IEEE ICCAR

ICCAR

The 8th International Conference on
Control, Automation and Robotics

2022

CONFERENCE PROGRAM

Virtual | April 8-10, 2022

www.iccar.org

Content

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Sessions at a Glance

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Welcome Message

Dear delegates,

We would like to welcome you to 2022 the 8th International Conference on Control, Automation and Robotics (ICCAR 2022). In light of the global health emergency, we are very pleased to offer you the experience of virtual conference. We sincerely hope that you stay healthy and well and that you enjoy the conference.

The conference brings together researchers looking for opportunities for conversations that cross the traditional discipline boundaries and allows them to resolve multidisciplinary challenging problems. It is the clear intent of the conference to offer excellent mentoring opportunities to participants.

This year, ICCAR will feature 5 interesting and timely keynote talks, 7 invited talks, 2 special sessions, 6 parallel sessions and 1 best paper competition.

Special thanks go to our Keynote Speakers, Prof. Huosheng Hu (University of Essex, United Kingdom), Prof. Danica Kragic (Royal Institute of Technology KTH, Sweden), Prof. CheeFai TAN (Infrastructure University Kuala Lumpur, Malaysia), Prof. Robert Katzschmann (ETH Zürich, Switzerland) and Prof. Zhaolong Ning (Chongqing University of Posts and Telecommunications, China), and the Invited Speakers, Prof. Yan-Wu Wang (Huazhong University of Science & Technology, China), Prof. Ning Sun (Nankai University, China), Prof. Ming Liu (Harbin Institute of Technology, China), Prof. Sheng-Quan Li (Yangzhou University, China), Prof. Yulong Wang (Shanghai University, China), Prof. Hesheng Wang (Shanghai Jiaotong University, China), and Prof. Zhijun Zhang (South China University of Technology, China). We greatly value their participation and look forward to their insightful vision and thoughts. We are also grateful to the strong support of the Steering Committee, the Sponsors and respective Technical Committees, which are vital to the success of the conference.

Finally, we would like to extend our most sincere congratulations and acknowledgement to all the authors, speakers and reviewers for a job well done. We are looking forward to meeting you all online.

ICCAR 2022
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Organizing Committee

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Hefei Institutes of Physical Science, Chinese Academy of Sciences, China

John Watkins
Wichita State University, USA

Longhan Xie
South China University of Technology, China

Chunshan Yang
Guilin University of Aerospace Technology, China

Jonghun Yoon
Hanyang University ERICA, South Korea

Yupeng Yuan
Wuhan University of Technology, China

Chengliang Zhang
University of Jinan, China

Xiaocong Zhu
Zhejiang University, China

Yaguang Zhu
Chang'an University, China

Eugenia Zhuo
University of Santo Tomas, Philippines

Guideline & Tips

Before the Conference

Time Zone
GMT+8
You're suggested to set up the time on your computer in advance.

Platform: ZOOM
Download link:
1. https://zoom.us/download
2. https://zoom.com.cn/download (Chinese authors only)

Equipment Needed
- ✓ A computer with internet connection and camera
- ✓ Headphones/earphones

Environment Needed
- ✓ A quiet place
- ✓ Stable internet connection
- ✓ Proper lighting and background

Test Your Presentation
Date: April 8, 2022
Prior to the formal meeting, presenters shall join the test room to ensure everything is on the right track.
Details, please check page 6.

Meeting Rooms
Opening, Keynote&Invited Talks, Special Session 1, Parallel Session 4, Closing&Awarding
Zoom ID: 893 3385 0921
https://us02web.zoom.us/j/89333850921

Best Paper Competition, Special Session 2, Parallel Session 2, Parallel Session 5
Zoom ID: 828 2060 9179
https://us06web.zoom.us/j/82820609179

Parallel Session 3, Parallel Session 6
Zoom ID: 820 4698 9939
https://us06web.zoom.us/j/82046989939

During the Conference

Name
Name yourself with your Paper ID+Name
Example: AR001+Mary

Voice Control Rules
- ✓ The host will mute all participants while entering the meeting.
- ✓ The host will unmute the speakers' microphone when it is turn for his or her presentation.
- ✓ Q&A goes after each speaker, the participant can raise hand for questions, and the host will unmute the questioner.

