2021 6th International Conference on Automation, Control and Robotics Engineering (CACRE)

In Conjunction with ICAIR 2021

Conference Programme

https://www.cacre.org/

Co-organized by

Dalian Maritime University

Hong Kong Society of Mechanical Engineers (HKSME)

Technically co-sponsored by

IEEE Robotics and Automation Society (RAS)

Sponsored by

Georgia Institute of Technology

Sichuan University

2021.07.15--07.17 ● Dalian ● China

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WELCOME MESSAGE

Dear Participants,

The world has seen great hope to overcome the virulent pandemic COVID-19. However, international travel has not been fully restored. Our conference, the 6th International Conference on Automation, Control and Robotics Engineering (CACRE 2021), will be held both in-person and virtually at Dalian, China from July 15 to 17, 2021.

Regardless of the meeting form, we wish to continue our communication to share our new research ideas, discuss challenges and form collaborations to solve various issues on Automation, Control and Robotics Engineering.

All accepted papers will be published into the Conference Proceeding of CACRE 2021 (ISBN: 978-1-6654-3576-5), which will be published by IEEE. The conference proceedings will be included in IEEE Xplore, and submitted to EI Compendex, Scopus, Thomson Reuters (WoS) and other databases for review and indexing.

On behalf of the organizing committee, I would like to thank the outstanding Speakers: Prof. Dan Zhang, York University, Canada; Prof. Dongbin Zhao, Chinese Academy of Sciences, China; Prof. Wenqiang Zhang, Fudan University, China; Prof. Jiancheng Yu, Shenyang Institute of Automation, Chinese Academy of Sciences, China; Prof. Iain D. Couzin, University of Konstanz, Germany; Prof. Sebastian Scherer, Carnegie Mellon University, USA; Prof. Ya-Jun Pan, Dalhousie University, Canada; for sharing their deep insights on future challenges and trends in a variety of research directions.

I would like to thank all the committees for their great support on organizing the conference. I also would like to thank all the reviewers for their great effort on reviewing the papers submitted to CACRE 2021. Special thanks to all the researchers and students who with their work and participate in the conference.

While some of us may not see each other face-to-face in Dalian, I hope the conference can still establish a solid linkage among all the participants. I look forward to your contribution to making CACRE 2021 a success.

Regards,

Fumin Zhang,
General Chair

CONFERENCE COMMITTEE

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CONFERENCE SPEAKERS

Keynote Speakers

Prof. Dan Zhang
York University, Canada

Biography: Dr. Dan Zhang is a Kaneff Professor and Tier 1 York Research Chair in Advanced Robotics and Mechatronics in the Department of Mechanical Engineering at York University. Dr. Zhang was a Canada Research Chair in Advanced Robotics and Automation, was a founding Chair of the Department of Automotive, Mechanical, and Manufacturing Engineering with the Faculty of Engineering & Applied Science at Ontario Tech University. He received his Ph.D. in Mechanical Engineering from Laval University, Canada, in June 2000.

Dr. Zhang's research interests include robotics and mechatronics; high performance parallel robotic machine development; sustainable/green manufacturing systems; rehabilitation robot and rescue robot.

Dr. Zhang's contributions to and leadership within the field of robotic and automation have been recognized with several prestigious awards, within his own university (Kaneff Professorship, Tier 1 York Research Chair in Advanced Robotics and Mechatronics, Research Excellence Award both from university level and faculty level), the Province of Ontario (Early Researcher Award), the professional societies (Fellow of CAE, Fellow of the ASME, Fellow of the EIC and Fellow of the CSME), and federal funding agencies (Canada Research Chair in January 2009 and renewed in January 2014). Besides, he was awarded the Inaugural Teaching Excellence by the Faculty of Engineering and Applied Science of UOIT in 2006 and the Best Professor Award by UOIT Engineering Students' Society in 2012.

Dr. Zhang has published 210 journal papers and 180 conference papers, 12 books, 9 book chapters and numerous other technical publications. Dr. Zhang has served as a General Chair for 51 International Conferences and delivered 94 keynote speeches. Dr. Zhang is listed as the World's Top Two Percent Researchers by Stanford's Standardized Citation Indicators in 2020 (published in PLOS BIOLOGY).

Dr. Zhang is a Fellow of the Canadian Academy of Engineering (CAE), a Fellow of the Engineering Institute of Canada (EIC), a Fellow of American Society of Mechanical Engineers (ASME), and a Fellow of Canadian Society for Mechanical Engineering (CSME), a Senior Member of Institute of Electrical and Electronics Engineers (IEEE), and a Senior Member of SME.

Keynote Lecture: Advancing and Integrating the Performance of Robotic Systems for the 21st Century Manufacturing

There has been increasing in developing enviromentally-benign manufacturing technologies, robots, etc. This is considered a significant step in achieving sustainable development. Sustainability of a manufacturing system becomes critical technology that enables manufacturing companies to reduce production costs and improve their global competitiveness. System sustainability can be achieved by reconfiguration and decentralization, whose system configurations are evolved with the changes of design requirements and dynamic environment. The modular construction of parallel robotic machines allows them to be used as a class of reconfigurable machine tools. Nevertheless, parallel robotic machines as contemporary manufacturing robotic systems often have difficulty meeting the highly increased workplace demands on (1) operational accuracy, (2) operational load capacity, (3)

task adaptability, and (4) reliability. For example, according to some large robot/robotic machine tool manufacturers and manufacturing robot user, i.e., ABB Robotics, Ingersoll Machine Tools Inc. and ATS Automation Tooling Systems Inc., the current robotic systems for high speed machining often fail due to thermal effects, which fatally distort the accuracy of the systems. According to the International Federation of Robotics (IFR), more than 60% of industry robots operating in the manufacturing industry are articulated robots (i.e., serial robots), or robots that can only allow material handling, but not material fabrication.

In this talk, the rational of using parallel robotic machines for green and sustainable manufacturing is discussed and explained. A comparative study is carried out on some successful parallel robotic machines and conventional machine tools. Meanwhile, the latest research activities of parallel manipulators in the Laboratory of Robotics and Automation of UOIT are introduced, they are: parallel robotic machines, reconfigurable/green robotic manipulators, web-based remote manipulation as well as the applications of parallel manipulators in micro-motion device, MEMS (parallel robot based sensors), wearable power assist hip exoskeleton, and rescue robot.

Prof. Dongbin Zhao
Chinese Academy of Sciences, China

Biography: Dongbin Zhao is a professor at Institute of Automation, Chinese Academy of Sciences, and also with the University of Chinese Academy of Sciences, China. Dr. Zhao serves as the Associate Editor of IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Cybernetics, IEEE Transactions on Artificial Intelligence, IEEE Transactions on Cognitive and Developmental Systems (TCDS), etc. He is the Chair of Distinguished Lecture Program of IEEE Computational Intelligence Society. He is involved in organizing many international conferences. He received the 2020 Outstanding Paper Reward of IEEE TCDS, etc. His group won 3 championships of 2020 Robomaster AI Challenge, and the Championship for Fighting AI Competition of 2020 IEEE Conference on Games, etc. He has published 6 books, and over 300 international journal and conference papers. His current research interests lie in deep reinforcement learning, computational intelligence, smart driving, game artificial intelligence, robotics, etc. He is an IEEE Fellow.

Keynote Lecture: Deep reinforcement learning for games and robotic applications

Deep reinforcement learning (DRL) plays more and more important role as a major artificial intelligence (AI) algorithm, by combining the merits of the decision ability of reinforcement learning and the perception ability of deep learning. Recent years witness the rapid progress of DRL in different kinds of domains to become a very hot topic of research and applications. This talk will first briefly introduce these major achievements and corresponding typical DRL algorithms, and then present some efforts on the design of several game AIs, extended to other interesting robotic applications from the speaker’s group.

Prof. Wenqiang Zhang
Fudan University, China

Biography: Dr. Wenqiang Zhang, Professor with the School of Computer Science, and as a deputy dean at the School of AI & Robotics, Fudan University, is also the Vice Director of Shanghai Key Laboratory of Intelligent Information. He engaged in the research work of robotics, AI, and Intelligent Equipment, etc. He has published more than 100 papers and applied for more than 50 invention patents. He has undertaken more than 40 research projects from Science and Technology Commission of Shanghai Municipality (STCSM), National Natural Science Foundation of China (NSFC), Ministry of Education, Shanghai Electric Group, etc. He has created the China's first autonomous mental development robot, and successfully developed robots of Fuwa, Ato, Haibao, etc.

Keynote Lecture: Knowledge guided Artificial Intelligence and Intelligent Manufacturing

In recent years, artificial intelligence technology, represented by deep learning, has achieved many amazing results in video / image analysis, semantic understanding and so on, but it is not satisfactory in autonomous learning. Inspired by the biological learning mechanism, this report discusses the deep learning theory and method for audio-visual information fusion in view of the difficulties and challenges faced by the current traditional manufacturing field, such as small learning samples and difficult skill transfer. Combined with the research work of the research group in "Artificial Intelligence + Intelligent Manufacturing", some thoughts on key technology and industrial innovation are given.

Prof. Jiancheng Yu
Shenyang Institute of Automation, Chinese Academy of Sciences, China

Biography: Jiancheng YU, Ph.D., Professor, is the director of the Center for Innovative Marine Robotics of the Shenyang Institute of Automation, Chinese Academy of Sciences. In 2006, he graduated from the Shenyang Institute of Automation, Chinese Academy of Sciences, and received his PH.D. in mechanical and electrical engineering. Since March 2005, he has been working at the Shenyang Institute of Automation, Chinese Academy of Sciences, mainly engaged in research on new concept underwater vehicles, underwater glider, and adaptive ocean sampling theory and technology, and underwater robot control methods. From August 2009 to July 2010, he was a visiting scholar at the Department of Electronics and Computer Science at the Georgia Institute of Technology.

Keynote Lecture: Technology and Application of Marine Observation Robots

In recent years, underwater vehicles for ocean observation, underwater glider as an outstanding example, have been significantly developed. They have been applied in the field of ocean observation and have achieved remarkable results. Incorporating autonomy and artificial intelligence into marine robotics towards intelligent ocean observing, for the increasing requirements of oceanography scientific research for multiple scales, high resolution, and real time observation, is a very important developing direction of ocean observation technology. This presentation will review the development history of ocean in-situ observation technology, introduce the development status of underwater vehicles, and discuss the application prospects of underwater vehicles for ocean observation and its revolutionary impact on the observation mode.

Prof. Iain D. Couzin
University of Konstanz, Germany

Biography: Iain Couzin is Director of the Max Planck Institute of Animal Behavior in Konstanz, Germany. Previously he was an Assistant- and then Full-Professor in the Department of Ecology and Evolutionary Biology at Princeton University, and prior to that a Royal Society University Research Fellow in the Department of Zoology, University of Oxford, and a Junior Research Fellow in the Sciences at Balliol College, Oxford. His work aims to reveal the fundamental principles that underlie evolved collective behavior, and consequently his research includes the study of a wide range of biological systems, from neural collectives to insect swarms, fish schools and primate groups. In recognition of his research he has been recipient of the Searle Scholar Award in 2008, top 5 most cited papers of the decade in animal behavior research 1999-2010, the Mohammed Dahleh Award in 2009, Popular Science's "Brilliant 10" Award in 2010, National Geographic Emerging Explorer Award in 2012, the Scientific Medal of the Zoological Society of London in 2013, Web of Science Global Highly Cited Researcher in 2018, 2019 and 2020, and the Lagrange Prize in 2019.

