IEEE ICMA 2025

2025 IEEE International Conference on Mechatronics and Automation

AUGUST 3 - 6, 2025

BEIJING, CHINA

Conference Proceedings

Conference Digest

Co-sponsored by

IEEE Robotics and Automation Society
Southern University of Science and Technology
Beijing Institute of Technology

Technically Co-sponsored by

Chinese Association of Automation
Chinese Mechanical Engineering Society
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Harbin Engineering University
The University of Electro-Communications
Tianjin Key Laboratory for Advanced Mechatronics System Design and Intelligent Control

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2025 IEEE International Conference on Mechatronics and Automation

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The University of Electronic Science and Technology of China
Tianjin Key Laboratory for Advanced Mechatronics System Design and Intelligent Control

IEEE ICMA 2025 PROCEEDINGS

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IEEE ICMA 2025 Conference Digest

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Foreword

On behalf of the IEEE ICMA 2025 Conference Organizing Committee, it is our great pleasure, an honor, and a privilege to welcome you to Beijing for the 2025 IEEE International Conference on Mechatronics and Automation. This conference reflects the growing interest in the broad research areas of mechatronics, robotics, sensors and automation.

IEEE ICMA 2025 marks the **22nd** edition of the IEEE ICMA annual conference series. We are proud to announce that a high number of **369** papers were submitted from **28** countries and regions, including **345** contributed papers, **24** papers for organized sessions, and **239** papers were accepted for oral or poster presentations at the conference after a rigorous full-paper review process, achieving an acceptance rate of less than **65%**. Presentations at IEEE ICMA 2025 are organized in **6** parallel tracks, for a total of **38** sessions, including **1** poster session and **1** invited talk session, taking place during the three conference days. We are fortunate to be able to invite **four** distinguished speakers to deliver Keynote Speech and plenary talks.

We are very pleased that you are joining us at IEEE ICMA 2025 in Beijing to take part in this unique experience. The main objective of IEEE ICMA 2025 is to provide a forum for researchers, educators, engineers, and government officials involved in the general areas of mechatronics, robotics, sensors and automation to disseminate their latest research results and exchange views on the future research directions of the related fields. IEEE ICMA 2025 promises to be a great experience for participants from all over the world, with an excellent technical program as well as social activities.

We would like to express our most sincere appreciation and thanks to all of our sponsoring societies and organizations and to all the individuals who have contributed to the organization of this conference. Our special thanks are extended to our colleagues in the Program Committee for their thorough review of all the submitted papers, which is vital to the success of this conference. We must also extend our thanks to our Organizing Committee and our volunteers who have dedicated their time toward ensuring the success of this conference. Last but not least, we thank all the contributors for their support and participation in making this conference a great success. Finally, we wish you a great conference and enjoyable stay in Beijing, China.

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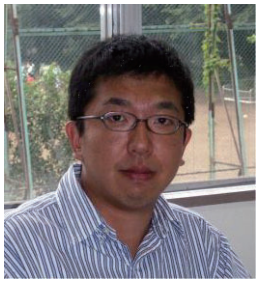
General Chair



Keisuke Morishima
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Welcome Message

It is my honor to welcome you to attend the 2025 IEEE International Conference on Mechatronics and Automation (IEEE ICMA 2025) on behalf of Beijing Institute of Technology. We are delighted to host the Conference which marked as the 22nd edition of the IEEE ICMA among the annual conference series. The Conference reflects the growing interests in the broad research areas of mechatronics, robotics, sensors and automation.

To begin with, I would like to make a brief introduction to Beijing Institute of Technology. Beijing Institute of Technology (BIT) is one of the national key universities in China, an open, public, research-oriented university with a focus on science and technology. The 10th university to enter the 985 Project, which started in order to develop 39 Chinese universities that would seek to become world renowned universities. One of the first 15 universities joined 211 Project which established roughly 100 universities to cope with the challenges of the 21st century. Annual research fund in 2024 amounts to over 7 billion RMB ranking in the top 10 in China. Our research on mechatronics and automation has become increasingly active.

It is sincerely hoped that IEEE ICMA 2025 will provide a forum for researchers, educators, engineers, and government officials involved in the general areas of mechatronics, robotics, sensors and automation to disseminate their latest research results and exchange views on the future research directions of the related fields.

Finally, on behalf of Beijing Institute of Technology, I would like to express my sincere gratitude to all of the sponsoring societies and organizations as well as all the individuals contributed to the organization of the Conference. Also, special thanks are owed to all the authors, session organizers, plenary speakers, exhibitors for contributing their research works and making IEEE ICMA 2025 a successful and fruitful event. To all participants, I extend my heartfelt welcome and thanks for attending this event, wish your stay here in Beijing, China, is very pleasant and enjoyable.

李振建

Zhenjian Li, Professor
Vice President of Beijing Institute of Technology
Advisory Council Chair of IEEE ICMA 2025

Welcome Message

On behalf of the College of Engineering, Southern University of Science and Technology, it is my great honor to extend a warm welcome to all participants attending the 2025 IEEE International Conference on Mechatronics and Automation (IEEE ICMA 2025), which will be held in Beijing, August 3 to August 6. We are delighted to take responsibility for organizing this important event, marking the 22nd edition of the IEEE ICMA conference series. As one of the premier annual gatherings in the field, the conference reflects the growing global interest in mechatronics, robotics, sensors, and automation.

To begin with, I would like to briefly introduce the College of Engineering at Southern University of Science and Technology (SUSTech). Established in May 2015, the College was created in response to the national call for reforming and modernizing engineering education in China. Since its inception, the College has taken a pioneering role in advancing innovative educational practices and cultivating future engineering leaders.

The College offers a comprehensive range of academic programs across various levels, including one Postdoctoral Mobile Station, two doctoral degree programs, four master's degree programs, and 22 undergraduate programs. It serves as a hub for over 318 distinguished scholars recruited from world-renowned institutions. Our faculty includes 23 academicians, 25 recipients of the National Science Fund for Distinguished Young Scholars, 15 recipients of the National Science Fund for Outstanding Young Scholars, and 23 Changjiang Scholars awarded by the Ministry of Education of China. The College has also established strong academic and research collaborations with leading universities and research institutes across America, the Pan-Pacific region, and Europe.

We are confident that IEEE ICMA 2025 will serve as a vital platform for researchers, educators, engineers, and policymakers engaged in the fields of mechatronics, robotics, sensors, and automation. This conference provides an excellent opportunity to share cutting-edge research findings and engage in meaningful discussions on emerging trends and future directions in these rapidly evolving disciplines.

We sincerely look forward to welcoming you to Beijing and hope that your participation in IEEE ICMA 2025 will be both intellectually enriching and professionally rewarding.

Mingwei Chen, Professor
Dean, the College of Engineering
Southern University of Science and Technology (SUSTech)

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Yang, Kwangjin	Yang, Qingsheng	Yang, Wu	Yang, Xiukun
Yang, Yong	Yang, Yousheng	Yang, Zhaojun	Yano, Masafumi
Yao, Yiyu	Ye, Cang	Ye, Changlong	Ye, Shujiang
Ye, Xiufen	Yi, Byung-Ju	Yi, Chuanyun	Yi, Jianqiang
Yin, Guofu	Yin, Zhengsheng	Yin, Zhouping	Ying, Lixia
Ying, Xianghua	Yokoi, Kazuhito	Yokokohji, Yasuyoshi	Yokota, Sho
Yoshida, Shunichi	You, Bo	Young, Nak	Yu, Dejie
Yu, Huadong	Yu, Jie	Yu, Junzhi	Yu, Qiang
Yu, Shui	Yu, Xiaoyang	Yu, Yong	Yu, Yueqing
Yu, Zhangguo	Yuan, Jianjun	Yuan, Juntang	Yuan, Libo
Yuan, Xiaobu	Yue, Chunfeng	Yue, Dong	Yue, Yong
Yun, Chao	Yuta, Shinichu	Zeng, Chunnian	Zha, Hongbin
Zhang, Baida	Zhang, Chengjin	Zhang, Dan	Zhang, Dianlun
Zhang, Hong	Zhang, Jianpei	Zhang, Jianwei	Zhang, Jinxiu
Zhang, Lei	Zhang, Lijun	Zhang, Lixun	Zhang, Mingjun
Zhang, Rubo	Zhang, Sen	Zhang, Songyuan	Zhang, Xianmin
Zhang, Xiaolong	Zhang, Xiaoyu	Zhang, Xinming	Zhang, Xuping
Zhang, Yanhua	Zhang, Yi	Zhang, Yimin	Zhang, Yong
Zhang, Yongde	Zhang, Yonggang	Zhang, Youmin	Zhang, Yunong

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The University of Electro-Communications
The University of Electronic Science and Technology of China
Tianjin Key Laboratory for Advanced Mechatronics System Design and Intelligent Control

General Information

Beijing

Beijing, which was founded 3000 years ago, is the capital of the People's Republic of China (PRC). It is also the nation's political and cultural hub. Additionally, it is the focal point for the country's transportation, scientific and technological development, education and communication. Its present-day population is over eleven million, thus, it is the second largest city in China. Previously known in English as Peking, the name was changed when the system for spelling Chinese words in English changed; the name in English means "northern capital". Beijing is one of the Great Ancient Capitals of China and has hosted the seat of government for much of China's history. It is the political, economic, academic, and cultural center of the country. Tradition and modern civilization are well integrated in this beautiful city.

The long history of Beijing endows the city with a rich cultural heritage. The Great Wall, one of the world's great wonders and one of the very few man-made structures that can be seen from space, extends several thousand miles, and passes relatively near to Beijing. The Forbidden City includes the most splendid group of imperial palaces in the world. The temple of heaven is the place of worship for emperors of various dynasties of China as well as a splendid representation of ancient Chinese architectural art. These sites have been selected by the United Nations Educational, Scientific and Cultural Organization as representing the world cultural heritage. Hutong (Chinese alleys) and compound courtyards (old Beijing residential quarters) are found throughout Beijing. These streets and buildings have witnessed the ups and downs of the city and the people in past centuries and are symbolic of the life of Beijing people. Few cities have the unique historical charm of Beijing. Its wide thoroughfares, magnificent gate tower and memorial arch, and grand palaces all speak to the extensive history of this city. It also stands as a symbol of China's grandeur, history, culture and mystery. Beijing is also an approachable and visitor-friendly city.

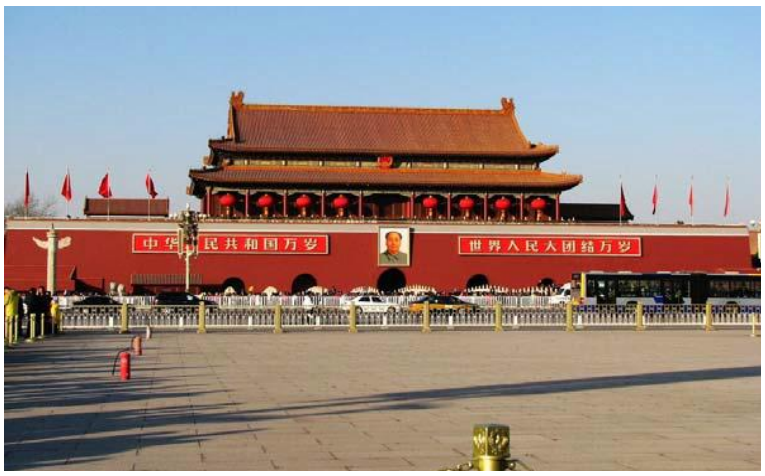
Changes have been taking place day-by-day in Beijing since China's reform and opening to the outside world. As summarized in a popular saying, Beijing is growing taller with more and more skyscrapers while growing younger with the improving living standards and more diversified life style. This is Beijing, old and young, full of attractions. It is our sincere wish that you will make the best of your time here and we believe you will bring home more than what you expect.

