PROGRAM AND ABSTRACTS

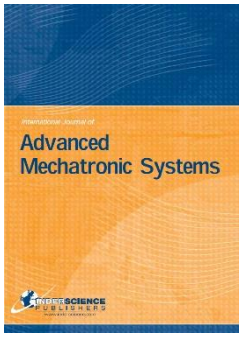
2024 International Conference on

Advanced Mechatronic Systems

Shiga, Japan

November 26-30, 2024

Organized by



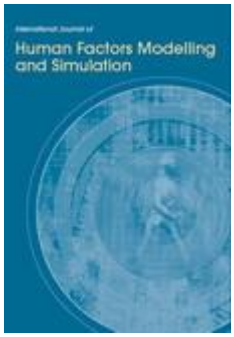
International Journal of Advanced Mechatronic Systems

RITSUMEIKAN UNIVERSITY

Ritsumeikan University

IEEE

IEEE Systems, Man, and Cybernetics Society



International Journal of Human Factors Modelling and Simulation

2024 ICAMechS

International Conference on Advanced Mechatronic Systems

Shiga, Japan

Nov. 26-30, 2024

PROGRAM

Organizers:

International Journal of Advanced Mechatronic Systems
Ritsumeikan University
IEEE Systems, Man, and Cybernetics Society
International Journal of Human Factors Modelling and Simulation

Sponsors:

The Institute of Complex Medical Engineering

Cooperation with:

The Society of Instrument and Control Engineers
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GREETINGS
FROM THE GENERAL CHAIRS AND PROGRAM CHAIRS

On behalf of the Organizing Committee, it is our great pleasure and honor to warmly welcome you to the 2024 International Conference on Advanced Mechatronic Systems (ICAMechS 2024), held at Ritsumeikan University in Shiga, Japan, from November 26-30, 2024. We hope ICAMechS 2024 will serve as a valuable platform for researchers and scientists in advanced mechatronic systems, industrial electronics, artificial intelligence, and related applications to present their latest research results, foster new collaborations, and expand professional networks.

As in recent years, this conference is proudly sponsored by the International Journal of Advanced Mechatronic Systems (IJAMechS), Ritsumeikan University, IEEE Systems, Man, and Cybernetics Society, International Journal of Human Factors Modelling and Simulation, and The Institute of Complex Medical Engineering. Additionally, we appreciate the cooperation of The Society of Instrument and Control Engineers and The Institute of Systems, Control, and Information Engineers.

ICAMechS 2024 offers a unique forum, featuring a comprehensive program of high-quality technical papers across ten sessions, covering Robotics Systems, Artificial Intelligence, Sensors and Actuators, Signal and Image Processing, Control System Design, Computer Vision, Mechatronic Systems, Advanced Methodologies, Machine Learning, and various Technologies and Applications. Through a rigorous two-step, blind review process, we have selected over 60 outstanding and innovative research papers for presentation, with the goal of inspiring new ideas and further innovation in these vital research areas.

We are also honored to welcome three distinguished keynote speakers: Prof. MengChu Zhou (New Jersey Institute of Technology, USA), Prof. Kazuyuki Ito (Hosei University, Japan), and Prof. Kiyotsugu Takaba (Ritsumeikan University, Japan). We extend our sincere thanks to Prof. Zhou, Prof. Ito, and Prof. Takaba for joining us and sharing their latest research insights.

We would like to express our heartfelt gratitude

Best regards,

General Chairs: Lin Meng and Mingcong Deng
Program Chairs: Changan Jiang and Takao Sato

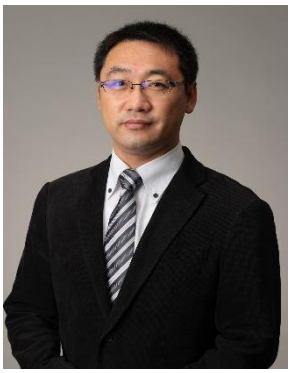
General Chairs

Lin Meng

Mingcong Deng

Program Chairs

Changan Jiang



Takao Sato

CONFERENCE HIGHLIGHTS

All the submitted papers have been rigorously reviewed by at least two experienced researchers in the corresponding fields. A total of 64 high quality papers from different countries and areas in the world have been accepted and included in the final program of ICAMechS 2024. Three distinguished keynote speakers in mechatronics have been invited. According to the research topics of the accepted papers, 12 regular sessions have been scheduled.

For the online presentations, Zoom Test will be conducted between 16:00 and 17:00, on Tuesday, Nov. 26, 2024.

The conference is held at Ritsumeikan University and the timetable is scheduled based on Japan Eastern Standard Time (GMT +9) as follows.

- The registration is being held at Epoch Ritsumei 21, between 9:00 and 17:00, on Tuesday and Wednesday, Nov. 26-27, 2024.
- Keynotes and regular sessions are conducted between 09:10-17:50, on Thursday, Nov. 28, 2024.
- Keynotes and regular sessions are conducted between 09:00-18:00, on Friday, Nov. 29, 2024.
- Panel discussions and technical tour are conducted between 09:10 and 16:30, on Saturday, Nov.30, 2024.

CONFERENCE REGISTRATION

The full registration includes a Welcome party, Banquet and Closing ceremony, USB data, Conference Proceedings.

SOCIAL EVENTS

- The **welcome party** will be held at **Epoch Ritsumei 21**, between 17:30 and 19:30, on Wednesday, Nov. 27, 2024.
- **The banquet** will be held at **Kusatsu Estopia Hotel (https://www.estopia.jp/)**, scheduled between 18:30 and 20:30, on Thursday, Nov. 28, 2024.

CONFERENCE LOCATION

- Conference site: Epoch Ritsumei 21, Ritsumeikan University, Shiga, Japan
- Address: Ritsumeikan University, Biwako Kusatsu Campus, 1-1-1, Nojihigashi, Kusatsu, Shiga, Japan

Shiga Prefecture (滋賀県, Shiga-ken) is a landlocked prefecture of Japan located in the Kansai region of Honshu. Shiga Prefecture borders Fukui Prefecture to the north, Gifu Prefecture to the northeast, Mie Prefecture to the southeast, and Kyoto Prefecture to the west. Ōtsu is the capital and largest city of Shiga Prefecture, with other major cities including Kusatsu, Nagahama, and Higashiōmi. Shiga Prefecture encircles Lake Biwa, the largest freshwater

lake in Japan, and 37% of the total land area is designated as Natural Parks, the highest of any prefecture. Shiga Prefecture's southern half is located adjacent to the former capital city of Kyoto and forms part of Greater Kyoto, the fourth-largest metropolitan area in Japan. Shiga Prefecture is home to Ōmi beef, the Eight Views of Ōmi, and Hikone Castle, one of four national treasure castles in Japan.

✧ **Recommended route to Ritsumeikan University from Kansai Airport (KIX)**

1. **Take a JR Line's limited express "Haruka" train to Kyoto station (80 min)**

   You should buy a train ticket from **Kansai International Airport** to **Kyoto station**.
   To use Haruka train, you also have to pay for the seat.
   Some trains **go directly** to **Minami-Kusatsu station**. If so, please ignore step 2.

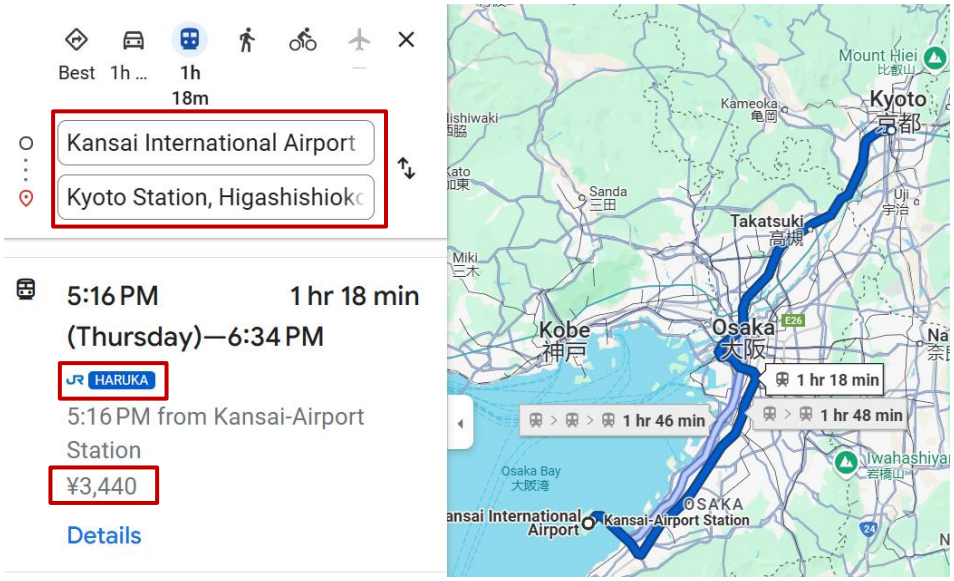


Figure. 1

2. **Transfer to the 2nd station of JR " Tokaido-Sanyo Line " and get off at Minami-Kusatsu station (20 min).**

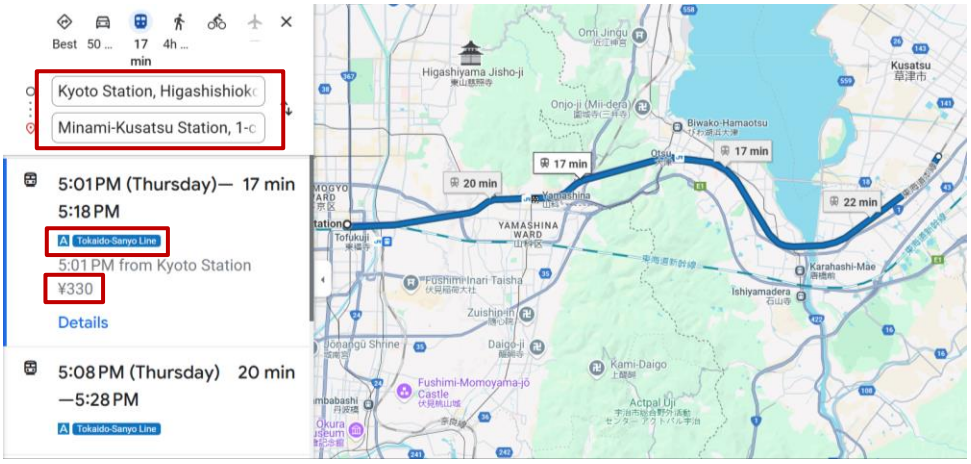


Figure. 2

From Kyoto station, please use trains on **Tokaido/Sanyo** line (also displayed as **Biwako line**) toward such as Yasu, Maibara, Nagahama, Kusatsu, or Ohmi-Shiotsu via Otsu, Ishiyama.

Please DO NOT use trains going to Kosei line(湖西線).

3. **Take a bus to Ritsumeikan University (15 min).**

From Minami-Kusatsu station, please use a bus heading for Ritsumeikan University (立命館大学) at **No.3** or **No.4** riding spot on the **east side of Minami-Kusatsu station**.

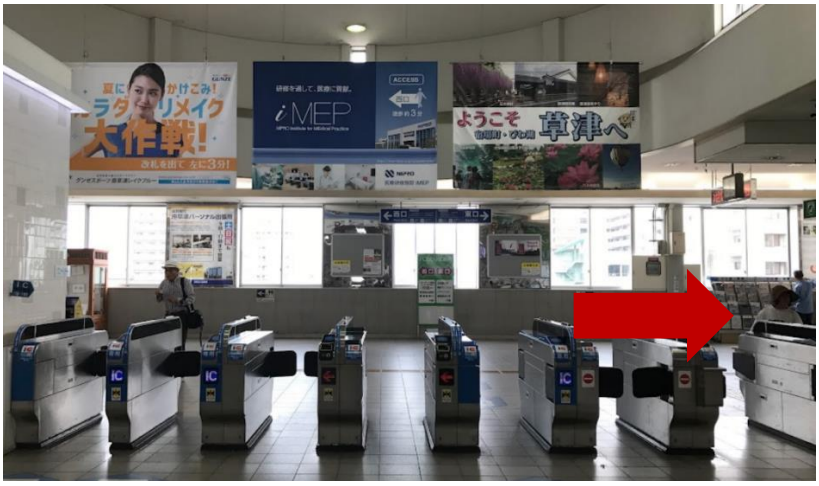
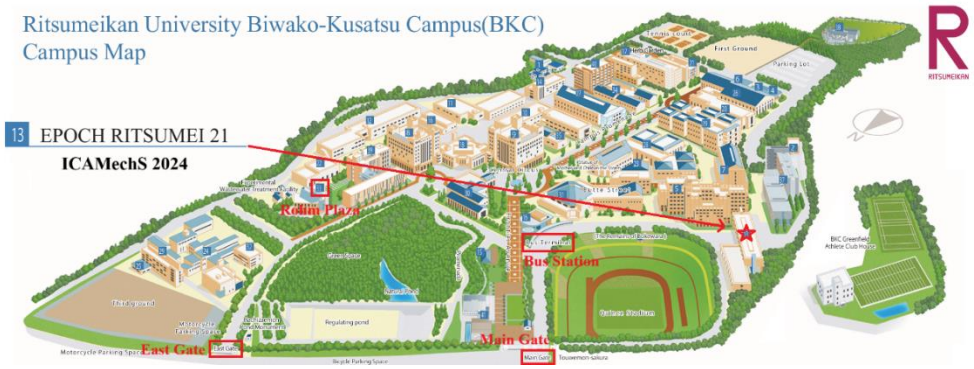


Figure. 3

Figure. 4

It is typically a 15-minute bus ride. You pay the fare (about **230 yen**) when you get off at the final stop. **Cash and IC cards (such as Suica, ICOCA) are accepted** (credit cards are not accepted). If you do not have the exact fare, you must use a change machine on the buses to make the exact fare. Please note that the change machines on the buses do not accept 5000 yen and 10000-yen bills.

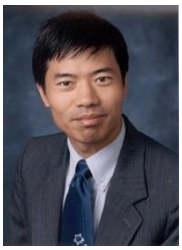
4. **Ritsumeikan University Map**



BKC Campus Map: https://www.ritsumei.ac.jp/~kore/jkcfe14/bkc-campusmap_e-1.pdf

PLENARY SPEAKERS

MengChu Zhou, Ph.D. & Distinguished Professor, Fellow of IEEE, IFAC, AAAS, CAA and NAI



MengChu Zhou received his B.S. degree in Control Engineering from Nanjing University of Science and Technology, Nanjing, China in 1983, M.S. degree in Automatic Control from Beijing Institute of Technology, Beijing, China in 1986, and Ph. D. degree in Computer and Systems Engineering from Rensselaer Polytechnic Institute, Troy, NY in 1990. He joined New Jersey Institute of Technology (NJIT), Newark, NJ in 1990, and has been Distinguished Professor in Electrical and Computer Engineering since 2013. His research interests are in Petri nets, intelligent automation, AI, Cloud/edge Computing, Internet of Things, big data, web services, and intelligent transportation. He has over 1200 publications including 17 books, 850+ journal papers (650+ in IEEE transactions), 31 patents and 32 book-chapters. He is the founding Editor of IEEE Press Book Series on Systems Science and Engineering, and Associate Editor of IEEE Internet of Things Journal, IEEE Transactions on Intelligent Transportation Systems, and IEEE Transactions on Systems, Man, and Cybernetics: Systems. He was Editor-in-Chief of IEEE/CAA Journal of Automatica Sinica (2018-2022). He is a recipient of Humboldt Research Award for US Senior Scientists from Alexander von Humboldt Foundation, Franklin V. Taylor Memorial Award and the Norbert Wiener Award from IEEE Systems, Man and Cybernetics Society, Excellence in Research Prize and Medal from NJIT, and Edison Patent Award from the Research & Development Council of New Jersey. He has been among most highly cited scholars since 2012 and ranked top one in the field of engineering worldwide in 2012 by Web of Science. His present Google citation count is well over 72,400 with h-index being 137. He was ranked #99 in the world among the 2023 Top 1000 Scientists in Computer Science in the World by Research.com. He is a Fellow of IEEE, International Federation of Automatic Control (IFAC), American Association for the Advancement of Science (AAAS), Chinese Association of Automation (CAA), and National Academy of Inventors (NAI).