Keynote Lecture: Collective sensing and decision-making in natural and engineered systems

There exists enormous research potential at the interface between engineering and biology. In the study of animal behavior there is a growing synergy whereby the development and use of technologies, such as bio-mimetic robotics and virtual reality, allow us to gain fundamental insights into behavior that can be used to inform engineered solutions. For example, the evolved strategies animals utilise to navigate complex, unpredictable and dangerous environments can directly inform new algorithms for robotics. In this presentation I will present our latest research on biological, engineered and hybrid systems and discuss how this interdisciplinary approach is providing new insights into the algorithmic basis of sensing, search and decision-naming across scales of biological organisation. For example I will demonstrate our bio-mimetic fish-like robots, which allow us to measure directly the energy consumption associated with swimming together. This allowed us to reveal a new strategy (which we term "vortex phase matching") that real fish (as well as robotic fish) can use obtain hydrodynamic benefits. Experiments with pairs of freely-swimming fish reveal that they do indeed adopt this strategy, and that doing so requires neither a functioning visual nor lateral line system. I will also show new imaging and virtual reality (VR) technology that allows us to reconstruct (automatically) the dynamic, time-varying networks of communication in real animal groups as well as how we use this to investigate the coupling between spatial and information dynamics. I will present a novel, emergent collective search strategy exhibited by schooling fish and show how this has directly informed robotics. Finally, I will use immersive VR for freely-moving animals to understand how individual animals make spatial decisions. We find that the brain repeatedly breaks multi-choice decisions into a series of binary decisions in space-time. At each critical point the brain will spontaneously becomes capable of discriminating between very small differences between options, a highly highly-valuable, emergent property for effective decision-making in biological and engineered systems.

Prof. Sebastian Scherer
Carnegie Mellon University, USA

Biography: Sebastian Scherer is an Associate Research Professor at the Robotics Institute (RI) at Carnegie Mellon University (CMU). His research focuses on enabling autonomy for unmanned rotorcraft to operate at low altitude in cluttered environments. He currently lead's team explorer CMU and OSU's entry to the SubT challenge. He and His team have shown the fastest and most tested obstacle avoidance on an Yamaha RMax (2006), the first obstacle avoidance for micro aerial vehicles in natural environments (2008), and the first (2010) and fastest (2014) automatic landing zone detection and landing on a full-size helicopter. Dr. Scherer received his B.S. in Computer Science, M.S. and Ph.D. in Robotics from CMU in 2004, 2007, and 2010. He is a Siebel scholar and a recipient of multiple paper awards and nominations, including AIAA@Infotech 2010 and FSR 2013. His research has been covered by the national and internal press including IEEE Spectrum, the New Scientist, Wired, der Spiegel, and the WSJ. His work on self-landing helicopters has received the Popular Science Best of What's New 2010 Award.

Keynote Lecture: Towards Robust Localization and Mapping in Challenging Conditions

At the core of most autonomous systems is a source of navigation data that provides position and orientation which often depends on a single state estimation system. This single-point of failure reduces robustness and reliability. Prior work in SLAM often focusses on accuracy. In this talk we will explore several ideas to improve the robustness of SLAM systems while maintaining high accuracy and mapping resolution. We present the challenges, as well as results of operating in dust, fog, high-resolution mapping, and robust place recognition in a variety of situations with traditional as well as learning-based approaches to SLAM.

Prof. Ya-Jun Pan
Dalhousie University, Canada

Biography: Ya-Jun Pan is a Professor in the Department of Mechanical Engineering at Dalhousie University, Canada. Her research interests are robust nonlinear control, cyber physical systems, intelligent transportation systems, haptics and collaborative multiple robotic systems. Dr. Pan has published around 150 journals and conference papers. She has served as Associate Editors for IEEE Transactions on Industrial Electronics, IEEE/ASME Transactions on Mechatronics, and IEEE Transactions on Cybernetics. She has served as Vice President-Atlantic Region of CSME, Canada. She has been awarded the Alexander von Humboldt Fellowship in 2016 and Research Excellence Award at Dalhousie University. She is a Fellow of Engineering Institute of Canada (2021), a Fellow of ASME (2017), a Senior Member of IEEE, a Member of CSME and a registered Professional Engineer in Nova Scotia, Canada.

Keynote Lecture: Cooperative Multi-Robot Systems: Challenges, Control and Applications

Using a group of robots to achieve a common task is usually more efficient and with more operational capability than a single robot especially for tasks which are difficult or impossible for an individual robot to complete, such as co-manipulation in industrial 4.0, combat, surveillance, mapping, and underwater mine hunting etc. In recent years, the cooperative control of multi-robot systems has been an active area of research with formulations such as COBOTs, swarming, flocking,

foraging, consensus and rendezvous, etc. This type of system is composed of several intelligent agents which interact with each other through communication channels, which imposes challenges in control to deal with the constraints such as time delays, data losses and bandwidth limitations. In this presentation, research on cooperative multi-robot systems in the Advanced Control and Mechatronics lab at Dalhousie University will be introduced. Specifically, the presentation will focus on the consensus of a team of multiple quadcopters, distributed event-triggered formation control for a team of mobile robots, and the adaptive robust control with fuzzy logic tuning for a group of multiple manipulator systems. Extensive simulation and experimental results of the proposed schemes will be demonstrated.

PRESENTATION GUIDE

Oral Presentation

1. File format: MS-PowerPoint (*.ppt) or Adobe PDF (*.pdf)

2. Time: About 15mins, including Q/A time.

3. Language: English

4. Fonts: Arial or Times New Roman

5. Dress code: Formal clothes

6. Facility: If presenters need to use own laptop, please notify conference secretary via e-mail in advance and test the connection before session start.

7. Online conference software: Tencent VooV

Poster Presentation

1. Poster Size: 1m*0.8m (height*width).

2. Language: English.

3. Poster format: jpg

4. The poster should include: Paper ID, Conference Name's Acronym, Significance of the research, the methods used, the main results obtained, and conclusions drawn.

5. Posters are required to be condensed and attractive.

6. The conference organizer won't send/keep any posters after the conference.

ONLINE CONFERENCE GUIDE

Software---Tencent Meeting(腾讯会议)

Download link：

A) Chinese version

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B) International Version

https://voovmeeting.com/download/darwin (Mac OS)

https://voovmeeting.com/download/windows (Windows)

Conference Information:

Room	Conference ID	Link
Room 1	386 758 641	https://meeting.tencent.com/s/epRhPFmaxvQG
Room 2	745 275 560	https://meeting.tencent.com/s/dgDaaQYeBuH1
Room 3	631 895 696	https://meeting.tencent.com/s/z2yIFBgBD6Rm
Room 4	936 188 334	https://meeting.tencent.com/s/RIvZKorfYAkG

Note:

1. Please rename your name to your paper ID-CACRE 2021 when you join the online room.

2. Suggest to change your virtual background to conference background.

3. Please wear headphones during the conference.

4.We will call the roll 10 minutes before the session, please join the conference in advance for at least 10-15 minutes.

6. If you have any questions, please hands up or unmute your microphone directly or send you questions to the Chat box.

7. We will take a group photo after all the presentations this session.

PROGRAMME OVERVIEW

Day 1 - July 15, 2021 | BJT, GMT+8

Offline 线下签到注册 14:00-17:00
Lobby # Hi-Chance (Dalian) Science & Technology Exchange Center
（海创（大连）科技交流中心大堂 1F）

Day 2 - July 16, 2021 | BJT, GMT+8 **Online&Offline**			**Day 3 - July 17, 2021 | BJT, GMT+8** **Online-only**		
Gao Xin Function Hall (高新厅 6F) Online Meeting Room 1 ID: 386 758 641			Online Meeting Room 3 ID: 631 895 696		
Host: Zhouhua Peng			**Host:** Fumin Zhang		
09:00-09:10	**Opening Remark:** Prof. Fumin Zhang		09:00-09:40	KN 5- Prof. Sebastian Scherer	
09:10-09:50	KN 1- Prof. Dan Zhang		09:40-10:20	KN 6- Prof. Ya-Jun Pan	
09:50-10:30	KN 2- Prof. Jiancheng Yu		10:20-10:40	**Break**	
10:30-11:00	**Coffee break & Group photo**				
11:00-11:40	KN 3- Prof. Dongbin Zhao		10:40-11:20	KN 7- Prof. Wenqiang Zhang	
11:40-14:00	**Lunch**		11:20-14:00	**Lunch**	
14:00-14:40	KN 4- Prof. Iain D. Couzin				
	Gao Xin Function Hall (高新厅. 6F) Online Room 1 ID: 386 758 641	Carleton Meeting Room (卡尔顿会议室.5F) Online Room 2 ID: 745 275 560		Online Room 3 ID: 631 895 696	Online Room 4 ID: 936 188 334
	Session 1 Chair: Ying Zhao	**Session 2** Chair:Haoliang Wang		**Session 3** Chair: Zhifu Li	**Session 4** Chair: Qing Lu
14:40-14:55	C028	C015	14:00-14:15	C011	C010
14:55-15:10	C064	C022	14:15-14:30	C012	C026
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15:40-15:55	C091	C076	15:00-15:15	C023	C060
15:55-16:10	C104	C092	15:15-15:30	C032	C067
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			15:45-16:00	**Break**	
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16:40-16:55	C119	C126	16:15-16:30	C088	C111
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17:10-17:25	C128	C131	16:45-17:00	C124	C137
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18:10-18:30	**Poster Session**		17:45-18:05	**Poster Session** Chair: Lu Liu	
18:30	**Dinner**				
Poster Session	C002;C003;C004;C006;C007;C008;C009;C013;C014;C018;C024;C030;C031;C036;C038; C040;C042;C046;C051;C052;C055;C056;C061;C062;C063;C066;C078;C079;C081;C082; C089;C090;C094;C095;C102;C103;C108;C110;C114;C117;C118;C121;C122;C123;C135; C139;C144;C145; C141; C143; C155;C157;C158;C162;C163;				

TECHNICAL SESSION

Keynote Lecture Session

Host: Zhouhua Peng (Dalian Maritime University, China)

09:00-14:40, July 16, 2021 (Friday)

Gao Xin Function Hall(高新厅)&Online Meeting Room 1 ID(线上会议室 1): 386 758 641

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9:50-10:30	K2	Technology and Application of Marine Observation Robots ***Jiancheng Yu***, Shenyang Institute of Automation, Chinese Academy of Sciences, China	6
10:30-11:00	**Group Photo &Coffee Break**		
11:00-11:40	K3	Deep reinforcement learning for games and robotic applications ***Dongbin Zhao***, Chinese Academy of Sciences, China	5
11:40-14:00	**Lunch**		
14:00-14:40	K4	Collective sensing and decision-making in natural and engineered systems ***Iain D. Couzin***, University of Konstanz, Germany	7

Technical Session 1: Robotics Science & Control Science

Session Chair: Ying Zhao (Dalian Maritime University, China)

14:40-18:10, July 16, 2021 (Friday)

