2024 8th International Conference on Robotics and Automation Sciences:
AI-Powered Robotics Advancements
(ICRAS 2024)

2024 International Conference on Robotics Systems and Automation Engineering
(RSAE 2024)

Tokyo, Japan | June 21-23, 2024

Co-Sponsored by
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Zhihong Liu, National University of Defense Technology, China
Dear distinguished delegates,

On behalf of the conference committee, we warmly welcome you to 2024 8th International Conference on Robotics and Automation Sciences: AI-Powered Robotics Advancements (ICRAS 2024) and 2024 International Conference on Robotics Systems and Automation Engineering (RSAE 2024), which will be held in Tokyo, Japan during June 21-23, 2024. The conference will be held both online and onsite based on all the participants’ willingness.

We would like to express our sincere gratitude to everyone who has contributed to this conference as its success could have only been achieved through a team effort. Special thanks go to our Honorary Chair, Advisory Committee, Conference Chairs, Program Chairs, Program Co-Chairs, and all the technical committee members for their excellent work in securing a substantial input of papers from all around the world.

Additionally special welcome is given to our keynote speakers who are pleased to contribute to our conference and share their new research ideas with us. They are: Prof. Makoto IWASAKI, Prof. Mingcong Deng, Prof. Liangjing Yang and Prof. Mo-Yuen Chow. We do hope that their speeches will provide the participants a broad overview of the latest research result in this field and that it will be a valuable reference source for your further research. We hope that you will find it useful, exciting and inspiring.

Through three days’ conference, we will have 2 onsite sessions, 1 poster session and 1 online session. We believe that by this excellent conference communication, you can get more opportunities for further communication with researchers and practitioners with the common interest in this field. Wish all of you will have an unforgettable experience in the conference.

Yours sincerely,

Conference Committee
**VENUE**

**Conference Venue:**
TKP 市ヶ谷カンファレンスセンター

**Detailed Address:**
東京都新宿区市谷八幡町 8 番地 TKP 市ヶ谷ビル

Google Map (for English): [https://goo.gl/maps/TQXvLaJcW28](https://goo.gl/maps/TQXvLaJcW28)

Official Website: [https://www.kashikaigishitsu.net/facilitys/cc-ichigaya/](https://www.kashikaigishitsu.net/facilitys/cc-ichigaya/)

**Notice:**
The accommodation is not included in the registration fee.
The conference hotel or conference secretary will not contact any participant for reservation, please be careful when anyone asks you to provide your credit card information to book rooms for you.
GENERAL INFORMATION

Onsite Conference Notice

Oral Presentation
- Regular oral presentation: 15 minutes (including Q&A).
- Get your presentation PPT or PDF files prepared. Presentations MUST be uploaded at the session room at least 15 minutes before the session starts.
- Laptop (with MS-Office & Adobe Reader), projector & screen, laser pointer will be provided in all oral session rooms.

Poster Presentation
- Please print poster (A1 size, English), content must be on 1 page. Please set the poster as vertical format, and give it to conference staff when collecting conference kit.
- The content must include: paper title, author names and paper ID, the key framework knowledge of the article and other necessary basic information.
- Template format is not fixed, no template restrictions.
- Please prepare around 3 minutes presentation of the framework for on-site communication.

Important Notes
- Please enter the meeting room at least 15 minutes before your session. Your punctual arrival and active involvement will be highly appreciated.
- Please wear your name tag for all the conference activities. Lending it to others is not allowed. If you have any companying person, please do inform our staff in advance.
- Please keep all your belongings (laptop and camera etc.) at any time. The conference organizer does not assume any responsibility for the loss of personal belongings.
- Please show name tag and meal coupons when dining.
Online Conference Notice

**Time Zone**
- The whole program is based on **Japan** Standard Time (GMT+9), please check on the program for your own test time and formal presentation time, and then convert it to the local time in your country.

**Platform: Zoom Meeting**
- Download Link: [https://zoom.us/download](https://zoom.us/download)

**Online Meeting Room**
- Zoom Number: 819 8570 2428
- Link: [https://us02web.zoom.us/j/81985702428](https://us02web.zoom.us/j/81985702428)

**Equipment needed**
- A computer with internet connection and camera
- Headphones
- Stable internet connection
- A quiet place and Proper background

**Test Your Presentation**
- Date: June 21, 2024
- Prior to the formal meeting, presenters shall join the test room to ensure everything is on the right track. Please check your test time on this program.

**Presentation Tips**
- Get your presentation PPT/Video files prepared. To effectively control the time and avoid some unexpected situations, we suggest you send us the recorded video in advance as a backup.
- Regular oral presentation: 15 minutes (including Q&A). The presentation should be about 12 minutes, 3 minutes for Q&A.
- Your punctual arrival and active involvement in each session will be highly appreciated. Please join in the room at least 15 minutes before your session.
- Stay online during Keynote & Invited speeches and your own session.
- English only during the conference.
- Certificates will be emailed to you after the conference
- Please rename as:
  - Author: Paper ID + Name
  - Listener: Listener + Name
  - Keynote Speaker: KN + Name
  - Committee: Position + Name
DETAILED AGENDA

All schedules will be scheduled in Japan Standard Time (GMT+9)

Day 1 | JUNE 21, 2024 Friday

Online Participants Test

Committee & Speakers’ Test Session
Zoom ID: 819 8570 2428
Zoom Link: https://us02web.zoom.us/j/81985702428

15:00-16:00
Online Session
S315 S323 S334 S343 S301 S317

Onsite Sign-up
Location: ミーティングルーム4J (Meeting Room 4J)

14:00-17:00
➢ Tell the staff your Paper ID or Name if you are the Delegate.
➢ Sign your name in the attendance list and check meal information.
➢ Check your conference kit, which includes conference bag, name tag, meal voucher, conference program, the receipt of the payment, the USB of paper collection.

