2024 IWAMechS

The International Workshop on Advanced Mechatronic Systems

(IWAMechS 2024)

December 27 – 28, 2024

Tokyo University of Agriculture and Technology, Tokyo, Japan

PROGRAM

Organizers:

International Journal of Advanced Mechatronic Systems

International Journal of Human Factors Modelling and Simulation

IEEE Systems, Man, and Cybernetics Society

Tokyo University of Agriculture and Technology, Tokyo, Japan

Ritsumeikan University, Shiga, Japan

Osaka Institute of Technology, Osaka, Japan

Instructions

Registration Guide:

Arrive at the Conference Venue → Inform the conference staff of your paper ID →Sign your name on the Participants List → Check your conference materials.

Checklist:

1 receipt, 1 name card, 1 printed conference abstract, 1 lunch coupon, 1 dinner coupon.

Devices Provided by the Conference Organizer:

- Laptops (with MS-Office & Adobe Reader)
- Projectors & Screen
- Laser Sticks

Material Provided by the Presenters:

PowerPoint or PDF files

Notice:

- Certificate of listener can be collected from the registration counter.
- Certificate of presentation can be collected from the session chair after each session.
- The organizer will not provide accommodation, so we suggest you make an early reservation.

Contact:

IWAMechS 2024
Secretariat
Email: icamechs2024@gmail.com
Phone/FAX: +81-42-388-7134

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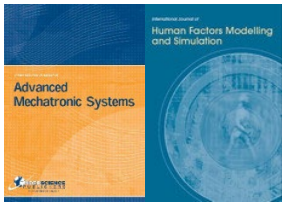


2024 International Workshop on

Advanced Mechatronic Systems

December 27 – 28, 2024

Tokyo, Japan

GREETINGS FROM THE GENERAL CHAIRS

On behalf of the IWAMechS2024 Organizing Committee, it is our great pleasure and honor to welcome you to The International Workshop on Advanced Mechatronic Systems. The workshop will be held on December 27 – 28, 2024, in Tokyo, Japan, sponsored by the International Journal of Advanced Mechatronic Systems (IJAMechS), International Journal of Human Factors Modelling and Simulation (IJHFMS), Tokyo University of Agriculture and Technology, Ritsumeikan University, Osaka Institute of Technology, IEEE Systems, Man, and Cybernetics Society.

IWAMechS2024 is in conjunction with ICAMechS 2024. It aims to provide a high-level international forum for scientists, engineers, and educators to present state-of-the-art research and applications in AI design, AI application, and advanced mechatronic systems research. The workshop features keynote speeches given by world-renowned scholars.

The Tokyo University of Agriculture and Technology, commonly known as TUAT, is a national university in Tokyo, Japan. The university has campuses in two cities in Western Tokyo, Fuchū and Koganei. Fuchu Campus has the university's head office and focuses on agriculture. Koganei Campus focuses on engineering. TUAT has developed as a unique science and technology institution based on agricultural science and engineering, two scientific fields that support the fundamentals of human society, agriculture, and industry. Academic and research activities conducted at TUAT across a broad range of areas can contribute to constructing a secure and safe society and can create and develop new industries.

We hope that you all enjoy the workshop and beautiful Tokyo.

Best regards,

General Chair

Lin MENG, Professor, Ph.D.

SOCIAL EVENTS

Welcome Reception

Conference Banquet

CONFERENCE LOCATION

Koganei Campus, Tokyo University of Agriculture and Technology, Japan.

Maps and Transportation

2-24-16 Naka-cho, Koganei-shi, Tokyo

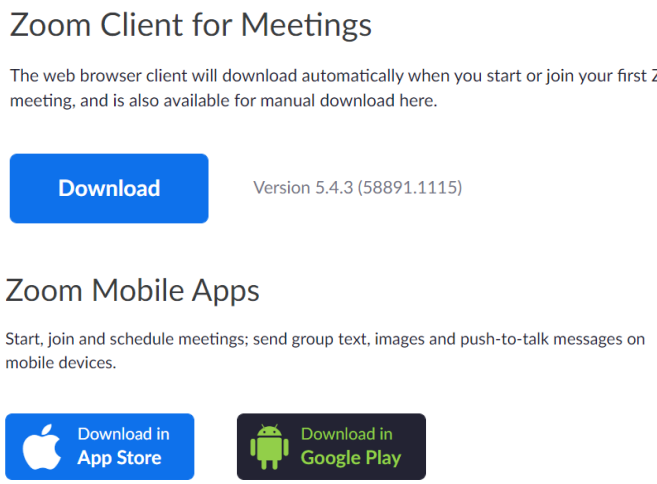
INSTRUCTIONS FOR ZOOM MEETINGS

- **Download and Install Zoom**

Go to https://zoom.us/ download.