Gao Xin Function Hall(高新厅)&Online Meeting Room 1 ID(线上会议室 1): 386 758 641

Time	No.	Content	Page
14:40-14:55	C028	Prediction-Based Event-triggered Extended State Observers Design for Unmanned Surface Vehicles ***Lu Liu,*** Dalian Maritime University, China	24
14:55-15:10	C064	A Novel Model Predictive Control for Switched Reluctance Motors Based on Torque Sharing Functions ***Di Liu,*** Dalian Maritime University, China	24

15:10-15:25	C077	Research on Development Status of Surgical Robot Based on Patent Analysis ***Jun Wang,*** Patent Examination Cooperation Hubei Center of the Patent Office, CNIPA, China	24
15:25-15:40	C083	Adaptive Dynamic Positioning Control for Marine Surface Vehicles with Prescribed Performance ***Jinjiang Li,*** Huazhong University of Science and Technology, China	25
15:40-15:55	C091	Adaptive Control Allocation Strategy for Overactuated System ***Guandao Wang,*** Huazhong University of Science and Technology, China	25
15:55-16:10	C104	Design of seven-function master-slave underwater electric manipulator ***Zejun Sun,*** Shanghai Maritime Univeristy, China	25
16:10-16:25	**Coffee Break**		
16:25-16:40	C105	Multi-robot Dynamic Task Allocation Based on Improved Auction Algorithm ***Shiguang Wu,*** Northeastern University, China	25
16:40-16:55	C119	Design of automatic lancing and televisual inspection robot for HPR1000 steam generator ***Wei-rang WU,*** Suzhou Nuclear Power Research Institute Co.,Ltd, China	26
16:55-17:10	C120	Adaptive Fuzzy Dynamic Surface Control for A Class of Fractional-Order Uncertain Nonlinear Systems ***Xingxing You,*** Sichuan University, China	26
17:10-17:25	C128	Composite Trajectory Tracking of a Shipborne Manipulator Based on Full-Order Terminal Sliding Mode Control ***Qianying Li,*** Dalian Maritime University, China	26
17:25-17:40	C129	Formation Control of Unmanned Surface Vehicles Using Fixed-time Sliding Mode Disturbance Observer ***Meng Joo Er,*** Dalian Maritime University, China	26
17:40-17:55	C132	RepUNet:A Fast Image Semantic Segmentation Model Based on Convolutional Reparameterization of Ship Satellite Images ***Meng Joo Er,*** Dalian Maritime University, China	27
17:55-18:10	C133	High Performance Wave Energy Tracking Control of Direct Drive Wave Energy Generation System	27

		Meng Joo Er, Dalian Maritime University, China	
18:10-18:30	**Poster Session**		

Technical Session 2: Automation Science & Vision Science & Intelligent Modeling and Optimization

Session Chair: Haoliang Wang (Dalian Maritime University, China)

14:40-18:10, July 16, 2021 (Friday)

Carleton Conference Room (卡尔顿会议室)&Online Meeting Room 2 ID(线上会议室 2): 745 275 560

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14:40-14:55	C015	Pallet detection and localization with RGB image and depth data using deep learning techniques ***Yong-yao Li,*** Changchun University of Science and Technology, China	28
14:55-15:10	C022	Development of AUV Mechatronics Integration for Underwater Intervention Tasks ***Jianhua Liu,*** Dalian Maritime University, China	28
15:10-15:25	C053	Surveying of lake on Plateau using a portable TS-100 AUV ***ZENG Junbao,*** Shenyang Institute of Automation, Chinese Academy of Sciences, China	28
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15:40-15:55	C076	Active Disturbance Rejection Path Following Control of USV Based on Fuzzy Optimization ***Lei Liu,*** Dalian Maritime University, China	29
15:55-16:10	C092	PID Control for Ship Course with Complex Marine Disturbance Modeled by General Noise ***Qihe Shan,*** Dalian Maritime University, China	29
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16:40-16:55	C126	Brushless DC Motor Driver based on SA306A Integrated Switching Amplifier ***Qishan Dong,*** Shanghai Maritime University, China	30

16:55-17:10	C127	Thrust allocation based on improved global artificial fish swarm algorithm for the dynamic positioning system of vessels ***Xuguang Zhou,*** Dalian Maritime University, China	30
17:10-17:25	C131	Adaptive Fuzzy Control for Nonlinear Systems in Nonstrict-Feedback Form with Full State Constraints: A Feasibility Condition Free Approach ***Gao Junjie,*** Dalian Maritime University, China	30
17:25-17:40	C136	A path planning strategy for marine vehicles based on deep reinforcement learning and data-driven dynamic flow fields prediction ***Qiming Sang,*** Shenyang Institute of Automation, Chinese Academy of Sciences, China	30
17:40-17:55	C154	Research on Motion Simulation for a Rigid-flexible Coupled Manipulator in CoppeliaSim ***Congjun Ma,*** Sichuan University, China	31
17:55-18:10	C156	Analysis on the Application of Cryptographic Technology in the Communication Security of Intelligent Networked Vehicles ***Chunhui Sun,*** Automotive Data of China (Tianjin) Co., Ltd., China	31

Keynote Lecture Session

Host: Fumin Zhang (Georgia Institute of Technology, USA)

09:00-11:20, July 17, 2021 (Saturday)

Online Meeting Room 3 ID(线上会议室 3): 631 895 696

Time	No.	Content	Page
9:00-9:40	K5	Towards Robust Localization and Mapping in Challenging Conditions ***Sebastian Scherer,*** Carnegie Mellon University, USA	8
9:40-10:20	K6	Cooperative Multi-Robot Systems: Challenges, Control and Applications ***Ya-Jun Pan,*** Dalhousie University, Canada	8
10:20-10:40	**Break**		
10:40-11:20	K7	Knowledge guided Artificial Intelligence and Intelligent Manufacturing ***Wenqiang Zhang,*** Fudan University, China	6

Technical Session 3: Automation Science & Vision Science & Intelligent Modeling and Optimization

Chair: Zhifu Li (Guangzhou University, China)

14:00-17:30, July 17, 2021 (Saturday)

Online Meeting Room 3 ID(线上会议室 3):631 895 696

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14:00-14:15	C011	Ship Detection Algorithm based on Improved YOLO V5 ***Zhou Baijun,*** Dalian Maritime University, China	31
14:15-14:30	C012	Cooperative localization between robots using vision and path planning algorithm ***M. Hassan Tanveer,*** Kennesaw State University Marietta, USA	32
14:30-14:45	C020	An Improved Imperialist Competitive Algorithm For Solving Traveling Salesman Problems ***Guangqiang Li,*** Dalian Maritime University, China	32
14:45-15:00	C021	Abstractive Summarization with Word Embedding Prediction and Scheduled Sampling ***Qing Liu,*** 1:Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei 230031, China 2: University of Science and Technology of China, Hefei 230026, China	32
15:00-15:15	C023	Effluent BOD soft measurement based on MNN ***Zhongli Yao,*** Dalian Maritime University, China	33
15:15-15:30	C032	Path Planning of Underwater Vehicles Based on Improved Whale Optimization Algorithm ***Guangqiang Li,*** Dalian Maritime University, China	33
15:30-15:45	C058	Cooperative Simultaneous Localization an Mapping with Local Measurements in 2D Space ***Mei Qu,*** Southeast University, Nanjing, China	34
15:45-16:00	**Break**		
16:00-16:15	C059	Intelligent Fault Classification and Identification of Heat Exchange Station Based on Time-Series Analysis ***Guan Hao-teng,*** Dalian Maritime University, China	34
16:15-16:30	C088	Design of Nonsingular Terminal Sliding Mode Controllers for DC-DC Power Converters based on a Particle Swarm Optimization ***Jose Andre Robles Loro,*** Universidad Nacional de Ingeniería, Peru	34

16:30-16:45	C107	STUGCN:A Social Spatio-Temporal Unifying Graph Convolutional Network for Trajectory Prediction ***Zhao Zhongjie,*** Dalian Maritime University, China	35
16:45-17:00	C124	Design and Implementation of a Small-scale Autonomous Vehicle for Autonomous Parking ***Wencen Wu,*** San Jose State University, USA	35
17:00-17:15	C148	Towards Efficient Exploration in Unknown Spaces: A Novel Hierarchical Approach Based on Intrinsic Rewards ***Yukai Song,*** National University of Defense Technology, China	35
17:15-17:30	C301	Towards Explainable Agency in Multi-Agent Systems Using Inductive Logic Programming and Answer Set Programming ***Minal Suresh Patil,*** Umeå universitet, Sweden	35

Technical Session 4: Robotics Science & Control Science

Session Chair: Qing Lu (Northwestern Polytechnical University, China)

14:00-17:45, July 17, 2021 (Saturday)

Online Meeting Room 4 ID (线上会议室 4):936 188 334

Time	No.	Content	Page
14:00-14:15	C010	Research on Landing Control for UAV Helicopter Based on Two-Stages Guidance Strategy ***XiaoHu Xia,*** Hefei University, China	36
14:15-14:30	C026	Speech Enhancement Based on Optimized End-to-End Fully Convolutional Neural Network ***Runze Zhang,*** Dalian Maritime University, China	36
14:30-14:45	C043	Formation Control for UAVs based on the Virtual Structure Idea and Nonlinear Guidance Logic ***Qingyang Chen,*** National University of Defense Technology, China	36
14:45-15:00	C049	Predictive Control of Thermal Barrier Coating Temperature Based on T-S Fuzzy Model ***Kang Yang,*** Sichuan University, China	37
15:00-15:15	C060	Finite-time control of spherical formation tracking of first-order UAVs ***Yihang Jiang,*** Southeast University, China	37

15:15-15:30	C067	Obstacle Avoidance for Autonomous Mobile Robots in Unstructured Human Environments ***Yugang Liu,*** Royal Military College of Canada, Canada	37
15:30-15:45	C071	Control Strategies for Target-Attacker-Defender Games of USVs ***Bin Lin,*** Shanghai Jiao Tong University, China	37
15:45-16:00	**Break**		
16:00-16:15	C106	Improved Fuzzy Flux-Weakening Control of Electric Vehicle Motor ***Ruixiang Chen,*** Southeast University, China	38
16:15-16:30	C111	Research on Prediction Algorithm of Vehicle Speed Based on Driving Intention Classification ***Wenda Ma,*** Tianjin University, China	38
16:30-16:45	C134	SiMPLeR: A Series-Elastic Manipulator with Passive Variable Stiffness for Legged Robots ***Sajiv Shah,*** Saratoga High School, United States of America	38
16:45-17:00	C137	An autonomous robotic system for collecting garbage over small water bodies ***Muhammad Farhan,*** Habib University, Karachi, Pakistan	39
17:00-17:15	C146	Fault-tolerant control of trajectory tracking for mobile robot ***Minghuang Qin,*** Sichuan University, China	39
17:15-17:30	C153	Give Me a Wrench!: Finding Tools for Human Partners in Human-Robot Collaborative Manufacturing Contexts ***Weitian Wang,*** Montclair State University, USA	39
17:30-17:45	C164	Beetle Antennae Search guided RRT* for path planning of GIS inspection and maintenance robot ***Jianning Zhong,*** Sichuan University, China	40

Online Poster Presentation

Session Chair: Lu Liu (Dalian Maritime University, China)

17:45-18:05, July 17, 2021 (Saturday)