Day 2 | JUNE 22, 2024 Saturday

Opening Remarks & Keynote Speeches

Onsite Venue: ミーティングルーム4F (Meeting Room 4F)
Zoom ID:819 8570 2428
Zoom Link: https://us02web.zoom.us/j/81985702428

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<tr>
<td>09:00-09:10</td>
<td>Opening Remarks&lt;br&gt;Prof.Chiharu Ishii, Hosei University, Japan (IEEE Member)</td>
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<td>09:10-09:50</td>
<td>Keynote Speech I&lt;br&gt;Prof. Makoto IWASAKI (IEEE Fellow, IEEJ Fellow)&lt;br&gt;Nagoya Institute of Technology, Japan&lt;br&gt;[Speech Title: GA-Based Practical System Identification and Auto-Tuning for Multi-Axis Industrial Robots]</td>
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| 09:50-10:30| Keynote Speech II<br>Prof. Mingcong Deng<br> Tokyo University of Agriculture and Technology, Japan<br>[Speech Title: Learning & Operator based Control Design for Smart Materials Actuated &
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<td>Coffee Break &amp; Group Photo</td>
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<tr>
<td>10:50-11:30</td>
<td>Keynote Speech III</td>
<td>Zhejiang University-University of Illinois at Urbana-Champaign (ZJUI) Institute, China</td>
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<td>Prof. Liangjing Yang</td>
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<td>[Speech Title: Human-Centered Immersive Robot-Man Coexistence]</td>
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<td>11:30-12:10</td>
<td>Keynote Speech IV</td>
<td>UM-Shanghai Jiao Tong University Joint Institute, China</td>
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<td>Prof. Mo-Yuen Chow</td>
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<td>[Speech Title: Disaster Relief Empowerment Through Collaborative Distributed Control of Energy Resources]</td>
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**Parallel Sessions**

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<td>15:45-18:00</td>
<td>Onsite Session 2</td>
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<td>18:00-19:30</td>
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**Day 3 | JUNE 23, 2024 Sunday**

**One Day Tour in Tokyo**


**KEYNOTE SPEAKER**

**TIME:** 9:10-09:50 (GMT+9)

**VENUE:** ミーティングルーム 4F (Meeting Room 4F)

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**Prof. Makoto IWASAKI (IEEE Fellow, IEEJ Fellow)**

Nagoya Institute of Technology, Japan

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**Biography**

Makoto Iwasaki received the B.S., M.S., and Dr. Eng. degrees in electrical and computer engineering from Nagoya Institute of Technology, Nagoya, Japan, in 1986, 1988, and 1991, respectively. He is currently a Professor at the Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology. As professional contributions of the IEEE, he has participated in various organizing services, such as, a Co-Editors-in-Chief for IEEE Transactions on Industrial Electronics since 2016, a Vice President for Planning and Development in term of 2018 to 2021, etc. He is IEEE fellow class 2015 for "contributions to fast and precise positioning in motion controller design". He has received many academic, foundation, and government awards, like the Best Paper and Technical Awards of IEE Japan, the Nagamori Award, the Ichimura Prize, and the Commendation for Science and Technology by the Japanese Minister of Education, respectively. He is also a fellow of IEE Japan, and a member of Science Council of Japan. His current research interests are the applications of control theories to linear/nonlinear modeling and precision positioning, through various collaborative research activities with industries.

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**Speech Title & Abstract**

**Speech Title:** GA-Based Practical System Identification and Auto-Tuning for Multi-Axis Industrial Robots

**Abstract:** Fast-response and high-precision motion control is one of indispensable techniques in a wide variety of high performance mechatronic systems including micro and/or nano scale motion, such as data storage devices, machine tools, manufacturing tools for electronics components, and industrial robots, from the standpoints of high productivity, high quality of products, and total cost reduction. In those applications, the required specifications in the motion performance, e.g. response/settling time, trajectory/settling accuracy, etc., should be sufficiently achieved. In addition, the robustness against disturbances and/or uncertainties, the mechanical vibration suppression, and the adaptation capability against variations in mechanisms should be essential properties to be provided in the performance.

The keynote speech presents a practical auto-tuning technique based on a genetic algorithm (GA) for servo controllers of multi-axis industrial robots. Compared to conventional manual tuning techniques, the auto-tuning technique can save the time and cost of controller tuning by skilled engineers, reduce performance deviation among products, and achieve higher control performance. The technique consists of two main processes: one is an autonomous system identification process, involving the use of actual motion profiles of a typical robot. The other is an autonomous control gain tuning process in the frequency and time domains, involving the use of GA, which satisfies the required tuning control specifications, e.g., control performance, execution time, stability, and practical applicability in industries. The proposed technique has...
been practically evaluated through experiments performed with an actual six-axis industrial robot.

### KEYNOTE SPEAKER

**TIME:** 09:50-10:30 (GMT+9)  
**VENUE:** ミーティングルーム 4F (Meeting Room 4F)

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

**Biography**

Prof. Mingcong Deng received his BS and MS in Automatic Control from Northeastern University, China, and PhD in Systems Science from Kumamoto University, Japan, in 1997. He was with Kumamoto University; University of Exeter, UK; NTT Communication Science Laboratories; Okayama University. Now, he is with Tokyo University of Agriculture and Technology, Japan, as a professor. Prof. Deng specializes in three complementary areas: Operator based nonlinear fault detection and fault tolerant control system design; System design on human factor based robot control; Learning based nonlinear adaptive control. Prof. Deng has over 550 publications including 195 journal papers, in peer reviewed journals including IEEE Transactions, IEEE Press and other top tier outlets. Prof. Deng is a co-chair of agricultural robotics and automation technical committee, IEEE Robotics and Automation Society; also a chair of the environmental sensing, networking, and decision making technical committee, IEEE SMC Society. He was the recipient of 2014 & 2019 Meritorious Services Award of IEEE SMC Society, 2020 IEEE RAS Most Active Technical Committee Award (IEEE RAS Society). He is a member of The Engineering Academy of Japan

**Speech Title & Abstract**

**Speech Title:** Learning & Operator based Control Design for Smart Materials Actuated & Sensed Nonlinear Systems

**Abstract:** Control design for nonlinear systems has been a key technology in many engineering fields. Especially learning based nonlinear control design is necessary to compensate nonlinear factors more efficiently. Recently, smart materials have been used as actuators and sensors in many nonlinear dynamic systems to realize the reduction in size and weight of the systems, such as piezoelectric elements, shape-memory alloy etc. In this talk, we show 1) nonlinear vibration control schemes for a wing plate system with piezoelectric actuators & sensors based on operator theory, 2) nonlinear vibration control for a flexible arm using an interactive Shape Memory Alloy actuation, 3) robust nonlinear vibration control for a L-type arm with piezoelectric actuator & sensor and linear motor. Further, some current results are shown to combine learning schemes.
Liangjing Yang is an assistant professor in Zhejiang University-University of Illinois at Urbana-Champaign (ZJUI) Institute, Zhejiang University (ZJU) where he is appointed as the Vice Director of Research Division for Data and Information Sciences. He is also the principal investigator leading the Intelligent Robot, Vision & Control research group (IRVC) in ZJUI. The group’s research vision is to advance the science and technology of robotics in a human-centric fashion with an emphasis in intuitive and interactive man-machine interface, especially in the biomedical and healthcare domains. Liangjing Yang received the B.Eng. and M.Eng. degrees in mechanical engineering from the National University of Singapore (NUS). He obtained the D.Eng. degree from the University of Tokyo (UTokyo) before receiving a joint postdoctoral fellowship to work at the Singapore University of Technology and Design (SUTD), and Massachusetts Institute of Technology (MIT). His work on image mapping for 3D ultrasound-guided endoscopic procedures is featured in both engineering and medical journals. He also developed a robotic system for overlapping ablation of large liver tumor, which is published in a special issue on “Surgical and Interventional Medical Devices” of ASME/IEEE Transactions on Mechatronics. He holds two US patents one on a Robotic Surgical Training System, which was named “Best Innovation in Biomedical Application” in a challenge organized by National Instruments.