URL: ①https://zoom.us/ ②https://zoom.com.cn/download (Author in China)

Opening this link on an iOS or Android device will open the app store to download the Zoom mobile application.



- **Join the meeting**

1. Joining via the link:

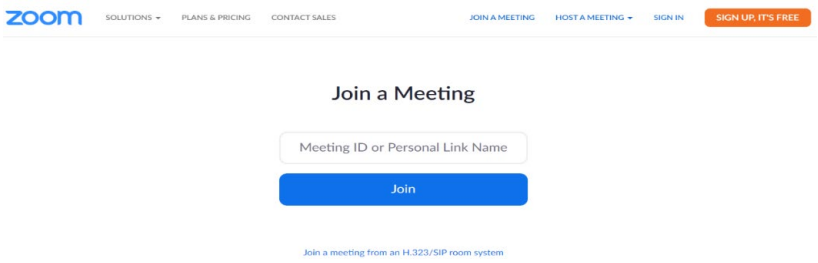
   https://us02web.zoom.us/j/4563545448?pwd=ZW4wa0l1bW9MRkJ0V2tvdGk1VE50dz09

   Meeting ID: 456 354 5448

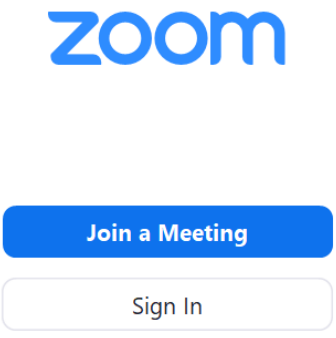
   Password: 9XMZpU

2. Joining via a web browser (https://zoom.us/)

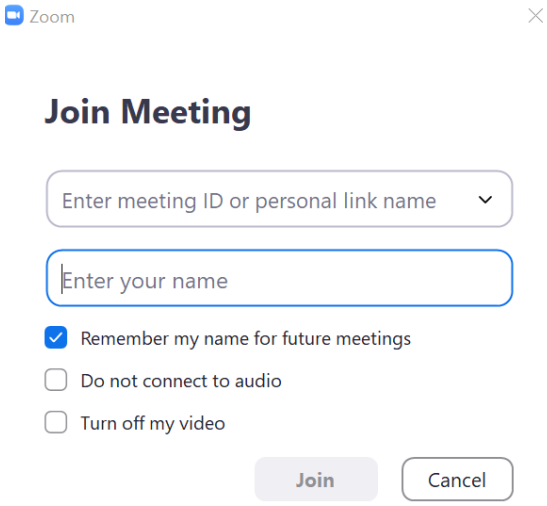
   Type the meeting ID or personal link name and click Join.



3. Joining the meeting via Zoom client



Type the meeting ID or personal link name, your name, and click Join.



Note: Zoom instructions for joining a meeting can be found here: https://support.zoom.us/hc/en-us/articles/206618765-Zoom-Video-Tutorials.

- **Functionality of Zoom in the Meeting**

The Zoom Menu Bar appears at the bottom of the Zoom window once the meeting begins. If you can't see the menu bar, move your mouse slightly and the bar will appear. (The bar disappears after a few seconds when in full-screen mode.)

With the Zoom Menu Bar, you are able to:

1. Mute/Unmute your audio. You can also select your audio input here by clicking the up arrow next to the microphone icon.
2. Start/Stop your video. You can also select your video input here by clicking the up arrow next to the video camera icon.
3. Invite more people to join by email, IM, or meeting ID.
4. Open/Close a window of a list of participants and related details. The participants list allows you to "raise your hand" to let everyone know you wish to speak and see who else has their hand raised. You can also easily mute/unmute yourself on the participants list.
5. Share your screen or select a specific application to share (e.g., Microsoft)
6. Send a message to one person (using private chat) or to all participants.
7. Record the meeting (if you have been granted permission).
8. Leave or end the video meeting.

Agenda Overview

Friday, December 27, 2024 (UTC + 9)