Online Meeting Room 3 ID (线上会议室 3): 631 895 696

C002	MADDPG Algorithm for Coordinated Welding of Multiple Robots ***Weibin Chen,*** School of Automation Southeast University；Jiangsu Automation Research Institute, China

C003	QMIX Algorithm for Coordinated Welding of Multiple Robots ***Liangchuang Liao,*** Southeast University;Jiangsu Automation Research Institute, China
C004	Measurement Based on Image Processing on Air Resistance Characteristics of Skiing in Wind Tunnel Experiment ***Jin Song,*** China Aerodynamics Research and Development Center, China
C006	Research on Global Path Planning of Unmanned Sailboat Based on Improved Ant Colony Optimization ***Wenna Ding,*** Dalian Maritime University, China
C007	An Improved Artificial Bee Colony Algorithm to Port L-AGV Scheduling Problems ***Peixiu Han,*** Dalian Maritime University, China
C008	MODELING, SIMULATION AND DECOUPLING CONTROL OF RESISTANCE FURNACE USING MATLAB AND SIMULINK ***Qianqian Chen,*** Dalian University of Science and Technoloy, China
C009	Research on calibration method of magnetic gradient tensor tracking system based on magnet ***Guang Zhang,*** NCO School Army Academy of Artillery and Air Defense of PLA, China
C013	Simulation analysis and experiment of unpowered roller conveying for culture bottle in tissue culture plant ***YANG YANLI,*** Guangzhou Sky Mechanical & Electrical Technology Co., Ltd, China
C014	Cooperative Diving of Multiple Under-actuated Saucer-type Autonomous Underwater Gliders Based on Linear Extended State Observers ***Yaxing Chai,*** Dalian Maritime University, China
C018	Generalized Predictive Control of Ship Rudder/Fin Joint Anti-rolling System ***Hongli Yue,*** Dalian Maritime University, China
C024	An Improved Fuzzy Control for Switched Reluctance Motor Based on Torque Sharing Function ***Xin Song,*** Dalian Maritime University, China
C030	Research and Experiment on Key Technology of Water-Fertilizer Integration Intelligent Equipment ***Xu Can,*** Guangdong Institute of Modern Agricultural Equipment, China
C031	Backlit Image Enhancement Based on Illumination-reflection Imaging Model ***Zhao Peicheng,*** Dalian Polytechnic University, China
C036	Flight Mode Demonstration of the Prototype Aircraft Based on Flight Test of Scaled Aircraft

	Yalong Wang, Chinese Flight Establishment, China
C038	Network optimization simulation of wireless temperature sensing device in public area based on ant colony algorithm ***Tao Zhang,*** Tianjin University of Technology and Education, China
C040	Design and Implementation of Grinding Robot Control System for Circumferential Weld on Inner Wall of Pipe ***Kai Chang,*** Shenyang Institute of Automation Chinese Academy of Sciences, China
C042	A Reinforcement Learning Model for Virtual Machines Consolidation in Cloud Data Center ***Qiang Chou,*** Lenovo Research, China
C046	Study of PMSM Servo System Based on A Novel Fuzzy Active Disturbance Rejection Controller ***Xiaohan Lv,*** Dalian Maritime University, China
C051	A research of multiple autonomous underwater vehicles cooperative target hunting based on formation control ***LI Liang,*** Shenyang Institute of Automation, Chinese Academy of Sciences, China
C052	Predictive Current Control of Switched Reluctance Motor Based on Extended Observer ***Liu Yue,*** Dalian Maritime University, China
C055	Position Tracking Control of Pneumatic System Based on Disturbance Observer ***Luo Enyong,*** Dalian Maritime University, China
C056	Kinect-based intelligent monitoring and warning of students' sitting posture ***Heng Sun,*** Yanbian University, China
C061	Optimization of ship speeds and sailing paths under emission control areas: From the perspective of a single liner shipping service ***Meiyu Qi,*** Dalian Maritime University, China
C062	Research on Truck Appointment Optimization Based on Fusion of Genetic Algorithm and Ant Colony Algorithm ***Cao Yue,*** Dalian Maritime University, China
C063	Extended state observer based anti-disturbance tracking control for omnidirectional mobile robots subject to uncertainties and wheel skidding ***Changshun Wang,*** Dalian Maritime University, China
C066	Inverter fault diagnosis based on BP neural network ***Xinhong Ni,*** Commercial Aircraft Corporation of China, Ltd, China
C078	Design and experiment of fork robot for trays in industrialized seedling production ***Yanli Yang,*** Guangzhou Sky Mechanical & Electrical Technology Co., Ltd, China
C079	A Robust LiDAR-based SLAM for Autonomous Vehicles aided by GPS/INS Integrated Navigation System ***Tao Su,*** 1.Hefei Institutes of Physical Science, Chinese Academy of Sciences,

	China 2.University of Science and Technology of China, China
C081	Adaptive PI Controller for Dredged Pipeline Transportation ***Shuang Jiang,*** Hohai University, China
C082	Conceptual design and implementation of an Arctic under-ice legged/gliding morphing robot ***Meng Lingshuai,*** Shenyang Institute of Automation (SIA), Chinese Academy of Sciences, China
C089	An automatic frequency conversion method of motor for cut tobacco flavoring drum ***HAN Shaolong,*** Hebei Baisha Tobacco Co. , Ltd., China
C090	Dredging pipeline conveying flow velocity process model based on Differential Evolution Algorithm ***LI Hong Bin,*** Hohai University, China
C094	Collision avoidance decision-making by altering course based on Pareto cuckoo algorithm in multi-ship encounter ***Aiyuan LIU,*** Dalian Maritime University, China
C095	Backstepping Control for Reentry Vehicle Improved by Bioinspired Neuro-dynamic ***Zhao Liangbo,*** Beijing Institute of Space Long March Vehicle, China
C102	A Underwater Acoustic Communication Network for Multi-AUV Cooperative Target Location ***QIU Tianyou,*** University of Science and Technology of China, China
C103	Improved real-time joint object detection and road segmentation multi-task network ***Min Yan,*** Beijing Institute of Technology, China
C108	The shape optimization design of the guide plate of the modular AUV recovery device ***Xuhui Wang,*** Northeastern University, China
C110	Modeling and Control of Discrete Event Systems under Joint Sensor-Actuator Cyber Attacks ***Shengbao Zheng,*** School of Electronics and Information Engineering Tongji University, China
C114	Sensor-less Complex System Control of PMSM Based on Improved SMO ***Yingjie Xiong,*** Northeastern University, China
C117	A method for Rapid Deployment of Brushless DC Motor Servo System Model Based on FPGA ***Wang Bolun,*** Shenyang Ligong University, China
C118	An Accelerated Iterative Learning Control Approach for X-Y precision plane motion stage ***Hongyu Yan***, School of Artificial Intelligence Shenyang University of Technology
C121	A Modified Proportional Navigation Guidance Law for Impact Time Control

	Zhanyuan Jiang, National University of Defense Technology, China
C122	Multi-stage Perception,Positioning and Planning for Automatic Wireless Charging of AGVs ***Zhengwei Qin***, Shanghai Jiaotong University, China
C123	The balancing problem for a reconfigurable flexible assemble line ***Fengyuan Shi***, Tsinghua University, China
C135	Research on the Trajectory Prediction of a Twin Screw AUV Based on an Accurate Dynamic Model ***Shuai Kang***, Shenyang Institute of Automation, Chinese Academy of Sciences, China
C139	A deep learning model for joint prediction of three-dimensional ocean temperature, salinity and flow fields ***Qianlong Jin***, Shenyang Institute of Automation, Chinese Academy of Sciences, China
C144	Target Three-Dimensional Localization and Error Analysis for Unmanned Aerial Vehicles * ***Anping Wu***, National University of Defense Technology, China
C145	Dynamic Model and Analysis of Soft ManipulatorFacing Underwater Complex Environment ***ZHANG Jun-Hao***, Dalian Maritime University, China
C141	Simulation Research on Maneuvering Efficiency of Marine Side Thrusters ***Yue Zhang***, Dalian Maritime University, China
C143	Simulation Research and Modeling of the Marine Auxiliary Boiler System ***Wentao Zhang***, Dalian Maritime University, China
C155	A Double Closed-loop Integral Sliding Mode Controller for Position and Attitude Tracking of Underwater Vehicle ***Wei Tao***, Naval Research Institute, China
C157	Estimation of Mars Rover Slip Based on GA-BP Algorithm ***Tianyi Zhang***, Jilin University, China
C158	Real-time Trajectory prediction for Hypersonic Glide Vehicle Based on 3-D Flight Corridor ***Yang Liu***, National University of Defense Technology, China
C162	Research on precise driving control of rover based on adaptive fuzzy controller ***He Tian***, Jilin University, China
C163	Reliability Analysis of Continuum Robot Actuated by Shape Memory Alloy (SMA) ***Qi Wang***, Beijing University of Posts and Telecommunications, China

ABSTRACT

Technical Session 1	
Time	**Content**
14:40-14:55 July 16	**C028:** Prediction-Based Event-triggered Extended State Observers Design for Unmanned Surface Vehicles **Abstract:** An event-triggered extend state observer is develope-d for dynamic positioning vessels in [1], and an event-triggering condition is developed by using the position errors. It is suitable for dynamic positioning task aimed at stabilizing to a stationary position. In this paper, we aim to solve the state and uncertainty estimation problem for unmanned surface vehicles in a moving task. Specifically, a prediction-based event-triggered extended state observer is developed for estimating the uncertainties using intermittent communication. A prediction mechanism is used to predict the current position of the vehicle by using the last transmitting position-yaw measurements, and an event-triggering condition is developed using the prediction errors. The main feature of this paper lies in that the communication times are drastically reduced regardless of fast variation of vehicle position. The input-to-state stability of the estimation errors is proven. Comparison studies are given to demonstrate the effectiveness of the proposed prediction-based event-triggered extended state observer.
14:55-15:10 July 16	**C064:** A Novel Model Predictive Control for Switched Reluctance Motors Based on Torque Sharing Functions **Abstract:** This paper reports on an improved control strategy for switched reluctance motors(SRMs) to reduce the torque ripple using a torque sharing function(TSF) and model predictive control(MPC) strategy. A improved MPC strategy is applied in the phase current controller to implement accurate tracking of the phase current. Moreover, for the MPC, the instantaneous current is estimated by a phase current model, and the reference phase current is determined by the speed controller and TSF block. Meanwhile, for avoiding the model mismatch problem, the phase current model with characteristics of offline training and online adjustment is built based on an radial basis function(RBF) neural network. Finally, the performance of the proposed control strategy is evaluated by using a simulation model. The results demonstrate the proposed method can effectively reduce the torque ripple, which verify the feasibility of the method.
15:10-15:25 July 16	**C077:** Research on Development Status of Surgical Robot Based on Patent Analysis **Abstract:** Surgical robot is an important branch of medical robot. Based on patent analysis, this paper studies the development status of surgical robot in terms of global patent application trends, main applicants ranking, and application area classifications. Especially focusing on the four application areas, orthopedic surgical robot, neurosurgical robot, laparoscopic robot and vascular intervention robot, the paper respectively analyzes and studies the competitive situation of domestic and foreign companies in terms of the top 10 patent applicants, patent layout, core patents, and patent technology developing map, and provides intelligence support for domestic companies to develop the surgical robot industry. The study results show that: surgical robot technology is in a period of rapid development; domestic