Speech Title & Abstract

Speech Title: Human-Centered Immersive Robot-Man Coexistence

Abstract: As robots permeate all aspects of our lives, from addressing medical needs, to easing imminent social issues like aging workforces, the coexistence of man and robot is inevitable. Robot-Man Coexistence (RoManCe) is especially inevitable in biomedical and healthcare applications involving humans in the workspace of the robots. It is, therefore, meaningful to adopt a human-centric approach for robotics research looking beyond the pursuit of autonomy. Building upon our work in biomedical robotics, the Intelligent Robot Vision & Control (IRVC) group strives to advance human-centricity in the design of robotic systems by incorporating machine perception, collaborative control and immersive technology. The talk will focus on our research work to augment human user with immersive man-machine interface, hence, achieving intuitive and safe human-robot interaction in applications including, but not limited to, biomedical, healthcare and educational areas.
Mo-Yuen Chow earned his degree in Electrical and Computer Engineering from the University of Wisconsin-Madison (B.S., 1982); and Cornell University (M. Eng., 1983; Ph.D., 1987). Dr. Chow joined as a Professor at UM-Shanghai Jiao Tong University Joint Institute in 2022. He was a Professor in the Department of Electrical and Computer Engineering at North Carolina State University.Dr. Chow’s recent research focuses on distributed control and management, smart micro-grids, batteries management, and mechatronics systems. Dr. Chow has established the Advanced Diagnosis, Automation, and Control Laboratory. He is an IEEE Fellow, the Co-Editor-in-Chief of IEEE Trans. on Industrial Informatics 2014-2018, Editor-in-Chief of IEEE Transactions on Industrial Electronics2010-2012. He has received the IEEE Region-3 Joseph M. Biedenbach Outstanding Engineering Educator Award, the IEEE ENCS Outstanding Engineering Educator Award, the IEEE ENCS Service Award, the IEEE Industrial Electronics Society Anthony J Hornfeck Service Award, and the IEEE Industrial Electronics Society Dr.-Ing. Eugene Mittelmann Achievement Award. He is a Distinguished Lecturer of IEEE Industrial Electronics Society.

Speech Title & Abstract

**Speech Title: Disaster Relief Empowerment Through Collaborative Distributed Control of Energy Resources**

**Abstract:** Maintaining reliable and stable power supplies is a significant challenge in a world frequently struck by natural disasters, ranging from severe hurricanes to unforeseen earthquakes. These calamities have a severe negative impact on the electrical grid, leading to power outages that paralyze daily life and hinder crucial rescue efforts, potentially leading to further casualties. Thus, the swift restoration of electricity emerges as a paramount task in the multifaceted arena of disaster response. Traditionally, this has involved making emergency repairs to central utility grids or deploying mobile power units to essential services like hospitals. However, these methods can be hindered by damaged infrastructure, limited resources, and difficult terrain. Emerging technologies, such as UAVs, AI, and distributed energy resources (DERs), offer new possibilities. This scenario requires a more dynamic, efficient, adaptable and systematic solution for flexibility, rapid response, and efficient coordination. This presentation will discuss research and technologies integrating distributed energy sources into the grid through Networked Microgrids (NMG) using a dynamic energy management framework. It will cover the work on Dynamic Collaborative Distributed Energy Management Systems by the ADAC research lab, the software and hardware-in-loop development, and introduce the initiatives of the Yangtze Delta Energy Management Systems Consortium Plus (YD-EMSC+).
Onsite Session 1: Robot kinematic analysis and control

Date: JUNE 22, 2024 Saturday
Duration: 13:30-15:30
Venue: ミーティングルーム4F (Meeting Room 4F)

Chair:

Title: Exploring Child-Robot Interaction in Individual and Group settings in India
Author(s): Gayathri Manikutty, Sai Ankith Potapragada, Devasena Pasupuleti, Mahesh S. Unnithan, Arjun Venugopal, Pranav Prabha, Arunav H., Vyshnavi Anil Kumar, Rthuraj P. R., Rao R Bhavani
Presenter: Gayathri Manikutty, Amrita Vishwa Vidyapeetham, India

Abstract: This study evaluates the effectiveness of child-robot interactions with the HaKsh-E social robot in India, examining both individual and group interaction settings. The research centers on game-based interactions designed to teach hand hygiene to children aged 7-11. Utilizing video analysis, rubric assessments, and post-study questionnaires, the study gathered data from 36 participants. Findings indicate that children in both settings developed positive perceptions of the robot in terms of the robot’s trustworthiness, closeness, and social support. The significant difference in the interaction level scores presented in the study suggests that group settings foster higher levels of interaction, potentially due to peer influence and collaborative dynamics. While both settings showed significant improvements in learning outcomes, the individual setting had more pronounced learning gains. This suggests that personal interactions with the robot might lead to deeper or more effective learning experiences. Consequently, this study concludes that individual interaction settings are more conducive for focused learning gains, while group settings enhance interaction and engagement.

Title: A method of robot DH parameter calibration based on the genetic algorithm
Author(s): Tao Zhang, Boqiang Zhang, Zejun Sun
Presenter: Zejun Sun, Shanghai Electric Group Central Academe, China, Shanghai

Abstract: The kinematic DH parameters of the robot directly affect the movement accuracy of the robot. Therefore, it is very important to calibrate the DH parameters. The commonly used method for robot parameter calibration is to approximate the data using the least squares method based on the actual collected data. However, this method inevitably requires calculating the inverse kinematics solution of the manipulator, which is cumbersome and complicated. To avoid the complex calculations caused by the inverse kinematics of the robot, this paper constructs the
DH parameter error model of the robot through forward kinematics, uses a genetic algorithm to iterate the DH parameter error as an individual, and obtains the optimized DH parameters. The genetic algorithm operators were designed to ensure species diversity and avoid falling into local optimality. Finally, the correctness of this method was verified through experiments, and the method can improve the accuracy of robot movement.