Title of the keynote:

Particle Swarm Optimizers with Mobile Robots as Particles: A Novel Paradigm for Effective Optimization

Abstract:

A Particle Swarm Optimizer (PSO) and mobile robot swarm are two widely studied subjects. Many applications emerge separately while the similarity between them is rarely explored. When a solution space is a certain region in reality, a robot swarm can replace a particle one to explore the optimal solution by performing PSO. In this way, a mobile robot swarm should be able to efficiently explore an area just like a particle swarm and uninterruptedly work even under the shortage of robots or in the case of unexpected failure of robots. Furthermore, the moving distances of robots are highly constrained because energy of robots is limited and so is their operation time. Inspired by such requirements, this presentation discusses a Moving-distance-minimized PSO for a mobile robot swarm to minimize the total moving distance of its robots while performing optimization and collaboration. The distances between the current robot positions and the particle ones in the next generation are utilized to derive paths for robots such that the total distance that all robots move is minimized, hence minimizing the energy and time for a robot swarm to locate the optima. Experimental results on optimizing benchmark functions show the advantage of the proposed method over the standard PSO. By adopting it, the moving distance of robots can be reduced by more than 40% while offering the same optimization effects. The implication is enormous since all population-based optimization algorithms can be potentially benefited from such replacement of their individuals with mobile robots, thus leading to their moving-distance-minimized variants.

Prof. Kazuyuki Ito, Hosei University, Tokyo Japan

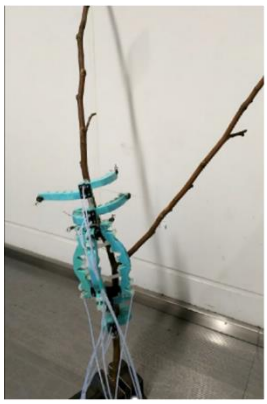
Kazuyuki Ito received his Ph.D. from the Tokyo Institute of Technology in 2002. In the same year, he joined the Department of Systems Engineering at Okayama University as a Research Associate. In 2005, he joined the Department of Systems and Control Engineering at Hosei University as an Assistant Professor. From 2022 to 2024, he served as the Dean of the Faculty of Science and Engineering at Hosei University. He is currently a Full Professor in the Department of Electrical and Electronics Engineering at Hosei University. He received the Young Investigator Excellence Award from the Robotics Society of Japan in 2003, the Funai Information Technology Award for Young Researchers in 2004, the Kisoi Motohiro Award (Academic Achievement) from the International Rescue System Institute in 2013, and the Best Paper Award at the IEEE International Conference on Intelligent Systems in 2020.

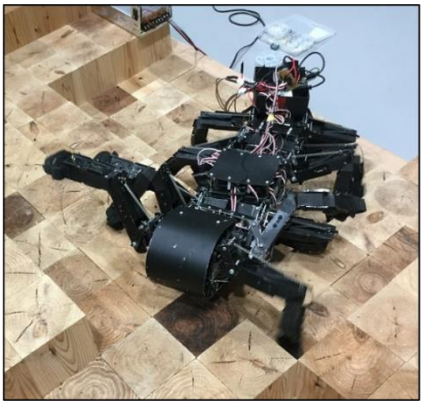
Title of the keynote:

Bioinspired Soft Robots: Flexibility and Softness Are the Keys to Realizing Adaptive Behaviors

Abstract:

Recent advancements in artificial intelligence have been extraordinary, with AI surpassing human capabilities in certain functions. Nevertheless, the operation of autonomous robots in unknown and complex environments, such as natural settings and disaster sites, is still impossible. To tackle this issue, various research has been conducted, and we considered that the problem is that the amount of information is too huge to calculate in real-time in such complex environments. On the other hand, by focusing on lower creatures, it is observed that they exhibit adaptive behaviors in complex environments despite having small brains or, in some cases, no brain at all, and their computational capacity is highly limited. Instead of relying on brain function, these organisms' bodies are controlled through interactions with their environment. In our research, we have incorporated this mechanism, and we developed various bio-inspired robots, including an octopus-like manipulator, a centipede-like robot, and robots capable of climbing walls and pipes. This presentation will introduce our bio-inspired robots and demonstrate that flexible mechanisms and the softness of the body are crucial to achieving adaptive behavior.






Prof. Kiyotsugu Takaba, Ritsumeikan University, Shiga Japan

Kiyotsugu Takaba received his B.Eng., M.Eng., and Dr.Eng. degrees all from Kyoto University, Japan, in 1989, 1991, and 1995, respectively. From 1991 to 1998, he was an Assistant Professor at the Department of Applied Mathematics and Physics, Kyoto University. From 1998 to 2012, he was an Associate Professor at the same department. In 2012, he joined the Department of Electrical and Electronic Engineering, Ritsumeikan University, where he is currently a Professor. His current research interests include linear system theory, optimal control, robust control, optimal filtering, multi-agent system and their applications. He is a member of IEEE, SIAM, SICE, and ISCIE.

Title of the keynote:

Data-driven control design for multi-agent synchronization

Abstract:

The importance of data-driven methodologies for control engineering has been increasing with the development of data science technologies. The data-driven methodology enables an efficient control system design by directly utilizing experimental response data without going through modeling or system identification processes. It may be noted that van Waarde and his co-workers (IEEE TAC vol. 65, no. 11, 2020) recently proposed the notion of data informativity which characterizes the response data necessary for achieving a given control objective such as stabilization. This talk is concerned with the data-driven synchronization problem for linear multi-agent systems from the viewpoint of data informativity. It is challenging to apply a data-driven technique to a multi-agent system since the agents in the system obtain their response data required for the control design in a distributed and individual manner. Therefore, we will discuss the data-driven synchronizing control design focusing on what data is needed to guarantee synchronizability (the existence of a synchronizing distributed controller) and how to aggregate enough data from all agents to design the desired synchronizing controller.

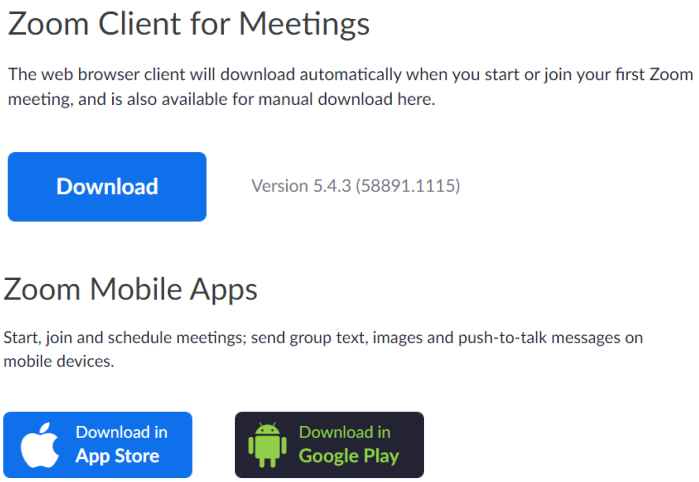
INSTRUCTIONS FOR ZOOM MEETINGS

➢ 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

   Room 1 (Main Hall):

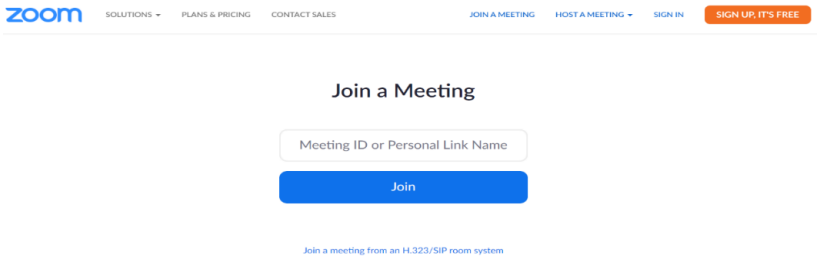
   https://us02web.zoom.us/j/4563545448?pwd=ZW4wa0l1bW9MRkJ0V2tvdGk1VE50dz09

   Room 2:

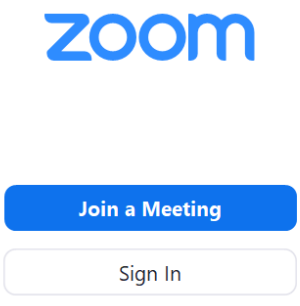
   https://ritsumei-ac-jp.zoom.us/j/5125852834?pwd=dStjT1I4a3dRT0JDaERoYXRZWXB3dz09

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

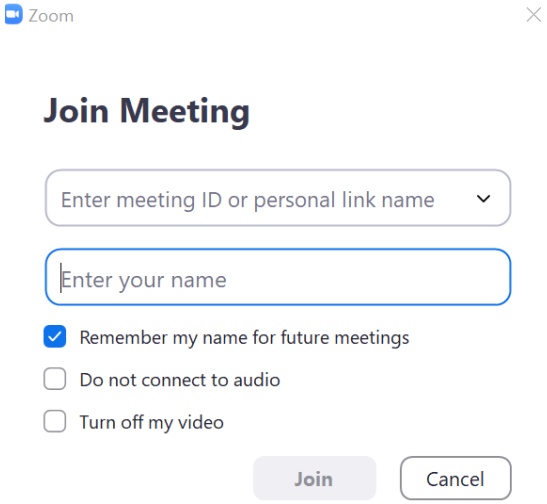
   Type the meeting ID or personal link name and click Join.



3. Joining the meeting via Zoom client



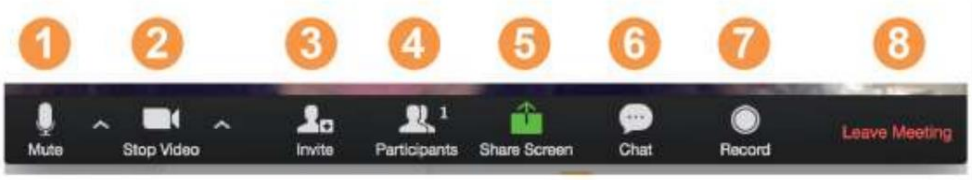
Type the meeting ID or personal link name, your name, and click Join.



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.

2024 International Conference on Advanced Mechatronic Systems

November 26-30, 2024
Shiga, Japan

CONFERENCE PROGRAM

*Tokyo time (UTC + 9)

Tuesday, November 26, 2024

16:00 - 17:00	**Zoom Test: Room 1**
	Zoom Test: Room 2

Wednesday, November 27, 2024

15:30 – 17:20	**USB Pick Up**
17:30 – 19:30	**Welcome party**

Note:

Room No.	Sessions	Zoom
Main Hall	ThuA01, ThuA02, ThuA03, FriA04, FriA05, FriA06	Link: https://us02web.zoom.us/j/4563545448?pwd=ZW4wa0l1bW9MRkJ0V2tvdGk1VE50dz09 Meeting ID: 456 354 5448 Password: 9XMZpU
Room 1		
Room 2	ThuB01, ThuB02, ThuB03, FriB04, FriB05, FriB06	Link: https://ritsumei-ac-jp.zoom.us/j/5125852834?pwd=dStjT1I4a3dRT0JDaERoYXRZWXB3dz09#success Meeting ID: 512 585 2834 Password: 095490

Thursday, November 28, 2024

9:00 - 09:10	**Opening Remarks**	Main Hall (Epoch 21 Hall)
09:10 - 10:00	**Plenary Speech 1 (PS01)**	Main Hall (Epoch 21 Hall)

Title: Particle Swarm Optimizers with Mobile Robots as Particles: A Novel Paradigm for Effective Optimization

Plenary Speaker: Prof. MengChu Zhou, *New Jersey Institute of Technology, USA*

Chair: Prof. Zhihong Man, *Swinburne University of Technology, Australia*

10:00 - 10:10	**Tea Breaks**	
10:10 - 11:50	**Regular Sessions**	

Session ThuA01 (K309) **Room 1**	**Session ThuB01 (K310)** **Room 2**
Intelligent control algorithm Paper ID: 24063, 24064, 24065, 24067, 24068 **Chair:** Prof. Takao Sato, *University of Hyogo, Japan* **Co-Chair:** Prof. Shiro Masuda, *Tokyo Metropolitan University, Japan*	*Technologies and applications* Paper ID: 24048, 24049, 24050, 24051, 24066 **Chair:** Prof. Ni Bu, *Qingdao University of Science & Technology, China* **Co-Chair:** Prof. Xianfeng Zhang, *Guangzhou College of Technology and Busines, China*

12:00 - 13:00	**Lunch Time**	
13:00 - 13:50	**Plenary Speech 2 (PS02)**	Main Hall (Epoch 21 Hall)

Title: Bioinspired Soft Robots: Flexibility and Softness Are the Keys to Realizing Adaptive Behaviors

Plenary Speaker: Prof. Kazuyuki Ito, *Hosei University, Japan*

Chair: Prof. Takao Sato, *University of Hyogo, Japan*

13:50 - 14:00	**Tea Breaks**	
14:00 - 15:40	**Regular Sessions**	

Session ThuA02 (K309) **Room 1**	**Session ThuB02 (K310)** **Room2**
Control system design Paper ID: 24008, 24010, 24030, 24035, 24036	*Computer vision* Paper ID: 24008, 24010, 24030, 24035, 24036

Chair: Dr. Guang Jin, *Tokyo University of Agriculture and Technology, Japan* **Co-Chair:** Prof. Changan Jiang, *Osaka Institute of Technology, Japan*	**Chair:** Prof. Yan Wang, *Zhongyuan University of Technology, China* **Co-Chair:** Prof. Zhongkui Wang, *Ritsumeikan University, Japan*
15:40 - 15:50	**Tea Breaks**
15:50 - 17:50	**Regular Sessions**
Session ThuA03 (K309) **Room 1**	**Session ThuB03 (K310)** **Room2**
Machine learning Paper ID: 24013, 24026, 24042, 24043, 24046, 24047 **Chair:** Prof. Lin Meng, *Ritsumeikan University, Japan* **Co-Chair:** Prof. Ni Bu, *Qingdao University of Science & Technology, China*	*Electrical system* Paper ID: 24003, 24004, 24034, 24058, 24060, 24061 **Chair:** Prof. Chengyan Zhao, *Ritsumeikan University, Japan* **Co-Chair:** Prof. Changan Jiang, *Osaka Institute of Technology, Japan*
18:30-20:30	**Banquet**

Friday, November 29, 2024

<table>
<tr><td colspan="2">09:00 - 09:50 Plenary Speech 3 (PS03) Main Hall (Epoch 21 Hall)

Title: Data-driven control design for multi-agent synchronization

Plenary Speaker: Prof. Kiyotsugu Takaba, Ritsumeikan University, Japan

Chair: Prof. Zi-Jiang Yang, Ibaraki University, Japan</td></tr>
<tr><td colspan="2">09:50 - 10:10 Tea Breaks</td></tr>
<tr><td colspan="2">10:10 - 11:50 Regular Sessions</td></tr>
<tr><td>Session FriA04 (K309) Room 1</td><td>Session FriB04 (K310) Room 2</td></tr>
<tr><td>Mechatronic systems

Paper ID: 24031, 24032, 24033, 24045, 24056

Chair: Prof. Aihui Wang, Zhongyuan University of Technology, China

Co-Chair: Prof. Zenghui Wang, University of South Africa, South Africa</td><td>Neural Network 1

Paper ID: 24007, 24022, 24023, 24024, 24025

Chair: Prof. Yoshihiro Matsui, Fukuoka Institute of Technology, Japan

Co-Chair: Prof. Lin Meng, Ritsumeikan University, Japan</td></tr>
<tr><td colspan="2">11:50 - 13:30 Lunch Time</td></tr>
<tr><td colspan="2">13:30 - 15:10 Regular Session</td></tr>
<tr><td>Session FriA05 (K309) Room 1</td><td>Session FriB05 (K310) Room 2</td></tr>
<tr><td>Advanced methodologies

Paper ID: 24006, 24037, 24053, 24054, 24059

Chair: Prof. Kazuyuki Ito, Hosei University, Japan

Co-Chair: Prof. Changan Jiang, Osaka Institute of Technology, Japan</td><td>Neural Network 2

Paper ID: 24011, 24012, 24015, 24020, 24027

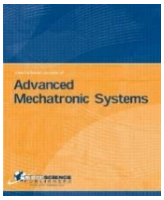
Chair: Prof. Zhihong Man, Swinburne University of Technology, Australia

