dynamically partitioned and reconstructed according to individual fitness values. High-fitness particles constitute an elite subgroup for local search, while low-fitness particles form a inferior subgroup responsible for global search, and common particles compose a general subgroup to coordinate exploration and exploitation. Furthermore, an adaptive role update strategy (ARUS) is embedded into the algorithm framework, where differentiated update rules are adopted for particles with different roles, effectively maintaining the dynamic balance between global exploration and local exploitation. Comparative experiments on the CEC2013 benchmark set and practical engineering cases are implemented to verify the algorithm performance. The results indicate that the proposed DMM-PSO outperforms several advanced mainstream algorithms in convergence rate, solution accuracy and overall optimization performance.

HC523

15:25-15:40

Title: A Study on a Multi-Objective Optimization Method for LVC Training Resource Allocation Based on NSGA-II

Authors: Jiazhe Lai, Keqing Zhu, Liru Ma, Longxuan Kou, Ying Geng, Zide Fan

Presenter: Longxuan Kou, Aerospace Information Research Institute, Chinese Academy of Sciences, China

Abstract: Modern air combat scenarios are characterized by high dynamics, intense information density, and high risk, placing extremely high demands on fighter pilots' on-the-spot decision-making capabilities. Conducting efficient, safe, and low-cost combat-realistic training has therefore become a critical challenge in the field of air combat training. As a core technical framework for intelligent combat training, the Live-Virtual-Constructive (LVC) architecture integrates three types of training assets—live entities, virtual simulators, and constructive computer-generated forces (CGF)—to remedy the drawbacks of traditional single-mode training. However, existing LVC training resource allocation relies heavily on human experience or simple rules and lacks a scientific, quantitative basis, which leads to imbalanced allocation schemes and severely limits training effectiveness. To address these problems, this paper proposes an NSGA-II–driven multi-objective optimization method for the allocation of live, virtual, and constructive entities in LVC training. Building upon a systematic analysis of the core requirements of air combat training, three objective functions are formulated—

mission complexity matching degree, flight safety, and formation consistency penalty—together with hard constraints, yielding a constrained multi-objective optimization model for deriving the optimal LVC allocation scheme. Concurrently, the TOPSIS method is introduced to comprehensively evaluate and rank the Pareto-optimal solutions output by the model, providing decision-makers with an optimal compromise scheme. In a case study of eight training entities, the recommended scheme assigns six entities to live and two to virtual resources, achieving the highest relative closeness degree of 0.685 with balanced gains in training effectiveness, flight safety, and formation coordination. The results demonstrate that the proposed method promotes a shift toward scientific and precise allocation of LVC training resources and provides methodological support for automated resource allocation in intelligent training.

Day 2- October 10, Saturday

Parallel Session 4

Time: 16:00-18:10 (GMT+8)
Date: Saturday, October 10 | 10 月 10 日（星期六）
Location: 4F- Yangtze River Hall / 4 楼 长江厅
Topic: Autonomous Control and Intelligent Decision-Making Algorithm Design for Unmanned Systems
Chaired by: Prof. Wen Kang, Beijing Institute of Technology, China

Invited Speech 16:00-16:25	**Title: Stabilization of PDE Systems and Its Application in Multi-Agent Systems** **Speaker**: Prof. Wen Kang, Beijing Institute of Technology, China **Abstract:** Many important plants (e.g. flexible manipulators or chemical reactors) are governed by PDEs and are often described by models with a significant degree of uncertainty. Stabilization for infinite-dimensional PDE systems is a challenging problem. We aim to provide efficient methods for stabilization of PDEs and for PDE-based multi-agent deployment.
HC530 16:25-16:40	**Title: Event-Triggered Adaptive Fixed-Time Integral Sliding-Mode Control for USV Trajectory Tracking** **Authors:** Zhijian Wang, Jiajia Zhou, Yang Wu, Danmi Xu **Presenter**: Zhijian Wang, Harbin Engineering University, China **Abstract:** This paper investigates trajectory-tracking control for an unmanned surface vehicle (USV) subject to time-varying parametric uncertainties, matched/mismatched marine disturbances, unknown nonlinear dynamics, and redundant controller updates. First, a control-oriented USV model is derived through a nonsingular coordinate and input transformation. Then, an adaptive parameter estimator, implementable disturbance observers, and a radial basis function neural network (RBFNN) are integrated into a fixed-time integral sliding-mode framework to compensate uncertain parameters, disturbances, and unknown nonlinearities. Furthermore, a state-dependent time-varying event-triggering mechanism is designed to update the control input only when the control-holding error reaches a prescribed threshold. Lyapunov analysis proves uniform ultimate boundedness of all closed-loop signals, practical fixed-time convergence of the tracking errors, and exclusion of Zeno behavior. Simulation results show that the proposed controller reduces control updates from 60001 to 13822, achieving a saving of 76.96%, while maintaining tracking accuracy comparable to the time-triggered controller. Compared with the event-triggered controller without RBFNN compensation, the ITAE is reduced by 59.11%.
HC531-2 16:40-16:55	**Title: Disturbance-Bound-Based Gain Tuning for Backstepping Sliding-Mode AUV Trajectory Tracking** **Authors:** Leilei ZHANG, Jiajia ZHOU **Presenter:** Leilei ZHANG, Harbin Engineering University, China **Abstract:** A component-wise disturbance-bound rule is developed to tune the switching gains of backstepping sliding-mode composite control (BSMC) for trajectory tracking of a five-degree-of-freedom autonomous underwater vehicle (AUV). Each generalized channel sets its switching gain to the analytical matched-disturbance bound plus a positive reaching margin. The rule links disturbance characterization, switching-gain selection, and boundedness analysis within a two-loop backstepping structure. Continuous backstepping control (BSC) provides the baseline under the same helical reference, initial condition, input limits, sampling period, and five-channel disturbance realization. The evaluation combines position and attitude errors with peak input ratio, normalized control effort, and raw-input normalized total variation. Under the matched-disturbance scenario, the tuned BSMC reduces position integral absolute error from 2.1425 m s to 0.1503 m s, position root-mean-square error from 0.008601 m to 0.000555 m, and maximum position error by 94.64%. The switching action raises normalized total variation from 5.2560 to 17863.1894. These results provide a gain-tuning baseline for adaptive-gain and smooth reaching-law AUV controllers.