Oral Presentation
Timing: a maximum of 15 minutes in total, including 3 minutes for Q&A. Please make sure your presentation is well timed.

Conference Recording
The whole conference will be recorded. We appreciate you proper behavior and appearance.

WeChat Contact
If you have any questions, please scan the QR Code to add the WeChat of ICCAR 2022:

Daily Schedule

DAY 1 — Friday April 8, 2022

10:00-12:00 **Presentation Test for Special Session 1&2**
Zoom ID: 828 2060 9179

Presentation Test for Parallel Session 1-3
Zoom ID: 893 3385 0921

14:00-16:00 **Presentation Test for Parallel Session 4-6, Best Paper Contestants**
Zoom ID: 828 2060 9179

Presentation Test for Keynote & Invited Speakers
Zoom ID: 893 3385 0921

DAY 2 — Saturday April 9, 2022

Zoom ID: 893 3385 0921
Host: Yanzheng Zhu, Huaqiao University, China & Youfeng Su, Fuzhou University, China

9:00-9:05 **Welcome Address**
Hui Huang, Huaqiao University, China

9:05-9:10 **Opening Remarks**
Jie Huang, Fuzhou University, China & Fujian Association of Automation, China

9:10-9:50 **Keynote Speech I**
The Digital Transformation of ASEAN Manufacturing for the Future
CheeFai TAN, Infrastructure University Kuala Lumpur, Malaysia

9:50-10:30 **Keynote Speech II**
Rethink How We Control Soft Robots to Explore the World
Robert Katzschmann, ETH Zürich, Switzerland

10:30-11:10 **Keynote Speech III**
Edge Intelligence Driven Communication and Computing Resource Coordination
Zhaolong Ning, Chongqing University of Posts and Telecommunications, China

11:10-11:20 **Break**

11:20-11:40 **Invited Speech I**
Learning based Robot Localization and Navigation
Hesheng Wang, Shanghai Jiaotong University, China

11:40-12:00 **Invited Speech II**
Vary Parameter Recurrent Neural Network Applied to Intelligent Robot
Zhijun Zhang, South China University of Technology, China

Zoom ID: 828 2060 9179
Chair: Dongsheng Yang, Northeastern University, China

13:00-14:30 **Best Paper Competition**

Zoom ID: 893 3385 0921
Host: Hamid Reza Karimi, Politecnico di Milano, Italy

14:40-15:20 **Keynote Speech IV**
Learning for Interaction in Robotic Tasks
Danica Kragic, Royal Institute of Technology KTH, Sweden

15:20-16:00 **Keynote Speech V**
Evolutionary Development of AI and Autonomous Robots
Huosheng Hu, University of Essex, United Kingdom

16:00-16:20 **Break**

16:20-18:20 **Special Session 1-A: Control of Advanced Robotic and Mechatronic Systems**
Zoom ID: 893 3385 0921

Special Session 2: Intelligent and Sustainable Solutions for Liveable Cities
Zoom ID: 828 2060 9179

Parallel Session 1: Intelligent Robot Design and Control
Zoom ID: 820 4698 9939

DAY 3 Sunday April 10, 2022

Zoom ID: 893 3385 0921
Host: Ning Wang, Dalian Maritime University, China

10:00-10:20 **Invited Speech III**
Cooperative Control of Interconnected Two-time-scale Systems
Yan-Wu Wang, Huazhong University of Science & Technology, China

10:20-10:40 **Invited Speech IV**
Dynamics and Advanced Control of Pneumatic Artificial Muscle Robot Systems
Ning Sun, Nankai University, China

10:40-11:00 **Invited Speech V**
Fault Detection and Fault Tolerant Control of Complicated Dynamic Systems with Spacecraft Applications
Ming Liu, Harbin Institute of Technology, China

11:00-11:10 **Break**

11:10-11:30 **Invited Speech VI**
Extended-State-Observer-Based Control with Applications to Smart Structures in Presence of Disturbances
Sheng-Quan Li, Yangzhou University, China

11:30-11:50 **Invited Speech VII**
Formation Control of Unmanned Marine Vehicles
Yulong Wang, Shanghai University, China