Co-Chair: Prof. Xudong Gao, Nanjing University of Information Science & Technology, China</td></tr>
<tr><td colspan="2">15:10 - 15:30 Tea Breaks</td></tr>
<tr><td colspan="2">15:30 - 17:30 Regular Session</td></tr>
<tr><td>Session FriA06 (K309) Room 1</td><td>Session FriB06 (K310) Room 2</td></tr>
<tr><td>Actuators and power system</td><td>Automatic systems and applications</td></tr>
</table>

Paper ID: 24002, 24005, 24014, 24021, 24055, 24057 **Chair:** Prof. Shiro Masuda, *Tokyo Metropolitan University, Japan* **Co-Chair:** Prof. Shinichi Imai, *Tokyo Gakugei University, Japan*	Paper ID: 24009, 24016, 24038, 24039, 24040, 24041 **Chair:** Prof. Zi-Jiang Yang, *Ibaraki University, Japan* **Co-Chair:** Prof. Kenshi Saho, *Ritsumeikan University, Japan*
17:40-18:00	Main Hall (Epoch 21 Hall)
Closing Ceremony and Award Ceremony	

Saturday, November 30, 2024

09:10-11:10	**Panel Discussion**
13:30-16:30	**Technical Tour**



RITSUMEIKAN UNIVERSITY

2024 International Conference on Advanced Mechatronic Systems November 26-30, 2024 Shiga, Japan

IEEE

TECHNICAL PROGRAM

ICAMechS 2024
Tuesday, Nov. 26, 2024

16:00-17:00 **Zoom Test**

ICAMechS 2024
Wednesday, Nov. 27, 2024

17:30-19:30 **Welcome Party**

ICAMechS 2024
Thursday, Nov. 28, 2024

09:00-09:10 **Main Hall (Epoch 21 Hall)**

Opening Remarks

09:10-10:00 **Main Hall (Epoch 21 Hall)**

Plenary Speech 1

Particle Swarm Optimizers with Mobile Robots as Particles: A Novel Paradigm for Effective Optimization

Prof. MengChu Zhou

New Jersey Institute of Technology, USA

Chair: Prof. Zhihong Man, Swinburne University of Technology, Australia

10:00-10:10 **Tea Breaks**

Regular Sessions
10:10-11:50, Thursday, Nov. 28, 2024

Session ThuA01 **Room 1 (K309)**

Intelligent control algorithm

10:10-10:30 **ThuA01-01**

Data-driven Ripple-free Control for Unstable Dual-rate Systems

Takao Sato — University of Hyogo, Japan

10:30-10:50 **ThuA01-02**

The Effect of Illuminance Change on Accuracy in Determining Warpage of 3D Printer Modeled Objects Using Convolutional Neural Network

Kenta Tsukagoshi — Tokyo Gakugei University, Japan
Munehiro Namba — Tokyo Gakugei University, Japan
Shinichi Imai — Tokyo Gakugei University, Japan

10:50-11:10 **ThuA01-03**

Data-Driven State Feedback Gain Update Based on Model Matching in Frequency Domain

Yoshihiro Matsui — Fukuoka Institute of Technology, Japan
Hideki Ayano — National Institute of Technology, Tokyo College, Japan
Shiro Masuda — Tokyo Metropolitan University, Japan
Kazushi Nakano — The University of Electro-Communications, Japan

11:10-11:30 **ThuA01-04**

Analysis of Construction Orchard Trunk Shrub Dataset and Target Detection

Xiangyang Lu — Zhongyuan University of technology, China
Lei Huang — Zhongyuan University of technology, China
Shiyong Geng — Zhongyuan University of technology, China
Liuqun Zhu — Zhongyuan University of technology, China

11:30-11:50 **ThuA01-05**

Model Reference Adaptive Control via Online Virtual Reference Feedback Tuning under Unmatched Controller Structures

Shiro Masuda — Tokyo Metropolitan University, Japan

Session ThuB01 **Room 2 (K310)**

Technologies and applications

10:10-10:30 **ThuB01-01**

Spatio-Temporal Graph Convolutional Networks for Pedestrian Trajectory Prediction

Jinrui Geng — Foshan University, China
Yong Lu — Foshan University, China
Ruishi Liang — University of Electronic Science and Technology of China, China
Jianlin Li — Foshan University, China
Hannan Shen — Foshan University, China

10:30-10:50 **ThuB01-02**

Factors influencing the results of the second-level computer examination of students in the School of Engineering of Guangzhou Institute of Technology and Business

Zhengguo Guan — Guangzhou College of Technology and Business,China

10:50-11:10 ThuB01-03

Analysis of $AgInGaSe_2$ Thin Films Based on Room-temperature Photoluminescence Characterization

Xianfeng Zhang — Guangzhou College of Technology and Business,China
Xianwang Zhou — Guangzhou College of Technology and Business,China
Yushan Li — Guangzhou College of Technology and Business,China
Yong Lu — Foshan University, China

11:10-11:30 ThuB01-04

Numerical simulation analysis of medium-low temperature heat-treating furnace

Li Zhang — University of Electronic Science and Technology of China, China

11:30-11:50 ThuB01-05

Traffic image text detection via Yolov8 based on attention mechanism and rotation proposals location

Xianwang Zhou — Guangzhou College of Technology and Business, China
Yang Zhang — Ritsumeikan University, Japan
Keigo Kutani — Ritsumeikan University, Japan
Zhongkui Wang — Ritsumeikan University, Japan

14:40-15:00 ThuA02-03

Robust Improvement of Integrated Position and Speed Control using Linear Active Disturbance Rejection Control

Kenta Kariyazono — Meiji University, Japan
Yoshihisa Ishida — Meiji University, Japan
Takahiro Murakami — Meiji University, Japan

15:00-15:20 ThuA02-04

Saturation Compensation for Nonlinear Unstable Plants Based on Coprime Factorization

Yuuki Morohoshi — Tokyo University of Agriculture and Technology, Japan
Mingcong Deng — Tokyo University of Agriculture and Technology, Japan

15:20-15:40 ThuA02-05

Friction Compensation Based Coprime Factorization for Nonlinear Systems

Tomoya Hoshina — Tokyo University of Agriculture and Technology, Japan
Mingcong Deng — Tokyo University of Agriculture and Technology, Japan

12:00 - 13:00 Lunch Time

13:00-13:50 Main Hall (Epoch 21 Hall)

Plenary Speech 2

Bioinspired Soft Robots: Flexibility and Softness Are the Keys to Realizing Adaptive Behaviors

Prof. Kazuyuki Ito

Hosei University, Japan

Chair: Prof. Takao Sato, University of Hyogo, Japan

13:50-14:00 Tea Breaks

Regular Sessions
14:00-15:40, Thursday, Nov. 28, 2024

Session ThuA02 Room 1 (K309)

Control system design

14:00-14:20 ThuA02-01

Right Coprime Factorization for Nonlinear System with Uncertainty Based on Time-Varying Bezout Identity

Zizhen An — Tokyo University of Agriculture and Technology, Japan
Mingcong Deng — Tokyo University of Agriculture and Technology, Japan

14:20-14:40 ThuA02-02

Durability Testing of Soft Pneumatic Actuators with A Portable Device

Session ThuB02 Room 2 (K310)

Computer vision

14:00-14:20 ThuB02-01

Crack Detection and Width Measurement for Concrete Building using Mobile Devices

Kotoha Makino — Tokyo City University, Japan
Hao San — Tokyo City University, Japan
Yue Bao — Tokyo City University, Japan

14:20-14:40 ThuB02-02

Improvement of myopia using brain vision training with variable focal length VR

Kazuma Shindou — Tokyo City University, Japan
Akira Taguchi — Tokyo City University, Japan
Yue Bao — Tokyo City University, Japan

14:40-15:00 ThuB02-03

Colorization of Automatic Hologram Generation from Photographs using Machine learning

Koya Makita — Tokyo City University, Japan
Akira Taguchi — Tokyo City University, Japan
Yue Bao — Tokyo City University, Japan

15:00-15:20 ThuB02-04

Cyber-physical Workbench for human digital twin integration: A system proposal

Ricardo N. C. Rodrigues — IPCA, Portugal
Jaime Fonseca — University of Minho, Portugal
Antonio H.J. Moreira — IPCA, Portugal

15:20-15:40 ThuB02-05

Depth Estimation using Omnidirectional Stereo Imaging and Machine Learning

Naoki Shibasaki — Tokyo City University, Japan
Akira Taguchi — Tokyo City University, Japan
Yue Bao — Tokyo City University, Japan

15:40-15:50 Tea Breaks

Regular Sessions
15:50-17:50, Thursday, Nov. 28, 2024

Session ThuA03 Room 1 (K309)

Machine Learning

15:50-16:10 **ThuA03-01**

Examining Factors Influencing Continuous Adoption of Drone Technology in Malaysian Paddy Farming Using an Adapted UTAUT Model

Mohamed Najib bin Salleh — Universiti Utara Malaysia, Malaysia
Rabiatul Saniah binti Azmi — Universiti Utara Malaysia, Malaysia
Wan Nadzri bin Osman — Universiti Utara Malaysia, Malaysia
Faisal bin Zulhumadi — Universiti Utara Malaysia, Malaysia
Muhd Ridzuan bin Zainol — Lembaga Kemajuan Pertanian Kemubu, Malaysia

16:10-16:30 **ThuA03-02**

A Comparative Study of Clustering Distance Metrics for Personalized Federated Learning in Human Activity Recognition

Xiaoxu Wen — Zhongyuan University of Technology, China
Chenggang Lu — Zhongyuan University of Technology, China
Ruixiang Hu — Zhongyuan University of Technology, China
Yingrui Geng — Ritsumeikan University, Japan
Yan Wang — Zhongyuan University of Technology, China
Hongnian Yu — Edinburgh Napier University, UK
Qiangsong Zhao — Zhongyuan University of Technology, China

16:30-16:50 **ThuA03-03**

Research of Adaboost integrated ELM based apple grading

Yang Cao — University of Jinan, China
Liyang Ma — University of Jinan, China
Lisha Chen — University of Jinan, China
Shuhui Bi — University of Jinan, China

16:50-17:10 **ThuA03-04**

Fitness-Distance Balance based Symbiotic Organism Search Algorithm for Path Planning of Warehouse Systems

Jun Liu — University of Jinan, China
Lei Wang — University of Jinan, China
Tao Shen — University of Jinan, China
Shuhui Bi — University of Jinan, China

17:10-17:30 **ThuA03-05**

Based on the Cooperative Game Strategy of Virtual-Thermal-IES Under the Electricity Carbon Trading

Ji Ding — Qingdao University of Science and Technology, China
Bing Lv — Qingdao University of Science and Technology, China
Ni Bu — Qingdao University of Science and Technology, China

17:30-17:50 **ThuA03-06**

CCNet: a segmentation network based on U-Net for calculating cell confluency

Xiaoyu Sheng — Qingdao University of Science and Technology, China
Shaoyuan Li — Qingdao University of Science and Technology, China
Ni Bu — Qingdao University of Science and Technology, China

Session ThuB03 Room 2 (K310)

Electrical system

15:50-16:10 ThuB03-01

RustGAN: A method to generate rusty screw with physicochemical constraints

Sicheng Lu — Zhejiang University, China
Chen Xu — Zhejiang University, China
Qiong Lin — Zhejiang University of Technology, China
Yicong Gao — Zhejiang University of Technology, China
Zhiliang He — Zhejiang University of Technology, China

16:10-16:30 **ThuB03-02**

Performance Evaluation of Filter Design Techniques for Harmonic Control in Three-level Inverter Systems

Peter Anuoluwapo Gbadega — University of Johannesburg, South Africa
Yanxia Sun — University of Johannesburg, South Africa
Olufunke Abolaji Balogun — University of Johannesburg, South Africa

16:30-16:50 **ThuB03-03**

Plug-in Compound Feedforward Odd Harmonic Repetitive Control for Single-Phase V2G Inverters

Shuangfeng Li — Zhongyuan University of Technology, China
Qiangsong Zhao — Zhongyuan University of Technology, China
Qifan Wang — Zhongyuan University of Technology, China
Guohui Zhou — Zhongyuan University of Technology, China
Yan Wang — Zhongyuan University of Technology, China
Aihui Wang — Zhongyuan University of Technology, China

16:50-17:10 **ThuB03-04**

Research on Modeling of Giant Magnetostrictive Actuator Based on Rate-Dependent Improved Prandtl-Ishlinskii Model

Xinyuan Tian — Zhongyuan University of Technology, China
Shengjun Wen — Zhongyuan University of Technology, China

17:10-17:30 **ThuB03-05**

An Improved Temperature-Dependent Prandtl-Ishlinskii Hysteresis Modelling and Parameters Recognition for Giant Magnetostrictive Actor

Hongjun Li — No.713 Research Institute of CSSC, China

Yixiang Wang — Zhongyuan University of Technology, China

17:30-17:50 **ThuB03-06**

Research on Friction Compensation Feedforward Control for Linear Motors Based on the Prandtl-Ishlinskii Model

Xinlong Xu — Zhongyuan University of Technology, China

Jun Yu — Zhongyuan University of Technology, China

Yixiang Wang — Zhongyuan University of Technology, China

18:30-20:30 Banquet

End of 3rd day

ICAMechS 2024
Friday, Nov. 29, 2024

09:00-09:50 **Main Hall (Epoch 21 Hall)**

Plenary Speech 3

Data-driven control design for multi-agent synchronization

Prof. Kiyotsugu Takaba

Ritsumeikan University, Japan

Chair: Zi-Jiang Yang, Ibaraki University, Japan

09:50-10:10 **Tea Breaks**

Regular Sessions
10:10-11:50, Friday, Nov. 29, 2024

Session FriA04 **Room 1 (K309)**

Mechatronic systems

10:10-10:30 **FriA04-01**

Humanoid Control Technology for Lower Limb Rehabilitation Robots Based on Human Gait Data

Shengda Gao — Zhongyuan University of Technology, China
Aihui Wang — Zhongyuan University of Technology, China
Huichao Duan — Zhongyuan University of Technology, China
Xuebin Yue — Zhongyuan University of Technology, China
Hengyi Li — Zhongyuan University of Technology, China
Jinkang Dong — Zhongyuan University of Technology, China

10:30-10:50 **FriA04-02**

Human-machine Integration of Lower Limb Rehabilitation Robot

Xiang Zhang — Zhongyuan University of Technology, China
Aihui Wang — Zhongyuan University of Technology, China
Shengda Gao — Zhongyuan University of Technology, China
Huichao Duan — Zhongyuan University of Technology, China
Hengyi Li — Zhongyuan University of Technology, China
Xuebin Yue — Zhongyuan University of Technology, China

10:50-11:10 **FriA04-03**

Target Grasping and Multi-modal Interaction System Based on Pepper Robot

Kuozhan Wang — Zhongyuan University of Technology, China
Aihui Wang — Zhongyuan University of Technology, China
Yan Wang — Zhongyuan University of Technology, China
Xuebin Yue — Zhongyuan University of Technology, China
Junjie Xie — Zhongyuan University of Technology, China
Yangyang Wang — Zhongyuan University of Technology, China

11:10-11:30 **FriA04-04**

Input-output Behavioral Data-driven LQG Control of Axial-gap Self-bearing Motor

Chengyan Zhao — Ritsumeikan University, Japan
Satoshi Ueno — Ritsumeikan University, Japan

11:30-11:50 **FriA04-05**

Axial Displacement Control of Bearingless Motor via State Feedback Linearization

Chengyan Zhao — Ritsumeikan University, Japan
Satoshi Ueno — Ritsumeikan University, Japan

Session FriB04 **Room 2 (K310)**

Neural Network 1

10:10-10:30 **FriB04-01**

Hybrid Architecture and pre-processing for Speech Emotion Recognition

Michael Norval — University of South Africa, South Africa
Zenghui Wang — University of South Africa, South Africa

10:30-10:50 **FriB04-02**

Evaluation of Missing Image Restoration with a Binary Character Image Diffusion Model

Yuya Yoshizu — Ritsumeikan University, Japan
Hayata Kaneko — Ritsumeikan University, Japan
Ryuto Ishibashi — Ritsumeikan University, Japan
Lin Meng — Ritsumeikan University, Japan

10:50-11:10 **FriB04-03**

IAD-CLIP: Vision-Language Models for Zero-Shot Industrial Anomaly Detection

Zhuo Li — Ritsumeikan University, Japan
Yifei Ge — Ritsumeikan University, Japan
Qi Li — Ritsumeikan University, Japan
Lin Meng — Ritsumeikan University, Japan