Venue: Tokyo University of Agriculture and Technology, Japan

09:50 - 10:00	**Opening Remark**
	Keynote Speaker 1
10:00 - 10:30	**Prof. Mingcong DENG, Tokyo University of Agriculture and Technology, Japan**
	Title: Learning & Operator Based Nonlinear Control Design and Its Applications
	Keynote Speaker 2
10:30 - 11:00	**Prof. Xingwen ZHENG, Zhejiang University, China**
	Title: Bio-inspired perception of underwater robot
11:00 - 13:00	***Lunch Break***
	Keynote Speaker 3
13:00 - 13:30	**GM. Yong LU, Xieji Industrial and Dongkai Semiconductor, China**
	Title: Introduction to a Full-Process Non-Contact Cleaning Equipment Solution for Precision Manufacturing
	Keynote Speaker 4
13:30 - 14:00	**Prof. Lihui WANG, Soochow University, China**
	Title: Towards dynamic image perception with advanced opto-mechatronic system
	Keynote Speaker 5
14:00 - 14:30	**Prof. Shengjun WEN, Zhongyuan University of Technology, China**
	Title: Intelligent driver and micro/nano manipulated robots
	Keynote Speaker 6
14:30 - 15:00	**Prof. Ya ZHANG, Tokyo University of Agriculture and Technology, Japan**
	Title: Novel terahertz bolometric detection by MEMS resonators
15:00 - 15:30	***Coffee Break***
	Keynote Speaker 7
15:30 - 16:00	**Prof. Shuhui BI, University of Jinan, China**
	Title: Research on ordinal model of soluble solid content based apple grading
	Keynote Speaker 8
16:00 - 16:30	**Prof. Xudong GAO, Nanjing University of Information Science and Engineering, China**
	Title: Control system optimization of power electronics using population-based metaheuristic methods
	Keynote Speaker 9
16:30 - 17:00	**Dr. Yuanhong XU, Tokyo University of Agriculture and Technology, Japan**
	Title: Operator-based nonlinear control on systems with disturbed open-loop dynamics
	Keynote Speaker 10
17:00 - 17:30	**Prof. Xianfeng ZHANG, Guangzhou College of Technology and Business, China**

	Title: Study of High Efficiency I-III-IV Group Solar Cells
18:00 - 20:00	***Banquet***

Saturday, December 28, 2024 (UTC + 9)

Venue: Tokyo University of Agriculture and Technology, Japan

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	Title: Fabrication and control of artificial muscles capable of both driving and sensing
	Keynote Speaker 12
10:30 - 11:00	**Dr. Ximei LI, Luoyang Institute of Science and Technology, China**
	Title: Performance analysis on the flexible arm based SMA interactive actuating control system
	Keynote Speaker 13
11:00 - 11:30	**Prof. Lin MENG, Ritsumeikan University, Japan**
	Title: High-Performance Image Processing AI for Broad Applications
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	Title: A method for measuring Virtual Image Distance for head-mounted display by using the variable focus optics mechanism
13:20 - 13:40	**Yutao HUANG, Soochow University, China**
	Title: Design and performance evaluation of a large-aperture liquid-filled variable-focus lens
13:40 - 14:00	**Chengyao LIU, Tokyo University of Agriculture and Technology, Japan**
	Title: Operator-Based Triboelectric Nanogenerator Control and Its Experimental Studies
14:00 - 14:20	**Zizhen AN, Tokyo University of Agriculture and Technology, Japan**
	Title: Novel Extension of Robust Condition for Right Coprime Factorization System Using Time-varying Bezout Identity
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15:00 - 15:20	**Xuan YANG, Nanjing University of Information Science and Engineering, China**
	Title: An optimization method for energy storage converter control systems based on hierarchical learning
15:20 - 15:40	**Qi LI, Ritsumeikan University, Japan**
	Title: Exploration of DNN Compression Techniques for Edge Devices Based on Layer Fusion and Subsampling
15:40 - 16:00	**Zhenling SU, Ritsumeikan University, Japan**
	Title: Real-time Object Detection Based on Nano Drones
16:00 - 17:00	***Panel Discussion***

KEYNOTE SPEAKERS

Prof. Mingcong DENG, Tokyo University of Agriculture and Technology, Japan

Prof. Mingcong Deng (M'03, SM'07, F'24) received his BS (1986) and MS (1991) in Automatic Control from Northeastern University, China, and PhD (1997) in Systems Science from Kumamoto University, Japan. From April 1, 1997 to September 30, 2010, he was with Kumamoto University; University of Exeter, UK; NTT Communication Science Laboratories; Okayama University. From October 1, 2010, he has been with Tokyo University of Agriculture and Technology, Japan, as a professor. Now he is the Chair of Department of Electrical and Electronic Engineering and a Chair of Division Applied Electronics Engineering, The Graduate School of Engineering. Prof. Deng specializes in three complementary areas: Learning & operator based nonlinear fault detection and fault tolerant control system design; System design on human factor based robot control; Learning based nonlinear adaptive control. Prof. Deng has over 610 publications including 210 peer reviewed journal papers. He also offered over 50 keynotes and plenary speeches in international conferences.

He is a member of Systems Science and Engineering Committee of SMCS, and Representative of IEEE Systems Council AdCom. He is a Chair of the ESNDM Technical Committee, IEEE SMCS and a Co-chair of ARA Technical Committee, IEEE RAS. He has served as AE for IEEE/CAA Journal of Automatica Sinica and IEEE Transactions on Automation Science and Engineering. He is the funding chair of annual International Conference on Advanced Mechatronic Systems (ICAMechS) technically sponsored by SMCS since 2011. As Program Chair & Co-Chair he organized 7 times IEEE SMCS sponsored international conferences, and 7 times IEEE SMC sponsored international conferences as International Advisory Committee. So far, Professor Deng was the recipient of 2020 IEEE RAS Most Active Technical Committee Award & 2024 IEEE Most Active SMCS Technical Committee, and 2014 & 2019 Meritorious Services Award, IEEE SMCS.