11:50-13:30 **Break**

13:30-15:30 **Special Session 1-B: Control of Advanced Robotic and Mechatronic Systems**
Zoom ID: 893 3385 0921

Parallel Session 2: Intelligent Driving and Unmanned Systems
Zoom ID: 828 2060 9179

Parallel Session 3: Control Theory and Control Systems
Zoom ID: 820 4698 9939

15:50-17:50 **Parallel Session 4: Modern Electronics and Control Technology**
Zoom ID: 893 3385 0921

Parallel Session 5: Machine Vision and Image Processing
Zoom ID: 828 2060 9179

Parallel Session 6: General Mechanical and Manufacturing Engineering
Zoom ID: 820 4698 9939

18:20-18:40 **Closing & Awarding**
Zoom ID: 893 3385 0921

Keynote Speeches

9:10-9:50, Saturday April 9, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Keynote Speech I- The Digital Transformation of ASEAN Manufacturing for the Future

Prof. CheeFai TAN

Infrastructure University Kuala Lumpur, Malaysia

Fellow of the ASEAN Academy of Engineering & Technology (AAET)

Industry 4.0 is a strategic initiative introduced by the German government during early 2010s to transform industrial manufacturing through digitalisation and exploitation of the potentials of new technologies. It is an effort to increase productivity and efficiency mainly in the manufacturing sector. Industry 4.0 production system aims to be highly flexible and should be able to produce individualised and customised products. In fact, it is an exciting deployment of automation within manufacturing, covering the use of robotics, data management, cloud computing and the internet of things (IoT). It has started to show that artificial intelligence, robotics, smart sensors and integrated systems are an important part of a normal manufacturing process. In interaction with machines, it needs horizontal integration at every step in the production process.

Manufacturing in ASEAN is often perceived as a traditional industry heavily reliant on human, equipment and processes. Beyond the big machineries, conveyer belts and assembly lines, manufacturing is in fact very diverse and has long helped shape the economic growth in this region. The Boston Consulting Group also estimates that ASEAN manufacturing output can impressively grow by an additional US$400 billion to US$600 billion a year by 2030 from 2020 levels. However, ASEAN manufacturers may risk falling behind as they face disruption from newer technologies, and more recently, pressure from a pandemic that has changed the world economy. Manufacturing and the supply chains that support it are under intense stress today and companies will have to look to digitalise through modern technology to adapt to newfound changes. In the presentation, an insight of the ASEAN manufacturing digital transformation initiative will be described.

Bio: Chee-Fai Tan PhD is the Fellow of the ASEAN Academy of Engineering & Technology (AAET), Honorary Fellow of ASEAN Federation of Engineering Organizations (AFEO) and Fellow of the Institution of Engineers Malaysia (IEM). Currently, he is the Professor and Deputy Vice Chancellor (Research) of the Infrastructure University Kuala Lumpur. In addition, Chee Fai is the President of ASEAN Federation of Smart Industry (AI) and the First National Chairman of the Chinese Mechanical Engineering Society (CMES), Malaysia Chapter. He is the Digital Transformation Advisor/Consultant with ASEAN Engineering Register and Malaysia Productivity Corporation. He is actively involved in intelligent strategic and advanced technical consultation to assist ASEAN industry towards Digital Transformation and the 4th Industrial Revolution. He has led various Industry, University, and Malaysia Government as well as International funded projects such as EU Seventh Framework Programme (FP7) and Industry4WRD Domestic Investment Strategic Funds (DISF). He is the Technical Expert for ISO/IEC Smart Manufacturing Standards Map Task Force (ISO/IEC SM2TF) since 2019. With the knowledge and experience, Chee-Fai Tan has contributed as Keynote Speaker in various important international engineering events such as Annual Meeting of China Association of Science & Technology (CAST), FEIAP General Assembly, World Intelligent Manufacturing Summit (WIMS) and Institution of Civil Engineers (ICE) Future Engineers Conference. He is the UNESCO Consultant to assess and study on engineering education at APEC Economy.