11:10-11:30 **FriB04-04**

Recurrent Neural Network-based Modeling Approach for 4D Printing Design

Yifan Xu — Ritsumeikan University, Japan
Mengtao Wang — Ritsumeikan University, Japan
Zhongkui Wang — Ritsumeikan University, Japan
Lin Meng — Ritsumeikan University, Japan

11:30-11:50 **FriB04-05**

Digital Twins and AI Management: Optimizing Biogas-Photovoltaic Systems for off-grid area

Runqian Zhang — Ritsumeikan University, Japan
Yifei Ge — Ritsumeikan University, Japan
Lin Meng — Ritsumeikan University, Japan
Zenghui Wang — University of South Africa, South Africa
Liston Matindife — National University of Science and Technology, Zimbabwe
Eric Maluta — University of Venda, South Africa
Nekhubvi Vhutshilo — University of Venda, South Africa
Langa B. Moyo — National University of Science and Technology, Zimbabwe

11:50-13:30 **Lunch Time**

Regular Sessions
13:30-15:10, Friday, Nov. 29, 2024

Session FriA05 — Room 1 (K309)

Advanced methodologies

13:30-13:50 **FriA05-01**

Adaptive PI control of a three-tank system with prescribed performance

Hisanori Takahashi — Ibaraki University, Japan
Zi-Jiang Yang — Ibaraki University, Japan

13:50-14:10 **FriA05-02**

Operator-based forced vibration control system design for a plate system with input nonlinearity

Guang Jin — Tokyo University of Agriculture and Technology, Japan
Mingcong Deng — Tokyo University of Agriculture and Technology, Japan

14:10-14:30 **FriA05-03**

Development of Pre-stretch Mechanism for Fabricating Thin DEAs

Bunta Morikawa — Osaka Institute of Technology, Japan
Ayumu Hirokawa — Osaka Institute of Technology, Japan
Changan Jiang — Osaka Institute of Technology, Japan

14:30-14:50 **FriA05-04**

Improvement of Finger Mechanism using Twisted and Coiled Polymer Fiber Actuator

Stephanie Nathania Soesenc — Osaka Institute of Technology, Japan
Changan Jiang — Osaka Institute of Technology, Japan

14:50-15:10 **FriA05-05**

ViViT fall detection and action recognition

Takashi Higashi — Ritsumeikan University, Japan
Ryuto Ishibashi — Ritsumeikan University, Japan
Lin Meng — Ritsumeikan University, Japan

Session FriB05 — Room 2 (K310)

Neural Network 2

13:30-13:50 **FriB05-01**

Multi-robot FastSLAM based on consensus of observed data

Daiki Tetsuno — Ritsumeikan University, Japan
Kiyotsugu Takaba — Ritsumeikan University, Japan

13:50-14:10 **FriB05-02**

Enhancing ResNet Architectures with Bayesian Optimized Stochastic Configuration Networks for Lung X-Ray Image Classification

Hengren Xu — Swinburne University of Technology, Australia
Jinchuan Zheng — Swinburne University of Technology, Australia
Zhenwei Cao — Swinburne University of Technology, Australia
Zhihong Man — Swinburne University of Technology, Australia

14:10-14:30 **FriB05-03**

Fault Detection of Cooling System Based on Long Short-Term Memory at Nam Ngum 1 Hydropower Plant

Bounpone Thansouphanh — Chiang Mai University, Thailand
S. Premrudeepreechacham — Chiang Mai University, Thailand
Kanchit Ngamsanroaj — University of South Carolina, USA
W. Srirattanawichaikul — Chiang Mai University, Thailand

14:30-14:50 **FriB05-04**

VE: Modeling Multivariate Time Series Correlation with Variate Embedding

Shangjiong Wang — Swinburne University of Technology, Australia
Zhihong Man — Swinburne University of Technology, Australia
Zhenwei Cao — Swinburne University of Technology, Australia
Jinchuan Zheng — Swinburne University of Technology, Australia
Zhikang Ge — Zhejiang University, China

14:50-15:10 **FriB05-05**

Accurate monitoring of machining process of Ti-6Al-4V using deep multi-task learning

Soyeon Park — Ulsan National Institute of Science and Technology, Republic of Korea
Sang Min Yang — Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
Gyeongho Kim — Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
Dong Min Kim — Tech University of Korea, Republic of Korea
Hoon Hee Lee — Korea Institute of Industrial Technology (KITECH), Republic of Korea
Jae Gyeong Choi — Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
Sujin Jeon — Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
Sunghoon Lim — Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
Hyung Wook Park — Ulsan National Institute of Science and Technology (UNIST), Republic of Korea

15:10-15:30 Tea Breaks

Regular Sessions
15:30-17:30, Friday, Nov. 29, 2024

Session FriA06 — Room 1 (K309)

Actuators and power system

15:30-15:50 **FriA06-01**

An Improved Frequency-controlled Speed Regulation Method for Piezoelectric Walking Stage

Yixiao Yan — Fudan University, China
Huazhou Kang — Fudan University, China
Xiaofeng Yang — Fudan University, China
Yu Sun — Fudan University, China
Yuping Liu — Fudan University, China
Zhiping Zhang — Fudan University, China

15:50-16:10 **FriA06-02**

Optimizing Energy Management in a Renewable Energy-based Microgrid With Built-in Frequency Support Features

Peter Anuoluwapo Gbadega — University of Johannesburg, South Africa.
Yanxia Sun — University of Johannesburg, South Africa.
Olufunke Abolaji Balogun — University of Johannesburg, South Africa.

16:10-16:30 **FriA06-03**

The enhancement of displacement of shear piezoelectric stack actuator with conductive adhesive

Huazhou Kang — Fudan University, China
Yixiao Yang — Fudan University, China
Quan Wang — Semiconductor Technology Co. Ltd., China
Xiaofeng Yang — Fudan University, China

16:30-16:50 **FriA06-04**

RBFNN-based nonsingular fast terminal sliding mode control for piezoelectric stack actuator

Xuchen Wang — Fudan University, China
Yu Jin — Fudan University, China
Yang Xu — Northwestern Polytechnical University, China
Xiaofeng Yang — Fudan University, China
Yixiao Yang — Fudan University, China
Yuping Liu — Fudan University, China

16:50-17:10 **FriA06-05**

An Islanding Detection and Load Curtailment Strategy for Radial Distribution Networks Using Squid Game Optimizer Algorithm

Peter Anuoluwapo Gbadega — University of Johannesburg, South Africa.
Yanxia Sun — University of Johannesburg, South Africa.
Olufunke Abolaji Balogun — University of Johannesburg, South Africa.

17:10-17:30 **FriA06-06**

An Economic Dispatch Method for Power System Based on Distributed Mutual-Fed-Consensus

Xiangjun Li — China Electric Power Research Institute, China
Panpan Zhang — Northeast Electric Power University, China
Bo Li — Northeast Electric Power University, China

Session FriB06 — Room 2 (K310)

Automatic systems and applications

15:30-15:50 **FriB06-01**

Motion Control Design for Peck Rigid Tapping Cycle Machining to Manufacture Internal Threads

Syh-Shiuh Yeh — National Taipei University of Technology, Taiwan
Yu-Shin Yang — National Taipei University of Technology, Taiwan
Ren-Jyue Hong — National Taipei University of Technology, Taiwan
Wei-Heng Sun — National Taipei University of Technology, Taiwan

15:50-16:10 **FriB06-02**

Automated wiring for a mechanized current collector of a trolley bus

Stefan Kupper — Technical University of Wildau, Germany
Stefan Frohlich — Deutzer Technische Kohle GmbH, Germany
Jorg Reiff-Stephan — Technical University of Wildau, Germany

16:10-16:30 **FriB06-03**

Intention-Controlled Wearable Exoskeleton for Upper Extremity Rehabilitation Using MotionSense Headband

Danaish — Southeast University, China
Liang Han — Southeast University, China
Gelin Xu — First Affiliated Hospital of Shenzhen University, Second People's Hospital, China
Mohammad Abbas Baig — Southeast University, China
GuanCheng Dong — Southeast University, China
Zongliang Xu — Nanjing Medical University, China

16:30-16:50 **FriB06-04**

Design and Manufacturing of Automatic Scraping Mark Units Based on Laser Ablation Technology

GuanCheng Dong — Southeast University, China
Liang Han — Southeast University, China
Zhenmeng Cui — Southeast University, China
Danaish — Southeast University, China
Mohammad Abbas Baig — Southeast University, China

16:50-17:10 **FriB06-05**

Cloud-Based Smart Coordinated Robot System for Strawberry Harvesting in Controlled Greenhouse Environment

Mohammad Abbas Baig — Southeast University, China
Liang Han — Southeast University, China
DongLei Yang — Yuehe Shiye (Zhejiang) Zero Carbon Technology Co., Ltd., China
Danaish — Southeast University, China
GuanCheng Dong — Southeast University, China
Muhammad Mubashir Niaz — Southeast University, China
Muhammad Sibtain — Southeast University, China
A. S. M. Hassan — Southeast University, China
Ahmed Sharif Shaybo Rabeh — Southeast University, China
M. A. A. AlShameri — Southeast University, China

17:10-17:30 **FriB06-06**

AI and IoT-enabled Workpiece Sorting System using Mini-PLC for Industrial Automation

Sarun Chattunyakit — Rajamangala University of Technology Suvarnabhumi, Thailand

Warunee Srisongkram	Rajamangala University of Technology Suvarnabhumi, Thailand
Phonchai Chukaew	Rajamangala University of Technology Suvarnabhumi, Thailand
Naratip Janhom	Rajamangala University of Technology Suvarnabhumi, Thailand
Naysara Satra	Rajamangala University of Technology Suvarnabhumi, Thailand
Ittiphong Yongyee	Rajamangala University of Technology Suvarnabhumi, Thailand
Jeerawan Homjan	Rajamangala University of Technology Suvarnabhumi, Thailand
Kreeta Sukthang	Rajamangala University of Technology Suvarnabhumi, Thailand
Promphak Boonraksa	Rajamangala University of Technology Suvarnabhumi, Thailand
Wipada Wongsuriya	Rajamangala University of Technology Suvarnabhumi, Thailand

17:40-18:00 **Main Hall (Epoch 21 Hall)**

Closing Ceremony and Award Ceremony

End of 4th day

ICAMechS 2024
Saturday, Nov. 30, 2024

09:10-11:10

Panel Discussions

13:10-16:30

Technical Tour

Regular Session ThuA01
Intelligent control algorithm

TokypTime (UTC +9)
10:10 - 11:50, Thursday, November 28, 2024

ThuA01, Room 1

Chair: Takao Sato (University of Hyogo, Japan)

Co-Chair: Shiro Masuda (Tokyo Metropolitan University, Japan)

ThuA01-01

Data-driven Ripple-free Control for Unstable Dual-rate Systems

Takao Sato
(University of Hyogo, Japan)

A dual-rate sampled-data control system is designed in which the sampling period of a process output is longer than the holding period of a process input. In such a system, there are the process output may still oscillate even when the sampled output converges to a reference input. Therefore, the intersample ripples caused by the input oscillation must be suppressed. For known dynamic systems, it is possible to design the output to follow the reference input while suppressing input oscillations in steady state, but this is not easy when the dynamic characteristics are unknown. For a control system with unknown dynamics, a dual-rate control law is extended using the step response of the control system to suppress the output oscillation between the sampling period.

ThuA01-02

The Effect of Illuminance Change on Accuracy in Determining Warpage of 3D Printer Modeled Objects Using Convolutional Neural Network

Kenta Tsukagoshi, Munehiro Namba and Shinichi Imai
(Tokyo Gakugei University, Japan)

Fused Deposition Modeling, one of the techniques for layered fabrication, has a problem of warpage during fabrication, and there is a need for a technique to avoid this problem. As one method to avoid this problem, a convolutional neural network (CNN) system has been developed to determine the presence or absence of warpage in real time and pause the printing process if warpage is detected. However, the system is based on the assumption that clear images are used, and it is unclear whether the system can determine warpage in an actual manufacturing environment, where the input image to determine warpage may be unclear. Therefore, the purpose of this study is to investigate whether changes in the quality of input images due to changes in illuminance affect the accuracy of warpage judgment by training the CNN proposed in the previous study using images taken in an environment where imaging conditions, such as illuminance, have been adjusted, and using images taken at different illuminance levels as test images. The results of the investigation revealed that the accuracy of warpage judgment in the test image was highest when the illuminance was the same as that of the training image, and that the accuracy of warpage judgment decreased when the illuminance was lower than that of the training image.

ThuA01-03

Data-Driven State Feedback Gain Update Based on Model Matching in Frequency Domain

Yoshihiro Matsui, Hideki Ayano, Shiro Masuda and Kazushi Nakano
(Fukuoka Institute of Technology, Japan)
(National Institute of Technology, Japan)
(Tokyo Metropolitan University, Japan)
(The University of Electro-Communications, Japan)

This paper presents a method for updating the state feedback gain of an LTI single-input nth-order system using data-driven techniques. The goal is to match the closed-loop system to a desired reference model, which is represented by a complementary sensitivity function. To achieve this, a new model matching error is introduced. The appropriate gain can be determined using the least squares method in the frequency domain, based on closed-loop data obtained from an improperly tuned system due to model errors. Although the proposed method is specialized for updating the state feedback gain, it can perform gain updates that take into account the effects of noise at an extremely low computational cost. The method ' s effectiveness is demonstrated through numerical experiments.

ThuA01-04

Analysis of Construction Orchard Trunk Shrub Dataset and Target Detection

Lu Xiangyang, Huang Lei, Geng Shiyong and Zhu Liuqun
(Zhongyuan University of technology, China)

Intelligence is the inevitable demand of agricultural modernization, and the target detection system has a broad application prospect. The deep learning perception algorithm requires a large number of datasets for training, and it is the prerequisite and foundation constructing an orchard environment to accurately identify shrubs and tree trunks datasets. A large amount of image is collected, the dataset is labeled to train the model, and the data is also analyzed using confidence, accuracy, recall and other indicators to ensure the reliability and accuracy. The intelligent algorithm based on YOLOv8 handles the complex orchard scene in real time, accurately identifies shrubs and tree trunks, and automatically adjusts the paths to avoid collision. The results show that the algorithm has good target detection and recognition ability, and its deployment can improve the efficiency of orchard management and reduce labor costs, which provides a strong support for the realization of agricultural automation.

ThuA01-05

Model Reference Adaptive Control via Online Virtual Reference Feedback Tuning under Unmatched Controller Structures

Shiro Masuda
(Tokyo Metropolitan University, China)

The study considers model reference adaptive control for a single-input, single-output discrete-time system using an idea of the virtual reference feedback tuning (VRFT). The standard VRFT resolves a model reference control problem using one-shot experimental input-output data instead of a mathematical controlled plant model. The study provides an online tuning method for controller parameter to follow a prescribed reference model output for the closed-loop output. The main feature in the study is to achieve asymptotically tracking to step-type reference signals under unmatched controller structures. The effectiveness of the proposed method is shown through a numerical example.

Regular Session ThuB01
Technologies and applications

TokypTime (UTC +9)
10:10 - 11:50, Thursday, November 28, 2024

ThuB01, Room 2

Chair: Ni Bu (Qingdao University of Science & Technology, China)
Co-Chair: Xianfeng Zhang (Guangzhou College of Technology and Busines, China)

ThuB01-01

Spatio-Temporal Graph Convolutional Networks for Pedestrian Trajectory Prediction

Jinrui Geng, Yong Lu, Jianlin Li and Hannan Shen
(Foshan University, China)
Ruishi Liang
(University of Electronic Science and Technology of China, China)

The pedestrian trajectory prediction has been extensively studied in some fields such as autonomous driving and intelligent surveillance, wherein the existing methods can not effectively capture the highorder dependencies and the diverse interaction patterns among pedestrians. To this end, this paper proposes a lightweight pedestrian trajectory prediction model called Spatio-Temporal Graph Trajectory (STGTraj), which not only enhances the ability on capturing both the global and local spatiotemporal dynamic features of trajectory, but also achieves the uniform coverage and stability of the trajectory sample distribution. Based on the proposed STGTraj model, this paper futher presents a pedestrian trajectory prediction model called the Spatio-Temporal Multiscale Graph Trajectory (STMGTraj). Through the multi-scale interaction model, STMGTraj can captures the spatiotemporal features more comprehensively compared with STGTraj. In addition, this paper adopts the Box-Muller transformation to enhance the stability of normally distributed random numbers with the Quasi-Monte Carlo (QMC) methods. The experiments and analyses are conducted on the ETH and UCY datasets, and the results confirm that the proposed methods outperform the existing state-of-the-art models across multiple metrics.