Attractions

- **Great Wall**

A Chinese saying goes that He who has never been to the Great Wall is not a true man. If we laid the bricks and rocks used in the Great Wall of Ming to form a wall one meter (1.1 yard) wide and five meters (16.4 feet) high, it could circle the earth at the equator with great ease. It is such a spectacular and formidable architectural feat that anyone who comes to China should not miss it under any circumstances. The Badaling Great Wall, constructed in 1502 (during the Ming Dynasty), once served as a crucial military fortification, and is now the most impressive and representative section of the striking Great Wall. It is about 70 kilometers (43.4 miles) from the downtown area of Beijing. As Badaling was once an important military strategy point, here the wall is comparatively high and firm. It has a length of 3,741 meters (2.3 miles) and it is equipped with dense watchtowers. The wall is about 8.5 meters (27.9 feet) high and slopes inward as it rises in height. The wall is 6.5 meters (21.3 feet) wide at its base, and its rim spans about 5.7 meters (18.7 feet) across.

- **Tiananmen Square**



Tiananmen Square is the geographical center of Beijing City. It is the largest city square in the world, occupying an area of 440,000 square meters (about 109 acres), and able to accommodate 10,000,000 people at one time. In the center of the Square stands the Monument to the People's Heroes, which commemorates the martyrs who devoted their lives to the Chinese people. It reaches 37.94 meters (124 feet) which makes it the biggest monument in Chinese history. The body is made of hardy granite and is surrounded by white balusters. Tiananmen Tower in the south was built in 1417 during the Ming Dynasty (1368-1644). During this dynasty and the following Qing Dynasty (1644-1911) it was where proclamations were issued to the whole nation. The common people were prohibited from entering the

tower, but now tourists with tickets are permitted to climb it. It has five arched gates and nine principle hall columns. With the delicately carved white marbles on its base and yellow tiles on the roof, the tower is quite resplendent. Under the tower flows the limpid Jinshui River, across which seven exquisite bridges are perched, named the Golden Water Bridges.

- **Beijing Lama Temple**

Beijing Lama Temple is one of the largest and most important Buddhist Tibetan monasteries in the world. Construction and works in the church to unite the Han Chinese and Tibetan styles. This story is as follows. Construction work at the Yong He Gong Lama Temple began in 1694 during the Qing Dynasty. Initially, he served as official residence for court eunuchs. It was then converted to a court Prince Yong (Yin Zhen), son of Emperor Kangxi and Emperor Yongzheng himself a future. After Yongzheng ascension to the throne in 1722, half of the building was converted into a monastery, a monastery for monks of Tibetan Buddhism. The other half was left of the Imperial Palace. After Yongzheng's death in 1735, his coffin was placed in the temple. Emperor Qianlong, Yongzheng's successor, gave the temple imperial status is indicated with its turquoise tiles replaced by yellow tiles, which were reserved for the emperor. Subsequently, the monastery became a residence for large numbers of Tibetan Buddhist monks from Mongolia and Tibet, and so Yonghe Monastery has become a national center of Lama administration. The temple is said to have survived the Cultural Revolution because of the intervention of Prime Minister Zhou Enlai. It was opened to the public in 1981.

- **Summer Palace**

The Summer Palace, Yiheyuan in Chinese, is the most celebrated imperial garden in China. The garden came into existence early in the 1750s and had once been a summer resort for the emperors. It is acclaimed as a museum of gardens in China, for a visit to this garden bestow on sightseers a glimpse of representative scenes all over China.

Weather

Beijing lies in the continental monsoon region in the warm temperature zone and its climate represents as hot and rainy in summer and cold and dry in winter. The four seasons in Beijing are distinct. It is dry, windy and sandy in spring and hot and rainy in summer. August and September are the end of summer and the beginning of autumn in Beijing. This is the best season of the year when the sky is blue and clear; the air is crisp, mild and humid.Beijing features a four season, monsoon-influenced climate, typical of East Asia, with cold, windy, very dry winters reflecting the influence of the vast Siberian anticyclone, and hot, humid summers, due to the monsoon.

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
° F	25	30	43	57	68	75	79	77	68	55	41	28
° C	-4	-1	6	14	20	24	26	25	20	13	5	2

Transportation

All the registrants should make their own local transportation in the city. Travel by taxi is the most convenient and fastest option for the journey. Beijing is not only famous for charming natural scenery but also for large numbers of taxis and the cheapest taxis cost: RMB2.30 per km with base price RMB13.00! Please prepare some changes in advance for taxi fee or city bus cost in the staying in Beijing. Moreever, for your convenience, all taxis in Beijing now accept payment via WeChat Pay or Alipay.

It takes about 60 minutes by taxi from the Beijing Capital Airport to Beijing Empark Grand Hotel, the taxi fare is about RMB 120 (approx. US$20), tollgate fee is RMB10. Whenever you arrive at the airport, there are always many taxis waiting at the airport to pick up passengers. We suggest you wait for taxi at the airport designated taxi station (The middle lane outside Doors 5-9 on the first floor of Terminal 2 and the B1 level of Terminal 3). Please ask for a receipt with the taxi.

Ps： Traffic information about the Beijing Capital International Airport (北京首都国际机场) and Beijing Empark Grand Hotle (北京世纪金源大饭店) can refer Appendix.

Transportations from/to Airport

- From/to Beijing Capital International Airport (北京首都国际机场) to/From Beijing Empark Grand Hotel (北京世纪金源大饭店)

Route 1: You will take the Subway Capital Airport Line from/to Beijing Capital International Airport (北京首都国际机场) to/from Sanyuan Qiao station (三元桥站). Then transfer to Line 12 to/from Landian Chang Station and take the Exit D. Then, you can walk to Beijing Empark Grand Hotel (北京世纪金源大饭店).

Route 2: You will take taxi. the distance is about 37 km and you need to pay about 130 RMB.

- From/to Tian An Men Square (天安门广场) to/From Beijing Empark Grand Hotel (北京世纪金大饭店)

Route 4: You take Subway Line 1 at Tian'anmen Xi or Dong station(天安门西或东站) to Gongzhu Fen station (公主坟站) and change the Subway line 10 to Changchun Qiao station (长春桥站). Then change the Subway line 12 to Landian Chang station (蓝靛厂站) and take the Exit D. Then, you can walk to Beijing Empark Grand Hotel (北京世纪金源大饭店).

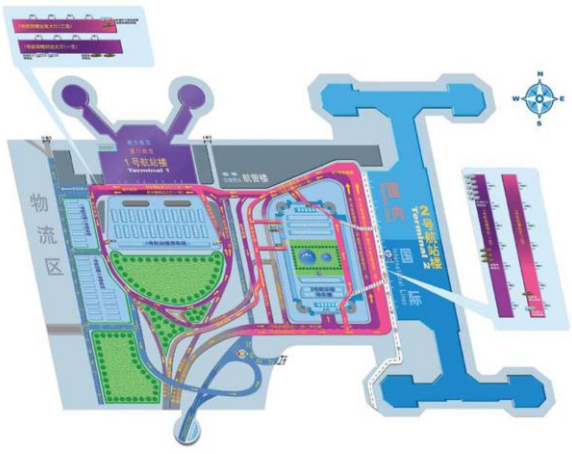
- From/to Wang Fu Jing (王府井) to/From Beijing Empark Grand Hotel (北京世纪金源大饭店)

Route 5: You take Subway Line 1 at Wangfujing station(王府井站) to Gongzhu Fen station (公主坟站) and change the Subway line 10 to Changchun Qiao station (长春桥站). Then change the Subway line 12 to Landian Chang station (蓝靛厂站) and take the Exit D. Then, you can walk to Beijing Empark Grand Hotel (北京世纪金源大饭店).

- From/to Summer Palace (颐和园) to/From Beijing Empark Grand Hotel (北京世纪金源大饭店)

Route 6: You take Subway Xijiao Line at Summer Palace Xi Men station(颐和园西门站) to Bagou station (巴沟站) and change the Subway line 10 to Changchun Qiao station (长春桥站). Then change the Subway line 12 to Landian Chang station (蓝靛厂站) and take the Exit D. Then, you can walk to Beijing Empark Grand Hotel (北京世纪金源大饭店).

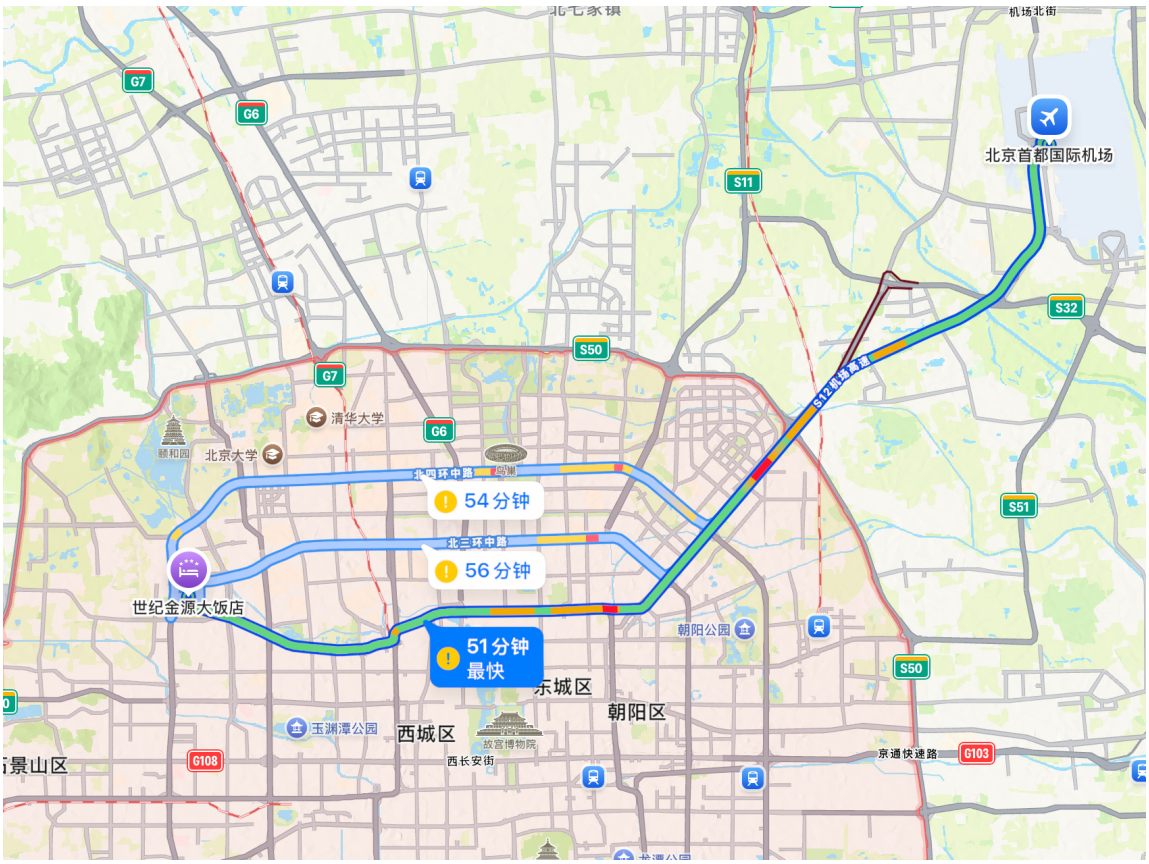
Appendix: Capital international Airport Terminals