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HC569

16:55-17:10

Title: Path Following Control Of Fully-Cushioned Hovercraft Based on Multi-Power Sliding Mode Fusing PPC and IBLF
Authors: Song Wu, Zhiguang Feng, Yujie Xu, Mingyu Fu, Wanying Liu, Bo Feng
Presenter: Song Wu, Harbin Engineering University, China

Abstract: To address the conflict between tracking accuracy and navigation safety for fully-cushioned hovercraft path following subject to model uncertainties and composite marine environmental disturbances, a multi-power sliding mode control scheme integrating prescribed performance control (PPC) and asymmetric integral barrier Lyapunov function (IBLF) is proposed. A fixed-time convergence performance function together with hyperbolic-tangent transformation is adopted to confine the lateral path-following error and heading error within the prescribed performance envelope. The adjustment term of asymmetric integral barrier Lyapunov constraint is embedded into the multi-power reaching law to enforce hard constraints on surge velocity and yaw rate while suppressing sliding-mode chattering. A second-order terminal sliding-mode observer is designed to estimate lumped disturbances and perform feed-forward compensation. Complete closed-loop stability analysis is carried out by constructing composite Lyapunov candidate functions. It is rigorously proven that all closed-loop signals are uniformly ultimately bounded, tracking errors satisfy prescribed performance constraints and system states never violate safety boundaries. Oblique straight-line path-following simulations are carried out on a 40-ton hovercraft, and comparisons are made with traditional backstepping control. Simulation results demonstrate that the lateral path error and heading error stay within preset performance bounds; surge velocity and yaw rate are strictly kept inside hard-constraint limits; the disturbance observer converges within 5 s; control outputs are smooth without obvious chattering. The proposed approach achieves better overall performance than backstepping control, which verifies the effectiveness of the presented control strategy.

HC565

17:10-17:25

Title: CA-LGTR: Confusion-Aware Local-to-Global Tactical Intention Recognition for Unmanned Surface Vehicles
Authors: Yunyi Liu, Chengtao Cai, Xiaopeng Gong
Presenter: Yunyi Liu, Harbin Engineering University, China

Abstract: Tactical intention recognition is important for unmanned surface vehicle (USV) surveillance, where a system must infer maneuver intentions from limited motion observations. Reliable labeled tactical trajectories are difficult to collect at scale, and local segments of different intentions may share similar geometric or kinematic patterns. This paper proposes CA-LGTR, a confusion-aware local-to-global recognition framework using externally observable motion features. A rule-guided simulation chain first converts maneuver semantics into randomized initial states, sparse waypoints, speed profiles, dense reference paths, and closed-loop USV trajectories through kinematic or MMG style motion simulation. A complete 13-dimensional observable feature pool is then constructed, and multiple compact feature subsets are evaluated through ablation. CA-LGTR selects a temporal backbone through model-window comparison, refines locally ambiguous reconnaissance/feint predictions with a top-2 confusion gate and a binary expert branch, and aggregates window-level evidence into trajectory-level decisions by top-k probability pooling. Experiments on 3500 clean simulated trajectories show that expert refinement improves window-level macro F1 from 0.8694 to 0.8754, while trajectory-level aggregation improves seven-class contact-level accuracy to 0.9676 and feint F1 to 0.9020.

HC567

17:25-17:40

Title: Research on Cooperative Evasion Methods for UUVs Based on Deep Reinforcement Learning
Authors: Gaoxing Zhang, Huijing Shi and Fantai Lin
Presenter: Gaoxing Zhang, Kunming Shipborne Equipment Research &Test Center, China

Abstract: With the widespread use of underwater unmanned vehicles (UUVs) in areas such as energy and military, intelligent confrontation for UUVs has attracted increasing research attention. However, relatively little work has addressed how UUVs at a disadvantage position break away from pursuit and ensure their own survival. This paper studies how a heterogeneous UUV formation can cooperatively protect its high-value members when facing multiple attack threats. Based on the Multi-Agent Twin-Delayed Deep Deterministic Policy Gradient (MATD3) algorithm, we realize navigation and motion control for multiple evading UUVs during the escape process. To cope with the pursuer's clear speed advantage, a conditional reward mechanism is designed for MATD3: before the pursuer identifies the high-value targets in the evading formation, the UUVs lure it away from those targets through coordinated maneuvers, thereby ensuring their successful escape. The proposed method is trained and evaluated in a two-dimensional environment. After training, the UUV formation completes the required cooperative escape in confrontation simulations. The results of simulation show that the proposed

Day 2- October 10, Saturday

	cooperative escape method based on MATD3 enables the formation to coordinate its movements adaptively according to the current situation and to protect the high-value members from being caught.
HC512 17:40-17:55	**Title: Uncertainty-Aware Hybrid Friction Compensation for Ball-Screw Feed Drives Using Smooth Stribeck Modeling and Residual Learning** **Authors:** Weiyuan Qi, Xu Wang, Shuo Song, and Li Li **Presenter:** Weiyuan Qi, Harbin Institute of Technology, China **Abstract:** Nonlinear friction is a major factor limiting the tracking accuracy of ball-screw feed drives, especially during low-speed motion and velocity reversal. Conventional Stribeck-model-based feedforward compensation can reduce friction-induced tracking errors, but its performance may deteriorate when friction parameters are inaccurate or vary with operating conditions. To improve compensation performance under friction parameter mismatch, this paper proposes a hybrid friction compensation method that combines a smooth Stribeck nominal model with an ILC-type residual feedforward learning term. The smooth Stribeck model provides nominal friction compensation, while the residual term reduces mismatch-induced error. A reversal-weighted learning mechanism is further introduced to emphasize the velocity-reversal region. The proposed method is combined with a PID controller and evaluated through simulations under different reference frequencies and friction parameter mismatches. For a 0.5 Hz sinusoidal reference, the proposed method reduces the RMSE from 4.264 μm with fixed-parameter Stribeck compensation to 1.406 μm, and reduces the maximum reversal error from 5.277 μm to 1.260 μm. At a friction parameter mismatch level of 30%, the proposed method maintains a 90.734% RMSE reduction, indicating improved robustness against friction parameter mismatch in simulation.
HC601 17:55-18:10	**Title: Uncertainty-Aware Hybrid Friction Compensation for Ball-Screw Feed Drives Using Smooth Stribeck Modeling and Residual Learning** **Authors:** Donghui Yuan, Lipeng Wang, Jialiang Liu and Tianyu Gao **Presenter:** Donghui Yuan, Harbin Engineering University, China **Abstract:** Nonlinear friction is a major factor limiting the tracking accuracy of ball-screw feed drives, especially during low-speed motion and velocity reversal. Conventional Stribeck-model-based feedforward compensation can reduce friction-induced tracking errors, but its performance may deteriorate when friction parameters are inaccurate or vary with operating conditions. To improve compensation performance under friction parameter mismatch, this paper proposes a hybrid friction compensation method that combines a smooth Stribeck nominal model with an ILC-type residual feedforward learning term. The smooth Stribeck model provides nominal friction compensation, while the residual term reduces mismatch-induced error. A reversal-weighted learning mechanism is further introduced to emphasize the velocity-reversal region. The proposed method is combined with a PID controller and evaluated through simulations under different reference frequencies and friction parameter mismatches. For a 0.5 Hz sinusoidal reference, the proposed method reduces the RMSE from 4.264 μm with fixed-parameter Stribeck compensation to 1.406 μm, and reduces the maximum reversal error from 5.277 μm to 1.260 μm. At a friction parameter mismatch level of 30%, the proposed method maintains a 90.734% RMSE reduction, indicating improved robustness against friction parameter mismatch in simulation.