9:50-10:30, Saturday April 9, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Keynote Speech II- Rethink How We Control Soft Robots to Explore the World

Prof. Robert Katzschmann

ETH Zürich, Switzerland

Soft robotics focuses on the deformable and non-rigid character of our world. These soft-bodied robots are made of deformable materials that greatly surpass the limited degrees of freedom of rigid robots and potentially offer inherently safe and adaptable ways of achieving versatile forms in locomotion and manipulation. A soft robot can homogeneously combine actuation, sensing, and structural complexity within the same component of the robot. In this talk, I will provide an overview of several efficient modeling and control approaches that bring us closer to the development of intelligent robotic "brains". We are aiming for an approach that exploits the unique properties of soft robots and the deformable world we life in. I will cover in this talk my lab's recent developments in overcoming the challenges in modeling and control of soft robotic systems. A focus will be on explaining and comparing our lab's modeling methods, which include: minimal parameter modeling, reduced order modeling, variational deep Koopman operator modeling, differentiable projective dynamics, and physics-informed model learning. Based on these modeling techniques, I will then introduce frameworks that perform model-based control of multi-segment pneumatic soft robotic arms. Finally, I will show how we use our modeling approach to co-optimize the designs of geometry and control of our soft robotic systems.

Bio: Robert is a professor of robotics at ETH. He takes inspiration from living creatures and develops robots with deformable properties that adapt better to their environment when compared to traditional robots. His lab designs, fabricates, models, and controls soft robotic systems such as robotic fish for ocean exploration, arms for dynamic manipulation tasks, and drones for swift grasping. Robert's work has appeared in leading academic journals, such as Science Robotics, and has been featured in major outlets, including New York Times. Robert is one of 20 TED Fellows in 2022. Robert is a member of the ETH AI Center, the Max Planck ETH Center for Learning Systems (CLS), and the ETH Competence Center for Materials and Processes (MaP). Robert is an Area Chair for Robotics Science and Systems (RSS), an Associate Editor for IROS, an Associate Editor for RA-L, and a reviewer for leading peer-reviewed journals, including Science and Nature.

10:30-11:10, Saturday April 9, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Keynote Speech III- Edge Intelligence Driven Communication and Computing Resource Coordination

Prof. Zhaolong Ning

Chongqing University of Posts and Telecommunications

Highly Cited Researcher

Pervasive Edge Computing (PEC) refers to one kind of edge computing that merely relies on edge devices with sensing, storage and communication abilities to realize peer-to-peer offloading without centralized management. However, on one hand, users may not make appropriate scheduling decisions based on their local observations. On the other hand, how to guarantee the fairness among different edge devices in the fully decentralized environment is rather challenging. In this talk, we first present a multi-agent Imitation learning model in PEC networks, to adapt to the high mobility of users and resolve the shortcomings of the limited storage capacity of edge servers. Then, we propose a remote health monitoring model for Internet of medical things, as an example for delay-sensitive service applications. Highlighting its characteristics, the cost of patients depends on medical criticality, age of information and energy consumption. After that, we propose an imitation learning enabled online task scheduling algorithm with near-optimal performance for Internet of vehicles, as an example for high-concurrency service applications. Specially, an expert can obtain the optimal scheduling policy by solving the formulated optimization problem with a few samples offline.

Bio: Zhaolong Ning received the PhD degree from Northeastern University, China in 2014. He was a research assistant with Kyushu University from 2013 to 2014, Japan, and a Hong Kong Scholar with The University of Hong Kong from 2019 to 2021. Currently, he is a full professor at the Chongqing University of Posts and Telecommunications, China. His research interests include Internet of Things, mobile edge computing, and network optimization. He has published more than 120 scientific papers in international journals and conferences, such as IEEE JSAC, IEEE TMC, IEEE TPDS, IEEE T-ITS, IEEE COMST, IEEE COMMAG, IEEE Wireless Communications, and so on. He is the recipient of several prestigious awards including the Best Land Transportation Paper Award of IEEE TVT 2020, Best Paper Award of IEEE Systems Journal 2019 and so on. He serves as an associate editor or guest editor of several journals, such as the IEEE TII and IEEE TCSS. He has also chaired more than 20 international conferences, such as IEEE GLOBECOM and IEEE Healthcom. He is a Highly Cited Researcher 2020, 2021 (Web of Science), Highly Cited Chinese Researchers 2020 (Elsevier), and elected to be the Young Elite Scientists Sponsorship Program by China Association for Science and Technology.