ThuB01-02

Factors influencing the results of the second-level computer examination of students in the School of Engineering of Guangzhou Institute of Technology and Business

Zhengguo Guan
Guangzhou College of Technology and Business, China)

In recent years, with the widespread application of AI technology, the informatization construction of higher education has made significant progress. It has become a research hotspot to use big data and artificial intelligence technology to discover potential problems in the teaching process and propose targeted solutions to improve teaching quality. This paper takes the first-year students of Guangzhou Industrial and Commercial College as the research object, and discusses the influence of individual characteristics, family support, learning motivation, learning methods, teaching quality, learning environment, social factors, learning resources and technology, learning attitude and emotion, reward and feedback, learning community and cooperation, school management and leadership, and social support on the performance of students in the National Computer Rank Examination. The data of examination results are collected by means of questionnaire, and the multiple regression algorithm in artificial intelligence is used to comprehensively analyze the influence of single factor, multiple factors and comprehensive factors on the results. The results of the study show that: there is a positive correlation between students' academic performance and the strength of their curiosity; girls in the middle height range often have better academic performance than boys; students whose parents have a strong educational background, attach great importance to education and invest heavily in it generally have more outstanding academic performance; students who grow up in the immersion of digital media show higher learning enthusiasm; students whose family members emphasize a balanced diet and physical health also perform better academically; students who can flexibly adapt to a variety of teaching methods, skillfully use a variety of educational resources, and reasonably plan the learning process perform better; in addition, students who are good at integrating a variety of educational resources and learning strategies also show higher academic achievements. This study provides direction for educators and effective strategies to improve students' performance in the computer grade examination.

ThuB01-03

Analysis of AgInGaSe2 Thin Films Based on Room-temperature Photoluminescence Characterization

Xianfeng Zhang, Xianwang Zhou and Yushan Li
Guangzhou College of Technology and Business, China)
Yong Lu
(Foshan University, China)

AgInGaSe2 (AIGS) solar cell with wide bandgap is very promising for fabricating CuInGaSe2 solar cell based tandem solar cells. Defects in AIGS solar cell play a very important role in the device performance. In this work, the temperature dependence of the photoluminescence (PL) was studied to reveal its influence on solar cell properties. The PL transitions associated with various recombination processes in AIGS solar cell are studied at temperatures from 15 K to room temperature (300K). In the PL spectra, strong PL emission lines generated by optical phonon replicas of free and bound excitons are clearly observed. The spectra of the room-temperature PL spectrum are dominated by the phonon replicas of the free exciton transition with the maximum at the LO phonon replica. The room temperature PL is also used to calculate bandgap of AIGS films and the result is compared with that measured by the transmission spectra. As a conclusion, the influence of temperature on the PL spectra of free and bound excitons has been studied in detail. The results demonstrate that the room-temperature PL of AIGS is dominated by the free exciton LO phonon replicas emissions. Also, room temperature PL is an effect method to calculate film bandgap. The AIGS film with high crystallinity show a conversion efficiency of 10%, which is over average.

ThuB01-04

Numerical simulation analysis of medium-low temperature heat-treating furnace

Zhangli
(University of Electronic Science and Technology of China, China)

The control of temperature field uniformity of heat-treating furnace is the key to affect the whole heat treating process. Due to the change of the structure of the heat-treating furnace, the entire temperature distribution in the furnace will change, and affect the utilization efficiency of gas, and then affect the quality of the heat treatment workpiece and the economy of the hot processing process. The design of the traditional heat-treating furnace structure is based on experience, and the improvement of the temperature uniformity in the furnace can only be adjusted on the basis of practical experience, and it is impossible to systematically obtain the influence law of the structure on the temperature in the furnace. There is no reliable theoretical guidance for the design process of the heat-treating furnace structure, and the distribution of the temperature field and flow field in the furnace cannot be obtained. In this study, a finite element analysis method is proposed to coupling multiple heat transfer processes, including: fuel combustion process, convection heat transfer process of flue gas in the furnace body, heat conduction process of the furnace wall and radiation heat transfer process in the furnace body were numerically simulated and analyzed according to the EDM finite reaction model in Fluent, the standard k-ε turbulence model and the implicit coupling, and the temperature field and flow field distribution in the furnace were obtained.

ThuB01-05

Traffic image text detection via Yolov8 based on attention mechanism and rotation proposals location

Zhou Xianwang
(Guangzhou College of Technology and Business, China)

Traffic scene text detection is an important technology in the field of image processing, which is of great significance in assisted driving, automatic driving, intelligent transportation and other technologies. Traffic scene text detection has problems such as complex background and diverse text angles. In this paper, YOLOv8s model is applied to traffic scene text detection. On the basic model of YOLOv8s, ResCBAM attention mechanism is added to strengthen feature extraction. At the same time, the Circular Smooth Label (CSL) angle classification method is introduced to complete the accurate prediction of text with different tilt angles. Conduct comparative analysis experiments on the self-made datasets CTST and the publicly available datasets ICDAR2015. The experimental results show that compared with the classic arbitrary direction text detection model EAST, the proposed model has improved F-measure on both CTST and ICDAR2015 datasets, and the detection speed is better than other comparison models, which verifies the feasibility and progressiveness of the proposed model. Finally, illumination brightness and clarity perturbation experiments were conducted on the CTST datasets and ICDAR2015 datasets, respectively, to verify the robustness of the model.

Regular Session ThuA02
Control system design

TokypTime (UTC +9)
14:00 - 15:40, Thursday, November 28, 2024

ThuA02, Room 1

Chair: Guang Jin (Tokyo University of Agriculture and Technology, Japan)
Co-Chair: Changan Jiang (Osaka Institute of Technology, Japan)

ThuA02-01

Right Coprime Factorization for Nonlinear System with Uncertainty Based on Time-Varying Bezout Identity

Zizhen An and Mingcong Deng
(Tokyo University of Agriculture and Technology, Japan)

In this note, a new structure of Right Coprime Factorization (RCF) for nonlinear systems with uncertainty has been proposed based on a time-varying Bezout identity. This is inspired from the concept of dilation from homogeneous theory. However, this time-varying dilation in right coprime factorized uncertain nonlinear systems is not limited to homogeneous plants but is integrated into Bezout identity so as to ensure the bounded input bounded output (BIBO) stability of uncertain systems. Additionally, simulation results of two numerical examples are exhibited to validate the proposition.

ThuA02-02

Durability Testing of Soft Pneumatic Actuators with A Portable Device

Yang Zhang, Keigo Kutani and Zhongkui Wang
(Ritsumeikan University, Japan)

Soft pneumatic actuators (SPAs) present significant advantages for handling a variety of objects due to the inherent flexibility and adaptability. However, their durability remains a key challenge in practical applications, as the soft materials used
are prone to failure. Therefore, there is a critical need for an effective device to evaluate the durability of SPAs. A portable, reliable, and scalable testing device would facilitate broader adoption across various work scenarios. Durability testing not only determines the operational lifespan of SPAs prior to deployment but also identifies areas prone to breakage, allowing for targeted improvements to enhance their strength and durability. In this study, we propose a design for a portable durability testing device and demonstrate its application in evaluating SPA durability and guiding targeted enhancements. The experimental tests validated the reliability of the proposed device, while the combination of testing and finite element (FE) analysis led to significant improvements in durability of the SPA. This study offers a available solution for SPA durability assessment, enabling both a deeper understanding of their lifespan and focused improvement initiatives.

ThuA02-03

Robust Improvement of Integrated Position and Speed Control using Linear Active Disturbance Rejection Control

Kenta Kariyazono, Yoshihisa Ishida and Takahiro Murakami
(Meiji University, Japan)

In this paper, a integrated position and speed control (IPSC) is improved. IPSC controls an object by speed control when the deviation is large and it is switched to position control when the deviation is small. IPSC prevents the saturation of the integrator in the controller. However, the conventional IPSC is not robust against disturbances and model errors. To overcome the disadvantage, we propose IPSC with Linear Active Disturbance Rejection Control (LADRC). Because LADRC has a simple structure and it can cancel both disturbances and model errors effectively, the proposed method improves robustness of IPSC. Simulation and experimental results verify the robustness of the proposed method against disturbances and model errors.

ThuA02-04

Saturation Compensation for Nonlinear Unstable Plants Based on Coprime Factorization

Yuuki Morohoshi, Mingcong Deng
(Tokyo Univ. of Agr. and Tech., Japan)

Plants often have constraints on actuator inputs due to physical limitations and protection mechanisms. Input saturation can lead to plant instability and increase the risk of accidents. Particularly in unstable plants, when the input saturates, the output can exceed the controllable range, potentially making it impossible to recover control performance. This presents a significant issue. In this paper, we propose a saturation compensator for nonlinear and unstable plants that compensates before the output exceeds the controllable range. This compensator extends a disturbance observer, functioning as the disturbance observer under normal conditions, and as the saturation compensator when the output approaches uncontrollable regions. Additionally, the compensator is designed based on coprime factorization, ensuring stability. This approach allows for improved control performance while maintaining system stability. The effectiveness of the proposed compensator was verified through simulations of a simple pendulum. The simulation results confirm that the compensator functions as the disturbance observer under normal conditions and compensates for input saturation when the output approaches uncontrollable regions. The effectiveness of the compensator was also confirmed by comparing cases with and without the compensator. Future research will focus on implementing the compensator for experiments with actual equipment.

ThuA02-05

Friction Compensation Based Coprime Factorization for Nonlinear Systems

Tomoya Hoshina, Mingcong Deng
(Tokyo Univ. of Agr. and Tech., Japan)

Friction is a powerful nonlinearity with discontinuity and uncertainty, and it is a significant obstacle to achieving high precision in control systems. In recent years, with the increasing demand for medical robots, high-precision positioning of robot arms is required. Since friction is an obstacle to high-precision control, friction compensation is essential. In this study, we propose a new approximation method for friction compensation and a method for compensating for uncertain friction based on coprime factorization. By using these two methods, we prove that the positioning error of the system is smaller than a finite user-set value λ.

Regular Session ThuB02
Computer vision

TokypTime (UTC +9)
14:00 - 15:40, Thursday, November 28, 2024

ThuB02, Room 2

Chair: Yan Wang (Zhongyuan University of Technology, China)

Co-Chair: Zhongkui Wang (Ritsumeikan University, Japan)

ThuB02-01

Crack Detection and Width Measurement for Concrete Building using Mobile Devices

Kotoha Makino, Hao San and Yue Bao
(Tokyo City University, Japan)

Crack detection and width measurement are critical for the long-term safe operation of concrete structures. In Japan, cracks with a width of 0.3 mm or larger are set as inspection standards because water penetration through cracks in reinforced concrete can cause corrosion of the reinforcing steel. Current inspection methods are typically manual which involve time-consuming and labor-intensive work, and there is a shortage of manpower. Additionally, measurement errors can occur depending on the measurer's experience and the inspection environment. In previous research on the automation of crack detection and width measurement in millimeters, it was necessary to use special equipment, place markers on the measurement surface, or take photographs with the measurement surface and camera axis facing each other vertically. The purpose of this study is to make the inspection easier by using a mobile device with a built-in LiDAR and RGB camera. In this study, we proposed a method for clarifying the angle and position of the measurement plane and camera using point cloud and camera self-position estimation, and for complementing the points corresponding to the image pixels. Consequently, it is possible to measure crack width even when the surface and camera axis were tilted. Furthermore, since all the necessary data can be obtained using only mobile devices, no special equipment or wall markers are required. In order to demonstrate the effectiveness, results of proposed method were compared with the manual measurement values. As a result, the maximum error was 0.148mm, and the standard deviation decreased at all 15 measurement points. According to these results, the flexibility of shooting camera position is increased. This achievement is important in terms of simplifying the inspection of concrete structures and reducing errors.

ThuB02-02

Improvement of myopia using brain vision training with variable focal length VR

Kazuma Shindou, Akira Taguchi and Yue Bao
(Tokyo City University, Japan)

There is growing interest in vision improvement methods because poor vision impairs quality of life and causes a variety of problems in daily living and cognitive function. However, many existing vision improvement methods are invasive, expensive, and require large training spaces and long training periods. In this study, we focused on the positive effects of HMD use on visual acuity and devised a noninvasive visual acuity training method using an HMD with variable focal distance and Gabor stimuli to enhance its effectiveness. In this training method, the image formation distance during training is adjusted according to the subject's visual acuity, providing training at the optimal difficulty level for each subject. It also aims to efficiently enhance visual function through perceptual learning using Gabor stimuli. The results of this study showed that this training method improved visual acuity by an average of 35 % in 1/8th the training time of the conventional method. This indicates that the proposed method is an effective way to improve visual acuity in a short period of time without the need for expensive equipment or a large training space.

ThuB02-03

Colorization of Automatic Hologram Generation from Photographs using Machine learning

Koya Makita, Akira Taguchi and Yue Bao
(Tokyo City University, Japan)

Holography is the only imaging technology that can faithfully reproduce reflected light from objects. The hologram reproduced on a computer is called a computer-generated hologram (CGH), but the generation of CGH has previously been problematic due to the enormous amount of computation required. One research that has solved this problem is TensorHolography. This research will use techniques such as machine learning to estimate CGH at high speed. However, this research required specialized equipment such as a Tof camera and LiDAR to acquire depth information. This problem was solved by research called "From picture to 3D hologram". This research used machine learning to obtain depth information to create a monochromatic CGH. However, color CGH was not realized. In this research, we proposed a method to automatically generate color holograms from photographs by using machine learning to obtain depth information from photographs using a monocular depth estimation model and then to use machine learning to create color CGHs. And, the effectiveness of the proposed method was confirmed by playing back the CGH actually generated.

ThuB02-04

Cyber-physical Workbench for human digital twin integration: A system proposal

Ricardo N. C. Rodrigues and Antonio H.J. Moreira
(IPCA, Portugal)
Jaime Fonseca
(University of Minho, Portugal)

"Industry 5.0" is the next step on an ever-evolving ecosystem with the objective of creating a symbiotic relation between automated processes and human workers, by bringing the human worker again to factory floors and use automated system to enhance the worker. This improvement can be done by using Digital Twins (DT) and Cyber-Physical Systems (CPS), by assessing the human and managing the task to improve performance and monitor ergonomics. To create a foundation for the implementation of this type of DTs a system is proposed to obtain workers joints and assess their state using two RGBD (Red, Green, Blue and Depth) cameras. To evaluate such a system, three distinct tests were executed, one to assess real time error, one for continuous measurements on simple tasks, and the last one to gauge complex tasks. The system showed promising results with an adequate assessment of instant positioning with error inferior to 0.03 m and work volume assessment below 0.01 m^3 , and an average root-mean-square of 0.035 m on trajectory assessment, but falling short on travel distance calculation with considerable error such as 0.3 m, but improvements are suggested.

ThuB02-05

Depth Estimation using Omnidirectional Stereo Imaging and Machine Learning

Naoki Shibasaki, Akira Taguchi and Yue Bao
(Tokyo City University, Japan)

In this study, we propose an omnidirectional depth estimation method applicable to autonomous driving systems by combining stereo vision and machine learning techniques. Recently, there has been active research in driver assistance systems and autonomous vehicles, making three-dimensional measurement of distances and surrounding environments indispensable for safe navigation. Traditional sensors like LiDAR and radar offer high accuracy but have limitations in field of view and measurement density. This necessitates the use of multiple sensors, leading to increased costs—a significant challenge for practical implementation. To address these issues, we developed a depth estimation method using Hyper Omni Vision, which enables wide-range and high-density data acquisition. By integrating stereo vision with machine learning, we combine distance measurements from parallax with monocular depth estimation. This approach achieves stable measurements unattainable with conventional methods. Experimental results show that the proposed method reduces detection omissions and improves obstacle visibility. Although it does not yet reach the same level of accuracy as sensors like LiDAR, it has been confirmed that stable and reliable measurements are possible. This indicates its potential as a costeffective alternative for autonomous driving applications.