18 :20-20 :00	**International Exchange Center-2F** **国际交流中心-2 楼**	**Dinner**

Day 2- October 10, Saturday

Parallel Session 5

Time: 16:00-17:45 (GMT+8)
Date: Saturday, October 10 | 10 月 10 日（星期六)
Location: 4F- Yellow River Hall / 4 楼 黄河厅
Topic: Intelligent Fault Diagnosis and Equipment Health Management in Complex Control Systems
Chaired by: Assoc. Prof. Chun Jia, Harbin Engineering University, China

HC514

16:00-16:15

Title: A Digital Twin Framework for Optoelectronic Tracking System with Intelligent Supervisory Control
Authors: Cheng Peng, Guanyu Qiao, Xun Gong and Bing Ge
Presenter: Cheng Peng, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China

Abstract: This paper proposes a digital twin framework based on intelligent supervisory control to enhance both the control accuracy and debugging efficiency of optoelectronic tracking system. A high-fidelity digital twin model of the optoelectronic tracking system is established from multiple layers, achieving synchronous mapping between the digital model and the physical equipment. Furthermore, a dynamic cascade intelligent supervisory control strategy is developed, enabling the system to adaptively learn under varying environmental conditions. The accuracy of the proposed digital twin framework and its superior control performance are comprehensively validated through multiple experiments.

HC584

16:15-16:30

Title: RAN Cell Degradation Prioritization under Limited Manual Inspection Resources: Masked Time-Series Reconstruction with Degradation-Aware Scoring
Authors: Jinbo Wang, Wei Hao, and Wenyan Jin
Presenter: Jinbo Wang, Department of Networks, China Mobile Communications Group Co., Ltd., China

Abstract: Intelligent radio access network (RAN) operations can manually inspect only a limited number of cells and must prioritize persistently degraded cells among thousands of candidates, although reliable degradation labels are scarce and incomplete. Unlabeled reference modeling can reveal deviations between observed key performance indicators (KPIs) and reference sequences, but direction-agnostic observed-reference deviations neither distinguish improvement from degradation nor directly constitute cell-level evidence across KPIs and time. We study RAN cell degradation prioritization when manual inspection resources are limited. Given multi-KPI time series over a complete observation window and the maximum number K of cells that can be manually inspected, the objective is to concentrate persistently degraded cells in the Top-K inspection list. The method separates reference estimation from degradation-aware scoring. Masked time-series reconstruction provides unlabeled reference sequences; for KPIs with predefined performance directions, only degradation-side deviations are retained; grouped severity, affected breadth, and cumulative-area temporal aggregation then form a cell-level degradation burden score. Experiments cover 6,371 cells with chronological training, calibration, and test splits and 10 paired runs under strong and mild controlled degradations; all methods share the same injection realization within each run. For affected-cell hits in the Top-100 list (TP@100), the proposed method reaches 96.3 and 96.0 under strong and mild degradation. It finds 2.3 and 3.5 more affected cells, respectively, than matched generic scoring using the same reconstructed references. A train-only periodic template indexed by hour and weekday/weekend reaches 95.3 and 94.5 with the same scorer; the proposed method finds 1.0 and 1.5 more affected cells, respectively. Over K <= 200, the main gain comes from performance-direction constraints and grouped severity/breadth aggregation, while masked reconstruction provides a consistent further gain over the periodic template. Incomplete operational records did not establish a consistent advantage over the matched generic-scoring baseline.

Day 2- October 10, Saturday

HC568

16:30-16:45

Title: KCRE: Enhancing Retrieval-Augmented Generation via Cross-Document Chunk-Level Relational Reasoning
Authors: Bin Shang, Zhihui Chu, Hongwei Zheng, Meng Xi, Shijing Shen, Yongxi Fan, Zhiwei Zhang
Presenter: Yongxi Fan, Binjiang Institute of Zhejiang University, China

Abstract: Fragmented knowledge poses a major challenge for LLM reasoning in multi-document question answering tasks. Existing RAGs lack dynamic modeling of cross-document semantic relations and complex relational dependencies, limiting their ability to assemble comprehensive factual evidence for coherent inference. To address this limitation, we propose a novel Knowledge Chain Relational Engine (KCRE) framework. Firstly, we introduce a Knowledge Chain Construction (KCC) module, which enhances retrieval coherence by constructing a cross-document associative network at the chunk level. KCC introduces eight relation types (e.g., Part-of, Causal, Sequential) to explicitly model fine-grained semantic and structural dependencies among heterogeneous knowledge chunks. Built upon these relations, we propose a two-stage knowledge expansion process that contains hybrid retrieval and relational expansion, transforming scattered evidence into a structured, context-aware reasoning chain. To further refine retrieval and improve chain quality, we introduce a Topological Fusion Knowledge Filtering mechanism that dynamically identifies potential reasoning paths and incorporates reasoning direction awareness. Experimental results on four public benchmarks show that KCRE achieves the best non-oracle performance in 10 of 12 dataset–metric settings, demonstrating strong overall effectiveness for multi-document question answering.

HC570

16:45-17:00

Title: Retrieval-Augmented Generation (RAG), Query-Centric Retrieval, Adaptive Schema Learning, Structured Knowledge Extraction, Hybrid Retrieval
Authors: Yongsheng Li, Shijing Shen, Xiaodong Xu, Wenzhe Li, Xiangyu Li
Presenter: Xiangyu Li, Binjiang Institute of Zhejiang University, China

Abstract: Standard Retrieval-Augmented Generation (RAG systems often suffer from suboptimal recall due to static text chunking strategies and the limited precision of fuzzy vector search. To address these limitations, we propose FABRIC-RAG a framework that enhances retrieval through Adaptive Schema Generation and Dynamic Document Structurization. Adopting a “query-centric, paradigm, our approach proactively generates synthetic queries from raw documents to infer a flexible, evolving schema. This allows unstructured text to be transformed into structured JSON-like records within a NoSOL store without manual annotation, during inference, FABRIC-RAG employs a hybrid retrieval strategy, fusing traditional vector similarity with precise, database queries to comprehensively capture dispersed evidence. Experimental results demonstrate that our approach consistently outperforms baselines across multiple benchmark datasets.