14:40-15:20, Saturday April 9, 2022

Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Keynote Speech IV- Learning for Interaction in Robotic Tasks

Prof. Danica Kragic

Royal Institute of Technology KTH, Sweden

IEEE Fellow

Google Scholar with H-index of 65

All day long, our fingers touch, grasp and move objects in various media such as air, water, oil. We do this almost effortlessly - it feels like we do not spend time planning and reflecting over what our hands and fingers do or how the continuous integration of various sensory modalities such as vision, touch, proprioception, hearing help us to outperform any other biological system in the variety of the interaction tasks that we can execute. Largely overlooked, and perhaps most fascinating is the ease with which we perform these interactions resulting in a belief that these are also easy to accomplish in artificial systems such as robots. However, there are still no robots that can easily hand-wash dishes, button a shirt or peel a potato. Our claim is that this is fundamentally a problem of appropriate representation or parameterization. When interacting with objects, the robot needs to consider geometric, topological, and physical properties of objects. This can be done either explicitly, by modeling and representing these properties, or implicitly, by learning them from data. The main cobjective of our work is to create new informative and compact representations of deformable objects that incorporate both analytical and learning-based approaches and encode geometric, topological, and physical information about the robot, the object, and the environment. We do this in the context of challenging multimodal, bimanual object interaction tasks. The focus will be on physical interaction with deformable and soft objects.

Bio: Danica Kragic is a Professor at the School of Computer Science and Communication at the Royal Institute of Technology, KTH. She received MSc in Mechanical Engineering from the Technical University of Rijeka, Croatia in 1995 and PhD in Computer Science from KTH in 2001. She has been a visiting researcher at Columbia University, Johns Hopkins University and INRIA Rennes. She is the Director of the Centre for Autonomous Systems. Danica received the 2007 IEEE Robotics and Automation Society Early Academic Career Award. She is a member of the Royal Swedish Academy of Sciences, Royal Swedish Academy of Engineering Sciences and Young Academy of Sweden. She holds a Honorary Doctorate from the Lappeenranta University of Technology. Her research is in the area of robotics, computer vision and machine learning. She received ERC Starting and Advanced Grant. Her research is supported by the EU, Knut and Alice Wallenberg Foundation, Swedish Foundation for Strategic Research and Swedish Research Council. She is an IEEE Fellow.

15:20-16:00, Saturday April 9, 2022

Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Keynote Speech V- Evolutionary Development of AI and Autonomous Robots

Prof. Huosheng Hu

University of Essex, United Kingdom

IET Fellow

Google Scholar with H-index of 58

After recent advancement of AI and robotics technologies, autonomous robots are gradually serving us in our home, hospital, office and everywhere. They are intelligent and interactive, inspired from behaviour demonstration of biological systems. Many people are worry about the risk of losing the jobs to robots, and some people thought these intelligent robots may control us in the future. In this talk, I will firstly outline a brief evolution history of AI and robotics technologies, and then their future trend is predicted in some depth. Some milestone robotic projects in the world and the robotics research work done at Essex will be presented, including behaviour modelling, sensor data fusion and behaviour-based control. Finally, my Keynote Speech will deliver a conclusion that humans will control the world and robots will be good servants to us.

Bio: Huosheng Hu is Professor in the School of Computer Science and Electronic Engineering at the University of Essex, United Kingdom. He received the MSc degree in industrial automation from the Central South University in China in 1982 and the PhD degree in robotics from the University of Oxford in the U.K. in 1993. His research interests include autonomous robots, embedded systems, data fusion, human-robot interaction, machine learning algorithms, cloud computing and mechatronics. He has published over 500 papers in journals, books and conferences in these areas. His research publications have received a high citation of 15870 and his H-Index is 58 (Google Scholar). Prof. Hu is a Fellow of Institute of Engineering and Technology, a Fellow of Institute of Measurement and Control, a founding member of IEEE Robotics and Automation Society Technical committee on Networked Robots. He has been a Program Chair or a member of Advisory Committee for many international conferences such as IEEE ICRA, IROS, ICMA, ROBIO during the last 20 years. He is currently Executive Editor for International Journal of Mechatronics and Automation.