Terminal 1 and Termina 2

Terminal 3

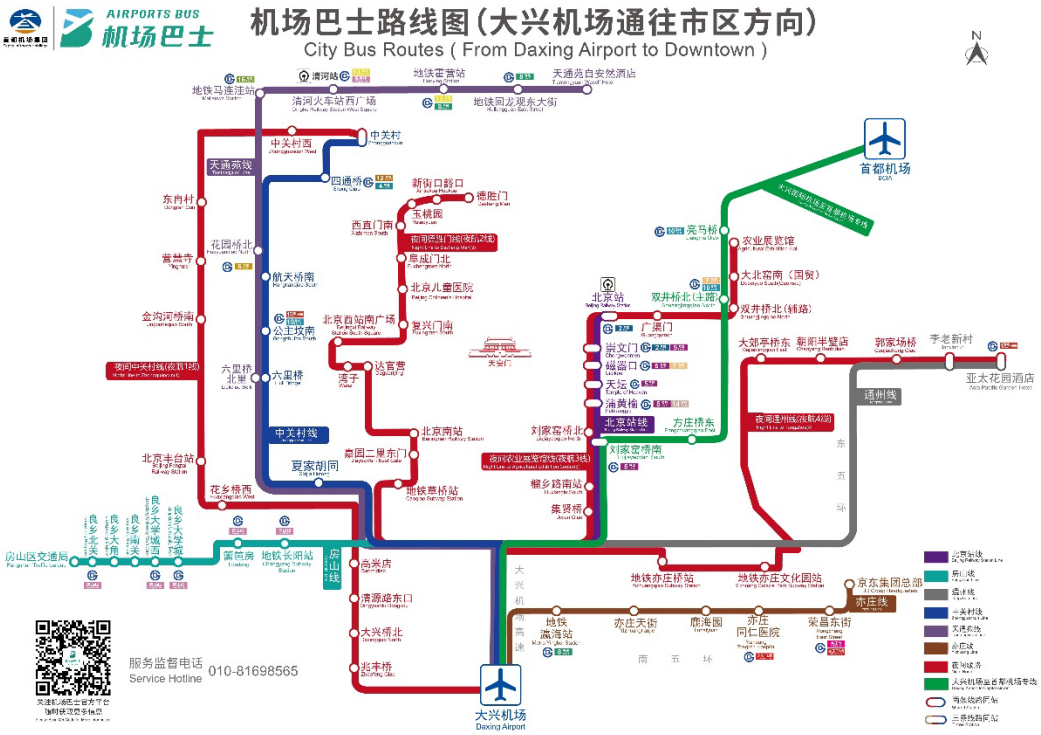
Beijing Subway

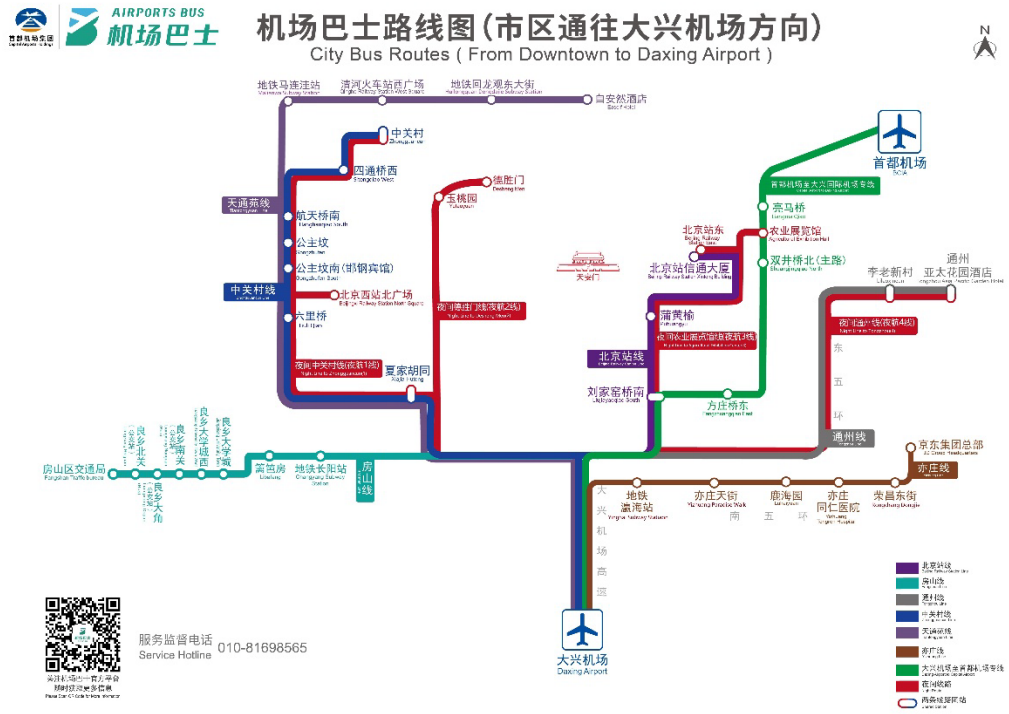


Location of Beijing Empark Grand Hotel

Daxing Airport (北京大兴机场) to hotel (58 km)

1. Taxi / e-hailing – it will take around 65 minutes on moderate traffic with an approximate cost of RMB 150.00.
2. Public transport – Board the Daxing Airport Metro Line (北京地铁大兴机场线) to Caoqiao station (草桥站). From Caoqiao station (草桥站) transfer to Metro Line 10 (北京地铁 10 号线) to Chedaogou station (车道沟站). Exit through Exit A (A 出口). Board Bus 360 （360 路公交车）and alight at Huangzhuang stop (黄庄站).





Useful Information

- **Language:** Official language is Mandarin and most people also use their local dialect. The standard spoken Chinese is Putonghua. English can be understood by many young people and is used in hotels and big restaurants. In all tourist hotels, staff can speak in English, Japanese and other languages. They can also write down addresses or instructions in Chinese for taxi drivers or others. In addition, roads in major cities are signposted in Pinyin, the official Romanization system of the Chinese characters, which makes it quite easy to get around with the help of a map.

- **Currency:** Renminbi (RMB) is the only currency to be used in China. RMB is also called Chinese Yuan. The unit of Renminbi is yuan and with smaller denominations called jiao. The conversion among the two is : 1 yuan =10 jiao. Paper notes are issued in denominations Aof 1, 5, 10, 20, 50 and 100 yuan. Coins are issued in denominations of 1 yuan; 5 jiao; 1 jiao.

  Money exchanges by cash or travel's cheques can be made at the branches of Bank of China at Beijing Capital International Airport, hotels and tourist stores. Please remember to keep the receipt to exchange back to foreign currency when leaving China.

- **Credit Cards:** Visa, Master Card and American Express are the most commonly used in China. Cards can be used in most middle to top-range hotels, department stores, but they cannot be used to finance your transportation costs.

- **Time:** GMT + 8 hours (the whole of China is set to Beijing time)

- **Electricity:** Electricity is 220 Volts, 50 AC; plugs can be three-pronged angled, three-pronged round, two flat pins or two narrow round pins.

- **Water:** Bottled mineral water can easily be bought in all stores and street kiosks for RMB 3. And sometimes hotels provide it free of charge. Furthermore, potable water is only available in a few 4 to 5 star hotels, while water in thermos flasks in rooms is usually non-potable tap water.

- **Measurement:** In Metric system

- **Tipping:** Tipping is not customary outside of the foreign joint-venture hotels and is officially discouraged. But hotel bellboys usually expect RMB 2-5 per bag.

- **Attention:** Smoking is prohibited in public places in Beijing, such as hospitals, office buildings, theatres, cinemas, museums, planes, and trains.

- **Hotlines:** 110 - Police 119 – Fire 120 – Ambulance

Conference Information

Conference Venue

IEEE ICMA 2025 will be held in the city of Beijing, at Beijing Empark Grand Hotel, which serves as both the official conference hotel and the venue for the technical program. Being a 5 star hotel, it is located in the west business district of Beijing and the east side of Zhongguancun with a total square area of 180000, the hotel features lobby, lobby lounge, tea house, business center, commodity department, cafeteria, bar, Japanese restaurant, Chinese Restaurant, conference rooms, banquet hall, executive floors, underground non-night city, satisfying every need of today's smart business and leisure travelers.

Chinese Address Cards

Beijing Empark Grand Hotel

北京世纪金源大饭店

地址：中国北京市海淀区板井路69号
Tel： 86-20 86009099

Conference Registration

A conference registration desk will be set up and opened at the Pre-Function Area of Beijing Empark Grand Hotel during the following hour:

August 3, 2025 13:00~18:30
August 4, 2025 07:30~12:00
August 4, 2025 12:00~18:30
August 5, 2025 08:00~18:00

Internet Access

Free internet access will be provided during the conference period, to the IEEE ICMA 2025 participants at the Conference Room of Beijing Empark Grand Hotel **(北京世纪金源大饭店)**. Broadband internet access services are also provided at the conference hotel for a fee. For the fee information, please contact the hotel you are staying directly.

Social Events

The social events organized by the IEEE ICMA 2025 include the conference reception, the awards banquet, the conference registration, etc.

Conference Reception

The Conference Reception will be held from 18:00 to 20:00 on August 3, 2025 in YuQuan Hall of Beijing Empark Grand Hotel**.** All the conference participants are welcome to join this event.