**Title:** Digital Twin of Industrial Robots over the Cloud: Framework, Design and Analysis  
**Author(s):** Hari Ganesan, Aaryan M Sandeep, Aakash Negi, Yuktha M, Ashok Kumar Patil  
**Presenter:** Aaryan Sandeep, VIT Chennai, India

**Abstract:** This paper presents a novel approach for creating real-time, secure and interactable Digital Twins of industrial robots. This approach diverges from previous approaches that relied on Digital Twin Definition Language (DTDL). The proposed method uses Robotics Operating Systems (ROS) and the Unity Game Engine to build the Digital Twins. The prototype built to showcase this approach comprises 4 sub-systems namely Data Acquisition sub-system, Cloud sub-system, Digital Client sub-system, and Remote-Control sub-system. The methodology focuses on real-time data synchronization using cloud-based communication services like IoT servers. There are also multiple security measures employed to secure the data-like passing data through proxy and end-to-end encryption of data. The prototype made using Niryo Ned 2 Robot and a Raspberry Pi 3b+ showcases accurate physical-Digital Twin and effective remote control. Key findings highlight the system’s ability to overcome latency, security and data accuracy, which in turn helps improve human-robot collaboration and interactions. This research contributes to the Digital Twin field by providing a modular and scalable framework that can be adapted for various robots and systems. This paper not only provides the general idea for implementation and problems faced during development but also suggests pathways for future work, like optimization of message rates, integration of machine learning for maintenance and other purposes.

**Title:** Mitigating the trade-off between robustness, optimality and sample efficiency in simulated legged locomotion  
**Author(s):** Thejaswi Amarendra, Samuel Thomas Thomas, Rishab Agrawal, Pratham Patil, Chandar T S  
**Presenter:** Thejaswi Amarendra, PES University Bengaluru, India

**Abstract:** This project aims to minimise the trade-off between two attributes in reinforcement learning in the context of training legged robots in simulation, namely, robustness and sample efficiency. A novel algorithm is developed and tested in this project which attempts to do the mentioned task by subjecting the agent in a constantly changing environment. This change is controlled by another reinforcement learning algorithm which updates its parameters based on the reward the agent obtains in the past episodes. The novelty lies in the fact that only the environment’s agent is aware about the optimal changes required to train the legged robot’s agent in the best possible way. The environments for the simulation were prepared on softwares
like OpenAI Gymnasium and MuJoCo [11]. Multiple structural changes were made to the source code of these environments for testing. These changes include making fixed parameters like gravity and friction into variable parameters. The algorithm was tested on three different test beds which were picked based on their difficulty and complexity levels. During training and testing, the environment’s reinforcement learning agent had the autonomy to change these variable parameters based on the robot’s reward in simulation. The results of these tests were plotted and analysed which led to the inference that the proposed novel algorithm is a viable method to train legged robots in a more robust and sample efficient way.

Title: MATLAB Toolbox for Reachability Analysis and Visualization of Robotic Manipulators  
Author(s): Pooyan Nayyeri, Kourosh Zareinia, Habiba Bouguerara  
Presenter: Pooyan Nayyeri, Toronto Metropolitan University, Canada

Abstract: Robotic manipulators have existed in the industrial landscape for decades. However, recent technological advancements have significantly increased their prevalence in various factories and research facilities. The effective utilization of a manipulator demands a comprehensive analysis of its specifications and capabilities. A crucial aspect of this analysis involves investigating the reachability of the manipulator’s end effector, enabling optimal placement and utilization of the robot. This paper introduces a MATLAB toolbox developed to calculate and visualize the reachability of the end effectors of manipulators. This toolbox assists robotic researchers and practitioners in generating a workspace and reachability map for a robotic manipulator—a feature not available in any other toolbox or library in MATLAB.

Title: An improved RRT* algorithm for multi-objective optimization based on NSGA-III  
Author(s): dong xiang, chu wang, zongze liu, shunxiang cao, kai hu, yibo zhang, weiye zhou  
Presenter: Chu WANG, Harbin Institute of Technology, China

Abstract: The RRT1 algorithm is a path planning method based on random sampling, which can effectively solve the path planning problem of high-dimensional planning or complex constraints. Although the RRT algorithm is a relatively efficient and completely probabilistic motion planning algorithm, there are still some problems, such as the result isn't relatively optimized or the stability of the path is awful. The improved RRT* algorithm improves the path optimization ability to a certain extent and is asymptotically optimal. However, this algorithm is incapable of dealing with multi-objective optimization problems. Since the NSGAIII-RRT*2 algorithm is proposed in this paper to solve the defect of multi-objective optimization ability of the RRT and its improved algorithms. The non-dominated genetic sorting algorithm based on reference points is used to improve the operation of reselecting the parent nodes of the RRT* algorithm, and Pareto optimal population is used instead of single path iteration. This algorithm can effectively solve the problem of high-dimensional path planning under complex approximate conditions. It can also carry out multi-objective optimization of the feasible path, and converge to a uniform set of feasible path’s Pareto front. According to the results of simulation experiments, the extreme value data of the rotation angle is reduced by 42.76% on average compared with the original RRT
Title: Enhancing Robotic Task Parameter Estimation through Unified User Interaction: Gestures and Verbal Instructions in Collaboration

Author(s): Shuvo Kumar Paul, Mircea Nicolescu, Monica Nicolescu

Presenter: Shuvo Kumar Paul, University of Nevada, Reno, United States

Abstract: As the presence of robots increases in our daily lives, it becomes crucial to gather task and environmental information through intuitive, meaningful, and user-friendly interaction interfaces. This not only aids users in adapting to and trusting robots in collaborative environments but also enhances core sensory data, enabling robots to make dependable decisions. This paper introduces a framework that incorporates two natural interaction interfaces—gesture and speech—to accurately deduce the object of interest and robotic task parameters. The gesture recognition module utilizes a pre-trained model trained on 21 hand landmarks from 2D images to deduce gestures. Additionally, we trained a model to extract task information from verbal instructions. Combining the extracted task parameters from verbal instructions with inferred gestures, the framework is capable of detecting and/or clarifying object(s) of interest (OOI) in the scene, which is needed to generate the final task configurations. The proposed system showcases how combining these two modules identify and disambiguate relevant robotic task parameters.