HC579

17:00-17:15

Title: Dual-Agent Differential Testing via Context Isolation
Authors: Weidong Wang, Wei Meng
Presenter: Weidong Wang, Beijing Jinghang Computing and Communication Institute, China Aerospace Science and Industry Corporation The Third Academy Beijing, China

Abstract: Software testing remains critical yet costly. LLM-based test generation continues to face core challenges such as assertion hallucination and weak-assertion inflation. We posit that the current monolithic information fusion paradigm—concatenating code and specification into a single model—may cause underlying inconsistencies to be concealed rather than surfaced during generation. We propose Dual-Agent Differential Testing via Context Isolation (DADT), which physically decouples implementation from specification via AST-level blinding, driving white-box and black-box agents independently. Their joint outcomes are mapped by a Differential Execution Matrix into five quadrants, triggering mutation assessment, trace attribution, and progressive feedback refinement. Evaluated on ULT and Defects4J, DADT substantially outperforms state-of-the-art baselines. The core contribution of this work is the replacement of monolithic information fusion with structural context isolation, which renders code-documentation inconsistencies observable through differential execution, and the establishment of a closed-loop automated test generation framework spanning diagnostic classification to controlled repair.

Day 2- October 10, Saturday

HC591

17:15-17:30

Title: Two-Dimensional Modeling of Transpiration Cooling with Multi-Zone Fuzzy PID Control
Authors: Huiyuan Wang, Wen Kang, Wenguang Zan
Presenter: Huiyuan Wang, Beijing Institute of Technology, China

Abstract: Transpiration cooling is an effective active thermal-protection method for blunt-nosed hypersonic vehicles. Con-ventional one-dimensional models, however, cannot represent nonuniform aerodynamic heating, surface-temperature distribu-tions, or thermal coupling between adjacent regions. This study develops a control-oriented two-dimensional dynamic model in-corporating spatially distributed aerodynamic heating, coolant-flm insulation, two-dimensional heat conduction, and coolant convection in the porous medium under the local thermal equilibrium assumption. The heated surface is divided into multiple cooling zones with independently adjustable coolant mass fow rates. A multi-zone fuzzy PID strategy regulates each zone using its average wall-temperature error and error variation rate. The governing equation is solved using a two-dimensional fnite-difference method with Crank–Nicolson time integration. Closed-loop simulations indicate that the regional wall temperatures approach the prescribed target and that the coolant allocation varies among the cooling zones under spatially nonuniform aerodynamic heating. An energy-based Lyapunov analysis provides sufficient conditions for local exponential sta-bility of the equilibrium temperature feld, while an LMI-based condition is derived for the fuzzy PID closed-loop system. The proposed framework provides a control-oriented approach for spatial temperature regulation and regional coolant allocation in transpiration-cooling systems.

HC534

17:30-17:45

Title: A New Design Method for Ship Synchronous Clock System Based on Power Line Communication
Authors: Jiaxiang Li, Chengyi Liao, Xiaoying Jiang
Presenter: Jiaxiang Li, Marine Design and Research Institute of China, China

Abstract: Ship synchronized clock system provide continuous and unified time display for onboard users. The power and time signal are provided by the serial port in traditional ship synchronized clock system. The output voltage of the master clock is increased to suppress the signal and voltage attenuation at the end slave clock, which is the key issue for the high failure rate of the slave clock during long-term operation. In order to enhance the reliability and economy of the ship synchronized clock system, we propose a new design method for the ship synchronized clock system based on Power Line Communication (PLC). The 24V DC power used in slave clocks is replaced by the 220V AC power. The time signal transmitted by serial port is replaced by modulating the time signal in the 220V marine lighting power grid. A real large-scale ship was used to verify the proposed method. The maximum average delay of the timing signal in the proposed method is 497ms, which meets the requirements for the time displaying in daily life.

18 :20-20 :00	**International Exchange Center-2F** **国际交流中心-2 楼**	**Dinner**

Day 2- October 10, Saturday

Poster Session

Time: 16:00-17:30 (GMT+8)
Date: Saturday, October 10 | 10 月 10 日（星期六）
Location: 4F- East China Sea Hall / 4 楼 东海厅
Topic: Machine Vision-Based Cooperative Control and Intelligent Positioning Technology for Unmanned Swarms
Chaired by: Assoc. Prof. Zhongping Zhang, Harbin Engineering University, China

HC508

16:00-16:10

Title: Hierarchical Reinforcement Learning with Target Prediction and Geometry-Aware Role Assignment for Multi-UUV Cooperative Encirclement
Authors: Haoyu Hou, Weiquan Huang, Zhaoxin Xu
Presenter: Haoyu Hou, Harbin Engineering University, China

Abstract: Cooperative encirclement of multiple unmanned underwater vehicles (UUVs) requires pursuers to surround the target from different directions, imposing stringent demands on tactical coordination. Existing multi-agent reinforcement learning (MARL) methods suffer from two structural deficiencies: symmetric rewards lead to policy homogenization among pursuers, preventing effective encirclement, while flat architectures lack multi-step planning capability and incur severe pursuit lag against maneuvering targets. To address these issues, this paper proposes the Hierarchical Prediction and Role-Assignment MADDPG (HPRA-MADDPG) framework. A two-level hierarchical architecture decouples tactical planning from motion control: a high-level controller generates subgoals, while a low-level MADDPG executes motion control under subgoal guidance. A geometry-aware dynamic role-assignment mechanism assigns pursuers to three complementary roles, namely front interceptor, left flanker, and right flanker, according to the target's motion direction, thereby breaking policy symmetry. A lightweight target-prediction module provides look-ahead anchors for the high-level controller, mitigating pursuit lag in dynamic encirclement. Furthermore, behavioral cloning pretraining combined with a linear transition strategy is employed to alleviate the cold-start problem. Simulation results show that HPRA-MADDPG substantially outperforms three baselines (MADDPG, MAPPO, and MATD3) in encirclement success rate, encirclement time, and encirclement uniformity, and ablation studies further verify the independent contribution of each module.