He was the Chair for TC on AI based Safety Control, Fault detection and Fault Tolerance Control, IEEJ. He was also an Officer for Advanced Fusion Division, SICE, a Council Member for SICE Chugoku Branch. He serves as Member for societies SICE, IEICE, JSME, ISCIE, IEEJ, in Japan.

Title:

Learning & Operator Based Nonlinear Control Design and Its Applications

Abstract:

In this talk, learning based nonlinear control design techniques for advanced mechatronic systems are shown. For dealing with nonlinear mechatronic system dynamics, case studies on modeling are introduced in detail. The studies describe the nonlinear dynamics based on learning rules. As for the control on the nonlinear dynamics, robust nonlinear control design schemes are employed to guarantee the robust stability and desired performance. Furthermore, learning & operator based robust nonlinear controls of uncertain systems, such as calorimetric power loss measurement system, 3-DoF soft actuator, micro reactor, DCS based tank process etc., are presented.

KEYNOTE SPEAKERS

Prof. Xingwen ZHENG, Zhejiang University, China

Xingwen Zheng is a tenure-track professor (under the Hundred Talents Program) with the College of Control Science and Engineering, Zhejiang University. Previously, he was a Japan Society for the Promotion of Science (JSPS) fellow with the Department of Mechanical Engineering, the University of Tokyo, Japan (in micro-robotic manipulations, supervised by Professor Fumihito Arai). He completed Ph.D. programs at Peking University, China (in dynamics and control, supervised by Professor Guangming Xie) and the University of Groningen, The Netherlands (in biomimetic sensory systems, supervised by Professor Ming Cao and Professor Ajay Kottapalli). He received a B.E. degree in mechanical engineering and automation from Northeastern University, China.

His research interests include underwater robots, bio-inspired robots, biomimetic sensory systems, and robotic manipulations. He has published papers (> 30) in journals such as IEEE Transactions on Robotics, Advanced Functional Materials, Advanced Science, IEEE/ASME Transactions on Mechatronics (TMECH), and Soft Robotics, as well as conferences such as IROS, ICRA, MEMS, Transducers, etc. He has published two academic books. He has 10 authorized patents and has served as PIs in 3 research projects funded by the National Natural Science Foundation of China (NSFC), the Japan Society for the Promotion of Science (JSPS), etc. He was the recipient of > 20 awards such as the JSPS postdoctoral fellow, Institute of Physics Publishing China Highly Cited Paper Award (2018-2020), Best Application Paper Award Nomination of MARSS 2024, Wiley China Open Science Author Award, IOP Outstanding Reviewer Award in 2023, etc. He served as an editorial board member for Advanced Bionics, Soft Science, Journal of Hydrodynamics, Frontiers in Robotics and AI, SES 2024, etc.

Title:

Bio-inspired perception of underwater robot

Abstract:

In harsh underwater environments, dim light, chaotic magnetic fields, and complex terrain can affect the normal operation of traditional visual, magnetic, and acoustic sensors. Therefore, investigating novel underwater information perception technologies and assisting underwater robots in their operations has become one of the research hotspots in recent years. Marine organisms can use their sensory systems (such as fish lateral lines, seal whiskers, etc.) to detect flow velocity and pressure in the flow field, thereby perceiving the surrounding environment. This phenomenon has inspired the development of biomimetic sensors to assist underwater robots in their operations. In this talk, I will introduce two bio-inspired sensory systems inspired by fish lateral lines and seal whiskers, respectively. The main content includes two aspects: 1) Autonomous localization and relative state estimation of underwater robots based on an artificial lateral line system; and 2) The ultra-sensitive sensing mechanism of seal whiskers and seal whisker-inspired sensors.

KEYNOTE SPEAKERS

GM. Yong LU, Xieji Industrial and Dongkai Semiconductor, China

- Holds a master's degree in Business Administration from Tongji University and previously studied at Kobe University in Japan for graduate school.
- Started working in Shanghai in 2004, serving as a market leader for materials and equipment technology at several Fortune 500 multinational companies in South Korea and Japan.
- Worked in South Korea from 2010 to 2012, participating in the smart manufacturing processes of Samsung and Apple smartphones.
- After returning to China, focused on process equipment and materials for domestic smart product manufacturing, serving as a technical project consultant for several publicly listed companies.
- In 2021, developed non-contact cleaning equipment and successfully entered the supply chains of Apple and Samsung.
- Currently serves as the General Manager of Xieji Industrial and Dongkai Semiconductor.