Awards Banquet

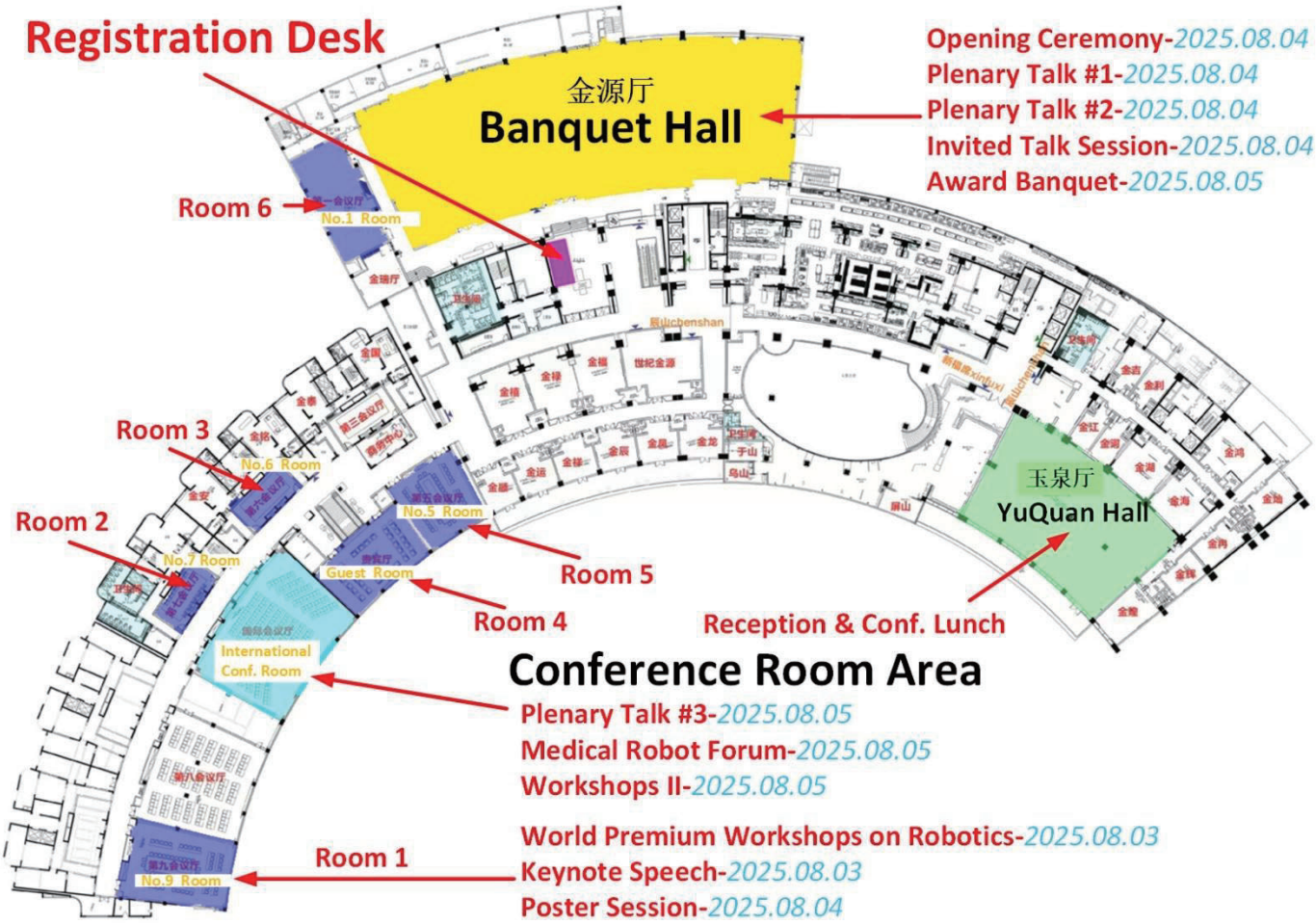
The Awards Banquet will be held from 18:30 to 21:00 on August 5, 2025 in Conference Banquet Hall of Beijing Empark Grand Hotel**.** All the conference participants are welcome to join this event.

IEEE ICMA 2025

Floor Map of Conference Rooms

Empark Grand Hotel, Beijing

Conference Room 1-6 and Banquet Hall



IEEE ICMA 2025 Conference

Plenary Talk 1

Intelligent Robotic System with Machine Learning

Toshio Fukuda, Ph.D.

Professor

Nagoya University, Japan

5Furo-cho, Chikusa-ku, Nagoya, Aichi

Postcode: 464-8601, Japan

E-mail t.fukuda@ieee.org

http://www.mein.nagoya-u.ac.jp/

Abstract:

Recent robot technology (RT) has made remarkable progress in both manufacturing and service sectors. Because of this RT advanced technology, there are growing demands to make robots work more friendly and flexible coordinated with human for service. There are many research and developing works undergoing for robot and human interaction, such as assistance and supports of human by robots in manufacturing, inspection and maintenance, entertainment, education, bio-medical applications, rehabilitation and techno-care of aged people. Robot is required to have the more flexibility and adaptation control to human behavior, more friendly robot and human interface, and estimation capability of human intention some way to make more proactive motion. There are a lot of problems to solve them with robotic sensor, actuator, control, communication and interface with human.

This talk is an overview of the Multi-scale robotics, based on the Cellular Robotics System, which is the basic concept of the emergence of intelligence in the multi-scale way from Organizational Level, Distributed robotics to Biological Cell engineering and Nano-robotics, which was proposed more than 30 years ago. It consists of many elements how the system can be structured from the individual to the group/society levels in analogy with the biological system. It covers with the wide range of challenging topics, but intelligent robotics is focused in this talk:

1. Distributed autonomous robotic system
2. Cooperation and competition of the multiple robotics system
3. Individual robot level, Brachiation Robots and Multi-locomotion robots,
4. Medical robotics and simulator,
5. Micro and nano robotics system
6. Bio analysis and bio-synthesis: bio-robotics system
7. Cyborg and Bionic System
8. Other systems.

Then I mainly focus on Robotics and AI and refer to applied areas for the future hybrid system to improve the quality of life of human.

Toshio Fukuda (M'83-SM'93-F'95) graduated from Waseda University, Tokyo, Japan in 1971 and received the Master of Engineering degree and the Doctor of Engineering degree both from the University of Tokyo, in 1973 and 1977, respectively. He studied at Graduate School of Yale University in 1973-1975. He joined the National Mechanical Engineering Laboratory in Japan in 1977, the Science University of Tokyo in 1982, and then joined Department of Mechanical Engineering, Nagoya University, Japan in 1989. He worked at University of Stuttgart, as Humboldt Fellow in 1979-1981.

He is Professor Emeritus of Nagoya University and Professor of Meijo University and Waseda University. He has been working as Professor of Shenyang University of

Technology, Suzhou University, Institute of Automation, Chinese Academy of Science, Russell Springer Chaired Professor at UC Berkeley, Seoul National University, Advisory Professor of Industrial Technological Research Institute in Taiwan and etc. He is a Foreign member of Chinese Academy of Sciences (2017).
He is mainly engaging in the research fields of intelligent robotic system, micro and nano robotics, bio-robotic system, and technical diagnosis and error recovery system.

He was the President of IEEE Robotics and Automation Society (1998-1999), Director of the IEEE Division X, Systems and Control (2001-2002), the Founding President of IEEE Nanotechnology Council (2002-2005), Region 10 Director (2013-2014), Director of Division X, Systems and Control (2017-2018) and IEEE President (2020). He was Editor-in-Chief of IEEE/ASME Trans. Mechatronics (2000-2002).

He was the Founding General Chair of IEEE International Conference on Intelligent Robots and Systems (IROS) held in Tokyo (1988). He was Founding Chair of the IEEE Conference on Nanotechnology(2001), IEEE Workshop on Robot and Human Communication (1994), IEEE Workshop on Advanced Robotics Technology and Social Impacts (ARSO, 2005), Founding Chair of the IEEE Workshop on System Integration International (SII, 2008), Founding Chair of the International Symposium on Micro-Nano Mechatronics and Human Science (MHS, 1990-2012), IEEE Conference on Cyborg and Bionic Systems(2017), IEEE Conference on Intelligence and Safety of Robots (2018).

He has received many awards such as IEEE Eugene Mittelmann Achievement Award (1997), IEEE Third Millennium Medal (2000) , Humboldt Research Prize (2003), IEEE Robotics and Automation Pioneer Award (2004), IEEE Transaction Automation Science and Engineering Googol Best New Application Paper Award (2007), George Saridis Leadership Award in Robotics and Automation (2009), IEEE Robotics and Automation Technical Field Award (2010). He received the IROS Harashima Award for Innovative Technologies (2011), Friendship Award of Liaoning Province PR China (2012), Friendship Award from Chinese Government (2014), JSME Achievement Award (2015), IROS Distinguished Service Award (2015) and Honor of Medal with the Purple Ribbon from Japanese Government (2015). Award from Automation Foundation (2016), Chunichi Culture Award (2019).

IEEE Fellow (1995). SICE Fellow (1995). JSME Fellow (2002), RSJ Fellow (2004), VRSJ Fellow (2011) and member of Science Council of Japan (2008-2014), and Academy of Engineering of Japan (2013-).

IEEE ICMA 2025 Conference

Plenary Talk 2

Model Driven Mechatronics in Medical Robot Design

Blake Hannaford, Ph.D.

Professor, Department of Electrical & Computer Engineering

Director, UW Biorobotics Lab

University of Washington

Seattle WA USA

https://www.ece.uw.edu/people/blake-hannaford

-xxx-

Abstract:

Development of robotic technology for medical application is a complex endeavor. Engineers with little or no formal medical training must understand highly evolved medical requirements as well as the state of the art in robotics engineering. The standard for accepting a new medical innovation prior to use in the clinic is extremely rigorous. In light of these challenges, even in the more relaxed constraints of research devices, model driven design and control engineering is required to supplement highly evolved and rigorously trained human skills. Lacking a general theory of models in medical robotics, this talk will introduce the use of models in medical robot system control and design through examples from the work of our students and collaborators.

Blake Hannaford received the B.S. degree in Engineering and Applied Science from Yale University in 1977, and the M.S. and Ph.D. degrees in Electrical Engineering from the University of California, Berkeley. From 1986 to 1989 he worked on the remote control of robot manipulators in the Man-Machine Systems Group in the Automated Systems Section of the NASA Jet Propulsion Laboratory, Caltech and supervised that group from 1988 to 1989. Since September 1989, he has been at the University of Washington in Seattle. He was awarded the National Science Foundation's Presidential Young Investigator Award, the Early Career Achievement Award from the IEEE Engineering in Medicine and Biology Society and was named IEEE Fellow in 2005.

He was at Google X / Google Life Sciences from April 2014 to December 2015. His currently active research interests include surgical robotics, surgical skill modeling, and haptic interfaces.

Blake Hannaford, Ph.D., is Director of Technical Programs and the University of Washington's, Global Innovation Exchange (GIX), and Professor of Electrical & Computer Engineering, Adjunct Professor of Bioengineering, Mechanical Engineering, and Surgery at the University of Washington.

IEEE ICMA 2025 Conference

Plenary Talk 3

Microrobotics and Nanomedicine: Future Directions in Medical Robotics

Bradley Nelson, Ph.D.

Professor, ETH Zurich

Head of Department of Mechanical and Process Eng.

Tannen Strasse 3, 8092 Zurich, Switzerland

ETH Zurich, Switzerland

Abstract:

While the futuristic vision of micro and nanorobotics is of intelligent machines that navigate throughout our bodies searching for and destroying disease, we have a long way to go to get there. Progress is being made, though, and the past decade has seen impressive advances in the fabrication, powering, and control of tiny motile devices. Much of our work focuses on creating systems for controlling micro and nanorobots as well as pursuing applications of these devices. As systems such as these enter clinical trials, and as commercial applications of this new technology are realized, radically new therapies and uses will result that have yet to be envisioned.