HC506

16:10-16:20

Title: Heading-Aware Encirclement Control of Underactuated USV Swarms with Prescribed-Time Convergence
Authors: Xinle Xie, Xiangli Jiang, and Wenxu Zhu
Presenter: Xinle Xie, Harbin Engineering University, China

Abstract: This paper addresses the cooperative encirclement control problem of underactuated unmanned surface vehicle (USV) swarms tracking a dynamic target. To achieve prescribed-time radius convergence and heading-aware adjustment of the encirclement formation, a cooperative encirclement control method is proposed. First, a radial encirclement control law is designed based on prescribed-time control theory, which drives each tracking USV to converge to the desired encirclement radius around the dynamic target within a preassigned time. Then, a heading-aware adaptive distribution mechanism is developed by incorporating the motion direction of the target into the angular spacing allocation. Compared with conventional uniform encirclement strategies, the proposed mechanism allocates more tracking USVs to the forward region of the target, thereby enhancing the blocking capability in the target's potential escape direction. Furthermore, considering the underactuated characteristics of USVs, an inner-loop execution controller is designed to transform the desired planar encirclement velocity into feasible surge force and yaw moment inputs. Stability analysis is provided to show the prescribed-time convergence of the nominal radial encirclement error and the boundedness of the inner-loop tracking errors. Simulation results demonstrate that the proposed method achieves prescribed-time radius convergence and heading-aware non-uniform encirclement formation in dynamic target encirclement.

Day 2- October 10, Saturday

HC507

16:20-16:30

Title: Distributed Optimal Formation Control for UAV-USV Swarm

Authors: Yuhan Wu, Xiangli Jiang, Wenxu Zhu

Presenter: Yuhan Wu, Harbin Engineering University, China

Abstract: To tackle the problems of dimensional disparity, dynamic heterogeneity, and the trade-off between formation error and control energy in unmanned aerial vehicles (UAV) and unmanned surface vehicles (USV) swarm, this paper proposes a distributed optimal formation control method based on feedback linearization and optimal control. First, feedback linearization is applied to eliminate the nonlinear coupling in the USV model, yielding a linear integrator system that is combined with the UAV dynamics to form a unified linear state-space model. Next, transformation matrices are introduced to define common position and velocity states, resolving the dimensional mismatch between UAVs and USVs. A distributed formation control law is then designed by incorporating Laplacian-based communication topology, with the stabilizing gain range derived via the Routh-Hurwitz criterion. Finally, a quadratic performance index balancing formation error and control energy is formulated, and the distributed optimal control law is obtained by solving the associated Riccati equation. Asymptotic stability of the closed-loop error system is proven via Lyapunov's second method. Simulation results validate the effectiveness of the proposed method.

HC527

16:30-16:40

Title: A CNN–GRU–SAC Method for AUV Local Dynamic Obstacle Avoidance Using Sonar-State Temporal Observations

Authors: Jianrui Yuan, Peihang Zhao

Presenter: Jianrui Yuan, Harbin Engineering University, China

Abstract: Autonomous underwater vehicles (AUVs) in locally unknown dynamic environments must represent obstacle geometry, capture short-term risk variation, and generate smooth continuous-control trajectories. This paper proposes a CNN–GRU–SAC method using hybrid temporal sonar range and motion-state observations. A one-dimensional CNN extracts beam-wise obstacle features, while a GRU models the evolution of target distance, speed, and line-of-sight angle. The fused representation is used by Soft Actor–Critic (SAC) under action smoothing, speed and heading-rate constraints, and a compact composite reward. Three-seed ablation experiments indicate that the proposed observation and encoding design consistently improves task reliability, path efficiency, and trajectory smoothness over the corresponding ablation variants. Random-target and moving-obstacle tests further evaluate the learned policy under varying target locations and time-varying local risks.

HC525

16:40-16:50

Title: Map-Constrained Deep Inertial Localization via Shape-Aware Cross-Modal Fusion

Authors: Meng Liu, Qipeng Wang, Jianli Song, Guowei Zhai

Presenter: Meng Liu, Tianjin Navigation Instrument Research Institute, China

Abstract: Accurate indoor positioning in GNSS-denied environments, such as underground parking garages and shopping centers, remains a challenging problem. While deep learning-based inertial odometry has shown promising results for pedestrian localization using smartphone IMUs, it suffers from unbounded drift over long distances and provides only relative motion estimates. In this paper, a map-constrained deep inertial localization framework is proposed that cross-modally couples a deep inertial odometry network with a 2D floor plan through a shape-aware particle filter. Specifically, a deep inertial network first reconstructs a local high-accuracy motion trajectory in real time. The trajectory segment is then constructed as a convolutional kernel, and frequency-domain cross-correlation is performed on a binary occupancy grid map to generate a dense probability distribution over poses. This distribution serves as the observation likelihood in a shape-aware particle filter and is fused with the incremental motion model provided by the deep odometry, thereby achieving map matching and drift correction at the trajectory-segment level. We evaluate our method on a public dataset collected in three buildings using consumer smartphones. Experimental results demonstrate that our method achieves superior localization performance compared with baseline methods, and works without any infrastructure or initial position prior.

HC549

16:50-17:00

Title: Topology-Guided Modular Actor-Critic Learning for Continuous Systems under Temporal Objectives

Authors: Lening Li, Zhentian Qian, Jianan Xia, Yawen Wang, Zhongjing Li, Qiren Geng, Huasheng Zhang, Liang Hu, Qishuang Li, and Junqiang Lou

Presenter: Lening Li, Ningbo University, China

Day 2- October 10, Saturday

Abstract: We study formal policy synthesis for continuous-state stochastic systems under linear temporal logic specifications. The product of the system with the automaton of the specification has a hybrid state space with sparse rewards. We introduce a generalized optimal backup order, defined in reverse to a topological order over automaton states, that guides value backups and provably preserves optimality. We further present a model-free actor-critic algorithm whose policy evaluation solves a constrained optimization problem by the augmented Lagrangian method, yielding hyperparameter self-tuning, and prove its optimality and convergence in the tabular case. Since integer encodings of automaton states impose a spurious ordinal relationship on functions learned by one network, we dedicate a value and a policy network to each automaton state (modular learning). The algorithm matches or outperforms PPO, DQN, and A2C on CartPole, and on a Dubins car under a temporal specification the topological order and modular learning raise the success rate from 26.0% to 71.5%.