Title: Optimal Path Planning for Autonomous Vehicles Using Artificial Potential Field Algorithm

Author(s): Giseo Park

Presenter: Giseo Park, University of Ulsan, Republic of Korea

Abstract: This paper proposes an optimal path planning algorithm to make the autonomous vehicle follow the desired path profile while avoiding nearby obstacles safely. Also, it utilizes only readily available sensors equipped with typical autonomous vehicle system. For optimal path planning, an artificial potential field (APF) algorithm to derive both desired vehicle longitudinal velocity and desired vehicle yaw angle in real time is newly designed, which includes both a repulsive field for avoiding road boundaries and nearby obstacles ahead, and an attractive field for following the proper lane. Next, the path tracking control algorithm consists of longitudinal and lateral motion controllers. Especially, a model predictive control (MPC) for vehicle lateral motion causes the yaw angle error between the desired path profile and the vehicle to approach zero. Then, it can derive an optimal front steering angle considering vehicle state and input constraints. Using CarSim and MATLAB/Simulink simulations, the effectiveness of the proposed algorithm in this paper is verified in some driving scenarios. Accordingly, its high performance for the path planning and tracking of autonomous vehicles can be clearly confirmed.
Date: JUNE 22, 2024 Saturday
Duration: 15:45-18:00
Venue: ミーティングルーム4F(Meeting Room 4F)

Chair: Prof. Rached Dhaouadi, American University of Sharjah, United Arab Emirates

**Title:** Implementation of water surface objects ranging system for collision warning

**Author(s):** Ren-Jie Huang, Chun-Shun Tseng, Wen-Chung Chen, Tsung-Ping Tu, Teng-Fu Huang, Cheng-Chun Lin, Ying-Ren Lin

**Presenter:** Chun-Shun Tseng, Ship and Ocean Industries R&D Center, Tamsui, Taiwan

**Abstract:** Compared to the common AI (artificial intelligence) applications in Self-driving cars, drones, and others, there are numerous untapped potentials for AI applications in the maritime domain. The utilization of AI computer vision for detecting and ranging floating objects on the surface is gradually gaining attention from researchers. The primary issue is on employing AI computer vision in maritime vessels to achieve the perception and collision avoidance capabilities necessary for autonomy. Due to this collision avoidance demand, the Ship and Ocean Industries R&D Center (SOIC) and the National Taiwan Ocean University Artificial Intelligence Research Center (NTOU-AIRC) have collaborated since 2019 to develop an AI computer vision system for applications related to surface ships. Since 2021, we have expanded our collaboration with Kolead Aerospace Co., Ltd. to focus on the implementation of AI computer vision products. This paper proposes an image-based distance ranging system for locating floating objects and overcoming motion (caused by waves and strong winds at sea) disturbance. The system utilizes a thermal camera combined with AI object detectors to detect floating objects such as boats and buoys (mAP of 94%), and then it estimates the target distance with a gyroscope and time series filtering to mitigate motion disturbance. As a result, the proposed system significantly reduces the distance ranging error within ±10%.

**Title:** Enhancing Automatic Microplastic Detection Through Density Separation and HSV Color Processing

**Author(s):** S.Chokchaitam, P.Kaewprapha,W.Chainam,C.Pattam, S.Phitaktim

**Presenter:** Somchart Chokchaitam, Thammasat School of Engineering, Thammasat University, Thailand, Thailand

**Abstract:** Microplastics are a growing concern in the environment due to their diverse sources and potential threats to aquatic ecosystems and human health. Detecting microplastics poses challenges due to their small size and varied origins, requiring a combination of methods such as visual inspection, chemical analysis, microscopy, density separation, and automated imaging systems for accurate detection and characterization. Density separation, utilizing differences in density between microplastics and other materials, is a popular method for efficient isolation, followed by digital image processing for further analysis. Leveraging the HSV color space, which
separates color and intensity, offers a promising approach for microplastic detection by assessing hue, saturation, and value components in images. This integration of density separation and HSV color processing provides a comprehensive framework for microplastic detection and analysis. In our report, we present a novel HSV color processing method designed to enhance microplastics detection through density separation. We validate the effectiveness of our approach by comparing the results with microplastics identified by environmental experts.

**Title:** Design of synchronized pulse signals for bump magnet power supply with FPGA-based system  
**Author(s):** Surapong Kokkrathoke, Nattawat Yachum, Somjai Chunjarean, Keerati Manasatitpong, Nathawut Suradet, Apichai Kwankasem  
**Presenter:** Surapong Kokkrathoke, Synchrotron Light Research Institute (SLRI), Thailand

**Abstract:** A new in-house pulse generator for bump magnet power supply at Siam Photon Source (SPS), a synchrotron light source managed by Synchrotron Light Research Institute (SLRI) in Thailand, has been designed with the Field Programmable Gate Arrays (FPGA)-based system for replacing the malfunctioning previous module. The power supply is required to generate synchronized current outputs of approximately 3 kA maximum for the bump magnets in the precise time from the timing system in which the trigger pulses are applied to create events of magnets in SPS. Particularly, the pulse width of 1.2 µs from the timing system is designed to operate the three bump magnets for beam injection into the storage ring. Therefore, the FPGA pulse generator is proposed to detect the trigger pulses from the main timing system with its real-time capability of the FPGA board to obtain the output pulses in the specific widths and individual delay time to the bump magnet power supply. This paper presents the design and the experimental results of the pulse generator, which demonstrates the excellent performance of this equipment leading to the accomplishment of beam injection for the SPS.

**Title:** Artificial intelligence-based error detection and adaption of shot curve parameters in the hot chamber high-pressure die-casting process  
**Author(s):** Sebastian Feldmann, Tobias Stempfle, Christos Mangos, Lothar Kallien, Manfred Rössle, Johann Jung  
**Presenter:** Matthias Wiedenmann, Aalen University, Germany

**Abstract:** The high-pressure die casting process has become one of the most important production processes today due to recent developments in the automotive industry. However, there are still large quantities of defective parts and waste of raw material, especially during the first cycles in manufacturing. In that case, it is necessary to identify defective parts and combine them with relevant process parameters to improve the part quality. To influence the process parameters, there is a very short time frame of a few milliseconds. Through this research a newly developed methodology is capable to visually identify quality-relevant process parameters at the die casting shot curve. A supervised learning algorithm helps to determine the part quality under assessment of the porosity by Artificial Intelligence. For this purpose, an adapted Convolutional Neural Network [CNN] evaluates the acquired end-of-line X-ray images of the generated casting.
parts. Parts are labelled according to their degree of porosity. A further step correlates the porosity degree with the real-time machine time-series data sets under the use of an adapted ResNet18-Convolutional Neural Network. The CNN is capable of inferring the part-porosity based on the acquired process datasets. Captured data sets are converted into shot-curve images that are assessed by Artificial Intelligence. Responsible areas for insufficient part quality are identified under the use of an occlusion sensitivity map. This method allows to manually adjust the die casting process parameter settings, with prediction accuracies of up to 80 % achieved in this research.

| Title: | Nonlinear output voltage control of triboelectric nanogenerator system |
| **Author(s):** | Mingcong Deng, Ryusei Shimane, Guang Jin |
| **Presenters:** | Mingcong Deng, Tokyo University of Agriculture and Technology, Japan |

**Abstract:** In recent years, there has been a growing interest in energy harvesting, driven by the increasing focus on IoT (Internet of Things) and carbon reduction. The triboelectric nanogenerator(TENG) harnesses the triboelectric effect and electrostatic induction to convert mechanical energy, such as vibrations, into electrical energy, serving as an energy harvesting device. Therefore, TENG has attracted attention. While it offers advantages such as low cost and high robustness, a drawback lies in the instability of the output voltage. The objective of this paper is to design a control system that combines operator theory, sliding mode control(SMC), and a disturbance compensator to mitigate modeling errors, ensuring the output voltage tracks the setpoint. This article is organized as follows: Section II provides an overview of the TENG system, while Section III outlines the design of the control system. Section IV presents the results of simulations controlling the DC-DC converter with and without disturbance compensator included in the control system. Finally, Section V concludes the article.