Prof. Bradley Nelson has been the Professor of Robotics and Intelligent Systems at ETH Zürich since 2002. He has over thirty years of experience in the field of robotics and has received a number of awards in the fields of robotics, nanotechnology, and biomedicine. He serves on the advisory boards of a number of academic departments and research institutes across North America, Europe, and Asia and is on the editorial boards of several academic journals. Prof. Nelson is the Department Head of Mechanical and Process Engineering at ETH and has been the Chairman of the ETH Electron Microscopy Center and a member of the Research Council of the Swiss National Science Foundation. He also serves on boards of three Swiss companies. Before moving to Europe, Prof. Nelson worked as an engineer at Honeywell and Motorola and served as a United States Peace Corps Volunteer in Botswana, Africa. He has also been a professor at the University of Minnesota and the University of Illinois at Chicago.

IEEE ICMA 2025 Conference

Keynote Speech

Nano-Tactile Sensors for Visualization of Texture: Achieving Super-Human Performance via Deep Learning

Hidekuni Takao, Ph.D.

Professor and Director

Nano/Micro Structure Device Integrated Research Center

Kagawa University

https://researchmap.jp/read0057664?lang=en

Abstract:

In this talk, recent advances in state-of-the-art tactile sensing technology for precise visualization of tactile textures are introduced. Using MEMS technology, we developed "nano-tactile sensors" that emulate human fingertip functionality, achieving tactile data acquisition at resolutions below 10 μm, significantly surpassing human sensitivity. By applying deep learning to high-density tactile data, we created a tactile sensing platform exceeding human perception. The sensors effectively distinguish tactile characteristics of materials such as metals and fabrics, enabling quantitative evaluation of hair cuticle structures for damage assessment and detailed hardness mapping of skin and tissues at approximately 100 μm resolution. Such data are invaluable for clinical diagnostics and healthcare applications. Additionally, deep learning algorithms detect subtle differences imperceptible to human touch. For example, the system identified 14 tissue paper types with over 95% accuracy and estimated market values within a 25% error margin, exemplifying "super-human" tactile capabilities. This advanced technology holds great promise as an innovative tool for various robotics applications, including medical, precision manufacturing, and caregiving fields.

Hidekuni Takao was born in Kagawa, Japan, in 1970, and received his Ph.D. from Toyohashi University of Technology in 1998. He is currently the Director and professor of the Nano-Microstructure Device Integration Research Center at Kagawa University. His research focuses on ultra-high-performance tactile sensors and their applications to pioneering new fields. He has been serving as the Principal Investigator of two JST-CREST projects since 2015. His contributions have been acknowledged through several awards, including the Commendation for Science and Technology by the Japanese Minister of Education, Culture, Sports, Science and Technology (2023), the CEATEC AWARD 2023 Grand-Prix (2023), and the 24th Yamazaki-Teiichi Prize (2024). In addition to his academic achievements, Prof. Takao actively serves the professional community as a Director of the Institute of Electrical Engineers of Japan (IEEJ) and the Chair of the IEEJ Shikoku Branch, and so on.

IEEE ICMA 2025 Conference

Invited Talk Session on Soft Mechatronics Systems

Monday, August 4, 2025
11:00 - 12:30
Jinyuan Banquet Hall
Beijing Empark Grand Hotel, Beijing, China

Venue: Jinyuan Banquet Hall
Beijing Empark Grand Hotel, Beijing

Date and Time: 11:00 - 12:30, August 4, 2025

Organizers:

Prof. Chengzhi Hu, Southern University of Science and Technology, China
Prof. Yajing Shen, Hong Kong Univ. of Science and Tech., Hong Kong SAR, China

About the invited Session:

This invited session will focus on the basic research and potential application of soft mechatronics systems. We invited five speakers to deliver talks, discuss the new research topics and challenge.

IEEE ICMA 2025 Conference

Invited Talk 1

Development of Bioinspired Dynamic Soft Robots

Aiguo Ming, Ph.D.

Professor

The University of Electro-Communications, Tokyo, Japan

mingag@uec.ac.jp

Abstract:

The evolution process for creatures is very, very long and contains many useful secrets and rationality mostly hidden in their structure, motion and configuration. Authors' group has been working on how to introduce creatures' structure and propulsion mechanism into soft robots to realize high mobility, efficient and creature like motions. The main challenge topic is how to design and control the soft robots with considering the synergetic coupling between soft structure and environment (air, water, etc.). In this talk, our basic approach toward the synergy will be introduced, and as the case studies some examples of the developed soft robots (fast caudal fin propulsion underwater robot, holonomic underwater robot using two-dimensional propulsion, very soft underwater robot, flapping robot with asymmetric and nonlinear structure, etc.) will be shown.

Short Bio

Aiguo Ming (Member, IEEE) received the Ph.D. degree in precision machinery engineering from The University of Tokyo, Tokyo, Japan, in 1990. He is currently a Professor with the Department of Mechanical Engineering and Intelligent Systems, The University of Electro-Communications (UEC), Chofu, Tokyo, Japan. His current research interests include biomimetic hyperdynamic robotics, soft robotics, intelligent robotic hands, and precise measurement systems.

IEEE ICMA 2025 Conference

Invited Talk 2

Magnetic Field Based Soft Tactile Sensor for Robot

Yajing Shen (申亚京) , Ph.D.

Associate Professor

the Department of Electronic and Computer Engineering

Director of Center for Smart Manufacturing

Hong Kong University of Science and Technology

Clear Water Bay, Kowloon, Hong Kong

Email: eeyajing@ust.hk

Lab: https://mirs.hkust.edu.hk/

Abstract:

The rapid advancement of robotics has significantly transformed various industries; however, achieving accurate tactile perception remains a formidable challenge. This talk discusses the development of a magnetic field-based soft tactile sensor, highlighting its potential applications in robotics. We will explore the underlying principles of the sensor's design, its operational mechanisms, and the experimental results that demonstrate its effectiveness in various scenarios. Furthermore, the talk will examine the implications of this technology for improving robotic interactions and functionality, paving the way for more sophisticated and responsive robotic systems.

Short Bio:

Prof. Yajing Shen is currently an Associate Professor in the Department of Electronic & Computer Engineering at The Hong Kong University of Science and Technology, Hong Kong, China. His mainly research interest is miniature intelligent robotic system, particularly in bioinspired miniature robotics and human-robot interaction. He has published more than 200 peer reviewed journal/conference papers, including the top multidisciplinary journal (e.g., Science Robotics, Science Advances, Nature Communications, PNAS), top specialized journal (e.g., IEEE Trans on Robotics), with widely fetched by international media, e.g., Associated Press, Thomson Reuters, etc. He received the Best Manipulation Paper Award in IEEE International Conference on Robotics and Automation (ICRA) in 2011, the IEEE Robotics and Automation Society Japan Chapter Young Award in 2011, the Early Career Awards of Hong Kong UGC in 2014, the Big-on-Small Award at MARSS in 2018, IEEE Distinguish lecture in 2019, CityU Outstanding Supervisor Award in 2020. He also received the “National Excellent Young Scientist Fund (Hong Kong & Macau)” for the topic “micro/nano robot” in 2019.

IEEE ICMA 2025 Conference

Invited Talk 3

Wireless Reliability Challenges in Gastrointestinal Ingestible Electronics

Hen-Wei Huang, Ph.D.

Assistant Professor

Nanyang Technological University

Email: henwei.huang@ntu.edu.sg

Website: https://dr.ntu.edu.sg/entities/person/Hen-Wei-Huang

Abstract:

Ingestible electronics offer a promising platform for rapid screening of gastrointestinal (GI) conditions, but robust wireless communication remains a core challenge. This talk highlights key electromagnetic constraints imposed by the GI environment, including high tissue attenuation, dynamic dielectric properties, and power limitations.
We evaluate signal propagation across sub-GHz to 6 GHz bands, showing that fluid-rich tissues and variable fat/muscle layers induce significant frequency-dependent loss. Local factors—such as pH (1–8), gastric volume, and intestinal content—shift antenna resonant frequency and degrade link reliability. Frequent reorientation of the capsule due to GI motility leads to severe misalignment losses, underscoring the importance of omnidirectional or orientation-resilient antenna design. High transmission power to overcome these effects is energy-inefficient for battery-constrained systems. We demonstrate that a PID controller can effectively reduce the power consumption while maintaining the RSSI and data through at a desired level.
By addressing frequency detuning, orientation variability, and tissue loading jointly, this talk outlines a path toward reliable, energy-efficient wireless links for next-generation ingestible diagnostics.

Short Bio

Dr. Hen-Wei Huang received his BS and MS in mechanical engineering from National Taiwan University, in 2011 and 2012, respectively. In 2018, he received his Ph.D. in robotics from ETH Zurich under the supervision of Prof. Bradley J. Nelson. His doctoral research focused on engineering soft reconfigurable micromachines that can emulate the locomotion and shape adaption to the local environments of their natural counterparts like Trypanosoma brucei and Caenorhabditis elegans. Before pursuing his Ph.D., he was an R&D engineer in a startup company developing a pocket-size cuffless blood pressure monitor from 2013 to 2014. He joined the MIT Langer Lab to conduct his postdoctoral research in 2018 where he was focusing on introducing robotics into controlled drug delivery to enable automated closed-loop therapies. He is also co-founder of AIO Therapeutics since 2021, focusing on using robotics to enhance patients' adherence to their medication. Before joining NTU Singapore, he was an Assistant Professor of the Department of Medicine at Harvard Medical School and an Associate Scientist at Brigham and Women’s Hospital since 2021. Currently, he is a Nanyang Assistant Professor at NTU, Singapore. He is also affiliated with the LKC Medicine. His current research interests involve robotics and AI for emergency medicine, therapeutic decision-making, and non-invasive diagnosis and treatment.

IEEE ICMA 2025 Conference

Invited Talk 4

Smart swarms at microscale: how tiny robots learn to work collectively

Hongri (Richard) Gu, Ph.D.

Assistant Professor

Hong Kong University of Science and Technology

Email: hongrigu@ust.hk

Website: https://guhongri.com/

Abstract:

Nature abounds with small bodies achieving outsized feats—ants lift prey many times their mass and kinesin motors haul vesicles through the cytoskeleton. Translating these cooperative principles to the micrometer scale, however, demands new control paradigms that can cope with Brownian noise, tight physical coupling, and severe hardware constraints. Here I present a laser-controlled swarm of up to 200 Janus microrobots (6 μm diameter) whose individual actions are optimized by multi-agent reinforcement learning (MARL). A counterfactual reward scheme quantifies each robot's marginal contribution by virtually "removing" it from the team at every timestep; this credit-assignment strategy eliminates the "lazy agent" problem, accelerates training, and yields robust collective policies despite thermal disturbances and unpredictable cargo–robot interactions. The learned policy enables the swarm to gather, align, and transport rod-shaped loads an order of magnitude heavier than a single robot while adaptively reconfiguring when units are lost. By fusing bio-inspired mechanics with learning-based autonomy, we take the next step toward microrobotic collectives that think, cooperate, and ultimately transport drugs inside the human body.

Short Bio

Hongri (Richard) Gu is currently an assistant professor at division of Integrated System and Design (ISD), Hong Kong University of Science and Technology (HKUST).