Regular Session TueA03
Machine Learning

TokypTime (UTC +9)
15:50 - 17:50, Thursday, November 28, 2024

ThuA03, Room 1

Chair: Lin Meng (Ritsumeikan University, Japan)

Co-Chair: Bu Ni (Qingdao Univ. of Sci. and Tech., China)

ThuA03-01

Examining Factors Influencing Continuous Adoption of Drone Technology in Malaysian Paddy Farming Using an Adapted UTAUT Model

Mohamed Najib bin Salleh, Rabiatul Saniah binti Azmi, Wan Nadzri bin Osman and Faisal bin Zulhumadi
(Universiti Utara Malaysia, Malaysia)
Muhd Ridzuan bin Zainol
(Lembaga Kemajuan Pertanian Kemubu, Malaysia)

The adoption of drone technology, a key application of mechatronics in agriculture, has shown substantial promise in improving crop monitoring, resource management, and overall productivity. This study explores the factors affecting the continued use of drones among paddy farmers in Malaysia's Kemubu Agricultural Development Authority (KADA) region. Applying a modified Unified Theory of Acceptance and Use of Technology (UTAUT) model, the research analyzes the influence of Performance Expectancy, Social Influence, Facilitating Conditions, and Trust on farmers' intentions to sustain drone usage. A quantitative methodology was used, gathering data from 50 paddy farmers with prior drone experience through structured questionnaires. The reliability and validity of the constructs were verified using Cronbach's alpha and correlation analyses. Regression results indicated that Facilitating Conditions and Trust significantly impact farmers' intentions to continue using drones, whereas Performance Expectancy and Social Influence were not significant predictors. These findings underscore the importance of enhancing support mechanisms and fostering trust to encourage long-term adoption of mechatronic systems in paddy farming. The study provides valuable insights for policymakers and service providers, guiding the development of targeted strategies to meet farmers' needs and facilitate sustainable, efficient agricultural practices through advanced mechatronic technology.

ThuA03-02

A Comparative Study of Clustering Distance Metrics for Personalized Federated Learning in Human Activity Recognition

Xiaoxu Wen, Chenggang Lu, Ruixiang Hu, Yan Wang and Qiangsong Zhao
(Zhongyuan University of Technology, China)
Yingrui Geng
(Ritsumeikan University, Japan)
Hongnian Yu
(Edinburgh Napier University, UK)

In Federated Learning (FL), Non-Independent and Identically Distributed (Non-IID) data across different clients presents a significant challenge for a global model to effectively generalize to all clients, thus affecting fairness across the system. To address this, the Clustered Personalized Federated Learning (CPFL) framework groups clients with similar data distributions and trains models that are tailored to the characteristics within each cluster. In this study, we experimentally evaluate the performance of four distance metrics - Cosine distance, Euclidean distance, Manhattan distance, and Mahalanobis distance - across varying numbers numbers of clusters within the CPFL framework, focusing on their impact on model accuracy and fairness across client models. Our results demonstrate that Euclidean distance not only improves model accuracy but also significantly reduces performance disparities between clients, exhibiting the lowest variance and enhancing fairness. In contrast, the other distance metrics introduce larger variance in certain scenarios, leading to greater differences in client model performance. This study provides empirical support for the use of distance metrics in CPFL, showing that selecting appropriate clustering methods can enhance both overall performance and fairness across client model.

ThuA03-03

Research of Adaboost integrated ELM based apple grading

Yang Cao, Liyang Ma, Lisha Chen and Shuhui Bi
(University of Jinan, China)

Near infrared spectroscopy (NIRS) is widely used in apple grading research. The correlation between spectral information and soluble solids content (SSC) can be established, which can be used to build predictive models during the use of NIR spectroscopy. Extreme Learning Machine (ELM) methods can be used to establish the apple’s classification model. However, the established prediction model has poor applicability and low classification accuracy. For improving the classification accuracy of the predictive model, the multivariate scattering correction (MSC) will be used for baseline correction of the original spectral data, and the genetic algorithm (GA) will be used to screen the characteristic wavelength for data preprocessing. Moreover, Adaboost will be used to integrate the ELM model to establish a strong prediction model. The experimental results show that the classification accuracy of ELM model is 64.66%. The classification accuracy of daboost-ELM is 81.20%. Compared with the single ELM model, the Adaboost integrated model has higher accuracy and the accuracy, and the stability of apple grading are also improved.

ThuA03-04

Fitness-Distance Balance based Symbiotic Organism Search Algorithm for Path Planning of Warehouse Systems

Jun Liu, Lei Wang, Tao Shen and Shuhui Bi
(University of Jinan, China)

The path planning of Automated Guided Vehicle (AGV) is a core focus of research in intelligent warehousing, with the primary objective of determining the shortest route that circumvents obstacles based on known starting and ending points. Many meta-heuristic search (MHS) algorithms have been applied in path planning, such as Genetic Algorithm (GA), Ant Colony Optimization (ACO) and so on. However, MHS algorithms face several limitations in path planning, including the risk of premature convergence to local optima, high demand for computational resources, and poor adaptability in dynamic environments etc. To address these issues, Symbiotic Organism Search (SOS) is applied in intelligent warehousing, and is improved by a Fitness-Distance Balance (FDB) method, named FDB-SOS algorithm. The FDB-SOS algorithm enhances the path planning process by dynamically adjusting search parameters, leading to improved search efficiency. Simulation experiments validate the effectiveness of the proposed method, showing that the FDB-SOS algorithm outperforms the traditional SOS algorithm in both path distance and running time, with an average reductuction of 32.83% in path distance and 26.70% in running time.

ThuA03-05

Based on the Cooperative Game Strategy of Virtual-Thermal-IES Under the Electricity Carbon Trading

Ji Ding, Bing Lv and Ni Bu
(Qingdao University of Science and Technology, China)

Under the " double carbon " goal, how to realize the rational and efficient use of renewable energy and reduce carbon emissions has become an important step in the transformation of low-carbon economy. At present, most of the studies are realized from the perspective of power utilization or power sharing, and do not consider the role of carbon emissions from thermal power output in the synthesis of methane.Aiming at this problem, this paper studies the electricity-carbon cooperation among virtual power plants, thermal power plants, and Integrated Energy Systems (IES). Firstly, it develops a multi-agent cooperative operation model involving virtual power plants, thermal power plants, and IES for energy and carbon trading. Secondly, based on Nash bargaining principles, it decomposes this model into two subproblems: maximizing the combined coalition benefits of multiple agents and determining the pricing for electricitycarbon trading, to solve for the trading volumes and prices. Finally, the effectiveness of the cooperative operation strategy among multiple agents is verified through numerical examples. The simulation results show that the virtual power plant and thermal power plant can improve the utilization rate of new energy and effectively reduce carbon emissions by forming an alliance with IES, so as to actively respond to the dual-carbon target.

ThuA03-06

CCNet: a segmentation network based on U-Net for calculating cell confluency

Xiaoyu Sheng, Shaoyuan Li and Ni Bu
(Qingdao University of Science and Technology, China)

Cell confluency is a critical indicator for determining the optimal collection time of cultured stem cells in vitro. Currently, assessing cell confluency heavily relies on the subjective experience of researchers, which can introduce significant variability. To achieve a more accurate calculation of cell confluency, we proposes an image segmentation network — cell confluency network (CCNet), based on the U-Net architecture. CCNet incorporates attention modules and a residual structure, thereby improving the network’s learning capacity and accuracy. By calculating the pixel ratio (the ratio of cell pixels to total pixels) from the images processed by CCNet, the cell confluency value is obtained. Experiments indicate that the proposed CCNet provides more accurate segmentation results for stem cell images compared to the previous version of U-Net, thereby demonstrating the effectiveness of CCNet.

Regular Session TueB03
Electrical system

TokypTime (UTC +9)
15:50 - 17:50, Thursday, November 28, 2024

ThuB03, Room 2

Chair: Chengyan Zhao (Ritsumeikan University, Japan)

Co-Chair: Changan Jiang (Osaka Institute of Technology, Japan)

ThuB03-01

RustGAN: A method to generate rusty screw with physicochemical constraints

Sicheng Lu, Chen Xu, Yicong Gao and Zhiliang He
(Zhejiang University, China)
Qiong Lin
(Zhejiang University of Technology, China)

As a crucial and pervasive component in industrial processes, screws are integral to the assembly, maintenance, and recycling of products. In light of the advancements in automation technology, it has become imperative to leverage vision systems for the identification and execution of automated disassembly and assembly of screws. However, the working environment of screws is complex and variable, and corrosion is one of the main causes of damage to screws. Therefore, it is essential that vision systems are able to accurately identify different types and degrees of corrosion in order that appropriate treatment measures can be taken. However, the current challenge is that it is more difficult to obtain samples of screws exhibiting various corrosion, which directly constrains the size of the dataset and, consequently, affects the accuracy and generalizability of the recognition algorithm. In this paper, we propose a Rust Generative Adversarial Network (RustGAN) approach with physicochemical constraints for the generation of images of screws exhibiting different types and degrees of rust. In particular, we initially delineate three screw rusting base models in practical scenarios and subsequently calculate the corresponding formulas under physicochemical constraints. Concurrently, we devise a novel screw rusting detail feature loss function based on the formulas and integrate it into the generative adversarial network to generate high-quality and diverse screw rusting images. The efficacy of the RustGAN proposed in this study has been demonstrated through experimentation, whereby the dataset of screws exhibiting various degrees of rust has been expanded, and the performance of the VGG16 target detection model on the task of recognizing rusty screws has been markedly improved.

ThuB03-02

Performance Evaluation of Filter Design Techniques for Harmonic Control in Three-level Inverter Systems

Peter Anuoluwapo Gbadega, Yanxia Sun and Olufunke Abolaji Balogun
(University of Johannesburg, South Africa)

This study investigates harmonic reduction inithreelevel inverters, focusing on the performance of single-tuned and double-tuned filters. Inverters, essential in microgrids for converting DC to AC power, often face the challenge of harmonic distortion, which can degrade power quality. The research models a three-level inverter using MATLAB, with design parameters for both filter types derived through mathematical equations. A comparative analysisi was conducted to evaluate the effectiveness of single-tuned and double-tuned filters in minimizing total harmonic distortion (THD) at the inverter's output. Results show that both filters reduced THD to levels compliant with International Electrotechnical Commission (IEC) standards, but the double-tuned filter outperformed the singletuned filter, achieving a lower THD. This demonstrates the superior capability of the double-tuned filter in enhancing the power quality of the inverter system. The study provides valuable insights into filter selection for inverters, offering a solution to the challenge of designing effective filters for harmonic reduction, with a particular emphasis on the advantages of using double tuned filters in three-level inverter systems.

ThuB03-03

Plug-in Compound Feedforward Odd Harmonic Repetitive Control for Single-Phase V2G Inverters

Shuangfeng Li, Qiangsong Zhao, Qifan Wang, Guohui Zhou,
Yan Wang and Aihui Wang
(Zhongyuan University of Technology, China)

Repetitive control (RC) is a widely used control technique in single-phase vehicle-to-grid (V2G) inverters to effectively reduce current harmonics. However, there is a need to enhance the dynamic response and to improve the harmonic suppression performance, which is susceptible to degradation, particularly during grid frequency fluctuations. This paper proposes a plugin compound feedforward odd harmonic RC (PCFORC) to significantly improve dynamic control accuracy and response speed when the grid frequency fluctuates. In comparison to existing plug-in compound odd harmonic RC (PCORC) methods, PCFORC exhibits the lager gains and broader resonantbandwidths at fundamental and odd harmonic frequencies, resulting in a higher-quality output current. In this paper, the principle, stability analysis, and parameter design of PCFORC are presented, and its effectiveness is verified by a simulation model of a 1.5 kW single-phase V2G inverter, which demonstrates its potential in improving the performance of V2G systems.

ThuB03-04

Research on Modeling of Giant Magnetostrictive Actuator Based on Rate-Dependent Improved Prandtl-Ishlinskii Model

Xinyuan Tian and Shengjun Wen
(Zhongyuan University of Technology, China)

To address the nonlinear issues of rate-dependent hysteresis in Giant Magnetostrictive Actuators (GMA), an initial Prandtl-Ishlinskii (PI) model was developed specifically for GMA. Building on this, an improved rate-dependent PI model was created. Experimental validation shows that, under conditions ensuring good linear performance of GMA, the model can accurately describe the rate-dependent hysteresis characteristics of GMA from 1Hz to 90Hz. The classic PI model has a symmetric internal structure and is rate-independent, which makes it unsuitable for addressing the asymmetric hysteresis characteristics of GMA. It also fails to accommodate the frequency-dependent hysteresis behavior of these actuators. In contrast, the improved rate-dependent PI model features an asymmetric internal structure and incorporates frequency factors. This enhancement allows the model to effectively manage the asymmetric hysteresis characteristics of GMA and adapt to changes in input frequency, thereby improving its overall adaptability.

ThuB03-05

An Improved Temperature-Dependent Prandtl-Ishlinskii Hysteresis Modelling and Parameters Recognition for Giant Magnetostrictive Actor

Hongjun Li
(No.713 Research Institute of CSSC, China)
Yixiang Wang
(Zhongyuan University of Technology, China)

Aimed at the hysteresis nonlinear change problem of Giant Magnetostrictive Actuator (GMA) under temperaturerelated disturbance, this paper established a hysteresis nonlinear composite model containing temperature field by adopting the method of weighting temperature offset and Prandtl-Ishlinskii (PI) model. This paper firstly establishes the traditional PI model under initial temperature, then utilizes the thermal expansion of Giant Magnetostrictive Material (GMM) and the characteristic that magnetostrictive coefficient changes with temperature, according to the cooling mode of an experimental device, derives the hysteresis nonlinear composite model containing temperature offset by using heat transfer law, finally identifies the PI model parameters by nonlinear least squares method, and identifies the temperature offset model parameters by nonlinear programming function respectively. The experimental results show that the established Temperature-Dependent Prandtl-Ishlinskii Hysteresis (TD-PI) model can accurately express the hysteresis nonlinear dynamic change characteristics caused by temperature disturbance.

ThuB03-06

Research on Friction Compensation Feedforward Control for Linear Motors Based on the Prandtl-Ishlinskii Model

Xinlong Xu, Xinlong Xu and Yixiang Wang
(Zhongyuan University of Technology, China)

The feeding axis driven by linear motors experiences nonlinear changes in friction resistance during the feeding process, making high-precision drive control difficult. By combining modeling and experiments, the Prandtl-Ishlinskii model is applied as the representative model for the linear motor servo system. The Prandtl-Ishlinskii model of the linear motor servo system is identified using output displacement as the system feedback signal. Based on this model, a friction compensation feedforward control scheme is proposed to compensate for nonlinear friction resistance. A comparative control study with and without feedforward control uses a self-built linear motor servo drive mechanism as the experimental platform. The results indicate that the proposed feedforward control scheme significantly improves the position-tracking accuracy of the linear motor servo system, reducing the relative error from 6.8% to 1.6% while tracking a sine curve.

Regular Session FriA04
Mechatronic systems

TokypTime (UTC +9)
10:10 - 11:50, Friday, November 29, 2024

FriA04, Room 1

Chair: Aihui Wang (Zhongyuan University of Technology, China)
Co-Chair: Zenghui Wang (University of South Africa, South Africa)

FriA04-01

Humanoid Control Technology for Lower Limb Rehabilitation Robots Based on Human Gait Data

Shengda Gao, Aihui Wang, Huichao Duan, Xuebing Yue, Hengyi Li and Jinkang Dong
(Zhongyuan University of Technology, China)

The lower limb rehabilitation robot is a wearable exoskeleton bionic device that integrates robotic features with human walking characteristics. This paper explores the control strategies, gait data acquisition and processing methods, as well as the design and experimental validation of a humanoid control system for lower limb rehabilitation robots. By collecting gait data from healthy individuals using the NOKOV 3D infrared passive optical motion capture system, a gait dataset was established, and methods such as spline interpolation and Gaussian regression were employed to integrate the gait data. A humanoid control system based on real gait data was designed, utilizing a high-performance computer, R4SE controller, and joint motors to simulate gait patterns. Experimental results demonstrate that the system effectively follows target gait trajectories, achieving high trajectory tracking accuracy and smoothness, ensuring the safety and effectiveness of rehabilitation training. Future research will incorporate a more diverse group of subjects and intelligent control algorithms to enhance the system ' s adaptability and intelligence.