Title:

Introduction to a Full-Process Non-Contact Cleaning Equipment Solution for Precision Manufacturing

Abstract:

1) As industrial upgrades continue to advance towards intelligence and ultra-precision, the post-Moore's Law era poses challenges for achieving more efficient and higher-quality production.

2) In precision manufacturing, particles are a significant pain point that seriously impact product yield in dynamic clean production lines.

3) By utilizing cleaning gases in a non-contact manner and leveraging microfluidic control, particle aggregation, and intelligent control technologies, we aim to thoroughly address particle issues, thereby improving yield and reducing costs. This forms the core of this report and our current work.

KEYNOTE SPEAKERS

Prof. Lihui WANG, Soochow University, China

Lihui Wang is a professor at the School of Future Science and Engineering, Soochow University, China. He received his Ph.D. degree from the University of Tokyo, Japan, in 2014, and then he worked as a project assistant professor and project researcher at the same university till 2019. After that, he was a professor of engineering at the Guangdong Academy of Sciences, China till 2024. He is a senior member of the IEEE, Optical Society of America (Optica). His research was endowed with a Special Prize from ACM SIGGRAPH, Innovative Technologies, and a Sponsor Award from the Digital Content Association of Japan. His research interests include adaptive optics, high-speed machine vision, interactive display, dynamic projection mapping, and the Opto-Electro-Mechanical system design and its applications.

Title:

Towards dynamic image perception with advanced opto-mechatronic system

Abstract:

The surrounding environment of human society has dynamic characteristics with rapid changes. Hence, if real-time observation and interaction are carried out on such dynamic objects, the traditional acquisition methods will face some bottlenecks.

This report will focus on high-speed vision, mainly in the fields of the high-speed focusing and tracking methods to solve the above bottleneck problems. It will illustrate some new opto-mechanical imaging solutions of high-speed focusing and tracking, and further discover the high-speed dynamic display interaction technology.

KEYNOTE SPEAKERS

Prof. Shengjun WEN, Zhongyuan University of Technology, China

Shengjun Wen received B.E. and M.Sc. degrees from Department of Electrical Engineering Zhengzhou University, China, in 2001 and 2004 respectively, and the Ph.D. degree on Electronic and Information Engineering from Graduate School of Engineering in Tokyo University of Agriculture and Technology in 2011. He is currently a Professor with Zhongyuan-Petersburg Aviation College in Zhongyuan University of Technology. He was a Visiting Fellow in Shibaura Institute of Technology, Japan, from September 2018 to August 2019. His research interests include nonlinear control, smart control, fault diagnosis and robotics. He has authored or co-authored 3 books, more than 70 journal papers and 50 conference papers. He received over 20 research projects sponsored by National Natural Science Foundation of China, National Key Research and Development Project, Natural Science Foundation of Henan, Key Research and Development Projects in Henan Province and so on, research scholarship sponsored by WESCO Scientific Promotion Foundation and National Scholarship for Privately Financed International Students Sponsored by Ministry of Education, Culture, Sports, Science and Technology of Japan. Until now, he was in charge of 8 courses for graduate and undergraduate students, including Computer Control, Industrial Computer and Networked Control, Intelligent Control, and so on.

Title:

Intelligent driver and micro/nano manipulated robots

Abstract:

Research status and existing problems of micro-nano manipulated robots based on intelligent driver. The working mechanism of intelligent driver is analyzed. And the complex hysteresis characteristic is discussed under various working conditions such as variable input signal and load, and a new modeling method is proposed. Based on the model, the nano-scale precision control theory and control algorithm are investigated.

KEYNOTE SPEAKERS

Prof. Ya ZHANG, Tokyo University of Agriculture and Technology, Japan

2006.7 Tsinghua University, Bachelor of Engineering
2008.7 Tsinghua University, Master of Engineering
2014.9 University of Tokyo, PhD (Engineering)
2014.10-2018.3 University of Tokyo, Postdoc research
2018.4-Now Tokyo University of Agriculture and Technology, Associate Professor.

Title:

Novel terahertz bolometric detection by MEMS resonators

Abstract:

Terahertz (THz) electromagnetic spectrum draws wide attention for nondestructive and/or biocompatible sensing. In order to be widely applicable to the THz sensing, it is of prime importance to develop THz sensors that can be operated at room temperature and have high sensitivity and fast operation speed. However, conventional room-temperature THz thermal sensors fall short of expectations in these characteristics. Utilizing a thermomechanical transduction scheme, we have developed an uncooled, sensitive, and fast THz bolometer by using a doubly clamped microelectromechanical system (MEMS) beam resonator as a sensitive thermistor. Owing to its ultra-high temperature sensitivity (the noise equivalent temperature difference of ~1 μK/√Hz), the present bolometer achieves not only a high sensitivity but also an operation bandwidth of several kHz, which is more than 100 times faster than other uncooled THz thermal sensors. The obtained electrical noise equivalent power (NEP) is as low as ~90 pW/√Hz, which is close to the limit set by the thermal fluctuation noise. The MEMS bolometers are fabricated by the standard semiconductor fabrication processes and are well suited for making detector arrays for realizing sensitive fast THz sensing applications.