Invited Speeches

11:20-11:40, Saturday April 9, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Learning based Robot Localization and Navigation

Prof. Hesheng Wang
Shanghai Jiaotong University, China
Senior Member, IEEE

Abstract: *The precise autonomous localization and perception of robots is a key technology for autonomous driving and intelligent service robots. This report focuses on precise localization, perception, and mapping in complex and dynamic environments based on vision and LiDAR, in order to improve the autonomous perception and localization capabilities of mobile robots in dynamic large outdoor scenes. This report includes multi-sensor online extrinsic parameter calibration, multi-sensor fusion based robust and high-precision localization, adjacent frame constraints based real-time dense depth estimation, optical flow estimation and dynamic 3D scene flow estimation. Based on above perception and localization works, we further realize the robot relocation system and SLAM back-end optimization work in the morning and evening and under the seasonal changes. Finally, a complete multi-sensor fusion robot intelligent autonomous localization, perception and mapping system framework is formed. This report also shows the test and practical application in real scenarios.*

11:40-12:00, Saturday April 9, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Vary Parameter Recurrent Neural Network Applied to Intelligent Robot

Prof. Zhijun Zhang
South China University of Technology, China
Senior Member, IEEE

Abstract: *Everything in nature changes with time is eternal and absolute, while stationary is only relative. Inspired by this fundamental law of nature and based on the neurodynamic approach, Dr. Zhijun Zhang designed and proposed a varying-parameter recurrent neural network. Various forms of varying- parameter recurrent neural networks are designed and derived, and it is theoretically demonstrated that the network has the property of super-exponential convergence in solving time-varying problems and robot motion planning problems. In solving noise-containing problems, this model can effectively suppress noise and has obvious advantages over similar methods. The network model can effectively overcome the limitations of the existing methods in terms of slow convergence and weak robustness in solving time-varying, nonlinear, underdetermined, and multi-solution problems of robot systems in complex environments, and has the advantages of high solution accuracy, fast error convergence, and robustness. In practical systems, this method can be applied to robot motion planning, natural human-robot interaction and flight controller design and many other aspects.*

10:00-10:20, Sunday April 10, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Cooperative Control of Interconnected Two-time-scale Systems

Prof. Yan-Wu Wang
Huazhong University of Science & Technology, China
Senior Member, IEEE

Abstract: *Many systems in real applications exhibit the two-time-scale property involving both slow and fast processes, for example the biological systems, chemical reactions, and power systems. Their dynamics are mathematically described as two-time-scale systems (TTSSs). Feedback design for such TTSSs is often subject to high dimensionality and is numerical ill-conditioned. Consequently, it is interesting, yet challenging, to consider the problem of cooperative control of interconnected TTSSs. In this talk, we will present several design strategies to address some typical problems encountered in real applications, including the unknown control direction problem, the discrete-time communication problem and disturbance rejection problem.*

10:20-10:40, Sunday April 10, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Dynamics and Advanced Control of Pneumatic Artificial Muscle Robot Systems

Prof. Ning Sun
Nankai University, China
Senior Member, IEEE

Abstract: *With the rapid development of rehabilitation robots and the growing demands for human-robot interaction, modeling and intelligent control of pneumatic artificial muscle (PAM) robots have increasingly attracted the attention of many researchers. It is a challenging research topic to overcome the effects of PAMs' inherent defects (e.g., high nonlinearities, hysteresis, time-varying characteristics, etc.), despite the merits of lightness, safety, and high power-to-weight/volume ratios of PAMs. To this end, we aim to achieve accurate modeling and advanced control for PAM robots, which may contribute to their further theoretical research and practical applications. Specifically, for single-PAM robots, there exist some difficulties as follows: 1) PAM systems are susceptible to unknown external disturbances due to their high nonlinearities, creep, hysteresis, etc. 2) PAM robots usually suffer from parameter uncertainties and unmodeled dynamics. 3) The ultimate control inputs (corresponding to the pressurized air) of PAM robots should be constrained to be nonnegative. To solve these problems, we propose a disturbance estimation-based nonlinear control method, a neuroadaptive control method with system uncertainties, and an adaptive control method with unidirectional input constraints, respectively. Further, for multi-PAM robots, the following issues should be considered: 1) Since torques/forces are generated by air pressure and are not the ultimate control inputs, the torque models of PAM robots are not direct and effective. 2) To ensure safety, the system state variables (e.g., contracted lengths of muscles, ranges of robots' movements, etc.) are usually limited. To this end, we propose an accurate dynamic modeling method and a nonlinear control method with overshoot constraints, respectively. Some future research directions will also be discussed.*