FriA04-02

Human-machine Integration of Lower Limb Rehabilitation Robot

Xiang Zhang, Aihui Wang, Shengda Gao, Huichao Duan, Hengyi Li, and Xuebing Yue
(Zhongyuan University of Technology, China)

As the prevalence of lower limb motor dysfunction due to conditions such as cerebral palsy, hemiplegia, and paraplegia continues to rise, the current medical infrastructure for sports rehabilitation is insufficient to meet the growing demand. There is also a serious shortage of rehabilitation doctors. In this context, lower limb rehabilitation robots have emerged as a critical role in the rehabilitation process. These robots not only alleviate the workload of rehabilitation doctor but also accelerate patient recovery. Aiming at the shortage in rehabilitation medical resources, this paper introduces a self-developed lower limb rehabilitation robot. This paper encompasses the comprehensive architecture design, hardware development, data collection and processing, control signal transmission, among other aspects. Experimental results demonstrate that the self-developed robot can effectively delivers gait trajectories tailored to the needs of sports rehabilitation, thereby enhancing the efficacy of rehabilitation programs.

FriA04-03

Target Grasping and Multi-modal Interaction System Based on Pepper Robot

Kuozhan Wang, Aihui Wang, Yan Wang, Xuebing Yue, Junjie Xie, and Yangyang Wang
(Zhongyuan University of Technology, China)

Pepper robot integrates an RGB-D camera, voice system, and control system, and has been widely used in homes, shopping malls, and hotels. However, existing Pepper robots are mostly based on preset programs and have limited flexibility. To improve the intelligence level of robots, this paper presents a multi-modal interactive system that integrates YOLOv8 and the large language model (LLM). Firstly, to allow the robot to recognize and grasp target objects in the home environment, YOLOv8 target detection is integrated into the robot vision system based on the robot operating system (ROS), and the coordinates of the object are obtained by combining the depth camera positioning algorithm. Aiming at the limitation of the detection distance of the structured light depth camera, an odometer coordinate compensation strategy is designed to ensure that the object can stably obtain its coordinates when it is in the working space of the robot arm. To further enhance the intelligent interaction ability of the robot, LLM is integrated into the robot system, so that the robot can program independently to interact with the user according to the user ' s intention. Finally, the feasibility of the proposed method is verified by experiments and the grasping and intelligent interaction of the target object are realized.

FriA04-04

Input-output Behavioral Data-driven LQG Control of Axial-gap Self-bearing Motor

Chengyan Zhao and Satoshi Ueno
(Ritsumeikan University, Japan)

This paper addresses the displacement control of the tilt-controlling axial-gap self-bearing motor via input-output data-driven Linear-Quadratic-Gaussian (LQG) approach. First, the dynamic model is stated and the linearized state-space model at the operating point is obtained. Although LQG method has been widely used in many practical problems, it is still hard to effectively address nonlinear processes, high-order dynamic modeling, and the negative effects caused by the complex structure of motors and noise. Therefore, we fully utilize actual inputoutput data from the system to reconstruct the system's dynamic behavior and compute the static feedback control rates that can compete with the dynamic feedback gains obtained from model-free data-driven methods, which effectively improve the displacement control performance of the axial-gap magnetic selfbearing motor.

FriA04-05

Axial Displacement Control of Bearingless Motor via State Feedback Linearization

Chengyan Zhao and Satoshi Ueno
(Ritsumeikan University, Japan)

This paper presents a control strategy for managing the axial displacement of bearingless motors, a system inherently governed by nonlinear differential equations. Given the complexities associated with such dynamics, the study employs nonlinear control techniques to perform state feedback linearization, transforming the system into a linear state-space form amenable to conventional control design. The proposed linearized model simplifies the control structure while retaining the system's essential dynamics. To ensure robust performance under parameter estimati conducted using Lyapunov-based methods. This approach not only guarantees stability but also provides valuable insights into the tolerance of the system to modeling inaccuracies, which is critical for the reliable operation of bearingless motors. The results demonstrate the effectiveness of the proposed method in stabilizing axial displacement, contributing to the broader body of research in advanced control methodologies for high-precision electromechanical systems.

Regular Session FriB04
Neural Network 1

TokypTime (UTC +9)
10:10 - 11:50, Friday, November 29, 2024

FriB04, Room 2

Chair: Yoshihiro Matsui (Fukuoka Institute of Technology, Japan)

Co-Chair: Lin Meng (Ritsumeikan Univ., Japan)

FriB04-01

Hybrid Architecture and pre-processing for Speech Emotion Recognition

Michael Norval and Zenghui Wang
(University of South Africa, South Africa)

Accurate emotion recognition from speech is vital for improving human-computer interaction, particularly in advanced Mechatronic systems where responsive and adaptive behaviour is crucial. Traditional deep learning models like CNNs and LSTMs often need help with transient emotional nuances, and the presence of temporal relationships in audio signals limits their effectiveness in practical scenarios. This study introduces the Dendritic Convolutional LSTM (DCLSTM) architecture, which integrates dendritic computational principles to enhance the learning of complex spatial and temporal features in emotional speech. An advanced audio preprocessing pipeline is also implemented, systematically refining speech signals through noise reduction, spectral processing, and filtering to optimise model performance. By enabling more accurate and nuanced emotion recognition, this research represents a significant advancement in integrating human-like emotional understanding into Mechatronic systems, leading to greater effortless and flexible machine interactions.

FriB04-02

Evaluation of Missing Image Restoration with a Binary Character Image Diffusion Model

Yuya Yoshizu, Hayata Kaneko, Ryuto Ishibashi and Lin Meng
(Ritsumeikan University, Japan)

Ancient Japanese literature is a Japanese cultural heritage with high historical value, and digital preservation increases opportunities for secondary use and prevents loss of
cultural heritage due to natural or human causes. However, they are subject to various types of deterioration over time and the preservation environment. In particular, loss of text is seen as a challenge from the perspective of ensuring data quality for digital preservation. In this study, masks of various proportions are applied to publicly provided binary ancient text images to simulate missing characters. In this study, a diffusion model is used to embed the character image in the masked region to facilitate its generation, and the accuracy of the recovery is compared with GAN.

FriB04-03

IAD-CLIP: Vision-Language Models for Zero-Shot Industrial Anomaly Detection

Zhuo Li,Yifei Ge,Qi Li and Lin Meng
(Ritsumeikan University, Japan)

This paper presents an efficient zero-shot industrial anomaly detection (IAD) framework based on visual-language models. Industrial anomaly detection usually adopts an unsupervised learning approach, which achieves excellent detection performance though. However, it is still difficult to recognize some more complicated anomalies, such as rotational defects. At this point, more detailed features are needed to describe the image. With the excellent performance of contrastive languageimage pretraining (CLIP), this paper proposes a zero-shot industrial anomaly detection framework IAD-CLIP based on visual language models. The framework contains a pre-trained CLIP model, a training-free adaptation module and a test-time adaptation mechanism. The training-free adaptation module uses a value-value attention mechanism and a state prompt space. The pre-trained CLIP model is used for feature extraction and the training-free adaptation module processes the extracted features through visual coders and text encoders for anomaly detection and localization. A test-time adaptation mechanism is used to improve the anomaly localization performance during the testing phase. The experimental results on the industrial anomaly detection dataset MVTec AD show that IAD-CLIP achieves 92.1% AUROC, 94.6% AUPR, and 91.9% F1Max, respectively. This result validates the significant effect of the IAD-CLIP framework proposed in this paper in the industrial anomaly detection task.

FriB04-04

Recurrent Neural Network-based Modeling Approach for 4D Printing Design

Yifan Xu, Mengtao Wang, Zhongkui Wang and Lin Meng
(Ritsumeikan University, Japan)

This study presents a method for predicting the deformation of hydrogel models fabricated by four-dimensional printing technology using deep learning. In this method, a large number of hydrogel models with the same shape but different distributions of length and expansion ratio are first created using the modeling software Abaqus. Then, deformation simulations are performed based on finite element analysis using the thermal expansion method, and the simulation results are processed and organized to create a data set. Afterward, a recurrent neural network (RNN) was created and trained using a composite dataset consisting of multiple hydrogel model sequences of different lengths to enable the RNN to learn model deformation features and, accordingly, predict the deformation of various longer sequences of hydrogels in a very short period of time while recording the change in accuracy of the prediction for each length. This research provides a new approach to modeling and inverse design for 4D printing technology.

FriB04-05

Digital Twins and AI Management: Optimizing Biogas-Photovoltaic Systems for off-grid area

Runqian Zhang, Yifei Ge and Lin Meng, Zenghui Wang and Nekhubvi Vhutshilo,
Liston Matindife and Langa B. Moyo, Eric Maluta
(Ritsumeikan University, Japan) (University of South Africa, South Africa)
(National University of Science and Technology, Zimbabwe)
(University of Venda,South Africa)

Biogas is often considered an energy alternative in off-grid areas, but a lack of knowledge, indifference towards biogas, and limited technical capacity prevent its promotion in these areas. In this paper, we proposed an IoT-based Intelligent intermixed biogas-photovoltaic system to address the challenges of fuel and energy supply in off-grid situations. This system was designed to provide reliable and clean energy for agricultural residents in underdeveloped regions. It incorporated a cloud server hosting AI algorithms, alongside sensor systems and data transmission networks within each biogas-photovoltaic hybrid installation. The system enables a affordable house-hold level of biogas production optimization, remote monitoring of biogas output, and remote maintenance.

Regular Session FriA05
Advanced methodologies

TokypTime (UTC +9)
13:30 - 15:10, Friday, November 29, 2024

Chair: Kazuyuki Ito (Hosei University, Japan)

FriA05, Room 1

Co-Chair: Changan Jiang(Osaka Inst. of Tech., Japan)

FriA05-01

Adaptive PI control of a three-tank system with prescribed performance

Hisanori Takahashi and Zi-Jiang Yang
(Ibaraki University, Japan)

An adaptive PI control approach for precise water level tracking control in an uncertain three-tank system is presented. By employing a coordinate transformation, we convert the system model into a canonical form that incorporates uncertainties. A higher-order sliding mode differentiator is utilized to estimate the canonical system ' s state variables based on the measured water level of the target tank. This enables the design of an adaptive PI controller that effectively compensates for modeling uncertainties while achieving predefined transient and steady-state performance. The control performance is validated through rigorous theoretical analysis and experimental studies.

FriA05-02

Operator-based forced vibration control system design for a plate system with input nonlinearity

Guang Jin and Mingcong Deng
(Tokyo University of Agriculture and Technology, Japan)

This paper studies a vibration control system design with input nonlinearity case. First, we consider the operatorbased stabilisation of the nonlinear system. Second, a compensation structure is designed to compensate for the effect of the disturbance and nonlinearity. The hysteresis nonlinearity is considered an input nonlinearity from the actuator. Finally, the validity of the designed method is confirmed through the numerical simulations.

FriA05-03

Development of Pre-stretch Mechanism for Fabricating Thin DEAs

Bunta Morikawa, Ayumu Hirokawa and Changan Jiang
(Osaka Institute of Technology, Japan)

In recent years, with the boom in soft robotics, soft actuators have also attracted attention. In this study, to improve the performance of dielectric elastomer actuator (DEA), which is one type of soft actuators, a pre-stretch mechanism using a stepping motor is developed. Performance testing for fabricated thin DEA will be conducted, and the experiments will also be done to confirm the effect of stretching speed on the performance of the actuator. Finally, a 3-DOF thin DEA fabricated using the developed pre-stretch mechanism is mounted on a drawing device to realize writing characters.

FriA05-04

Improvement of Finger Mechanism using Twisted and Coiled Polymer Fiber Actuator

Stephanie Nathania Soeseno and Changan Jiang
(Osaka Institute of Technology, Japan)

This study explores the design and performance of Twisted and Coiled Polymer Fiber Actuators (TCPFAs), focusing on their mechanical and functional properties. TCPFAs, which utilize a polymer fiber structure twisted and coiled to enhance actuation capabilities, are investigated for their potential applications in adaptive materials and soft robotics. The research involves the fabrication of TCPFAs, followed by a series of experiments to verify its feasibility of grasping a variety of tested objects.

FriA05-05

ViViT fall detection and action recognition

Takashi Higashi, Ryuto Ishibashi and Lin Meng
(Ritsumeikan University, Japan)

In Japan, the medical and nursing care industry is facing a serious shortage of medical and nursing care workers due to a decrease in the number of medical and nursing care workers as the population ages and the workforce shrinks due to the declining birthrate and aging population. In addition, falls are an indicator of certain medical conditions and health problems, and early detection has the potential to enhance medical intervention. Fall detection technology could contribute to improving the safety of the elderly and the efficiency of caregiving. Therefore, building a system for fall detection is important for society and can be applied and contributed to various fields. In this research, a video recognition AI using deep learning will be used to automate fall detection. Specifically, the system recognizes falls and other human behaviors using video recognition with ViViT for fall detection and behavior recognition. Furthermore, based on these recognition results and those of conventional video recognition AI, its accuracy and processing speed will be evaluated. The experimental results showed the effectiveness of video recognition using ViViT, with fall detection showing accuracy: 98.88%, recall 96.67%, precision: 92.36%, F-score: 95.72%, throughput: 5782.80gps. The 10-class action recognition was accuracy 74.73%.

Regular Session FriB05
Neural Network 2

TokypTime (UTC +9)
13:30 - 15:10, Friday, November 29, 2024

FriB05, Room 1

Chair: Zhihong Man (Swinburne University of Technology, Australia)
Co-Chair: Xudong Gao (Nanjing University of Information Science & Technology, China)

FriB05-01

Multi-robot FastSLAM based on consensus of observed data

Daiki Tetsuno and Kiyotsugu Takaba
(Ritsumeikan University, Japan)

This paper is concerned with a fast alorithm for the multi-robot SLAM (Simultaneous Localization and Mapping) in the uncertain envrionment without any host robots or base stations. In the single robot case, the well-known FastSLAM is sucessful in making a proper trade-off between computational efficiency and estimation accuracy by combining the extended Kalman filter and particle filter. We propose a novel fast multirobot SLAM algorithm by extending the FastSLAM with the aid of a distributed particle filtering technique. The distributed particle filter incorporates a consensus mechanism on the observed data from all robots which enables an efficient and accurate state estimation under the practical situation where the sensor chracteristics of all robots are available as prior information. The effectiveness of the proposed algorithm is verified through a numerical experiment and simulations.

FriB05-02

Enhancing ResNet Architectures with Bayesian Optimized Stochastic Configuration Networks for Lung X-Ray Image Classification

Hengren Xu, Jinchuan Zheng, Zhenwei Cao and Zhihong Man
(Swinburne University of Technology, Australia)

This paper introduces the ResNet-BOSCN architecture, which integrates Bayesian Optimized Stochastic Configuration Networks (SCNs) with traditional Residual Networks (ResNet) to tackle the challenges of lung X-ray image classification. Unlike conventional methods, ResNet-BOSCN employs Bayesian Optimization to dynamically optimize the network's hidden node count, effectively addressing the complexities inherent in medical imaging datasets. This optimization enables the architecture to adapt more precisely to varying data characteristics, significantly enhancing classification accuracy. ResNet-BOSCN achieves an accuracy of 98.81% in three-class lung X-ray image classification, marking a substantial improvement over the standard ResNet101's accuracy of 97.62%.

FriB05-03

Fault Detection of Cooling System Based on Long Short-Term Memory at Nam Ngum 1 Hydropower Plant

Bounpone Thansouphanh, Suttichai Premrudeepreechacham
and Watcharin Srirattanawichaikul
(Chiang Mai University, Thailand)
Kanchit Ngamsanroaj
(University of South Carolina, USA)

Synchronous generators play a vital role in hydropower plants, making reliable cooling systems essential to prevent severe performance issues and potential failures. Traditional maintenance methods for these cooling systems often rely on periodic inspections or time-based strategies, which may be limited in their ability to detect subtle or evolving faults. This paper introduces a deep-learning approach using Long ShortTerm Memory (LSTM) networks for fault detection in the cooling system of the Nam Ngum-1 (NNG-1) hydropower plant in Lao PDR. The methodology involves preprocessing historical operational data to extract key features, which are then used to train the LSTM network. This network is designed to learn complex temporal patterns associated with various fault conditions. The model ' s effectiveness is assessed through accuracy, precision, and recall metrics. The proposed approach not only enhances fault detection but also minimizes downtime, and optimizes maintenance schedules, ultimately improving the overall reliability and efficiency of the hydropower plant.