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| Title: | Switching of Assist Motion by Voice Recognition for Exoskeleton that Supports Lifting and Walking |
| **Author(s):** | Chiharu Ishii, Takahiro Yamashita |
| **Presenters:** | Chiharu Ishii, Dept. of Mechanical Engineering, Hosei University, Tokyo, Japan |

**Abstract:** In our previous study, an exoskeleton that can be used for both lifting assistance and walking assistance was developed, in which motions of the wearer’s hip joint are assisted by motor actuation. In this study, in order to make the exoskeleton highly practical, a control system that allows the user to switch lifting assistance or walking assistance through voice recognition was developed. In addition, since workers in transportation work carry objects of various weights, a control strategy of walking assistance which allows the user to choose one of three walking speeds (fast, normal and slow) in accordance with the weight of the object to carry, was proposed. To verify an effectiveness of the developed control system for the exoskeleton, experiments of lifting and carrying a heavy object were carried out under the conditions of not wearing the exoskeleton and wearing the exoskeleton. Then, the assist effect was evaluated by expired gas analysis. As a result of the experiments, the assist effect of the developed exoskeleton was confirmed. To verify a usefulness of the proposed control strategy of walking assistance with variable walking speed, experiments of lifting and carrying heavy objects were carried out under
the conditions of changing the weight of heavy object and the walking speed. Then, mental workload of subjects was calculated from CSTLX (card-sort TLX) and compared. As a result of the experiments, the usefulness of the proposed control strategy of walking assistance with variable walking speed was confirmed.

| Title: Traffic Sign Classification using Attention Fused Deep Convolutional Neural Network | Author(s): Shravan Venkatraman, Santhosh Malarvannan, Abeshek A, Shriyans A, Jashwanth R, Joe Dhanith P R |
| Presenter: Shravan Venkatraman, Vellore Institute of Technology, Chennai, India |
| Abstract: Autonomous vehicular technology, also known as self-driving or driverless technology, refers to the innovation that enables vehicles to operate without human intervention. Traffic sign classification (TSC) is a critical component in autonomous vehicular technology, as it allows vehicles to recognize and interpret traffic signs, which is essential for safe and rule-compliant navigation. This work proposes a novel attention-fused deep convolutional neural network (AFDCNN) for TSC. The proposed AFDCNN incorporates the capabilities of ResNet50 and EfficientNetV2 by combining their outputs through a self-attention mechanism which enhances its ability to classify traffic signs. Analysis of the GTSRB, LISA, and MASTIF datasets revealed that the proposed model exhibited superior performance compared to state-of-the-art models, as evidenced by higher scores in recall, precision, F1-score, and accuracy metrics. |

| Title: An Integrated Transportation Model in a Coordinated Supply Chain Environment | Author(s): Min-Yang Li, Chia-Yu Kao |
| Presenter: Min-Yang Li, National Cheng Kung University, Taiwan |
| Abstract: The intensification of global environmental awareness and sustainability demands has prompted businesses to reimagine their supply chain strategies with a focus on integration and remanufacturing to bolster competitiveness and environmental stewardship. This paper introduces a comprehensive four-tier supply chain model that integrates a reverse logistics framework to align with contemporary sustainability goals and cost efficiency. The model's architecture pivots on a two-stage mixed integer programming approach: the first stage deals with strategic location selection for reverse logistics operations, while the second stage optimizes operational efficiencies in logistics through the calculation of optimal distribution volumes and vehicle utilization. Central to this model is the seamless coordination between various supply chain echelons — suppliers, factories, distribution centers, and retailers. It harnesses both forward and reverse logistics, effectively reducing transportation costs by integrating the movement of goods from suppliers to factories and on to consumers, alongside the flow of recycled materials back into the production cycle. Numerical experiments using the Gurobi Optimizer underscore the model's robustness, demonstrating cost savings and enhanced logistical efficiencies in both hypothetical small and large-scale scenarios compared to traditional supply chain models. This research not only provides a strategic framework for supply chain managers to optimize |
logistics operations but also encourages the adoption of flexible, sustainability-driven business practices that can dynamically respond to changing market conditions and technological advancements. The findings from this study have significant implications for enhancing operational sustainability in supply chains, advocating for a shift towards more resilient and adaptable business models.

**Title:** Hybrid Particle Swarm Optimization with Quasi-Newton Local Search for Quadrotor Altitude and Attitude Control  
**Author(s):** Ishaq Hafez, Rached Dhaouadi  
**Presenter:** Rached Dhaouadi, American University of Sharjah, United Arab Emirates

**Abstract:** This paper presents a novel Hybrid Particle Swarm Optimization with Quasi-Newton method (HPSO-QN) for tuning Proportional–Integral–Derivative (PID) controllers in quadrotor altitude and attitude stabilization. The proposed HPSO-QN method combines the global search capability of Particle Swarm Optimization (PSO) with the local search strength of the Quasi-Newton (QN) method to improve the optimization of the controller gains while avoiding local minima. Additional penalty conditions are integrated into the algorithm to maintain system stability throughout the optimization process. Comparative results with the standard PSO demonstrate that the proposed HPSO-QN method achieves significant performance improvements in robustness and precision. Statistical analysis of the cost functions confirms that the average is 2.3 times lower and the standard deviation is 30.4 times lower compared to SPSO, emphasizing its effectiveness in quadrotor control systems.

**Title:** Design and Analysis of Novel Wall-Climbing Robot on Discontinuous Ferromagnetic Surface  
**Author(s):** Bo Zhong, Qi Lan, Wencong Lian, Peng Sun, Hao Chen, Yong Lei  
**Presenter:** Qi Lan, Zhejiang University, China

**Abstract:** In order to carry out automatic cleaning of ventilation openings on the hydroelectric generator stator surface, a wall-climbing robot needs to face challenges in maintaining stable adhesion and smooth movement on the stator surfaces composed of discontinuous ferromagnetic materials. This paper proposed a novel magnetic adhesion wall-climbing wheeled robot with integration of permanent magnet arrays. Firstly, a permanent magnet array adhesion unit is designed and its structural parameters is optimized through magnetic field simulation. Secondly, an adhesion force model for magnetic wheels on the discontinuous permeable material surface is
constructed to analyze the force characteristics on the transition zones between permeable materials. Finally, the magnetic adhesion force model is validated through magnetic field simulation, calculating the total magnetic adhesion force of the robot based on different transition positions. Simulation results show that the proposed robot structure can moving smoothly on the surface of the stator with certain load capability.