KEYNOTE SPEAKERS

Prof. Shuhui BI, University of Jinan, China

Shuhui Bi received the M.Sc. degree in Operational Research and Control Theories from Ocean University of China in 2007, and the Ph.D. degree in Control Theory and Control Engineering from Okayama University, Japan in 2010, respectively. She is currently a professor at the school of Electrical Engineering, University of Jinan, China. Her research interests include nonlinear system control, filter design of integrated navigation system, evidence theory based multi-model fusion.

Title:

Research on ordinal model of soluble solid content based apple grading

Abstract:

As a non-destructive detection technique, near infrared spectroscopy (NIRS) detection technology has been widely used in the internal quality testing of fruits, which is feasible to detect the sugar or acidity of fruits due to its advantages of fast, non-destructive and pollution-free. However, a prediction model between NIRS data and soluble solid content (SSC) is required for the apples grading. Due to the traditional apple classification method only outputs the class labels which the sample belongs, and cannot express the order relationship existing in the class labels {first grade apple > second grade apple > third grade apple}. Therefore, ordinal classification is proposed for dealing with the order relationship between class labels, which not only considers the ordinality of the sample class labels, reflecting the order relationship between different class labels directly, but also can better handle the grading of sample data with ordinal nature between class labels. In addition, NIRS technology based model has disadvantages: it is affected by the properties of input data, variation of model parameters, and change of operation environments, which leads poor applicability, model instability, and grading cognitive uncertainty causing by the grading boundary. Therefore, evidence theory for fusing multiple ordinal models are studied to improve the adaptability, stability and grading prediction ability of the model. This study not only expands the application of evidence theory in multi-model fusion, but also improves the grading accuracy of nondestructive testing of apples based on NIRS.

KEYNOTE SPEAKERS

Prof. Xudong GAO, Nanjing University of Information Science and Engineering, China

He is currently employed at Nanjing University of Information Science and Engineering, and he has been engaged in research in the field of information engineering for a long time, publishing over 20 papers in the areas of intelligent control algorithms and intelligent decision-making. He has served as the session chair for the ICAMechS 2021 conference; is a member of the Chinese Association of Automation and the Electrical Engineering Society; and a member of the Institute of Electrical Engineers of Japan. Gao xudong is also an editorial board member of the International Journal of Advanced Mechatronic Systems, a TPC member of ICCSI 2022, and the chair of the Publication Committee for the ICAMechS 2021 conference.

Title:

Control system optimization of power electronics using population-based metaheuristic methods

Abstract:

This report delves into the application of population-based metaheuristic methods for the optimization of power electronic control systems. Power electronic control systems are the backbone of modern power systems, with their performance directly impacting energy conversion efficiency and system stability. As power electronic technology rapidly advances, the demand for control system optimization grows to adapt to fluctuating loads and operating conditions. Metaheuristic methods, with their global search capabilities and flexibility, have emerged as effective tools for addressing these complex optimization challenges.The report begins by outlining the basic components of power electronic control systems and optimization objectives, including improving efficiency, reducing losses, enhancing stability, and adapting to dynamic changes. Then the report presents several case studies demonstrating the application of these metaheuristic methods in practical power electronic control system optimization. These cases include the optimization of variable frequency drive parameters, the design of inverter control strategies, and the optimization of battery management systems. By comparing with traditional optimization methods, the superior performance of metaheuristic methods in handling multi-objective, nonlinear, and high-dimensional problems is demonstrated.

KEYNOTE SPEAKERS

Dr. Yuanhong XU, Tokyo University of Agriculture and Technology, Japan

2016.7 Ocean University of China, Bachelor of Engineering

2019.7 Ocean University of China, Master of Engineering

2024.9 Tokyo University of Agriculture and Technology, PhD(Engineering)

Title:

Operator-based nonlinear control on systems with disturbed open-loop dynamics

Abstract:

Disturbed open-loop dynamics in the form of disturbances, uncertainties and perturbations occur in systems, due to time delay, noise, physical constraints, unmodelled dynamics and so on, and may be present in sundry separate units of the system paths. These disturbed open-loop dynamics can cause system performance degradation even make a stable open-loop plant unstable.