FriB05-04

VE: Modeling Multivariate Time Series Correlation with Variate Embedding

Shangjiong Wang, Zhihong Man, Zhenwei Cao and Jinchuan Zheng
(Swinburne University of Technology, Australia)
Zhikang Ge
(Zhejiang University, China)

Multivariate time series forecasting relies on accurately capturing the correlations among variates. Current channel-independent (CI) models and models with a CI final projection layer are unable to capture these dependencies. In this paper, we present the variate embedding (VE) pipeline, which learns a unique and consistent embedding for each variate and combines it with Mixture of Experts (MoE) and LowRank Adaptation (LoRA) techniques to enhance forecasting performance while controlling parameter size. The VE pipeline can be integrated into any model with a CI final projection layer to improve multivariate forecasting. The learned VE effectively groups variates with similar temporal patterns and separates those with low correlations. The effectiveness of the VE pipeline is demonstrated through experiments on four widely-used datasets. The code is available at: https://github.com/swang-song/VE.

FriB05-05

Accurate monitoring of machining process of Ti-6Al-4V using deep multi-task learning

Soyeon Park, Sang Min Yang, Gyeongho Kim, Dong Min Kim, Hoon Hee Lee, Jae Gyeong Choi, Sujin Jeon, Sunghoon Lim and Hyung Wook Park
(Ulsan National Institute of Science and Technology (UNIST), Republic of Korea)
(Tech University of Korea, Republic of Korea)
(Korea Institute of Industrial Technology (KITECH), Republic of Korea)

Accurate machining process monitoring (MPM) is crucial to ensure manufacturing process stability and efficiency. In particular, tool wear, surface roughness, and cutting force comprise primary elements of MPM, which are physically interconnected and significantly affect machining quality and productivity. Hence, MPM should be performed through comprehensive consideration of the primary elements and their interactions. Yet, there is a lack of a unified approach to MPM that holistically predicts, which limits the practical applicability of MPM in real-world machining processes. Therefore, this work proposes a novel deep multi-task learning (MTL)-based method that integrates primary MPM elements by simultaneously predicting tool wear, surface roughness, and cutting force. To this end, the proposed method develops a probabilistic multitask likelihood that considers task uncertainty for seamless endto-end training. The proposed method's efficacy in MPM is validated with real-world datasets from an end-milling process of Ti-6Al-4V. The comprehensive experimental results demonstrate.

Regular Session FriA06
Actuators and power system

TokypTime (UTC +9)
15:30 - 17:30, Friday, November 29, 2024

FriA06, Room 1

Chair: Shiro Masuda (Tokyo Metropolitan University, Japan)

Co-Chair: Shinichi Imai (Tokyo Gakugei University, Japan)

FriA06-01

An Improved Frequency-controlled Speed Regulation Method for Piezoelectric Walking Stage

Yixiao Yang, Huazhou Kang, Xiaofeng Yang, Yu Sun, Yuping Liu
and Zhiping Zhang
(Fudan University., China)

The piezoelectric walking stage (PWS) commonly uses frequency-controlled method for open-loop speed regulation, without considering the rate-dependent feature of piezoelectric actuation on the single-step length. This oversight leads to inaccurate speed and reduced positioning precision of the PWS's movement. To address this issue, this paper proposes an improved frequency-controlled speed regulation method (ISRM). This method describes the rate-dependent feature phenomenologically and compensates for the impact through precise model calibration of the speed formula. By adjusting the frequency value under value-unchanged voltage signals, it well meets the speed regulation needs of the PWS. Experimental results show that in two sets of speed comparison experiments on the PWS, the openloop control results of the ISRM significantly outperforms that of the traditional frequency-controlled speed regulation method (TSRM).

FriA06-02

Optimizing Energy Management in a Renewable Energy-based Microgrid With Built-in Frequency Support Features

Peter Anuoluwapo Gbadega, Yanxia Sun and Olufunke Abolaji Balogun
(University of Johannesburg, South Africa)

The growing adoption of Plug-in Electrie Vehicles (PEVs) is expected to challenge the stability of electricity networks due to increased demand. However, Vehicle-to-Grid(V2G) technology offers a solution by enabling PEVs to provide ancillary services that enhance grid stability and reliability. This paper introduces an optimal power management system with built-in frequency support capabilities, leveraging the Squid Game Optimizer (SGO) algorithm to determine the optimal power exchange between PEV batteries and the grid throughout the day. The study further explores the potential of PEVs to provide frequeney support through a frequency-PEV load droop control approach, which dynamically adjusts the PEV's power output in response to frequency deviations. After the need for frequency support is met, the SGO algorithm reschedules the PEV's operations, ensuring that all pre-set objectives and constraints are satisfied. This dual-purpose approach optimizes energy management within a renewable energy-based microgrid and contributes to maintaining grid frequency stability, thereby enhancing the resilience and efficiency offuture power systems.

FriA06-03

The enhancement of displacement of shear piezoelectric stack actuator with conductive adhesive

Huazhou Kang, Yixiao Yang and Xiaofeng Yang
(Fudan University., China)
Quan Wang
(Semiconductor Technology Co. Ltd., China)

The shear piezoelectric stack actuator operates under d15 mode with shear output, offering a vertical displacement with the voltage output. Restricted by the manufacturing of shear stacks, the bonding layer with adhesive has the ability of dielectrics, which has an energy loss and makes the input electric less than the desired value. The dielectric from the bonding adhesive would reduce the displacement output of the actuator. To enhance the displacement, in this paper, we alter the regular dielectric adhesive into conductive adhesive by adding metalcoated fillers inside. Results show that the actuator's displacement with the conductive adhesive is 19% higher than that of the stack with regular dielectric adhesive with 3.5% fillers. The displacement enhancement indicates that the replacement of conductive adhesive will have a future application in the design of the piezoelectric-base motor.

FriA06-04

RBFNN-based nonsingular fast terminal sliding mode control for piezoelectric stack actuator

Xuchen Wang, Yu Jin, Xiaofeng Yang, Yixiao Yang and Yuping Liu
(Fudan University, China)
Yang Xu
(Northwestern Polytechnical University, China)

To enhance the performance of finite-time trajectory tracking control for piezoelectric stack actuator (PSA), this paper proposes an innovative control methodology by integrating Radial Basis Function Neural Networks (RBFNN) with Nonsingular Fast Terminal Sliding Mode Control (NFTSMC). In consideration of the inherent uncertainties within PSA systems, an NFTSMC strategy is formulated to ensure finite-time convergence of system states to the desired trajectory. To further refine control precision, the RBFNN is employed to compensate for lumped disturbances in real-time, with its weights adaptively updated via an adaptive law. The proposed controller incorporates both a robust control term and the RBFNN, effectively mitigating various external disturbances. Stability analysis, based on Lyapunov theory, confirms that the proposed RBFNN-NFTSMC scheme guarantees finite-time convergence of the trajectory tracking error, along with global stability. Simulation results substantiate the superior performance of the proposed control strategy compared to conventional methods.

FriA06-05

An Islanding Detection and Load Curtailment Strategy for Radial Distribution Networks Using Squid Game Optimizer Algorithm

Peter Anuoluwapo Gbadega, Yanxia Sun and Olufunke Abolaji Balogun
(University of Johannesburg, South Africa)

The reliable operation of islanded radial distribution networks with Distributed Generation (DG) presents significant challenges, particularly in maintaining voltage and frequency stability, Traditional demand curtailment strategies often resultin excessive or insufficient load reduction, leading to suboptimal system performance.This paper introduces an advanced demand curtailment technique based on the Squid Game Optimizer Algorithm (SGOA) to address these inefficiencies. The proposed method optimizes load curtailment by incorporating aconstrained funetion that evaluates the voltage stability margin (VSM) index and the total remaining load after curtailment. The goal is to achieve a stable and balanced operation of the islanded system, To validate the effectiveness of this strategy, fourislanding scenarios were modeled using the lEEE 33-bus radial distribution network in MATLAB, The performance of the SGOA was benchmarked against other optimization techniques such as Particle Swarm Optimization (PSO)and Ant Colony Optimization (ACO). Simulation results demonstrated that the SGOA outperformed these methods, delivering higher remainingloads and improved VSM values across all test cases. This suggests that the SGOA provides a more efficient and reliable approach to demand curtailment, contributing to enhanced voltage and frequeney stability in islanded distribution networks.

FriA06-06

An Economic Dispatch Method for Power System Based on Distributed Mutual-Fed-Consensus

Xiangjun Li
(China Electric Power Research Institute, China)
Panpan Zhang and Bo Li
(Northeast Electric Power University, China)

This paper presents a distributed algorithm based on mutual feedback mechanism for economic dispatch problem of power system. In such a mutual feedback mechanism, the average of the load demand and power generated are estimated, respectively. Simulation results on standard test cases show the convergence and effectiveness of the proposed algorithm.

Regular Session FriB06
Automatic systems and applications

TokypTime (UTC +9)
15:30 - 17:30, Friday, November 29, 2024

FriB06, Room 2

Chair: Zi-Jiang Yang (Ibaraki University, Japan)

Co-Chair: Kenshi Saho (Ritsumeikan University, Japan)

FriB06-01

Motion Control Design for Peck Rigid Tapping Cycle Machining to Manufacture Internal Threads

Syh-Shiuh Yeh, Yu-Shin Yang, Ren-Jyue Hong and Wei-Heng Sun
(National Taipei University of Technology, Taiwan)

This study aims to develop a motion control design that integrates the constrained acceleration-anddeceleration (ACC/DEC) algorithm, synchronous motion control, and best-fit control parameter tuning. This design enables the spindle system of a computer numerical control (CNC) machine tool to perform rapid and synchronous repetitive motions in peck rigid tapping cycle (PRTC) machining, ensuring that the internal threads produced have good surface texture and dimensional accuracy. A three-axis CNC machining center was used to perform the PRTC machining experiment and ultrasonic vibration-assisted tapping (UVAT) experiment. These experiments validated the feasibility and performance of the developed motion control design and evaluated the performance and applicability of PRTC machining and UVAT methods for manufacturing internal threads.

FriB06-02

Automated wiring for a mechanized current collector of a trolley bus

Stefan Kupper and Jorg Reiff-Stephan
(Technical University of Wildau, Germany)
Stefan Frohlich
(Deutzer Technische Kohle GmbH, Germany)

Carbon neutral transport is a well articulated approach of many governments worldwide and is essentially mandatory given the need to achieve carbon-neutrality. This is also very important to avoid the most severe impacts of concurrently occurring climate change both on a national and worldwide level. A particular useful approach to achieving this carbon-neutrality is the use of electrified public transport in particular on existing road networks. To be efficient however, the network of contact wires has to be as small as is feasible. This in turn can be achieved when trolley buses can connect and de-connect to overhead lines quickly and reliably. In this paper a new sensor approach is introduced that allows for the current collector to securely connect to the overhead lines at specific connecting stations throughout the network laying some groundwork towards more carbon-neutral public transport.

FriB06-03

Intention-Controlled Wearable Exoskeleton for Upper Extremity Rehabilitation Using MotionSense Headband

Danaish, Liang Han, Mohammad Abbas Baig and GuanCheng Dong
(Southeast University, China)
Gelin Xu
(First Affiliated Hospital of Shenzhen University, Second People's Hospital,China)
Zongliang Xu
(Nanjing Medical University, China)

Many existing exoskeletons lack intentioncontrolled systems, which can significantly impede effective rehabilitation and present challenges in the performance of activities of daily living (ADLs). We present a human-robot interaction (HRI) that allows the wearer to control the upper limb exoskeleton's active joints in real time using head motion. The HRI-based active control empowers the user to perform rehabilitation and ADL tasks confidently and independently. This paper describes the control system strategy and integration of MotionSense Headband (MSHB) with the developed exoskeleton. It also presents the experimental results of an ablebodied subject. The experiment involves the control of the exoskeleton ' s three joint motions with the MSHB device, such as shoulder abduction-adduction (AA), elbow flexion-extension (FE), and forearm pronation-supination (PS) respectively. The experimental findings indicate that translating head movements into exoskeleton actions is straightforward and valuable, facilitating smooth and efficient robot control. This strategic approach should enable the user to control the exoskeleton's joints regardless of the significant prior experience requirement. Integrating intention-controlled modules in the exoskeleton devices could benefit a broad spectrum of users with upper limb joint impairments.

FriB06-04

Design and Manufacturing of Automatic Scraping Mark Units Based on Laser Ablation Technology

Guancheng Dong, Liang Han, Zhenmeng Cui, Danaish and Mohammad Abbas Baig
(Southeast University, China)

Scraping is a crucial process in the surface finishing of machine tool guideways, significantly enhancing machine tools ' assembly precision and is widely adopted in the heavy-duty machinery manufacturing industry. Traditionally, scraping is a manual process with inherent limitations, necessitating the shift toward automatic scraping as a developing trend. Laser surface texturing, a novel research direction in the field of machine tool guideways, offers a promising alternative. This study briefly explores integrating laser surface texturing technology into an automatic scraping scheme. We designed laser scraping mark units based on the standard model of manual scraping marks, determined the laser processing parameters and schemes, conducted practical processing using laser marking equipment, subjected the processed samples to grinding and polishing, and finally examined the surface morphology of the samples using a confocal microscope to observe and evaluate the processing outcomes. The experimental results demonstrate that laser ablation can successfully produce laser scraping mark units according to the predefined morphology, thereby preliminarily validating the feasibility of automatic scraping via laser ablation.

FriB06-05

Cloud-Based Smart Coordinated Robot System for Strawberry Harvesting in Controlled Greenhouse Environment

Mohammad Abbas Baig, Liang Han, Danaish, GuanCheng Dong, Muhammad Mubashir Niaz, Muhammad Sibtain, Almogdad SalahEldeen Mohammed Hassan, Ahmed Sharif Shaybo Rabeh and Mohammad Ali Abdulrahman AlShameri
(Southeast University, China)
DongLei Yang
(Yuehe Shiye (Zhejiang) Zero Carbon Technology Co., Ltd., China)

The growing global population has intensified the need for automating agricultural harvesting to meet increasing food demands. Researchers are now focused on developing solutions that are both cost-effective and efficient to tackle these challenges. Harvesting robots are a promising option, but most existing models are either costly, inefficient, or both. This is partly because these robots must individually handle all the necessary tasks, including plant data collection, data processing, and the actual harvesting of ripe fruits. Moreover, their requirement for powerful hardware to enable real-time data processing further drives up costs. In this paper, we propose a novel system that distributes these tasks between two robots: Robot-A for data collection and Robot-B for harvesting. Additionally, we integrate cloud computing to not only coordinate the robots but also to handle the data processing performed by Robot-A. By leveraging the cloud's hardware resources, we aim to enhance the efficiency and costeffectiveness of the harvesting process. We demonstrate the system's functionality through a simulated tabletop strawberry greenhouse. In the experiment, Robot-A collects plant data using a depth camera and transmits it to the cloud server. The data is processed and stored in the cloud database, taking only 1.76 seconds, illustrating the potential of integrating cloud computing with harvesting systems to overcome the limitations of current harvesting robots.

FriB06-06

AI and IoT-enabled Workpiece Sorting System using Mini-PLC for Industrial Automation

Sarun Chattunyakit, Warunee Srisongkram, Phonchai Chukaew, Naratip Janhom, Naysara Satra, Ittiphong Yongyee, Jeerawan Homjan, Kreeta Sukthang, Promphak Boonraksa and Wipada Wongsuriya
(Rajamangala University of Technology Suvarnabhumi, Thailand)

Integrating digital technology into the production and management processes is the key to increasing the work system's efficiency and accuracy in the Industry 4.0 era. This paper presents the retrofit of a non-functional workpiece sorting system using Mini-PLC integrated with IoT technology and the K210 AI-based camera to enhance the sorting system ' s performance. Consequently, the YOLO-2 model was trained with 180 images and then transferred to the k-model for computation. The experimental results show that the retrofitted machine can successfully identify all three types of workpieces with an overall accuracy of 95%, meaning that the proposed retrofit of the workpiece system is feasible for enhancing non-functional or outdated automation systems.

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K = Keynote speaker, C = Chair, CC = Co-Chair, PS = Plenary Speech

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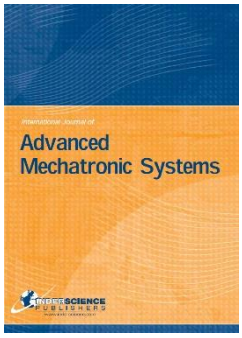

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