	companies have a gap with foreign companies in the number and quality of patents; in addition, it provides countermeasures and suggestions for domestic companies to further develop surgical robot technology.
15:25-15:40 July 16	**C083:** Adaptive Dynamic Positioning Control for Marine Surface Vehicles with Prescribed Performance **Abstract:** This paper presents an adaptive dynamic positioning (DP) control scheme for marine surfaces vehicles. Firstly, by the merit of the prescribed performance function, the dynamic positioning issue of the marine surface vehicle (MSV) is transformed into stabilization problem for the new-constructed system, thereby providing a framework for designment of the prescribed performance DP controller. Subsequently, the virtual velocity law is established under the backstepping recursive framework. Meanwhile, the “explosion of complexity” is successfully excluded by employing the dynamic surface control (DSC) technique. Finally, the adaptive dynamic control law is derived by combing the nonlinear observer and feedback linearization technique. Theoretical analysis and simulation results illustrate the effectiveness of proposed scheme. More significantly, the hardware-in-the-loop test is carried out to further validate the performance of proposed scheme for nautical practice.
15:40-15:55 July 16	**C091:** Adaptive Control Allocation Strategy for Overactuated System **Abstract:** T To deal with the external time-varying disturbances and the possible failure of the actuator during the operation of the underwater vehicle, this paper presents robust adaptive motion controller. By virtue of the power reaching law and the boundary layer technology, the underwater vehicle can track and stabilize at the target point with a quick converge rate. For possible faults, a quadratic programming problem is constructed the state deviation sequence. The efficiency factor of each thruster is obtained by solving it, and the allocation matrix is modified to realize the adaptive thrust allocation. Numerical simulation results illustrate that the control system of the underwater vehicle can effectively estimate the efficiency factor of the thruster in the process of tracking the target. Moreover, the state of the underwater vehicle can be swiftly regulated to desired states even if actuator failures occur during the operation.
15:55-16:10 July 16	**C104:** Design of seven-function master-slave underwater electric manipulator **Abstract:** This paper presented a seven-function master-slave underwater electric manipulator. The forward kinematics equation of the manipulator was deduced by the DH parameter method. And use the Robotics toolbox in Matlab to establish a model of the robotic arm. After that, the simulation model was compared with the kinematics structure of the manipulator. The calculated working space was more than 1.5m by the Monte Carlo method verified that the manipulator meets the design requirements. The master control part selects the touch tactile device. The main parameters of the haptic device were obtained by the callback function in the serial communication transmitted to the master to realize the master-slave control of the underwater electric manipulator.
16:25-16:40 July 16	**C105:** Multi-robot Dynamic Task Allocation Based on Improved Auction Algorithm **Abstract:** Multi-robot task detection and task execution is an important direction that people have considered recently. We have considered the dynamic issues related to the detection and execution tasks of multiple robots. This paper presents an improved auction algorithm to solve this problem and combines it with the auction algorithm by optimizing the execution capacity utilization and load balancing of the robot. By

	designing a new auction cost function, the execution ability and load balancing of the robot are added to the auction algorithm, and the matching of the execution ability and task difficulty is added to the assignment of task execution. In addition, we also add a task sequence adjustment mechanism to avoid the redundant loss of the robot due to a lack of global consideration during a single auction. We compare the algorithm with SSI and CBBA. The experimental results show that this method is superior to the existing methods of performance utilization and load balancing.
16:40-16:55 July 16	**C119:** Design of automatic lancing and televisual inspection robot for HPR1000 steam generator **Abstract:** HPR1000(abbreviation of China Hualong Pressurizer Reactor 1000) steam generator is the vital part of the 3rd generation of nuclear power technologies and has its unique structure. With its running, how to carry out sludge lancing and televisual inspection during outage needs to be taken into consideration. Design of lancing and inspection robot was proposed based on the analysis of structure layout and function requirement. The design follows principle of module and intelligence design. The robot is composed of three parts: support jack for better results, transition module for movement and implementation module for lancing and inspection. The main challenges were listed and solutions were introduced. The mechanism, design process, validation calculation and some tests were also described in the paper. Test results prove that the robot's functions satisfy all the demands of sludge lancing and televisual inspection. It will be applied on site when the time window is ready this July.
16:55-17:10 July 16	**C120:** Adaptive Fuzzy Dynamic Surface Control for A Class of Fractional-Order Uncertain Nonlinear Systems **Abstract:** This paper is devoted to addressing the issue of adaptive fuzzy control for single-input single-output (SISO) fractional-order nonlinear systems with uncertainty. In order to avoid the "explosion of terms" caused by solving the fractional derivative of virtual signal, a new fractional-order dynamic surface control (DSC) method is proposed for fractional-order systems. Based on backstepping technique and Lyapunov direct method for fractional derivatives, the stability of closed-loop system is proved, which can ensure that the tracking error can converge to a small region. Finally, a simulation example is provided to reveal the effectiveness of the proposed control scheme.
17:10-17:25 July 16	**C128:**Composite Trajectory Tracking of a Shipborne Manipulator Based on Full-Order Terminal Sliding Mode Control **Abstract:** A composite trajectory tracking strategy based on full-order terminal sliding mode (FOTSM) control is proposed for a shipborne manipulator installed on an unmanned surface vehicle (USV). The main contributions of this paper are: (1) The USV and manipulator are modeled systematically. (2) A novel coordination controller based on FOTSM control is designed to control the USV and the manipulator. (3) Stability of the full-order dynamic tracking system can be ensured by virtue of the FOTSM controller. (4) A finite-time disturbance observer (FTDO) is designed to deal with complex disturbances and sliding mode chattering phenomenon so that the end-effector of the manipulator can accurately track the desired trajectory in finite time. Simulation results demonstrate that the proposed controller is superior to the state-of-the-art methods.
17:25-17:40 July 16	**C129:** Formation Control of Unmanned Surface Vehicles Using Fixed-time Sliding Mode Disturbance Observer

	Abstract: In this paper, a leader-follower formation control strategy for unmanned surface vehicles (USVs) employing fixed-time sliding mode disturbance observer is proposed. The main contributions of this paper are: (1) A USV tracking control strategy based on terminal sliding mode (TSM-TC), which greatly increases convergence rate of the tracking control subsystem, is proposed; (2) A fixed-time sliding mode disturbance observer (FTSMDO) is designed to deal with unknown disturbances of the formation subsystem, and greatly enhance the capability of handling disturbances. The proposed formation control strategy based on FTSMDO (FTSMDO-FC) ensures stability of the for-mation system. Simulation results demonstrate that the proposed formation control strategy is superior to the state-of-the-art methods.
17:40-17:55 July 16	**C132:** RepUNet:A Fast Image Semantic Segmentation Model Based on Convolutional Reparameterization of Ship Satellite Images **Abstract:** In this paper, a fast image semantic segmentation model based on convolutional reparameterization of ship satellite images is developed. The salient features of the proposed approach are: (1) Various semantic segmentation networks are evaluated using high-resolution ship satellite data. (2) A high-precision and high-speed semantic segmentation network，termed RepUNet, for detecting ships according to complex characteristics of the actual marine situation is developed. The semantic segmentation network of RepUNet is divided into four parts, namely encoding layer, decoding layer, convolutional reparameterization and batch normalization feature fusion. The RepUNet has the following characteristics: (1) The structure of 3*3 convolution is used as the basic skeleton, and the basic propagation speed is high. (2) The 1*1 convolution and identity branch layer are adopted to enhance feature extraction. (3) All the branches of the encoding layer are reparametrized and the parameters are embedded in the convolution kernel of 3*3. The branch structure is abandoned when inferring so that feature extraction is strengthened. Batch normalization of each branch is fused to make the feedforward speed faster. Validation of the RepUNet demonstrates that it outperforms other semantic segmentation networks. The IoU and feedforward speed (Ffs) of 22.26% and 153.11%, respectively are significantly higher than those achieved by the UNet.
17:55-18:10 July 16	**C133:** High Performance Wave Energy Tracking Control of Direct Drive Wave Energy Generation System **Abstract:** In this paper, a high performance energy tracking control methodology for direct-drive wave energy converters (WEC) based on both backstepping and sliding mode approaches is developed. It is well known that the high frequency of chat-tering phenomenon reduces the control accuracy of traditional sliding model control (SMC). In order to alleviate chattering and the effect of external disturbances, a backstepping sliding model control (BSMC) scheme is proposed. The salient features of the proposed approach are: (1) Maximum wave energy of WEC can be generated. Moreover, velocity tracking of the permanent mag-net linear generator (PMLG), which is a subsystem of the WEC, is carried out in real time. (2) Close-loop system is asymptotically stable. (3) By virtue of the robustness of the BSMC, perturbations can be effectively tackled by the BSMC. Comparative studies with the state-of-the-art methods demonstrate superior performances of the proposed method in terms of wave energy tracking.

Technical Session 2	
14:40-14:55 July 16	**C015:** Pallet detection and localization with RGB image and depth data using deep learning techniques **Abstract:** This paper presents a novel approach of pallet identification and localization algorithm (PILA) based on RGB image and depth data. The algorithm is implemented in C++ for real-time running and the RGB and depth data from low-cost RGB-D camera. Deep neural network (DNN) method is applied to detect and locate the pallet in the RGB images. The pallet's point cloud data is correlated with the labeled region of interest (ROI) in the RGB images through RGB-D fusion. The pallet's front-face plane is extracted and the orientation of the pallet is obtained at the same time. The triangle centric points of pallet's front-face could be determined with extracting x and y lines at the edge by the simple geometrical rules. Experimentally, the orientation angle and centric location of the two kinds of pallets are investigated with natural pallet surface without any artificial markings. The results show that the pallet could be located with the 3D localization accuracy of 1cm and the angle resolution of 0.4 degree at the distance of 3m. The end-to-end running time is less than 700 ms from CAN-IO interface and this is a promising solution for autonomous pallet picking instrument and self-driving forklift applications.
14:55-15:10 July 16	**C022:** Development of AUV Mechatronics Integration forUnderwater Intervention Tasks **Abstract:** Autonomous underwater vehicle (AUV) is usually utilized to perform complex underwater tasks, such as envi-ronmental monitoring, oceanographic mapping, and organism capture, due to their autonomy and high precision maneuver-ability. These tasks require AUVs' ability to perform autonomous navigation, especially under the condition of limited communi-cations in underwater environments. This paper develops a new breed of lightweight intervention AUV for autonomous navigation using visually detected targets rather than acoustic counterparts. The main advantage of our design is the robustness of the mechanical structure and software components, and provides a feasible platform for secondary development. Experiments of tracking and object manipulation show the applicability of the system and its potential applications in science and industrial fields.
15:10-15:25 July 16	**C053:** Surveying of lake on Plateau using a portable TS-100 AUV **Abstract:** Aiming at the scientific research of lakes on the Tibetan Plateau, tow portable AUVs (Autonomous Underwater Vehicle) TS-100 were used to survey Karakul Lake. The lakebed terrain of Karakul was mapped, and the water profile parameters from inlet to outlet of the lake were observed continuously by a multiparameter sonde. In this paper, the TS-100 AUV is introduced firstly, and then describe the deployment of this vehicle on the lake. Finally, a method of original survey data processing is proposed based on the Kriging method, a 3D model of the lake was built, and the lake capacity was calculated by using this method.
15:25-15:40 July 16	**C054:** Model Predictive Control Method for Multi-motor System with Dead Zone **Abstract:** The multi-motor system shows excellent perfor-mance in achieving high-precision control in the applications with large load inertia, such as large-aperture telescopes and high-precision processing machine tools. However, the