In this report, firstly, robustness is analyzed for sundry disturbed open-loop dynamics by employing robust right coprime factorization where disturbed open-loop dynamics that locate in both the forward and feedback loops are considered. A new disturbed Bezout identity and a new robustness condition in the form of norm inequality are proposed. Secondly, a nonlinear control design scheme is proposed for an unstable networked plant with disturbed open-loop dynamics due to input saturation, time delay and noise. An unstable plant is right coprime factorized based on isomorphism and operator theory, and a feedback controller based on the continuous-time generalized predictive control is designed for the unstable right coprime factorized operator. For the disturbed open-loop dynamics owing to input constraints, a controller in the feedback loop is designed in a switched. Considering the disturbed open-loop dynamics due to time-varying delay and noise, an identity operator definition in the feedback loop is implemented. Further, a pre-operator is designed based on steady state performance for tracking. Finally, a nonlinear control design scheme is proposed for an unstable nonlinear plant with disturbed open-loop dynamics due to input saturation. A new robustness condition in the form of a norm inequality is proposed which extends bounded input bounded output (BIBO) stability to state stability. A plant with unstable modes is normalized right coprime factorized. A controller based on nonlinear continuous-time generalized predictive control is embedded into the normalized right coprime factorization to achieve stability and tracking. For the disturbed open-loop dynamics due to input saturation, a feedback controller is designed satisfying the proposed robustness inequality condition.

KEYNOTE SPEAKERS

Prof. Xianfeng ZHANG, Guangzhou College of Technology and Business, China

Zhang Xianfeng received his master degree in Mechanical Engineering from Tsinghua University in 2009, and received his Ph.D. degree in Electronic Physics from Tokyo Institute of Technology (Institute of Science Tokyo, now) in 2012. He joined International Course for Science and Engineering Program (ICSEP) of Waseda University in 2013 and Join Guangzhou College of Technology and Business in 2024. His main research is on I-III-IV group solar cells, like CuInGaSe2, AgInGaSe2 and so on. He has published more than 40 scientific papers and received more than 10 patents, including that of China, America, Australia, and South Affrica. Currently, his in charge of a project from the National Science Foundation of China (Grant Nos. 12275051).

Title:

Study of High Efficiency I-III-IV Group Solar Cells

Abstract:

The interface ofAg(In,Ga)Se2 (AIGS) and Cu(In,Ga)Se2 (CIGS) solar cells was investigated by high-angle annular dark-field (HAADF) scanning transmission electron microscopy (STEM) imaging method. It was found from the results that the AIGS film had Ag-rich and Ag-poor layers. The CdS layer in the CIGS solar cell had a denser structure and a better connection with the CIGS layer than the CdS layer in the AIGS solar cell. The lattice between CIGS and CdS was continuous and ordered. However, there were some defects in CdS and the lattice arrangement was distorted at the AIGS/CdS interface in the AIGS solar cell, resulting in the poor performance of the AIGS solar cell compared with the CIGS solar cell.

KEYNOTE SPEAKERS

Prof. Changan JIANG, Osaka Institute of Technology, Japan

Changan Jiang received his B. E. degree and M. E. degree from Northeastern University, China in 2003 and 2006, and his Ph.D. degree from Okayama University, Japan in 2009. He worked in Okayama University as a Specially Appointed Assistant Professor (2009-2010), then in SCA Co., Ltd as a JST Researcher (2010-2011). He became a Doctoral Researcher in Kagawa University (2011), after that joined RIKEN as a Research Scientist (2012-2015). He became an Assistant Professor in Department of Mechanical Engineering, Ritsumeikan University (2015-2020). Now he is currently an Associate Professor in Department of Robotics, Osaka Institute of Technology, Japan (since 2020). He also was a Visiting Scientist in Concordia University, Canada for 6 months from September 2017. His research interests include robotics, nonlinear robust control with input nonlinearity, vibration control, modelling of smart material based actuator, magnetic levitation and active magnetic bearing.

Title:

Fabrication and control of artificial muscles capable of both driving and sensing

Abstract:

In recent years, the development of smart materials has led to the creation of various types of smart material actuators, some of which have been applied to biomimetic robots. Among these, dielectric elastomer actuators (DEAs), which possess both stretchability and force generation capabilities similar to biological muscles, are expected to be implemented in soft devices as artificial muscles. In this research, a mechanism for easily adjusting the tension of DEA-based artificial muscles is developed. The focus is placed on the actuation and sensing characteristics of the created artificial muscles, and models for each are constructed. A feedback control system that can integrate both actuation and sensing is designed. Furthermore, to improve the motion accuracy of the artificial muscles, a Prandtl-Ishlinskii-type parallel compensator is implemented to address the hysteresis characteristics of the dielectric elastomer. Since external sensors are not required, the artificial muscle system is used to develop and verify a compact 3-DOF thin flexible parallel mechanism as one of its practical applications.