HC509

17:00-17:10

Title: Observation Quality Weighted Factor Graph Optimization for Robust UWB Indoor Localization

Authors: Haohua Xing, Jianhua Cheng, Shengrong Mao, Sicheng Chen, Chun Jia, Nan Zang, Miaomiao Wang
Presenter: Haohua Xing, Harbin Engineering University, China

Abstract: Ultra-wideband (UWB) ranging errors induced by non-line-of-sight (NLOS) propagation, multipath effects, and dynamic occlusions significantly degrade the positioning accuracy of conventional factor graph optimization with fixed weights. To address this problem, this paper proposes an observation quality factor graph optimization (OQ-FGO) UWB indoor positioning method. The proposed method extracts observation quality features from UWB measurements, including first path power (FP Power) , first path amplitude (FPA), the channel impulse response (CIR) rising edge, total received power (RX Power), and the power difference, and then constructs a continuous observation quality score. This score is mapped to the information weight of the UWB ranging factor in the factor graph. By dynamically adjusting the constraint strength of each ranging measurement according to its real-time quality, the proposed method suppresses the influence of suspected NLOS and severe multipath observations while retaining the geometric constraint information of partially degraded measurements. Therefore, the robustness and availability of the positioning model in complex environments are improved. Experiments were conducted on a real indoor UWB positioning platform. The results show that the proposed OQ-FGO method achieves the best performance among the four compared methods. In experiment 1, OQ-FGO reduces the 3D RMSE to 0.2285 m, corresponding to reductions of 44.8%, 40.7%, and 31.8% compared with conventional FGO, distance-weighted FGO (D-FGO), and residual-weighted FGO (R-FGO), respectively. In experiment 2, the 3D RMSE is reduced to 0.1451 m, achieving reductions of 70.7%, 70.4%, and 70.9% over the three baseline methods, respectively. Meanwhile, the 3D STD of OQ-FGO decreases to 0.1289 m and 0.0950 m, respectively, demonstrating that the proposed method effectively reduces positioning error fluctuations and improves trajectory estimation stability.

HC580

17:10-17:20

Title: LUCA: A Large-Scale Knowledge Graph Applicable Unsupervised Contrastive Learning Framework for Anomaly Detection

Authors: Xiaojiang Xu, Sihan Lv, Shijing Shen, Zhiwei Zhang, Xiaodong Du, Meng Xi
Presenter: Sihan Lv, Zhejiang University, China

Abstract: Knowledge graphs (KGs) underpin many Web applications, including Web search, recommendation, question answering, and retrieval-augmented generation. Because Web-scale KGs are largely constructed automatically from heterogeneous sources, they contain anomalous or spurious relations that degrade the reliability of every downstream service. Existing detectors are either embedding-based, which suffer from low precision and data leakage, or reconstruction-based, which demand heavy computation. We propose LUCA, an unsupervised KG anomaly detection framework that couples textual and structural representation learning through graph contrastive learning and triple reconstruction. LUCA combines a large language model enhanced graph feature extractor, a structure-aware subgraph sampling strategy that leaves the forward pass of target nodes unchanged, and a contrastive loss with linear time and space complexity. On three public KGs, LUCA outperforms state-of-the-art detectors in most settings and trains in as little as 1.7 percent of the time needed by the fastest baseline. We further introduce an anomaly injection algorithm that produces more realistic and harder anomalies, enabling stricter evaluation of KG anomaly detection methods.

Day 2- October 10, Saturday

HC571 17:10-17:30	**Title: A Novel Robust Maneuvering Target Tracking Method Based on GSTG Mixing Distribution and VB Inference** **Authors:** Chen Chen, Guixi Zhao, Ruizhi Wang, Jiajun Yi, Fujun Chen, and Jiaxin Sun **Presenter**: Chen Chen, Unit 93199 of the PLA, China **Abstract:** Aiming to solve the maneuvering target tracking problems in the presence of non-stationary heavy-tailed measurement noise, this paper designed a novel Gaussian-student's t-Gamma (GSTG) mixing distribution to model the measurement noise, leading to the construction of a hierarchical Gaussian state-space model. Based on this framework, variational Bayesian (VB) inference is employed to estimate the system state and distribution parameters simultaneously. Target tracking simulation results demonstrate that the proposed filter significantly enhances tracking accuracy under non-stationary heavy-tailed measurement noise conditions, outperforming existing algorithms.

18 :20-20 :00	**International Exchange Center-2F** **国际交流中心-2 楼**	**Dinner**

Day 3- October 11, Sunday

Online Parallel Session 1

Time: 09:30-11:15 (GMT+8)
Date: Sunday, October 11 | 10 月 11 日（星期日）
ZOOM ID: 876 0822 6427
Password: 100911
Topic: Cooperative Control of Multi-Agent Systems and Network Resource Optimization Scheduling
Chaired by: Assoc. Prof. Jing Zhu, Nanjing University of Aeronautics and Astronautics, China

Invited Speech
09:30-09:55

Title: Secure Consensus Control on Multi-agent Systems Using Blockchain Smart Contract
Speaker: Assoc. Prof. Jing Zhu, Nanjing University of Aeronautics and Astronautics, China

Abstract: This talk investigates secure consensus control in multi-agent systems with Byzan tine agents that send malicious information to interfere with consensus. A novel hierarchical model of multi-agent systems (MASs) based on blockchain is established by devising a dual layer communication system and designing a smart contract to detect and isolate Byzantine agents. Within this framework, we propose a blockchain-based secure consensus control method for MASs to identify Byzantine agents and support secure consensus. The proposed blockchain approach enables the identification of Byzantine agents with inconsistent state submissions and facilitates secure consensus among normal agents. Moreover, the proposed algorithm requires no prior global information about the MAS, making it widely applicable to real-world industrial scenarios.

Invited Speech
09:55-10:20

Title: Model Reference Adaptive Fault Tolerant Control under Limited Information for Unmanned Underwater Vehicles
Speaker: Assoc. Prof. Xianghua Wang, Beijing University of Posts and Telecommunications, China

Abstract: Unmanned Underwater Vehicles (UUVs) work in the harsh sea environment and are prone to faults, which can degrade their performances and even cause accidents. Therefore, it is necessary for UUVs to have the ability of fault tolerant control (FTC). Here, we propose a model reference adaptive FTC scheme to achieve trajectory tracking for an UUV subject to actuator faults, actuator saturation, external disturbances and other system uncertainties. To make matters more challenging, it is assumed that the velocities (linear and angular) are unavailable. In this condition, the UUV motion model in the horizontal plane has a high relative degree, thus increasing the design complexity. In contrast to observer-based FTC schemes, we introduce a dynamic compensator, which produces an augmented error system whose dynamics is minimum phase and relative degree one. An adaptive learning observer is then introduced to address the composite uncertain tiesa rising from actuator faults, uncertain nonlinearities, actuator saturation and disturbances. We show that the proposed scheme can ensure that the trajectory tracking errors converge to a small neighborhood around zero. Some simulations are conducted to verify the efficiency of the proposed scheme.