	non-linearity of gear transmission remains a key challenge that will cause the fluctuation of angular velocity and position of the load in the multi-motor system. In order to compensate for the non-linearity in the multi-motor system, this paper introduces a dead-zone model into the spring-damper dynamics of the multi-motor system, based on which a model predictive control (MPC) method is proposed to control the angular velocity and angle of the load. The optimization target of the proposed controller is to limit the fluctuations of input torque as much as possible. The effectiveness of the dead-zone based dynamic model and the MPC method are verified by simulation.
15:40-15:55 July 16	**C076:** Active Disturbance Rejection Path Following Control of USV Based on Fuzzy Optimization **Abstract:** In this paper, the path following control problem of unmanned surface vehicle (USV) is studied. Two different controllers are designed respectively. One is the path following controller designed by combining the active disturbance rejection control algorithm and LOS guidance algorithm. The other is the path following controller which combines the fuzzy optimization active disturbance rejection control algorithm and LOS guidance algorithm. Then the corresponding simulation experiments are carried out. The research object of the simulation experiments is the USV "Lanxin" of Dalian Maritime University. Finally, through the analysis and comparison of the above simulation experiments, the effectiveness of the controller designed in this paper is verified.
15:55-16:10 July 16	**C092:** PID Control for Ship Course with Complex Marine Disturbance Modeled by General Noise **Abstract:** In this paper, proportion integral differential(PID) algorithm with general noise is designed for the ship course. The General noise is proposed to describe disturbance. Non-Gaussian colored noise is always present in ship's actual heading control. Considering the tracking error, the tracking effects of color noise and white noise are compared. Based on random differential equations (RDEs) theory, the stability of ship heading system is analyzed. The algorithm proposed in this paper shows that the system can tolerance stronger noise under broader constraints. Finally, simulation verification is carried out. Taking the YUPENG of Dalian Maritime University as an example, the tracking effect of colored noise is better than that of white noise, and the tracking error of colored noise is smaller than that of white noise. This algorithm can satisfy the higher demand of ship motion control system.
16:25-16:40 July 16	**C112:** The Ship Target Detection Based on Sea-Sky-Line **Abstract:** The autonomous target detection of Marine ships plays an important role in both military and civil applications. Marine ship inspection can usually be carried out first by sea-sky-line inspection to reduce image interference information and calculation amount to improve the accuracy and efficiency of ship inspection. In this paper, a sea-sky-line detection method based on a local OTSU segmentation and Hough transform is proposed based on the characteristics of the sea-sky-line. Then the image is segments and some interference information is deleted to preserve the area to be detected. Based on the sea-sky-line detection, the single-stage target detection method is introduced into the ship detection task. The experimental results show that the aid of sea-sky-line reduces certain interference and computation, and optimizes the accuracy and speed of ship target detection.

16:40-16:55 July 16	**C126:** Brushless DC Motor Driver based on SA306A Integrated Switching Amplifier **Abstract:** Brushless DC motor is widely used in the field of industrial control because of its low price and excellent performance. In this paper, the hardware system of the brushless DC driver is designed. In this driver, SA306A three-phase intelligent switching amplifier is used as the power drive module, and STM32F103VET6 is used as the controller. The provided scheme of printed circuit board integrates the motor control, current monitoring, temperature monitoring, speed feedback, communication, and other modules. The safety and reliability of the system are verified by practice, and the results are in line with the expectations.
16:55-17:10 July 16	**C127:** Thrust allocation based on improved global artificial fish swarm algorithm for the dynamic positioning system of vessels **Abstract:** The dynamic positioning (DP) system can keep the position and heading of a vessel by using the thrusters to resist the environmental disturbances. Thrust allocation is an important module of the DP system, and its performance will directly affect the control accuracy and system reliability. As an optimization algorithm with strong local search capability, artificial fish swam algorithm (AFSA) has great application prospects in the thrust allocation optimization of dynamic positioning systems. But the algorithm can easily fall into a local optimal value. In this paper, an improved global AFSA with jumping behavior and swallowing behavior is proposed to solve the aforementioned problem. Simulations are conducted to demonstrate that the proposed improved global AFSA can increase the probability to find the global optimal solution, and the convergence efficiency and the global searching ability of the algorithm can be improved.
17:10-17:25 July 16	**C131:** Adaptive Fuzzy Control for Nonlinear Systems in Nonstrict-Feedback Form with Full State Constraints: A Feasibility Condition Free Approach **Abstract:** In this paper, we aim to solve the full state constrained control problem for nonstrict-feedback nonlinear systems subject to completely unknown nonlinearities, unknown control gains and external disturbances. The full state constraints are assumed to be asymmetric and time-varying. Fuzzy log-ic systems (FLSs) are utilized to approximate the completely unknown nonlinearities. A shifting function is first introduced to remove the feasibility condition on the virtual controllers while using the traditional barrier Lyapunov functions (BLFs). Then, a dynamic surface control (DSC) based adaptive fuzzy controller is developed to prevent the state constraints from being violated. The main feature of this paper lies in that a unified structure for both symmetric and asymmetric full state constraints is constructed without feasibility condition, and the Lyapunov stability of the closed-loop system is proven. Simulation results are given to demonstrate the effectiveness of the proposed control structure.
17:25-17:40 July 16	**C136:** A path planning strategy for marine vehicles based on deep reinforcement learning and data-driven dynamic flow fields prediction **Abstract:** This paper presents a strategy for planning a path of a marine vehicle in dynamic flow fields. This strategy composes of two modules: deep reinforcement learning based path planning and dynamic mode decomposition (DMD) based flow fields prediction. The path planning module employs the deep reinforcement learning algorithm of proximal policy optimization (PPO) to implement the time-optimal path planning of a marine vehicle in predicted spatially-temporally

	dynamic flow fields, where the long short-term memory (LSTM) is introduced to address the partially observable issue. The objective of the flow prediction module is to provide the path planning module with predicted dynamic flow fields. In the flow prediction module, the data-driven method of DMD is used to learn the low-dimensional model of flow dynamics and make future predictions. And a network of marine vehicles with flow sensing capability are adopted to generate data of flow fields for the on-line DMD learning and prediction, where their flow sensing locations are optimized by the deep reinforcement learning algorithm of deep-Q learning with the aim at minimizing the reconstruction error of the flow field with the sparse in-situ point flow observations by the swarm of marine vehicles. The strategy is implemented in computer simulations, where the flow data outputted by a numerical ocean model is utilized to test the strategy. The simulation results demonstrate the performance of the proposed strategy.
17:40-17:55 July 16	**C154:** Research on Motion Simulation for a Rigid-flexible Coupled Manipulator in CoppeliaSim **Abstract:** For the task of inspecting in complex and narrow space and overcoming shortcomings from rigid manipulator, a type of manipulator with strong adaptability and deformable characteristics is urgently needed. Therefore, a type of rigid-flexible coupled manipulator is analysed from the perspective of mechanical structure and working mechanism in this paper, which are the bases of creating the simulation platform. Then, for the purpose of simplifying tedious motion control processes and analysing its motion state under the data collected, we build the CoppeliaSim model of the manipulator studied in this paper step by step. Finally, a stochastic motion test and an unclosed circle end positioning control task are carried out with detail result analyses, which prove the created CoppeliaSim model of flexible manipulator is well-designed with high accuracy.
17:55-18:10 July 16	**C156:** Analysis on the Application of Cryptographic Technology in the Communication Security of Intelligent Networked Vehicles **Abstract:** Intelligent networked vehicles are rapidly developing in intelligence and networking. The communication architecture is becoming more complex, external interfaces are richer, and data types are more complex. Different from the information security of the traditional Internet of Things, the scenarios that need to be met for the security of the Internet of Vehicles are more diverse and the security needs to be more stable. Based on the security technology of traditional Internet of Things, password application is the main protection method to ensure the privacy and non-repudiation of data communication. This article mainly elaborates the application of security protection methods using password-related protection technologies in car-side scenarios and summarizes the security protection recommendations of contemporary connected vehicles in combination with the secure communication architecture of the Internet of Vehicles.
Technical Session 3	
14:00-14:15 July 17	**C011:** Ship Detection Algorithm based on Improved YOLO V5 **Abstract:** With the rapid development of computer vision and machine vision, deep learning based methods have achieved good results in the field of target detection, recognition, and tracking. However, for ship detection and recognition on the sea surface, the detection and recognition rate is greatly affected by the uneven

	distribution of the horizontal and vertical features for ships and the different sizes of ships. In order to improve the ship detection accuracy and real-time performance, this paper proposed a ship detection algorithm based on YOLO V5, in which the feature extraction process was merged with the GhostbottleNet algorithm. Specifically, the algorithm consisted of two stacked GhostNet to refine and capture the image features, so as to overcome the incomprehensive feature capture problem in the original YOLO V5 network due to the inhomogeneous distribution of ship image features in transverse and vertical. Experimental results show that the proposed method not only improves the detection accuracy of YOLO V5 algorithm but also makes the GIoU decrease steadily.
14:15-14:30 July 17	**C012:** Cooperative localization between robots using vision and path planning algorithm **Abstract:** The aim of this article is to provide a solution for obstacle avoidance in order to navigate a robot from an initial point to a final point. The considered robots are i) NAO Humanoid robot, and ii) Rosbot 2.0 a wheeled robot. The main focus of this article is to understand the collaboration between robots to reduce positioning errors. By integrating Inverse Perspective Mapping techniques (IPM) and the A-Star algorithm the image processing robot (NAO) would be able to instruct the wheeled bot (Rosbot) to navigate around obstacles more effectively. This method shows the capability to advance the collaboration between robots in order to diagnose different collisions and develop different path following techniques. Even though odometry is a widely used technique for calculating the position of robots, it has certain drawbacks in the long run. To combat this, we addressed solutions to these drawbacks by using Inverse Perspective Mapping and the A-Star algorithm. When IPM is applied, calculating the position of the obstacles relative to the wheeled robot makes the path network more accurate. Additionally, by applying the A-Star algorithm the path network can be analyzed to find the most direct route. The attractiveness of this methodology simplifies the navigation process by analyzing the data at a birds-eye view and computing decisions that will instruct the wheeled robot to take the shortest path. The performances of the proposed approach are analyzed by means of a series of experiments performed in a static environment.
14:30-14:45 July 17	**C020:** An Improved Imperialist Competitive Algorithm For Solving Traveling Salesman Problems **Abstract:** In order to better solve traveling salesman problems, we proposed an improved imperialist competitive algorithm (IICA). Firstly, the original continuous algorithm is discretized to be suitable for solving combinatorial optimization problems. Then, four improvements are proposed to enhance the overall performances of the proposed algorithm: introducing immune fitness based on immune mechanism, employing parallel computation strategy, improving the strengthening link of imperialist countries according to the idea of simulated annealing, as well as adopting adaptive mechanism to accelerate algorithm convergence speed. Finally, comparing simulation results by proposed algorithm and other algorithms on typical traveling salesman problems selected from the classic test library demonstrate that IICA can solve these problems on different scales more effectively, and it has better convergence accuracy and speed.
14:45-15:00 July 17	**C021:** Abstractive Summarization with Word Embedding Prediction and Scheduled Sampling **Abstract:** Abstractive summarization models based on the encoder-decoder