He studied mechatronic engineering at Zhejiang University from 2009 to 2014. During his Bachelor's program, he joined Young Scientist Exchange Program at the Tokyo Institute of Technology from 2012 to 2014. Later he started the Master's program in Micro and Nano System at ETH Zurich and finished in 2016. From 2017 to 2021, he performed doctoral research at Multi-Scale Robotics Lab, ETH Zurich under Prof. Brad Nelson. From 2022 to 2024, He did his postdoc at Department of Physics, University of Konstanz, Germany.

His research focuses on developing structured magnetic materials and robotic systems for future disruptive medical technologies, through investigating the multi-scale physiological transport and inventing new medical devices and surgical tools.

IEEE ICMA 2025 Conference

Invited Talk 5

Efficient Active Perception and Mobile Manipulation with Autonomous Robots

Boyu Zhou, Ph.D.

Assistant Professor

Southern University of Science and Technology

zhouby@sustech.edu.cn

robotics-star.com

Abstract:

In recent years, unmanned aerial vehicles (UAVs) have garnered significant attention due to their high flexibility and mobility. This talk will present research on UAVs in the areas of active perception and mobile manipulation, with applications in inspection and logistics. First, we will introduce methods for autonomous drones to efficiently explore unknown environments, including advancements in real-time planning, efficient environmental representation, and swarm collaboration. Next, we will discuss the challenges of coverage and reconstruction in complex 3D scenes, presenting prediction-enhanced real-time coverage planning methods and heterogeneous drone collaboration strategies. Finally, we will explore recent advancements in transportation, delivery, and mobile manipulation.

Short Bio

Boyu Zhou is an Assistant Professor (Associate Researcher) at the Southern University of Science and Technology (SUSTech), where he serves as the Director of the Smart Autonomous Robotics (STAR) group. Boyu obtained his Ph.D. degree from the Aerial Robotics Group, Robotics Institute, at the Hong Kong University of Science and Technology in 2022, where he was awarded the HKUST Academic Excellence Award. He received his B.Eng. degree from Shanghai Jiao Tong University in 2018, graduating as an Outstanding Graduate in Shanghai. His research interests encompass aerial and mobile robots, motion planning, autonomous exploration, dense mapping, 3D reconstruction, and multi-robot systems. Boyu has published papers in prestigious robotics journals and conferences, including TRO, RAL, ICRA, IROS. His team's work has been recognized with the 2023 IEEE Transactions on Robotics Best Paper Award, the 2023 IEEE RAL Best Papar Award, and was a finalist for the 2024 IEEE ICRA Best Paper Award on Unmanned Aerial Vehicles. His publications have been listed as popular papers in TRO and RAL, with the highest ranking of No. 1. The research results have been reported by well-known technology media, such as IEEE Spectrum, Tech Xplore, etc.

IEEE ICMA 2025 Conference Workshop

World Premium Workshops on Robotics

Sunday, August 3, 2025
13:30 - 15:40
Room 1 (No.9 Room)
Beijing Empark Grand Hotel, Beijing, China

Robotics for Automated Garment Production

Venue: Room 1 (No.9 Room)
Beijing Empark Grand Hotel, Beijing

Date and Time: 13:30 - 15:40, August 3, 2025

Organizers:

Prof. Kazuhiro Kosuge, Director, JC STEM Lab of Robotics for Soft Materials, Chair Professor of Robotic Systems, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, Deputy Managing Director, Centre for Transformative Garment Production, Hong Kong SAR

About the workshop:

This workshop investigates the application of intelligent automation to solve enduring challenges in garment production. We will delve into how AI-powered perception and control are enabling robots to dexterously handle, align, and sew fabric plies in a fixture-less environment, paving the way for more flexible and resilient apparel supply chains.

The research presented at this workshop was supported in part by the Innovation and Technology Commission of the HKSAR Government under the InnoHK initiative and conducted in part at the JC STEM Lab of Robotics for Soft Materials, The University of Hong Kong, funded by The Hong Kong Jockey Club Charities Trust.

List of Speakers and Schedule

Time	Topics	Speaker List
13:30-13:40	Welcome Speech	Prof. Kazuhiro Kosuge Chair Professor of Robotic Systems JC STEM Lab of Robotics for Soft Materials Department of Electrical and Electronic Engineering The University of Hong Kong, Hong Kong SAR Deputy Managing Director, Centre for Transformative Garment Production, Hong Kong SAR
13:40-13:52	Fabric Handling End-effector by Rolling-up	Dr. Akinari Kobayashi Research Officer, Centre for Transformative Garment Production, Hong Kong SAR Visiting Research Associate, JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR
13:52-14:04	Destacking of Fabric Parts Using Passive Actuator-Less Gripper (PALGRIP)	Dr. Akira Seino Research Officer, Centre for Transformative Garment Production, Hong Kong SAR Visiting Research Associate, JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR
14:04-14:16	Bridging Control and Learning: A Hierarchical Robotic Sewing System	Kai Tang (PhD Student) JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR Centre for Transformative Garment Production, Hong Kong SAR
14:16-14:28	Automated Sewing of Elastic Fabric with Different Length	Bingchen Jin (PhD Student) JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR Centre for Transformative Garment Production, Hong Kong SAR
14:28-14:40	Break and Discussion	
14:40-14:52	CNN-based Visual Servoing for Flattening of Fabric Parts	Dr. Fuyuki Tokuda Research Officer, Centre for Transformative Garment Production, Hong Kong SAR Visiting Research Associate, JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR

14:52-15:04	Precise Top-Layer Fabric Segmentation and a Novel Fabric Alignment System	Wenbo Dong (PhD Student) JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR Centre for Transformative Garment Production, Hong Kong SAR
15:04-15:16	Mesh-based Fabric State Estimation and Manipulation	Dr. Dipankar Bhattacharya Senior Research Engineer (Postdoctoral Fellow), Centre for Transformative Garment Production, Hong Kong SAR Visiting Research Associate, JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR
15:16-15:28	Garment Unfolding Strategy Using Structural Information	Xuzhao Huang (PhD Student) JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR Centre for Transformative Garment Production, Hong Kong SAR
15:28-15:40	Fabric Piece Dynamic Motion Planning	Letian Li (PhD Student) JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR Centre for Transformative Garment Production, Hong Kong SAR

IEEE ICMA 2025 Conference
Robotics for Automated Garment Production
Workshop Talk 1
Fabric Handling End-effector by Rolling-up

Akinari Kobayashi and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.
JC STEM Lab of Robotics for Soft Materials
Department of Electrical and Electronic Engineering
The University of Hong Kong, Hong Kong SAR.; E-mail: akinari.kobayashi@transgp.hk

Abstract:

Robotic manipulation of deformable materials like fabric is challenging due to their tendency to wrinkle and deform. To maintain a flat state, fabric requires either controlled tension or full support. We address this challenge with a novel robotic end-effector that grasps fabric by rolling it. The end-effector features a roller with integrated suction, which first secures the fabric's edge and then smoothly rolls it up, preventing wrinkles. We integrated these end-effectors into a dual-arm robotic system with force sensors, enabling bimanual handling with active tension control to keep the fabric taut. Performance was evaluated through pick-and-place experiments on stacked fabric pieces. The results demonstrate that our system achieves precise and reliable fabric manipulation, showing significant potential for automating tasks in industries like apparel manufacturing.

Dr. Akinari Kobayashi received the B.S. and M.S. degree in Engineering from Tohoku University, Sendai, Japan, in 2013, 2017, respectively. He received the Ph.D. degree in Engineering from Tohoku University, Sendai, Japan, in 2020. He has been serving as a Research Officer at the Centre for Transformative Garment Production, Hong Kong SAR, since 2021 and a Visiting Research Associate at the University of Hong Kong from 2022. This work is also supported in part by the JC STEM Lab of Robotics for Soft Materials funded by The Hong Kong Jockey Club Charities Trust. His research focuses on robot hands, robotic manipulation, and robot sewing.

IEEE ICMA 2025 Conference

Robotics for Automated Garment Production

Workshop Talk 2

Destacking of Fabric Parts Using Passive Actuator-Less Gripper (PALGRIP)

Akira Seino and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: akira.seino@transgp.hk

Abstract:

The automation of fabric destacking and pick-and-place operations is critical for textile manufacturing. Conventional grasping solutions, such as parallel, suction, or needle-based grippers, are fundamentally limited by their reliance on active actuation and external power sources. This paper presents the Passive Actuator-Less Gripper (PALGRIP), a novel, fully mechanical end-effector for fabric manipulation. PALGRIP utilizes a compliant internal mechanism that is triggered by the application of a simple compressive force, enabling it to grasp a single fabric ply without requiring any onboard power or tethered supplies. By virtue of its passive, power-free design, PALGRIP facilitates low-cost, simplified system integration, presenting a significant advancement in accessible automation for the textile industry.

Dr. Akira Seino received the B.S. degree in Engineering from the Department of Mechanical System Engineering at Yamagata University, Japan, in 2014, and the M.S. and Ph.D. degrees in Engineering from the Department of Bioengineering and Robotics and the Department of Robotics at Tohoku University, Japan, in 2016 and 2019, respectively. From 2019 to 2021, he was a Project Assistant Professor in the Faculty of Symbiotic Systems Science at Fukushima University, Japan. He is a Research Officer at Centre for Transformative Garment Production, Hong Kong SAR, and Visiting Research Associate in the Department of Electrical and Electronics Engineering at The University of Hong Kong, Hong Kong SAR.

IEEE ICMA 2025 Conference

Robotics for Automated Garment Production

Workshop Talk 3

Bridging Control and Learning: A Hierarchical Robotic Sewing System

Kai Tang and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: tangkai@eee.hku.hk

Abstract:

This work introduces a hierarchical system architecture for robotic sewing that synergizes deep learning-based perception with modern control theory. The proposed architecture consists of five layers: perception, dual-arm sewing Petri net, fundamental operations, control primitives, and hardware layers. This architecture features two key contributions. First, a perception layer with our novel High-speed Fabric Edge Detection System (Hi-FEDS), which formulates edge detection as a classification problem and achieves a state-of-the-art inference speed of more than 120 FPS with about 1-pixel error. Second, a control primitive layer where sewing kinematics are modeled as a non-holonomic process, precisely linearized via time-scaling, and managed by a model-based feedback controller. This framework enables the decomposition of complex sewing commands into a sequence of fundamental operations that are robustly executed in real-time. Experimental validation across various materials and shapes confirms the system's high performance and practical viability.

Kai Tang received his B.Sc. degree in Process Equipment and Control Engineering from South China University of Technology (SCUT), Guangzhou, China, in 2020, and his M.Sc. degree in Control System (Distinction) from Imperial College London (ICL), London, United Kingdom, in 2021. He is currently towards his Ph.D. degree at JC STEM Lab of Robotics for Soft Materials, the Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR. He is involved in the Centre for Transformative Garment Production, Hong Kong SAR. His research focuses on robotics manipulation and sewing, control engineering, and deep learning.