10:40-11:00, Sunday April 10, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Fault Detection and Fault Tolerant Control of Complicated Dynamic Systems with Spacecraft Applications

Prof. Ming Liu
Harbin Institute of Technology, China
Member, IEEE, Highly Cited Researcher

Abstract: *With the widespread popularity of control system in human's various fields, the development of society is becoming more and more dependent on control system. The safety, reliability and effectiveness of system equipment has received extensive research attention. The appearances and development of fault detection (FD) and fault-tolerant control (FTC) methods have presented a novel way to ensure and improve the safety and reliability of the systems. In this presentation, the FD and FTC design problem is considered for dynamic systems in modern industrial systems, where network-induced phenomenon such as data communication delay, data packet dropout, signal quantization, etc, and some unexpected phenomenon including sensor/actuator faults, measurements noise, input/output disturbance, model nonlinearity are considered in a unified framework. Such a design problem is difficult and challenging, and traditional FD and FTC methods cannot be applied directly here. We will give a new systemic FD and FTC design approaches for complicated dynamic system to solve this design problem. The proposed FD methods includes network-based FD filtering method, descriptor sliding mode observer and extended unknown input observer techniques, etc. The proposed FTC methods include adaptive control based FTC strategy and sliding mode control based FTC strategy. Finally, some practical applications of the developed FD and FTC methods on spacecraft in orbit are introduced.*

11:10-11:30, Sunday April 10, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Extended-State-Observer-Based Control with Applications to Smart Structures in Presence of Disturbances

Prof. Sheng-Quan Li
Yangzhou University, China
Senior Member, IEEE

Abstract: *A large number of uncertainties such as external excitement, model parameters perturbation, complex boundary conditions, time delays, seriously impact the operation of the piezoelectric smart structures. Therefore, an active disturbance rejection controller (ADRC) is designed and implemented based on an extended state observer (ESO) to address such issues. Mathematical model is established based on the method of subspace identification (SID) method. Knowing that some dynamics are intractable, the compensations for these disturbances, hence, are applied to achieve better disturbance rejection and vibration suppression performances. They involve:*
1) a delay-free part by a smith predictor with a novel differentiator; 2) a tracking differentiator (TD) to eliminate the influence of the measurement noises; 3) an acceleration feedforward channel for each vibration mode to deal with multivariable couplings. The stability and disturbance rejection characteristics are analyzed via both time and frequency domains based on Nyquist diagram, description function method and Lyapunov theorem. The control scheme of the introduced approach is general, but is conveyed here using solely an all-clamped piezoelectric plate with delays, which is considered a typically benchmark for vibration phenomenon. Theoretical and experimental results show the effectiveness of the proposed approach to suppress smart structure vibrations in the presence of delays and disturbances.

11:30-11:50, Sunday April 10, 2022
Zoom ID: 893 3385 0921 (https://us02web.zoom.us/j/89333850921)

Formation Control of Unmanned Marine Vehicles

Prof. Yulong Wang
Shanghai University, China

Abstract: *The last two decades have witnessed the booming development of formation control for multiagent systems due to its potential applications, ranging from mobile agents localization to robot team search and rescue, target enclosing, and surveillance. The main task of formation control is to manipulate a team of mobile agents to operate in a desired geometrical shape or pattern. Unmanned marine vehicles (UMVs) are typical multiagent systems, and the formation control of UMVs has attracted much attention. This speech will introduce some recent advances regarding formation control of UMVs, including event-triggered dynamic positioning for mass-switched UMVs, H∞ cluster formation control of multiple UMVs with stochastic sampling, cooperative target tracking of multiple UMVs under switching interaction topologies, and the practical applications, etc.*