	framework have made great advances over the recent years. Since most summarization datasets only provide a reference summary for each article, and encoder-decoder models typically adopt the negative log likelihood loss function, the predicted synonym of the target word is equally punished as other semantically dissimilar words. To mitigate the problem, we train the summarization model to additionally predict the word embedding of the target word. A loss function calculated from the distance between the predicted embedding and target embedding is then integrated into the training loss. Besides, ground truth words are provided during training, but they are not available during inference and the model has to use predicted words instead. The discrepancy can yield errors that accumulate quickly along the generated summary. To bridge the gap, we apply the scheduled sampling strategy that partially uses the generated words during training phase. Experiments on the mainstream CNN/Daily Mail dataset demonstrate that word embedding prediction and scheduled sampling can consistently improve the pointer-generator baseline.
15:00-15:15 July 17	**C023:** Effluent BOD soft measurement based on MNN **Abstract:** Aiming at the difficulty of real-time and accurate measurement of biochemical oxygen demand (BOD) in effluent of wastewater treatment process, a design method based on modular neural network is proposed to predict BOD in effluent. Firstly, the BOD sequence is decomposed by Complementary Ensemble Empirical Mode Decomposition (CEEMD) algorithm, Fuzzy Entropy (FE) is used to quantify the complexity of each subsequence. Then, using density clustering to determine the adaptive RBF sub-network structure, and Error Feedback and Sensitivity Analysis (SA) could dynamically adjust the number of neurons. On this basis, the network width is adjusted by clustering algorithm. Experiments verify that this method has a more concise network structure and higher prediction accuracy.
15:15-15:30 July 17	**C032:** Path Planning of Underwater Vehicles Based on Improved Whale Optimization Algorithm **Abstract:** In order to better solve path planning problems of underwater vehicles on complicated seabed terrains under ocean currents, a global path planning method based on whale optimization algorithm (WOA) is proposed. We focus on the fixed-depth navigation, and the underwater environment is modeled based on the MAKLINK graph. Three criteria of the length, smoothness and energy cost are used to evaluate a path. Considering that the original WOA algorithm lacks of balance in the exploration and exploitation at different positions in the search space and is easy to fall into local optima, the improved whale optimization algorithm (IWOA) is presented. The proposed algorithm creates an adaptive elite set by selecting best individuals from the population, and the members of the set will be randomly selected to be combined into new individuals to guide the searching process of the proposed algorithm. The corresponding guidance strategy is that the search agents update the position directionally based on the locations and orientations of the new individuals, replacing the encircling update centered on the position of prey in the original algorithm. Dijkstra algorithm is utilized for “coarse-grained planning” of path planning, and an approach to augment the waypoints is developed to cooperate with the proposed IWOA to complete the “fine-grained planning”. Above two-step planning forms the global path planning method proposed in this paper. The simulation results show that the proposed method is feasible and effective through testing under different circumstances. Compared with original WOA, paths planned

	by proposed method and IWOA have higher qualities, with shorter lengths, smoother paths and more energy saving.
15:30-15:45 July 17	**C058:** Cooperative Simultaneous Localization and Mapping with Local Measurements in 2D Space **Abstract:** This paper solves the problem of cooperative simul-taneous localization and mapping (CSLAM) based on local rel-ative position measurements in 2D space. A sufficient solvability condition for the node-localization problem is provided. Then, a distributed iterative method for CSLAM using local relative position measurements in noise-free environment is given. A proposition about the invariance of the vector's distribution char-acteristics on axis is developed. By using the distributed weighted least-squares method, the distributed method is suitable for node-location in noisy environment. Finally, simulation experiments are conducted to validate the feasibility and effectiveness.
16:00-16:15 July 17	**C059:** Intelligent Fault Classification and Identification of Heat Exchange Station Based on Time-Series Analysis **Abstract:** In this paper, an online fault diagnosis strategy based on time-series analysis is proposed, by combining the problem of inaccurate fault identification and fault classification during operation of the automatic control system in heat exchange station. First of all, this paper simulates common operating fault of heat exchange station, builds the fault database by selecting feature data, at the same time introduces Support Vector Data Description (SVDD) method to set the judgment threshold for the identification of unknown faults. Next, in order to solve the information transfer relationship between multiple operating conditions and various variables, transfer entropy and data sliding window technology are used to analyze the time series. Finally, introduces Long Short-Term Memory (LSTM) to classify of status and determine of fault type for different running data sequences. This method can identify known types of faults online, and can intelligently increase the abnormal detection of unknown faults verified by physical simulation platform, and it is helpful to guarantee the operation safety of the heat exchange station. This method can also be used as a reference for fault detection and dynamic and accurate classification in this kind of production process.
16:15-16:30 July 17	**C088:** Design of Nonsingular Terminal Sliding Mode Controllers for DC-DC Power Converters based on a Particle Swarm Optimization **Abstract:** This paper is focused on the development of a general approach to design Nonsingular Terminal Sliding Mode Controllers (NTSMC) for DC-DC Power Converters by considering some concepts of the Linear Sliding Mode Control with constant switching frequency in order to present two types of NTSM controllers. Thus, the main purpose of these controllers is to guarantee a finite time convergence avoiding singularities of the Terminal Sliding Mode Control as well as the asymptotical convergence of the Linear Sliding Mode Control and the infinite switching frequency which can damage the electronic components. Moreover, due to the lack of a method to select the coefficients of the NTSMC, a Particle Swarm Optimization (PSO) based on different Cost Functions is proposed to handle the proper selection of them. Finally, simulation results are presented to validate the performance of the proposed controllers with their coefficients optimized. In the case of the first NTSM controller, called Duty Cycle Controller, the best settling time obtained was about 3.56 milliseconds while with the second one, called

	Reaching Law Controller, the best settling time obtained was 3.34 milliseconds. On the other hand, both controllers maintain their stability in the presence of parameter variations such as load resistance or input voltage; however, the Reaching Law Controller exhibits the fastest response.
16:30-16:45 July 17	**C107:** STUGCN:A Social Spatio-Temporal Unifying Graph Convolutional Network for Trajectory Prediction **Abstract:** Trajectory prediction, also known as trajectory forecasting, of interacting agents in dynamic scenes is a critical problem for many applications, including robotic systems and autonomous driving. Because of the complex interactions between the pedestrian, the problem poses a significant challenge. To predict future pedestrian trajectories, we propose a Spatio-Temporal Unifying Graph Convolutional Network (STUGCN) based on a Spatio-Temporal Graph Convolutional Network architecture. At each time step, the Spatio-temporal interactions captured by the Cross-Spacetime Skip Connections. Finally, in the temporal dimension of the aggregated features, a Time-extrapolator Convolutional Neural Network (TXP-CNN) is used to predict the pedestrians' future trajectories. In comparison to state-of-the-art methods, our model outperforms them on two publicly available crowd datasets (ETH and UCY) and achieves state-of-the-art performance.
16:45-17:00 July 17	**C124:** Design and Implementation of a Small-scale Autonomous Vehicle for Autonomous Parking **Abstract:** In this paper, we introduce the design and imple-mentation of a low-cost, small-scale autonomous vehicle equipped with an on-board computer, a camera, a Lidar, and some other accessories. We implement various autonomous driving-related modules including mapping and localization, object detection, obstacle avoidance, and path planning. In order to better test the system, we focus on the autonomous parking scenario. In this scenario, the vehicle is able to move from an appointed start point to a desired parking lot autonomously by following a path planned by the hybrid A* algorithm. The vehicle is able to detect objects and avoid obstacles on its path, and achieve autonomous parking.
17:00-17:15 July 17	**C148:** Towards Efficient Exploration in Unknown Spaces: A Novel Hierarchical Approach Based on Intrinsic Rewards **Abstract:** Exploration in unknown environments using deep reinforcement learning (DRL) often suffers from sampling inef-ficiency due to notoriously sparse extrinsic rewards and complex spatial structures. To this end, we present a hierarchical and modular spatial exploration model that integrates the recently popular concept of intrinsic motivation (IM). The approach addresses the problem in two levels. On the higher level, a DRL based global module learns to determine a distant but easily reachable target that maximizes the current exploration progress, once such a target is needed by the local controller. On the lower level, a classical path planner is used to produce locally smooth movements between targets based on the known areas and free space assumption. This segmented and sequential decision-making paradigm, with an informative intrinsic reward signal, dramatically reduces training difficulty. Experimental results on diverse and challenging 2D maps show that the proposed model has consistently better exploration efficiency and generality than a state-of-the-art IM based DRL and some other heuristic methods.
17:15-17:30	**C301:** Towards Explainable Agency in Multi-Agent Systems Using Inductive Logic

July 17	Programming and Answer Set Programming **Abstract:** Logical reasoning is a fundamental aspect of human behaviour,and this is an important criterion to build human-like reasoning in intelligent autonomous multi-agent systems. So far, the field of knowledge representation and reasoning has employed logic-based symbolic techniques to mimic the challenging task of incorporating human-like reasoning in multi-agent systems. However, the field of machine learning has shown increasing interest to take on this challenge. In this research, we describe a methodology which is based on Inductive Logic Programming and Answer Set Programming that enables autonomous agents to generate explanations and logic-based reasoning in form of a hypothesis from a rich knowledge base(ontologies). Whilst this preliminary work addresses key limitations such as scalability and adaptability, we strongly emphasise the need for logic-based reasoning in multi-agent systems for interpretability and transparency in their behaviour.
Technical Session 4	
14:00-14:15 July 17	**C010:** Research on Landing Control for UAV Helicopter Based on Two-Stages Guidance Strategy **Abstract:** Soft landing control of unmanned aerial vehicles (UAVs) is a challenging task due to their nonlinear and under-actuated dynamics. However, it is of importance for autonomous flight. A novel terminal discrete control strategy is put forward which include two-stages Guidance Strategy. In the first stage, the terminal constraint is embedded in cost function directly and sweep method is used to find solution. In the second stage, the terminal constraint is embedded in cost function quadratically and transition matrix method is used to find solution. The numerical simulations have been done and the results show the effectiveness of two-stages guidance strategy and it advantage over conventional method with respect to final errors. The added computational cost of two-stage guidance strategy is acceptable
14:15-14:30 July 17	**C026:** Speech Enhancement Based on Optimized End-to-End Fully Convolutional Neural Network **Abstract:** Single-channel speech enhancement methods based on deep learning have developed rapidly in recent years, Since end-to-end speech enhancement can reduce computational complexity and reduce complex feature extraction steps, it has become a research hotspot in deep learning speech enhancement. Based on the end-to-end deep learning approach, this paper proposes two optimization solutions to solve two problems: (1) Traditional methods have poor ability to suppress non-stationary noise, and the existing deep learning method models are too complex. Therefore, from the data point of view, this article proposes a plan to optimize the activation function and the loss function on the basic model; (2) A "music noise" suppression scheme based on feature fusion is proposed. Experimental results show that the proposed scheme can better suppress non-stationary noise and "music noise", and improve speech intelligibility.
14:30-14:45 July 17	**C043:** Formation Control for UAVs based on the Virtual Structure Idea and Nonlinear Guidance Logic **Abstract:** To realize a compact and robust formation flight with multiple Unmanned Aerial Vehicles (UAVs), a method combining the virtual structure idea and the nonlinear guidance logic is proposed in the paper. The virtual structure idea is adopted, to generate the guidance points for UAVs to follow. The nonlinear