KEYNOTE SPEAKERS

Dr. Ximei LI, Luoyang Institute of Science and Technology, China

2014.7 Zhengzhou University of Science and Technology, Bachelor of Engineering

2017.7 Henan University of Science and Technology, Master of Engineering

2023.9 Tokyo University of Agriculture and Technology, PhD(Engineering)

Title:

Performance analysis on the flexible arm based SMA interactive actuating control system

Abstract:

This research provides a performance analysis on a flexible arm based shape memory alloy (SMA) interactive actuating control system, which is a fundamental theory research and its application of nonlinear control system. The vibration problem of flexible arms will impair the performance of the high-precision control system. The concept of SMA based interactive actuating control system is proposed for govern the flexible arm's vibration. Two SMA wires in parallel are unified an interactive actuator, which are installed on the left and right sides of the flexible arm in the horizontal direction. In the SMA actuating control design, the flexible arm is regarded as the controlled plant. The vibration dynamics of the flexible arm is modeled based on Euler-Bernoulli beams theory. SMAA thermal model describes the relationship between temperature and electric power. The PC-based input signal is the electric power, which is the output of controller to drive the SMAA. The output of the plant is the vibration displacement of the flexible arm.

This research focuses on three key issues: vibration suppression of flexible arms, hysteresis nonlinearies compensation of shape memory alloy actuator (SMAA) and actuator fault-tolerant characteristics. SMA based interactive actuating control systems are designed to achieve faster, more accurate and safety-reliability performance for controlling flexible arm's vibration displacement. Based on operator-theoretic approach, the robust stability of SMA actuator-based vibration control system is guaranteed by using robust right coprime factorization (RRCF) condition; the desired tracking performance of the system is obtained by increasing multiple feedback loops; the effect of hysteresis behavior of SMAA is reduced by modified vibration controller and an active compensation unit; the fault-tolerant characteristics for partial actuator fault are ensured the safety and reliability of the system.

KEYNOTE SPEAKERS

Prof. Lin MENG, Ritsumeikan University, Japan

Lin MENG is a Professor at the College of Science and Engineering and head of the Intelligent High-performance Computing Lab., at Ritsumeikan University (RU), Japan. He received his Ph.D. from the Graduate School of SE at RU 2012. He was a Research Associate, Assistant Professor, and lecturer at the Dept. of ECE, RU. In 2015, he was a visiting scholar in the Dept. of CSE, University of Minnesota at Twin Cities, USA. His research interests include Computer Architecture, Parallel Processing, Intelligence High-Performance Computing (IHPC), FPGA-based Accelerator Design, the Internet of Things (IoT), and Artificial Intelligence (AI). He has published over 300 papers, including IEEE TETCI, IEEE TIM, IEEE TSC, IEEE TITS, IEEE IoT J, Adv. Sci., AIRE, APIN, Neurocomputing, Heritage Science, etc. He is among the top 2% of scientists in the updated science-wide author databases of standardized citation indicators created by Elsevier. In the past three years, he received several funds from the Japan Society for the Promotion of Science (JSPS) and the Japan Science and Technology Agency (JST), etc. He is a senior member of IEEE and a member of ACM, IPSJ, IEICE, and IEE.

Title:

High-Performance Image Processing AI for Broad Applications

Abstract:

Artificial Intelligence (AI) is widely utilized across numerous fields and holds significant potential for future advancements. It has become indispensable in addressing complex challenges and driving innovation across industries. In our efforts, we aim to develop high-performance image-processing AI that meets the demands of current applications and paves the way for future technological breakthroughs.

Firstly, we introduce several proposed methods for compressing AI models tailored for resource-constrained edge devices. These methods ensure that AI can be efficiently deployed in environments with limited computational power and energy resources, such as IoT devices, autonomous systems, and real-time monitoring solutions.

Subsequently, we demonstrate the applications of AI across multiple industries in our group, including:

- The preservation and organization of cultural heritage through integrating AI and ICT technologies.
- Automation in the food industry is achieved through the fusion of AI and robotics.
- Cell profiling technologies that combine AI and bioengineering.
- Anomaly detection in industrial settings using AI-based methodologies.
- AI applications in nano-drones.

These topics illustrate the versatility and potential of our high-performance image-processing AI.

Students Session

Shuangjiang HUANG, Soochow University, China

Title: A method for measuring Virtual Image Distance for head-mounted display by using the variable focus optics mechanism

Yutao HUANG, Soochow University, China

Title: Design and performance evaluation of a large-aperture liquid-filled variable-focus lens

Chengyao LIU, Tokyo University of Agriculture and Technology, Japan

Title: Operator-Based Triboelectric Nanogenerator Control and Its Experimental Studies

Zizhen AN, Tokyo University of Agriculture and Technology, Japan

Title: Novel Extension of Robust Condition for Right Coprime Factorization System Using Time-varying Bezout Identity

Xuan YANG, Nanjing University of Information Science and Engineering, China

Title: An optimization method for energy storage converter control systems based on hierarchical learning

Qi LI, Ritsumeikan University, Japan

Title: Exploration of DNN Compression Techniques for Edge Devices Based on Layer Fusion and Subsampling

Zhenling SU, Ritsumeikan University, Japan

Title: Real-time Object Detection Based on Nano Drones