IEEE ICMA 2025 Conference
Robotics for Automated Garment Production
Workshop Talk 4
Automated Sewing of Elastic Fabric with Different Length

Bingchen Jin and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: bcjin@connect.hku.hk

Abstract:

Automating Different Length Alignment Sewing (DLAS)—the task of stretching a shorter fabric piece to match a longer one during sewing—presents significant challenges in tension control and handling. We have developed a novel robotic system to address this, consisting of a 6-DoF manipulator equipped with a custom roller end-effector and a real-time sewing speed sensor. The system executes a four-phase process: it first picks up and wraps the fabric layers onto its rollers, then dynamically controls the roller velocity during sewing to achieve the required stretch based on live speed feedback and a predefined length ratio. The end-effector is specifically designed to prevent slippage as the seam is completed. This integrated approach successfully automates the entire DLAS workflow, demonstrating a robust solution for a challenging industrial sewing task.

Bingchen Jin received his B.Sc. degree in Mechanics and Electronics Engineering from Jiangsu University, China, in 2015, and his M.Sc. degree in Mechanical Engineering from Harbin Institute of Technology (Shenzhen), in 2018. He is currently towards his Ph.D. degree at the Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR. He is involved in the Centre for Transformative Garment Production, Hong Kong SAR. His research focuses on robotics manipulation, and artificial intelligence.

IEEE ICMA 2025 Conference
Robotics for Automated Garment Production
Workshop Talk 5
CNN-based Visual Servoing for Flattening of Fabric Parts

Fuyuki Tokuda and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: fuyuki.tokuda@transgp.hk

Abstract:

This work presents a CNN-based visual servoing framework for the simultaneous positioning and flattening of a deformable fabric part on a table using a dual-arm manipulator system. We introduce a neural network that integrates multimodal data, combining grayscale images from a camera with force/torque measurements obtained from wrist-mounted sensors. The network is trained on a dataset collected from real-world manipulator movements, allowing it to learn a mapping from visual and force information to end-effector motions in Cartesian space. To enhance the visibility of surface features on non-textured fabrics, structured lighting is employed, addressing the limitations of grayscale imaging alone. Experimental results demonstrate that our method can successfully manipulate and flatten fabric pieces with previously unseen wrinkles using the proposed visual servoing approach.

Dr. Fuyuki Tokuda received the B.S. degree in Engineering from Nagoya Institute of Technology, Nagoya, Japan, in 2017, and the M.S. and Ph.D. degrees in engineering from Tohoku University, Sendai, Japan, in 2019 and 2022, respectively. From 2022 to 2023, he was a Post-Doctoral Fellow at the Centre for Transformative Garment Production, Hong Kong SAR, which was established by the collaborative research between the University of Hong Kong and Tohoku University. He is a Research Officer at the Centre for Transformative Garment Production, Hong Kong SAR, from 2023, and a Visiting Research Associate at the University of Hong Kong, Hong Kong SAR, from 2022. He received an Outstanding Presentation Award from SICE Tohoku 55th Anniversary Conference in 2020, a research fellowship from the Tohoku University Graduate Program for Integration of Mechanical Systems in 2018, a research fellowship from Japan Society for the Promotion of Science (JSPS) in 2021. His research focuses on robot vision, visual feedback control, robotic assembling, and robotic sewing.

IEEE ICMA 2025 Conference

Robotics for Automated Garment Production

Workshop Talk 6

Precise Top-Layer Fabric Segmentation and a Novel Fabric Alignment System

Wenbo Dong and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail:

Abstract:

Automated garment production presents significant challenges in the perception and handling of deformable fabrics, particularly in tasks requiring precise segmentation and alignment. This work presents a dual-component solution for two critical tasks: de-stacking and alignment. First, we introduce a novel deep learning framework for segmenting the topmost fabric layer from a stack. To overcome the visual ambiguity between layers, our model enhances a standard encoder-decoder architecture with two specialized branches: edge-aware branch and shape-aware branch guided by CAD. Second, we developed an automated alignment system that integrates localization and manipulation. This system employs an ICP-based registration method that jointly uses global contours and local sewing lines to determine fabric pose with high accuracy, even with shape irregularities. Quantitative evaluations and experiments with real fabrics demonstrate significantly improvement, contributing to a more robust and precise automation pipeline for garment manufacturing.

Wenbo Dong received his B.Sc. degree in Automation from Northeastern University, Shenyang, China, and his M.Sc. degree in Control Engineering from Harbin Institute of Technology, China, in 2017. He received a second M.Sc. degree in Mechanical Engineering from the University of California, Riverside, USA, in 2022. He is currently pursuing his Ph.D. degree at the JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR. He is also affiliated with the Centre for Transformative Garment Production, Hong Kong SAR. His research interests include robotic manipulation and robotic perception.

IEEE ICMA 2025 Conference
Robotics for Automated Garment Production
Workshop Talk 7
Mesh-based Fabric State Estimation and Manipulation

Dipankar Bhattacharya, Kai Tang and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: d.bhattacharya@transgp.hk

Abstract:

Estimating the state of crumpled cloth is a major challenge for robotic manipulation due to its high dimensionality and frequent self-occlusion. To tackle this, we propose a novel two-stage method for reconstructing a high-fidelity, explicit mesh from a single viewpoint. First, we use a template-based model, trained entirely in simulation, to generate an initial mesh from a top-down depth image. Unlike implicit representations, this explicit mesh directly encodes vertex positions and visibility. Second, to bridge the sim-to-real gap, we introduce a refinement stage that leverages deformable 3D Gaussian Splatting (GS) and differentiable rendering to fine-tune the mesh using real-world RGB images. The resulting accurate state representation enables both single and dual-arm manipulation strategies to achieve desired cloth configurations, demonstrating a robust solution for complex cloth handling tasks.

Dr. Dipankar Bhattacharya is currently a Senior Research Engineer (Postdoctoral fellow) at the Center for Transformative Garment Production (TransGP). He was awarded the Marie Skłodowska-Curie Postdoctoral Fellowship (2025–2027) and will be hosted at Imperial College London, UK. Previously, he was a Postdoctoral Fellow at The Chinese University of Hong Kong, where he worked on cable-driven parallel robots. He received his Ph.D. degree in Mechatronics Engineering from the Department of Mechanical and Mechatronics Engineering, The University of Auckland (UoA), New Zealand, in 2021. He obtained his M.Tech degree in Systems and Control from the Department of Electrical Engineering, Indian Institute of Technology (IIT), in 2013. He received his B.Tech degree in Electronics and Communication Engineering from the North Eastern Regional Institute of Science and Technology (NERIST) in 2010.

IEEE ICMA 2025 Conference
Robotics for Automated Garment Production
Workshop Talk 8
Garment Unfolding Strategy Using Structural Information

Xuzhao Huang and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: x.z.huang@connect.hku.hk

Abstract:

Garment seams contain critical information for robotic manipulation. We leverage this information in a novel Seam-Informed Strategy (SIS) for unfolding garments. Our method first identifies all potential grasp points along seams using a specialized feature extractor. From these candidates, it selects the optimal grasp pair for a dual-arm robot using a decision matrix. This matrix is uniquely trained through a combination of human demonstrations and is iteratively refined based on the robot's execution feedback. Crucially, our entire framework is trained on real-world data, avoiding any reliance on simulation. Experiments demonstrate that this seam-informed approach is highly effective and generalizes well across various garments and initial crumpled states, providing a robust solution for real-world automation.

Xuzhao Huang received his B.Eng. degree in mechanical design, manufacturing, and automation from Xiamen University, Xiamen, China, in 2018, and his M.Eng. degree in mechatronics engineering from the Harbin Institute of Technology, Shenzhen, China in 2021. He is currently pursuing his Ph.D. degree at JC STEM Lab of Robotics for Soft Materials, the Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR. He is involved in the Centre for Transformative Garment Production, Hong Kong SAR. His research interests include learning-based visual perception, robotic manipulation strategies, and manipulation planning for deformable objects.

IEEE ICMA 2025 Conference
Robotics for Automated Garment Production
Workshop Talk 9
Fabric Piece Dynamic Motion Planning

Letian Li and Kazuhiro Kosuge

Centre for Transformative Garment Production, Hong Kong SAR.

JC STEM Lab of Robotics for Soft Materials

Department of Electrical and Electronic Engineering

The University of Hong Kong, Hong Kong SAR.; E-mail: letian.li@connect.hku.hk

Abstract:

Planning collision-free motion for deformable fabrics is a significant hurdle in robotics, as their complex and unpredictable dynamics defy accurate analytical modeling. Instead of attempting to create an intractable physics-based model, we propose a pragmatic, data-driven approach. Our system first abstracts the fabric's complex state from a segmented point cloud into a simplified geometric representation. We then introduce a novel neural network architecture specifically designed to predict the time-series evolution of this approximated state. This predictive model is integrated into a motion planner, which generates robot trajectories that proactively avoid collisions between the fabric and obstacles. Experimental validation under various obstacle configurations demonstrates that our system achieves reliable, real-time collision avoidance, offering a practical solution for safe fabric handling in cluttered industrial environments.

Letian Li received the B. Eng. degree in detection, guidance, and control technology and the M. Eng. degree in instrumentation science and technology from the School of Instrumentation and Optoelectronic Engineering, Beihang University, Beijing, China, in 2019 and 2022, respectively. He is currently pursuing the Ph.D. degree in robotics with JC STEM Lab of Robotics for Soft Materials, Department of Electrical and Electronic Engineering, Faculty of Engineering, The University of Hong Kong, Hong Kong SAR, China. He is engaged in collaborative research with the Centre for Transformative Garment Production, Hong Kong SAR, China. His research interests include motion planning and learning.

IEEE ICMA 2025 Conference Forum

World Premium Forum on Medical Robotics

Tuesday, August 5, 2025
9:30 - 10:45

International Conference Room, 2F
Beijing Empark Grand Hotel, Beijing, China

Medical Robotics and its Real-world Applications: State of the Art and Challenge

Organizers:

Shuxiang Guo, SUStech and Beijing Institute of Technology, Beijing, China
Yili Fu, Harbin Institute of Technology, Harbin, China

About the Forum:

Medical Robotics is significantly changing the way people live and Medicine and healthcare Style. Robots are being widely employed for personal assistance, healthcare, extreme environment applications, etc. In the 2nd World Premium Forum on Medical Robotics, we assembled a group of Academic professors and Industry leaders, who are the key members of IEEE ICMA Conference, have been pursuing cutting-edge research on medical robotics for universal manipulation, operation surgery and health promotion. From their experience and discoveries, the state of the art in medical robotics and its application will be introduced and presented.

Forum host 论坛主持人

Prof. Yili Fu, Harbin Institute of Technology,

Vice Director of the State Key Laboratory of Robotics and Systems, China

哈尔滨工业大学 付宜利教授，机器人技术与系统国家重点实验室副主任

Forum panelist 论坛讨论人

Dr.Jian Guo, CEO, Shenzhen Institute of Advanced Biomedical Robot Co., Ltd

郭健 博士，深圳爱博合创医疗机器人有限公司总经理

Dr.Yiling Zhang, Chairman， Beijing Longwood Valley Medtech Co., Ltd

张逸凌 博士，北京长木谷医疗科技股份有限公司，董事长

Dr. Lan Qin, Founder, Chairman & CEO, UnionStrong (Beijing) Technology Co., Ltd.