Invited Speech
10:20-10:45

Title: Scalable Distributed Rough Hypercuboid Approach
Speaker: Assoc. Prof. Chuan Luo, Sichuan University, China

Abstract: The popularity of granular computing, to a large extent, is due to the theory of rough sets. As a concrete theory of granular computing, rough set model enables us to tackle incomplete knowledge, manage the inconsistent information, and manipulate different levels of granularity. In that context, much attention has been paid and continues to be given to the rough sets in modeling and propagating uncertainty from both theoretical and applied points of view. The selection of prominent features for building more compact and efficient models is an important data preprocessing task in the field of data mining and machine learning. Rough set offers a powerful information granulation-oriented feature selection framework from data with imprecise, inconsistent and incomplete information. Noting that there is a growing consensus among the data science communities that the proliferation of data volume presents an immediate challenge pertaining to the scalability issue in recent years. As a practical pathway to pursue the challenge of explosive growth of data, parallelization of algorithms by exploiting high performance computing resources in a distributed computing environment have increasingly gained strengths in facilitating large-scale data analysis. In this tutorial, we focus on the scalability aspect of the rough sets-related research. We will

Day 3- October 11, Sunday

	introduce our recent attempts for improving the scalability of rough feature selection approach via the parallel and distributed optimization under the premise of ensuring accuracy.
HC529 10:45-11:00	**Title: Self-Adaptive Multi-Agent Deep Reinforcement Learning for Resource Orchestration in Ultra-Dense Networks** **Authors:** Meng Wan, Shouzhi Li, Xingzheng Li, Fang Fang, Wenzhang Ren, Zhangjing Ruan, Wei Hao, Beibei Zhao **Presenter:** Meng Wan, China Mobile Group Design Institute Co.,Ltd., China **Abstract:** Ultra-dense networks require distributed resource allocation that can respond to traffic and interference changes without collecting per-slot channel state at a central controller. We develop SA-MARL, a multi-agent actor-critic method for joint power, subcarrier, and association decisions. Its main elements are sparse inter-agent attention, hysteretic critic updates, and an entropy coefficient driven by recent Q-value volatility. The evaluation varies the number of base stations M from 4 to 32 in a fixed 0.25 km² area (16–128 BS/km²) while using the same 3GPP UMa assumptions throughout. Thus, the density sweep changes coordination load without also changing the propagation model; M = 24 and 32 are the ultra-dense cases. For M = 16 and five matched seeds, SA-MARL obtains 38.2 ± 2.1 bps/Hz sum rate, 0.92 ± 0.02 Jain fairness, 12.5 ± 0.5 Mbps/W energy efficiency, and 97.3 ± 1.4% QoS satisfaction (median ± sample standard deviation). Its median sum rate is 5.8% above MADDPG and 32.8% above WMMSE. At M = 32, the corresponding rates are 62.5 ± 3.0 and 55.2 ± 5.1 bps/Hz.
HC519 11:00-11:15	**Title: Hardware-Software Decoupling Architecture Design for Integrated Avionics of Unmanned Aerial Vehicles** **Authors:** Song Gao, Bao Song, Mingkai Wang, and Jiali Qu **Presenter:** Song Gao, Beijing Electro-mechanical Engineering Institute,China **Abstract:** With the continuous increase in the complexity of Unmanned Aerial Vehicle (UAV) systems, the functional integration of avionics systems is rising significantly. Traditional tightly-coupled hardware-software architectures are increasingly unable to meet the requirements for system scalability, maintainability, and multi-task adaptability. This paper proposes a hardware-software decoupling architecture tailored for integrated avionics system design in UAVs. Based on an embedded real-time operating system and employing a publish-subscribe communication mechanism provided by Micro Object Request Broker (UORB), the architecture establishes a loosely-coupled information interaction environment among system modules. By abstracting hardware resources such as computing, storage, and I/O, a unified hardware abstraction layer is established, enabling effective decoupling of core functional software from the underlying hardware platform. The proposed architecture supports independent development, dynamic deployment, and cross-platform migration of functional modules, thereby enhancing system integration efficiency, reliability, and scalability. Practical applications demonstrate that the architecture effectively enables flexible reconfiguration and rapid iteration of UAV integrated avionics systems under multi-task and multi-scenario conditions, providing a feasible technical pathway for the future development of intelligent and modular avionics systems.

Day 3- October 11, Sunday

Online Parallel Session 2

Time: 13:00-14:25 (GMT+8)
Date: Sunday, October 11 | 10 月 11 日（星期日）
ZOOM ID: 876 0822 6427
Password: 100911
Topic: Vision-Based Embedded Sensing Systems and IoT Applications
Chaired by: Dr. Sukarnur Che Abdullah, National Panasonic Malacca, Malaysia

Invited Speech
13:00-13:25

Title: Machine Vision Immersive Research via Emerging AR/VR-IoT Technologies Framework
Speaker: Dr. Sukarnur Che Abdullah, National Panasonic Malacca, Malaysia

Abstract: Rapid advancements in real-time perceptual computing have accelerated the convergence of computer vision, Extended Reality (AR/VR), and the Internet of Things (IoT). However, conventional systems frequently struggle with fragmented data pipelines, high synchronization latency, and limited spatial context when attempting to map real-world IoT telemetry into interactive 3D virtual environments. This paper presents a unified architectural framework that seamlessly integrates deep learning-based machine vision with distributed IoT sensor networks to power next-generation AR/VR immersive research and applications.

HC528
13:25-13:40

Title: TimeNILM: Exploring Large Language Model-Based Representation Learning for Non-Intrusive Load Monitoring
Authors: Qiting Hou
Presenter: Qiting Hou, Chongqing Normal University, China

Abstract: Non-Intrusive Load Monitoring (NILM) aims to estimate appliance-level energy consumption from aggregated power measurements and plays an important role in smart grids and intelligent energy management. However, existing deep learning-based NILM methods still suffer from limited capability in learning transferable temporal representations due to the complex operating patterns and transient characteristics of appliance loads. Inspired by the recent progress of large language models (LLMs) in sequence representation learning, this paper proposes TimeNILM, a framework that explores pretrained language model representations for non-intrusive load disaggregation. Specifically, TimeNILM first adopts a patch-based representation strategy to transform electrical power sequences into compact temporal embeddings. Then, a cross-modal time-series reprogramming mechanism is introduced to align electrical load representations with the embedding space of a pretrained language model. Furthermore, a parameter-selective adaptation strategy is employed, where the majority of the pretrained language model parameters are frozen while task-specific adaptation modules are optimized for appliance-level load reconstruction. Extensive experiments conducted on the TDHA dataset demonstrate that TimeNILM achieves competitive performance compared with representative CNN-, RNN-, and Transformer-based NILM methods. The results indicate the potential of pretrained language model representations for improving temporal feature learning in NILM tasks.