**Title:** Person Tracking Control of Mobile Robots Using a Lightweight Object Detection and Tracking System  
**Author(s):** Yu-Chen Chiu, Huan-Wei Hsu, Chi-Yi Tsai  
**Presenter:** Huan-Wei Hsu, Tamkang University, Taiwan R.O.C.

**Abstract:** This paper aims to develop a lightweight person tracking control system to facilitate real-time pedestrian tracking tasks for mobile robots. The proposed system utilizes deep learning technology and lightweight network architecture to perform pedestrian detection tasks to achieve powerful pedestrian detection capabilities. Subsequently, the integration of multi-object tracking technology enables the system to effectively track identified pedestrian targets, thereby enabling real-time pedestrian tracking of mobile robots. Experimental results show that the proposed lightweight person tracking control system exhibits robust pedestrian following performance, stability, and effectiveness under various scenarios and environmental conditions. These properties increase the potential of the proposed system in many practical applications.

**Title:** Real-Time Aero Obstacle Detection and Tracking for UAV Navigation  
**Author(s):** Guanghui Wang  
**Presenter:** Guanghui Wang, Toronto Metropolitan University, Canada

**Abstract:** The capability of sense and avoid (SAA) allows Unmanned Aerial Vehicles (UAVs) to identify potential collision threats and execute necessary avoidance maneuvers. Vision-based SAA systems, in particular, have gained significant attention due to the lightweight and cost-effective nature of cameras, providing richer information compared to other sensors. Despite the advantages, many vision-based systems are computationally expensive, limiting their practical applications. This research addresses the challenge of vision-based aero obstacle detection and tracking for UAV navigation. A real-time strategy for object localization and tracking is developed by seamlessly integrating object detection and tracking into a dynamic Kalman model. During the detection phase, aero obstacles in front of the UAV are automatically detected and localized from a saliency map computed using the image background connectivity cue in each frame. In the tracking phase, a Kalman filter is utilized to offer a coarse prediction of the object's state, subsequently refined through a local detector that incorporates the saliency map and temporal information between consecutive frames. In comparison to existing methods, the proposed approach demonstrates superior accuracy and speed. The primary contributions of this study are as follows: 1) The study proposes a novel algorithm for real-time aero obstacle detection by integrating a saliency map into a dynamic model and utilizing a target-specific saliency map as the observation for tracking; 2) The proposed approach does not require any manual initialization for tracking; 3) Extensive experimental evaluations demonstrate the superior performance of the proposed technique in terms of precision, success rate, and center location error compared to previous trackers of its kind.
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<th>Session</th>
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<td>S327</td>
<td>Research on multi-objective optimization of grinding robots based on Multi-Verse Optimizer</td>
<td>ZHANG Tao, PENG Tianchen, ZHANG Shun</td>
<td>Tianchen PENG, Shanghai Electric Group Co., Ltd. Central Academe, China</td>
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<td>S327</td>
<td><strong>Abstract</strong>: Aiming at the problems of energy consumption and operation efficiency during the robot's working process, a multi-objective optimization method for the robot was proposed based on the multivariate universe algorithm. First, the robot trajectory was planned according to the specific grinding requirements. Second, multi-objective optimization of the fitness function was designed in consideration of the kinematic constraints. Third, the Sin Log Multi-Verse Optimizer (SLMVO) algorithm was proposed and used to optimize the robot trajectory. Ultimately, the optimization effect was verified through simulations and experiments. The self-designed collaborative robot was selected as the experimental object, and the grinding scene was selected as the test scenario. The experiments proved the effectiveness of this algorithm. The working trajectory was optimized effectively with shorter running time and lower energy consumption.</td>
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<td>S330</td>
<td>IMPLEMENTATION OF WATER COOLING SYSTEM CONTROL OF 6-MEV LINEAR ACCELERATOR FOR FRUIT STERILIZATION</td>
<td>Nattawat Yachum, Surapong Kokkrathoke, Somjai Chunjarean, Keerati Manasatitpong, Nilaped Russamee</td>
<td>Nattawat Yachum, Synchrotron Light Research Institute, Thailand</td>
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<td>S330</td>
<td><strong>Abstract</strong>: In-house 6-MeV Linear Accelerator (linac) for fruit Sterilization Laboratory in Synchrotron Light Research Institute, Thailand which is operated to control an electron beam energy and used for the generation of X-ray radiation. The experiments required an important component, such as linac tube, Electron gun, Microwave source and One of the components affect to Quality, Stability and Reliability of the linac operation that is Water Cooling System (WCS) Control. There is used to minimize heat dissipation on the linac tube. It is specification of operation within 40° C. Though the designing linac structure was operated which the parameters at 90 Hz repetition rate frequency and 5 µs pulse width beam. Fluctuation of the beam energy suggested that stability of the WCS was insufficient to X-ray intensity of fruit sterilization application. The improvement of WCS was reduced high temperatures on the linac surface and also adjusted fine control parameters with PID controller algorithm of water temperature was suppressed to within 40 ± 0.1° C. As a result of the improvement the X-Ray intensity was effective for stabilization of fruit Sterilization application.</td>
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Online Session: Intelligent Autonomous Systems and Intelligent Robots

Date: JUNE 22, 2024 Saturday
Duration: 13:30-15:30
Zoom ID: 819 8570 2428
Zoom Link: https://us02web.zoom.us/j/81985702428

Chair:

Title: 3D Lidar Technology for Slag Flushing of BF in Auto Crane
Author(s): Jing CHEN, Dong LIU
Presenter: Jing CHEN, Capital Engineering & Research Incorporation Limited., China

Abstract: Recently Auto Crane research and 3D lidar technology has been gradually applied in the industrial field. Aiming at 3D lidar scanning and identification technology of blast furnace slag material surface, this paper introduces a multiple scanning self-learning method to achieve laser point cloud data fusion, which solves the problems of equipment occlusion and measurement error. A reduced-order 3D plane fitting method is proposed, which simplifies the identification of key parameters of the 3D model of the slag pond, realizes the good segmentation of the point cloud data between the slag pond and the material surface, and provides the theoretical basis and 3D model support for the auto crane. The system has been implemented in several projects in Slag Flushing system of blast furnace.