	guidance logic with a feedback term is used, to follow the guidance points and realize formation keeping. With the combination of the virtual structure idea, the problem of leader-dependence in the traditional leader-follower method can be conquered. From the simulation results, the compact formation requirement can be guaranteed in the flight process by the proposed method, even during the turning maneuver.
14:45-15:00 July 17	**C049:** Predictive Control of Thermal Barrier Coating Temperature Based on T-S Fuzzy Model **Abstract:** Aiming at the high nonlinearity of the thermal barrier coating heating system of aero-engines, the traditional control method cannot meet its temperature control accuracy requirements. In this paper, a fuzzy generalized predictive control method is proposed. First, an improved fuzzy partition clustering algorithm is used to identify the antecedent parameters of the Takagi-Sugeno (T-S) fuzzy model. Then, combined with the recursive least square method with forgetting factor, the subsequent parameters of the fuzzy model are identified. Finally, the generalized predictive control algorithm and PID algorithm are used to simulate and verify the thermal barrier coating heating system. The simulation results illustrate the effectiveness of the method in this paper.
15:00-15:15 July 17	**C060:** Finite-time control of spherical formation tracking of first-order UAVs **Abstract:** This paper studies the spherical formation tracking control problem of first-order multi-agent system with bidirectional topologies. Different from the general consensus or formation tracking control problem, the control objectives are multiple. Due to the trajectory restrictions, and based on the dynamic model of first-order multi-agent and the geometric extension method of three-dimensional (3D) sphere, a novel continuous finite-time control algorithm with barrier functions is developed. The convergence speed and stability of the system can be improved by this continuous finite-time control algorithm. The convergence of resulting system is analyzed in detail. Simulation results prove the effective of the proposed method.
15:15-15:30 July 17	**C067:** Obstacle Avoidance for Autonomous Mobile Robots in Unstructured Human Environments **Abstract:** This paper presents an obstacle avoidance approach for autonomous mobile robots in unstructured human environ-ments, focusing on avoiding irregular obstacles that cannot be de-tected by traditional 2D laser-based obstacle detection techniques. With the aid of ultrasound sensors and RGB-D cameras, the developed approach can effectively avoid obstacles below the laser scanning plane, which can address the challenges of mobile robots crashing human's feet in unstructured human environments. Furthermore, the developed approach can reliably avoid obstacles hanging in the air, which put up severe challenges to mobile robots working in such unstructured human environments as airports. The effectiveness of the developed obstacle avoidance approach is verified by extensive experiments.
15:30-15:45 July 17	**C071:** Control Strategies for Target-Attacker-Defender Games of USVs **Abstract:** This paper presents two strategies for the target-attacker-defender (TAD) game of unmanned surface vessels (USVs) with bounded velocity and angular velocity. We use nonlinear model predictive control (NMPC) to design strategies which minimize the effort for each agent to win the game. A novel R-C-S trajectory framework is proposed to evaluate the time for USVs to reach the prearranged coordinates, and is applied to both sides' strategies of the TAD game. It is assumed

	that strategies of both sides are unknown to each other. The attacker's strategy is based on the dynamic artificial potential field method, which guides the attacker to evasive actions according to the threat level of the defender. The strategy for the defender and the target guides the two agents to cooperate for the overall interest of the team. The performance of the proposed algorithms is tested in numerical simulations, and it turns out that the the strategies perform better than traditional methods.
16:00-16:15 July 17	**C106:** Improved Fuzzy Flux-Weakening Control of Electric Vehicle Motor **Abstract:** With the development of rare earth technology, permanent magnet synchronous motors have been increasingly used and have broad development prospects. In order to extend the speed limit of the high-efficiency range of motor operation, the predecessors conducted extensive research on the flux-weakening technology of the motor, which has the characteristics of fast, high performance and high precision. Based on previous research, this paper proposes an improved fuzzy flux-weakening control strategy for electric vehicle motors. Based on the triangular method leading angle flux-weakening control and fuzzy control principle, the re-optimized fuzzy PI(Proportional Integral) adjustment parameters and leading angle flux-weakening control are re-optimized. In combination, the maximum torque of the motor operating point is obtained. The feedback speed is obtained according to the principle of double reaction, which improves the field weakening characteristics of the motor, and further improves the reaction speed and control accuracy. And verified the feasibility of the entire strategy and improved performance advantages through MATLAB/Simulink.
16:15-16:30 July 17	**C111:** Research on Prediction Algorithm of Vehicle Speed Based on Driving Intention Classification **Abstract:** Speed prediction of surrounding vehicles has received much attention because of its great potential to improve the vehicle's safety, fuel consumption, and efficiency. However, its driving prediction faces significant challenges due to the uncertainty of its driving intention, vehicle dynamics, and the interaction between the predicted object and its surrounding environment. First, the Fuzzy C-mean (FCM) method is used to achieve automatic recognition of driving intentions by offline training using information related to vehicle acceleration; Second, the Gaussian process regression (GPR) method is used to predict future speeds under three different driving intentions using historical and cur-rent vehicle speeds; Third, the three predicted speeds are fused according to the fuzzy classification results of driving intentions by iterative method for 1s rolling prediction; Finally, experimental validation is performed on a 6.6m-long electric mobile robot. The results show that 90.33% of the prediction errors are less than 1m/s in the future 1s speed prediction, and the maximum speed prediction error is 2.45m/s.
16:30-16:45 July 17	**C134:** SiMPLeR: A Series-Elastic Manipulator with Passive Variable Stiffness for Legged Robots **Abstract:** We propose a mechanically simple and cheap design for a series elastic actuator with controllable stiffness. Such characteristics are necessary for animals for running, jumping, throwing, and manipulation, yet in robots, variable stiffness actuators are either complicated or mimicked at low bandwidth through feedback controllers. A robust and simple design is needed to build reliable and cheap robots with animal capabili-ties. The key insight of our design is attaching torsional springs to timing belts to create a variable stiffness linear spring. In an antagonistic pair,

	varying the distance between motor and joint then varies the actuator stiffness. We build a prototype of our proposed actuator, show the theoretical behavior matches the experimental characterization, and demonstrate an application to robotic one-legged hopping.
16:45-17:00 July 17	**C137:** An autonomous robotic system for collecting garbage over small water bodies **Abstract:** Water pollution is a grave problem requiring utmost attention as it directly affects marine lives. In freshwater ecosystem, for example, lakes and ponds, a major chunk of water garbage is plastic floating on the surface of water which is labor intensive to collect manually. In this paper, we present a novel autonomous robotic system capable of navigating small water bodies and is equipped with computer vision that helps it to detect the garbage. The detection is followed by focusing on an area of interest to determine whether the garbage lies in the scope of robot for collection. Additionally, if WiFi communication is available, the robot has the provision of tracking the detected garbage to determine its path. The design of garbage collection unit of the robot ensures the garbage does not move outward once collected. The robot is tested in two different pools and with plastic bottles as main type of garbage. The results manifest the high degree of control of its locomotion as well as of detection and collection of the bottles. The deep neural network based detector onboard the robot can be retrained after self-collection of appropriate data to detect other types of garbage as well.
17:00-17:15 July 17	**C146:** Fault-tolerant control of trajectory tracking for mobile robot **Abstract:** Due to various reasons, mobile robot faults occur from time to time, especially actuator faults. To reduce the impact of actuator faults, actuator fault-tolerant controller for two-wheeled mobile robots is designed for actuator faults which are composed of loss of effectiveness actuator fault and bias-actuator fault. When the actuator faults occur, in order to compensate the faults, a fault observer is designed to estimate the value of the faults. Traditional method of designing con-troller parameters requires system identification, which has complex algorithms and poor robustness, in order to select the controller parameters automatically, the fuzzy system is uti-lized. Finally, the performance of the fault-tolerant control scheme is verified by a numerical simulation.
17:15-17:30 July 17	**C153:** Give Me a Wrench!: Finding Tools for Human Partners in Human-Robot Collaborative Manufacturing Contexts **Abstract:** Manufacturing processes can be optimized by enabling human-robot collaboration. A relevant goal in this area is to create a collaborative solution in which robots can provide assisting actions to humans, thereby, reducing menial labor as well as increasing productivity. The solution is based on implementing efficient hand-over of mechanical tools from robots to humans. Hand-over tasks are inevitable in human-robot collaborative manufacturing contexts. These tasks need three-step mechanism: object identification, object grasping, and the actual hand-over. This paper presents an approach for robots to find tools for human partners in human-robot collaboration via deep learning. This is achieved using the object detection system YOLOv3 for identification of commonly used mechanical tools. By training on a custom dataset of 800 images of mechanical tools created for the study, the tool recognition is implemented in real-world human-robot hand-over tasks. Experimental results show that the proposed approach achieves a high accuracy for identification of tools in real-world human-robot collaboration. Future

	work of this study is also discussed.
17:30-17:45 July 17	**C164:** Beetle Antennae Search guided RRT* for path planning of GIS inspection and maintenance robot * **Abstract:** Aiming at efficient path planning of the gas insulated switchgear (GIS) robot which is used for inspecting and maintaining the GIS equipment, this paper proposed a Beetle Antennae Search (BAS)-inspired RRT* algorithm. The new algorithm combines basic RRT* with BAS, a metaheuristic approach, to inspire the sampling, and utilizes a weighted lazy extension mechanism to contribute expanding useful nodes. BASL-RRT* is firstly compared with three improved RRT* algorithms and simulation results verify the effectiveness and the superiority of BASL-RRT*. Then, we apply this new method on path planning of GIS robot. The result shows that safe and smooth path could be obtained efficiently.

CONFERENCE VENUE

Hi-Chance (Dalian) Science & Technology Exchange Center

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ADD: No.507, Huangpu Road, Hi-tech Park, Dalian, Liaoning, China

地址:中国，辽宁，大连，高新园区黄浦路 507 号

1、大连周水子国际机场——海创（大连）科技交流中心

Dalian Zhoushuizi International Airport —Hi-Chance (Dalian) Science & Technology Exchange Center

A、**地铁（Subway）**

在大连周水子国际机场站搭乘 2 号线→在西安站换成 1 号线→在大连海事大学站下车（约 49 分钟）

Get in at Dalian Zhoushuizi International Airport subway station（Line 2）→ Transfer to Line 1 at Xi'an Road station→get off at Dalian Maritime University station（About 49 minutes)

B、**出租车（Taxi）**

约 30 分钟，14 公里

About 30 minutes and 14 kilometres.

2、大连火车站——海创（大连）科技交流中心

Dalian Railway Station——Hi-Chance (Dalian) Science & Technology Exchange Center

A、地铁（Subway）

在大连友好广场站搭乘 2 号线→在西安站换成 1 号线→在大连海事大学站下车（约 42 分钟）

Get in at Dalian Youhao Square subway station（Line 2）→ Transfer to Line 1 at Xi'an Road station →get off at Dalian Maritime University station（About 49 minutes)

B、出租车（Taxi）

约 33 分钟，13.7 公里

About 33 minutes and 13.7 kilometres.

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