HC556
13:40-13:55

Title: Benchmarking Machine Learning Models for Biogas Production Efficiency in Diverse Agro-Climatic Settings
Authors: Mirwais Mohebi, Aliya Jemal Getahun, Bibars Amangeldy, Nurdaulet Tasmurzayev, Baglan Imanbek, Ulzhalgas Zhunissova
Presenter: Mirwais Mohebi, AlfaCenter, Farabi University, Kazakhstan

Abstract: Accurate prediction of biogas production efficiency remains challenging in anaerobic digestion (AD) systems because feedstock composition, environmental conditions, and digester operating parameters interact in nonlinear ways. This study develops a machine learning pipeline for predicting biogas production efficiency using the Indian Biogas Production Dataset, comprising 15,298 records. A normalised efficiency metric, defined as biogas production per unit mass of total organic input, is used as the target variable. Three domain-informed engineered features are constructed to represent selected feedstock proportions and the interaction between the carbon-to-nitrogen ratio and digester temperature. The dataset is partitioned chronologically by observation date into training, validation, and test subsets to reduce temporal leakage. Four models are benchmarked:

Day 3- October 11, Sunday

	Linear Regression, XGBoost, CatBoost, and the Feature Tokenizer + Transformer (FT-Transformer). In the reported experiment, FT-Transformer achieved the best test performance, with $R^2 = 0.8408$, RMSE = 0.01214, MAE = 0.00952, and MAPE = 1.566%, while CatBoost and XGBoost also outperformed the linear baseline. Kernel SHAP analysis of 200 test observations identified ambient temperature, pig manure, and bagasse feed as the largest average contributors to FT-Transformer predictions, while C/N ratio and digester temperature showed smaller average contributions. These findings suggest that attention-based and gradient boosting models may be useful for biogas efficiency prediction under the evaluated setting.
HC599 13:55-14:10	**Title: Road Maintenance Management System (RMMS): A Cost-Effective IoT-Based Sensing Platform for Road Anomaly Detection and Mapping** **Authors:** RENILDA SORIANO LAYNO, Angelica Mae Inaudito Moraca, Lorenzo Paul Fernandez Lopez, Reginald Christian Villa Gonzales, Czer Dominic M. Lumibao **Presenter:** Angelica Mae I. Moraca, Mapua University, Philippines **Abstract:** Infrastructure degradation along critical transport corridors, such as the AH26 Pan-Philippine Highway, incurs severe economic burdens and safety risks. This paper presents the Road Maintenance Management System (RMMS), a lowcost, interrupt-driven mobile sensing platform designed for automated road surface monitoring. The hardware unit integrates an MPU6500 Inertial Measurement Unit (IMU), an ESP32-CAM microcontroller, and a NEO-6M GPS module to detect, visually capture, and georeference road anomalies. Real-time edge detection uses a vertical acceleration threshold interrupt ($|Gz| > 1.7g$) that immediately locks GPS coordinates and triggers photographic acquisition. A backend Python machine learning pipeline then classifies anomaly severity calibrated to vehicle chassis and model characteristics. Evaluated across 563 realworld road segments, the platform achieved a mean hardware response latency of 100.41 ms (maximum spatial displacement of 1.71 m at 60 km/h), an overall classification accuracy of 97.7%, a precision of 91.2%, and a specificity of 97.8%. Defect coordinates are compiled into a geographic information system (GIS) heatmap to support data-driven road repair prioritization for local government units.
HC600 14:10-14:25	**Title: PalayScan: A Portable Embedded System for Real-Time Rice Leaf Disease Detection in the Philippines** **Authors:** RENILDA SORIANO LAYNO, Anne Kelsea Dantes Palo, Karylle Cate Rendon Tuazon **Presenter:** Renilda S. Layno, Mapua University, Philippines **Abstract:** This study presents a compact, low-power system for rice leaf disease detection using TinyML. The system is built around an ESP32-CAM microcontroller with an LCD display, so that images can be captured and classified on the device without an internet connection. A dataset of 1,551 images covering 14 classes (13 fungal, bacterial and viral rice diseases plus healthy plants) was used to train and compare eight lightweight models using transfer learning and full-integer (int8) quantization. The selected model, MobileNetV1 ($\alpha = 0.25$, 128×128 input), achieved 85.8% accuracy (macro-F1 0.870) on a held-out test set with a model size of 318 KB, which fits the ESP32-CAM's memory. The results indicate that a compact quantized model can classify rice leaf diseases at a size suited to low-cost microcontrollers, making the approach a promising, practical tool for early disease detection in rural and resource-limited farming environments.

Welcome to Harbin

As the enchanting capital of Heilongjiang Province, Harbin（哈尔滨） serves as China's northernmost major city and offers first-time visitors an extraordinary introduction to Sino-Russian culture, winter sports, and the spectacular ice festival that transforms frigid weather from hardship into artistic triumph. Picture yourself walking through a crystalline fantasy world where massive ice sculptures tower overhead like frozen cathedrals, where Russian Orthodox churches with onion domes rise against snow-covered streets that could belong in St. Petersburg, where the aroma of Russian bread and Chinese dumplings mingles in winter air so crisp it sparkles, and where January temperatures of -30°C transform an entire city into the world's largest outdoor art gallery made entirely of ice and snow.

Harbin Ice and Snow World

This spectacular winter wonderland represents the world's largest outdoor ice art exhibition, featuring massive ice sculptures carved from Songhua River ice that create entire cities, castles, and artistic installations illuminated by colored lights that transform the frozen landscape into magical fairyland. The festival includes ice slides, interactive activities, and cultural performances while demonstrating Chinese artistic excellence in working with natural materials under extreme conditions. Open December through February, the festival attracts millions of visitors while showcasing ice carving techniques, architectural innovation, and artistic creativity that has made Harbin's winter festival internationally famous.

Saint Sophia Cathedral and Central Avenue

This stunning Russian Orthodox cathedral, built in 1907, represents Harbin's architectural crown jewel while anchoring the historic Central Avenue (Zhongyang Street) that preserves dozens of European-style buildings from Harbin's international golden age. The cathedral now houses a museum explaining Harbin's multicultural history while the surrounding pedestrian street includes Russian restaurants, European-style shops, and cultural venues that maintain the international atmosphere that made early Harbin unique. Evening illumination creates magical atmosphere while demonstrating how architectural preservation can support contemporary cultural and economic development.

Siberian Tiger Park

This conservation facility houses over 500 Siberian tigers in semi-natural habitats while conducting crucial breeding and research programs for this critically endangered species that represents northeastern China's most important wildlife conservation success. Visitors can observe tigers in spacious enclosures designed to encourage natural behaviours while learning about conservation efforts, traditional Chinese medicine impacts on tiger populations, and international cooperation in species protection. The park includes educational centers explaining tiger ecology and conservation while demonstrating how tourism can support wildlife protection.

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