Title: Optimization-Based Trajectory Planning for Multiple Robots in Unstructured Environments
Author(s): Lixiang Zheng, Gang Zhang, Zhangduan Chai, Jie Niu, Chengran Lin
Presenter: Lixiang Zheng, Beijing University of Chemical Technology, China

Abstract: This work focuses on a trajectory planning problem for multiple ground mobile robots in unstructured environments. Considering the problem, we propose a safety-enhancing multirobot trajectory planning method. Our proposed method uses a two-stage strategy, path planning and trajectory optimization, to solve the multi-robot trajectory planning problem. To reduce computational burden of the trajectory optimization, we construct safe corridor for each robot. In the safe corridor construction, we introduce an extended distance to solve its invalid construction problem. In a 90m\_x005f90m experiment scenario, our method saves almost 91\% safe corridor construction time. Moreover, to enhance safety of the trajectory that the proposed method generates, a distance penalty term is added to the objective function of trajectory optimization problems. Compared to a state-of-the-art method, the proposed method outperforms it. Simulations and real-world experiments validate the feasibility of the proposed
Title: Autonomous Sensor-based Control of Aerial Manipulator for Horizontal Pipe Structure Tracking with Continuous Contact  
**Author(s):** Naisarg Pandya, Amit Shukla, Pushkar Kumar, Ankit Mehra  
**Presenter:** Naisarg Pandya, Indian Institute of Technology Mandi, India

**Abstract:** This paper proposes an autonomous sensor-based control of an aerial manipulator for tracking horizontal pipe structures with continuous contact. This approach can be used for continuous contact inspection of long-range industrial pipe structures. To automate the aerial manipulator, the perception module of the proposed approach includes a deep learning technique for pipe identification in the image, a classical vision for feature extraction, and a Kalman filter to increase the frequency of data flow in a system. The integration of LIDAR and the camera sensor has been used to locate the approximate contact point. We have designed and developed a novel manipulator along with feed-forward position control to maintain continuous contact with the pipe. The sliding mode controller has been developed for lateral, yaw, and altitude motion control of the aerial platform. The novel forward velocity function is introduced which serves the purpose of smooth tracking along with maintaining a pipe in the reachable space of the manipulator. The fully autonomous operation strategy has been designed to organize subtasks sequentially with feedback. During the tracking of a pipeline, the lateral position and altitude position with respect to the manipulator’s base did not deviate beyond $\pm 0.2$m. Fully autonomous sensor-based control of aerial manipulator has been validated experimentally on a 10-meter long pipeline.

Title: A Teleoperation Framework for Upper Limb Rehabilitation Based on Improved Dynamic Movement Primitives and Hybrid Control  
**Author(s):** Zhixuan Shi, Jing Luo  
**Presenter:** Zhixuan Shi, School of Automation, Wuhan University of Technology

**Abstract:** To achieve efficient rehabilitation training for hemiplegic limbs of stroke patients conducted by therapists in the teleoperation environment, we propose a robot skill learning method based on improved dynamic movement primitives (DMPs) and virtual fixture (VF) based on a hybrid control strategy in this paper. To overcome the noise problems faced by traditional DMPs when learning from a single trajectory, Gaussian Mixture Model - Gaussian Mixture Regression (GMM-GMR) is introduced. This approach extracts the main movement features from multiple demonstration trajectories, facilitating autonomous training for the patient without the real-time guidance of a therapist. In addition, the hybrid control method utilizes the muscle activation obtained from the surface electromyography signal processing. It incorporates variable stiffness control reflecting the patient’s control intention on top of position error-based proportional derivative control, thus helping patients train interactively under therapist-driven
training. Finally, the experiments conducted with a Sawyer robot and a Touch device have confirmed the effectiveness of the proposed methods.

| Title: Research on Key Technologies of Robot Fusion Algorithm Path Planning in Unknown Environment  
Author(s): Sanli Fu  
Presenter: Sanli Fu, University of Sanya, China  
Abstract: In the current research field, aiming at the problem of robot path planning, this study proposes an optimization strategy combining RRT algorithm and APF method. This strategy aims to achieve more efficient and reliable robot path planning by improving the path search efficiency of RRT algorithm and combining the goal-oriented and obstacle avoiding capability of APF. Specifically, we optimize the RRT algorithm as follows: First, we introduce an APF-based heuristic strategy, which helps guide the path search process closer to the target point faster; Secondly, in the process of path generation, the APF method is used to smooth the path in real time to reduce the complexity of the path and the energy consumption during execution. After extensive testing in simulation environments, the optimization strategy shows significant improvements in path length, planning time, and obstacle avoidance. Compared with the traditional RRT algorithm, the new strategy not only reduces the path length, but also shows stronger adaptive ability and robustness in the face of complex environment and sudden obstacles. In addition, through the path smoothing process guided by APF, the dynamic response and stability of the robot when executing the path are also improved. |

| Title: Fault detection and diagnosis based on ant colony algorithm  
Author(s): Jinxing Zhao, Gula Da  
Presenter: Jinxing Zhao, Inner Mongolia University, China  
Abstract: In this paper, the fault diagnosis problem is transformed into an optimization problem and solved by biological heuristic algorithm ant colony algorithm. Combined with the nearest neighbor function criterion in pattern recognition, this method optimizes the initial pheromone matrix and the value of nearest neighbor function, which greatly improves the speed of the algorithm. In the process of algorithm analysis, the errors in literature [1] are corrected. Finally, an empirical analysis is carried out to prove that our method can greatly improve the diagnosis efficiency. |
ATTRACTIONS OF TOKYO

Sensoji Temple ( transgender )
Sensoji ( 浅 草 寺, Sensōji, also known as Asakusa Kannon Temple) is a Buddhist temple located in Asakusa. It is one of Tokyo's most colorful and popular temples.

Akihabara
Akihabara (秋葉原), also called Akiba after a former local shrine, is a district in central Tokyo that is famous for its many electronics shops and has also gained recognition as the center of Japan's otaku (diehard fan) culture.

Shibuya (渋谷)
Shibuya (渋谷) is one of the 23 city wards of Tokyo, but often refers to just the popular shopping and entertainment area found around Shibuya Station. In this regard, Shibuya is one of Tokyo's most colorful and busy districts, packed with shopping, dining and nightclubs serving swarms of visitors that come to the district everyday.

Tokyo Tower (東京タワー)
Standing 333 meters high in central Tokyo, Tokyo Tower (東京タワー) is the world's tallest, self-supported steel tower and 3 meters taller than its model, the Eiffel Tower. A symbol of Japan's post-war rebirth as a major economic power.

More Japan Travel Information: https://www.japan-guide.com/