秦岚 博士，强联智创（北京）科技有限公司 创始人、董事长、总经理

Dr. Yongxiang Zou

Distinguished Researcher, Ruihong'an(Guangdong) Science Equipment Co., Ltd.

邹永向 博士，瑞鸿安（广东）科学设备有限公司 意大利 OT 特约专家

Dr. Bin Wang, Director of the Interventional Vascular Department

The Aerospace Center Hospital, China

王斌 博士，航天中心医院 介入血管科主任

Beijing Institute of Technology

Dr. Jian Yang, Beijing Institute of Technology (BIT)。
The National Science Fund for Distinguished Young Scholars,
Chief Scientist of the National Key Research and Development Program.

杨健 教授，北京理工大学二级教授

国家杰出青年科学基金获得者，国家重点研发计划项目首席科学家

IEEE ICMA 2025 Conference Workshop II

Workshop on OT high-density electromyography and its application technology

Tuesday, August 5, 2025
11:00 - 12:00
International Conference Room
Beijing Empark Grand Hotel, Beijing, China

Application of OT high-density electromyography in intelligent robot technology

Venue: International Conference Room
Beijing Empark Grand Hotel, Beijing

Date and Time: 11:00 - 12:00, August 5, 2025

Organizers:

Ruihong'an (Guangdong) Scientific Equipment Co., Ltd. currently acts as an agent for Italian OT Bioelettronicar high-density electromyography. OT's high-density electromyography, wireless surface electromyography, dynamic high-density electromyography acquisition and analysis equipment has published over 1000 papers in more than 200 academic journals, including top international scientific journals such as Nature and Science, fully demonstrating its outstanding performance and wide recognition in the field of bioelectric signal research.

About the workshop:

The work shop Mainly exploring the application of high-density electromyography acquisition equipment in intelligent automation. We will conduct in-depth research on motion intention perception and on-demand assistance technology based on multimodal signals (such as high-density electromyography), which has important application value in fields such as rehabilitation medicine, intelligent prosthetics, and exoskeleton robots. The growing prevalence of physical disabilities has driven the demand for advanced prosthetic devices. Grip force estimation plays a crucial role in controlling prosthetic hands during various activities of daily living for amputees. Recent advances in sEMG-based grip force estimation have demonstrated their potential to improve prosthetic hand control.

List of Speakers and Schedule

Time	Topics	Speaker List
11:00-11:30	Motion intention perception and on-demand assistance based on multimodal signals such as electromyography 基于肌电等多模态信号的运动意图感知与按需辅助	Dr. Zou Yongxiang Dr. Zou Yongxiang, Assistant Researcher of State Key Laboratory of Automation, Institute of Automation, Chinese Academy of Sciences. His main research interests are human-computer interaction control and rehabilitation evaluation in the field of medical robots, with a focus on the integration of biomechanical electrical signals. He has been selected as a national funded postdoctoral researcher program, a general postdoctoral fund, and a cutting-edge project of the Beijing Natural Science Foundation. He participated in two key research and development projects funded by the Ministry of Science and Technology.
11:30-12:00	Cross arm posture and adversarial learning grip strength estimation based on high-density electromyography 基于高密度肌电的跨手臂姿势与对抗学习握力估计	Dr. Liao Xiaolan Dr. Liao Xiaolan is from the Tianjin Key Laboratory of Intelligent Robotics at the School of Artificial Intelligence, Nankai University. Her main research areas include human-computer interaction of biological, mechanical, and electrical signals, intelligent diagnosis and treatment, and rehabilitation assistance technology. Participated in one national key research and development project.

IEEE ICMA 2025 Conference

Workshop II on OT high-density electromyography and its application technology

Workshop II Talk 1

Motion intention perception and on-demand assistance based on multimodal signals such as electromyography

Dr. Zou Yongxiang

Assistant Researcher, State Key Laboratory of Automation, Institute of Automation,

Chinese Academy of Sciences, China

Abstract:

Motion intention perception and on-demand assistance technologies hold significant application value in fields such as rehabilitation medicine, intelligent prosthetics, and exoskeleton robotics. These technologies can notably improve the mobility of individuals with functional impairments or enhance the motor performance of healthy individuals. Surface electromyography (sEMG), as a core biological signal source for decoding motion intention, directly reflects neuromuscular activity. To overcome limitations such as noise interference and incomplete representation of single-mode sEMG signals in complex dynamic scenarios, the integration of multimodal information and deep learning-based robust intention recognition methods has become a research hotspot. Based on accurately perceived user intentions, adaptive impedance control strategies can be employed to dynamically adjust the assistive torque of exoskeletons/prosthetics, thereby ensuring the further realization of "human-in-the-loop" personalized on-demand assistance.

Dr. Zou Yongxiang, Assistant Researcher of State Key Laboratory of Automation, Institute of Automation, Chinese Academy of Sciences. His main research interests are human-computer interaction control and rehabilitation evaluation in the field of medical robots, with a focus on the integration of biomechanical electrical signals. He has been selected as a national funded postdoctoral researcher program, a general postdoctoral fund, and a cutting-edge project of the Beijing Natural Science Foundation. He participated in two key research and development projects funded by the Ministry of Science and Technology.

IEEE ICMA 2025 Conference

Workshop on OT high-density electromyography and its application technology

Workshop II Talk 2

Cross arm posture and adversarial learning grip strength estimation based on high-density electromyography

Dr. Liao Xiaolan

Tianjin Key Laboratory of Intelligent Robotics, School of Artificial Intelligence,

Nankai University, China

Abstract:

Robotic manipulation of deformable materials like fabric is challenging due to their tendency to wrinkle and deform. To maintain a flat state, fabric requires either controlled tension or full support. We address this challenge with a novel robotic end-effector that grasps fabric by rolling it. The end-effector features a roller with integrated suction, which first secures the fabric's edge and then smoothly rolls it up, preventing wrinkles. We integrated these end-effectors into a dual-arm robotic system with force sensors, enabling bimanual handling with active tension control to keep the fabric taut. Performance was evaluated through pick-and-place experiments on stacked fabric pieces. The results demonstrate that our system achieves precise and reliable fabric manipulation, showing significant potential for automating tasks in industries like apparel manufacturing.

Dr. Liao Xiaolan is from the Tianjin Key Laboratory of Intelligent Robotics at the School of Artificial Intelligence, Nankai University. Her main research areas include human-computer interaction of biological, mechanical, and electrical signals, intelligent diagnosis and treatment, and rehabilitation assistance technology. Participated in one national key research and development project.

IEEE ICMA 2025
Program at a Glance

August 3-6, 2025

Beijing Empark Grand Hotel, Beijing, China

https:// en.empark.com.cn/

Sunday, August 3, 2025	
13:30 - 18:30	Registration Desk Open
13:30 - 15:40	World Premium Workshops on Robotics Organized by Prof. Prof. Kazuhiro Kosuge, The University of Hong Kong
16:00 - 17:00	Keynote Speech (Prof. Hidekuni Takao)
18:00 - 20:00	Reception
Monday, August 4, 2025	
08:30 - 09:00	Opening Ceremony
09:00 - 09:50	Plenary Talk 1 (Prof. Toshio Fukuda)
09:50 - 10:40	Plenary Talk 2 (Prof. Blake Hannaford)
10:40 - 11:00	Morning Break
11:00 - 12:00	Technical Sessions MA1 (Poster Session)
11:00 - 12:30	Invited Session
12:00 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions MP1
15:00 - 15:15	Afternoon Break
15:15 - 16:45	Technical Sessions MP2
17:00 - 18:30	Technical Sessions MP3
Tuesday, August 5, 2025	
08:30 - 09:30	Plenary Talk 3 (Prof. Bradley Nelson)
09:30 - 10:45	Medical Robot Forum
10:45 - 11:00	Morning Break
11:00 - 12:00	Workshop II Technical Sessions TA1
12:15 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions TP1
15:00 - 15:30	Afternoon Break
15:30 - 17:00	Technical Sessions TP2
18:30 - 21:00	Award Banquet in Beijing Empark Grand Hotel
Wednesday, August 6, 2025	
08:30 - 12:00	Technical Tour

* 15 minutes (Speech: 12 minutes, Q&A:3 minutes) are scheduled for oral presentation including discussions for each paper.

*30 minutes (core time) are scheduled for poster presentation

IEEE ICMA 2025 Technical Program, Sunday, August 3, 2025

Time \ Room	ROOM 1 No.9 ROOM	ROOM 2 No.7 ROOM	ROOM 3 No.6 ROOM	ROOM 4 GUEST ROOM	ROOM 5 No.5 ROOM	ROOM 6 No.1 ROOM
13:00-18:30	**Registration Desk Open**					
13:30-15:40	**World Premium Workshops on Robotics at ROOM 1**					
16:00-17:00	**Keynote Speech** (Prof. Hidekuni Takao) **at ROOM 1**					
18:00-20:00	**Reception at YUQUAN HALL**					

IEEE ICMA 2025 Technical Program, Monday, August 4, 2025

08:30-09:00	**Opening Ceremony at BANQUET HALL**					
09:00-09:50	**Plenary Talk #1** (Prof. Toshio Fukuda) **at BANQUET HALL**					
09:50-10:40	**Plenary Talk #2** (Prof. Blake Hannaford) **at BANQUET HALL**					
10:40-11:00	**Morning Break**					
11:00-12:00	**Technical Sessions MA1 Poster Session (Intelligent Mechatronics and Automation) at ROOM 1**					
11:00-12:30	**Invited Talk Session at BANQUET HALL**					
12:00-13:30	**Lunch Break**					
13:30-15:00	MP1-1 Intelligent Mechatronics and Application (I)	MP1-2 Intelligent Mechatronics and Application (IV)	MP1-3 Intelligent Biomedical Instrument Technology (I)	MP1-4 Manipulator Control and Manipulation (I)	MP1-5 Mobile Robot System (I)	MP1-6 Robot Navigation and Control Algorithm (I)
15:00-15:15	**Afternoon Break**					
15:15-16:45	MP2-1 Intelligent Mechatronics and Application (II)	MP2-2 Intelligent Mechatronics and Application (V)	MP2-3 Intelligent Biomedical Instrument Technology (II)	MP2-4 Manipulator Control and Manipulation (II)	MP2-5 Mobile Robot System (II)	MP2-6 Robot Navigation and Control Algorithm (II)
17:00-18:30	MP3-1 Intelligent Mechatronics and Application (III)	MP3-2 Intelligent Mechatronics and Application (VI)	MP3-3 Intelligent Biomedical Instrument Technology (III)	MP3-4 Biomimetic Systems	MP3-5 Mobile Robot System (III)	MP3-6 Sensor Networks,Distributed Sensor Systems

IEEE ICMA 2025 Technical Program, Tuesday, August 5, 2025

08:30-09:30	**Plenary Talk #3** (Prof. Bradley Nelson) **at INTERNATIONAL CONF. ROOM**					
09:30-10:45	**Medical Robot Forum at INTERNATIONAL CONF. ROOM**					
10:30-11:00	**Morning Break**					
11:00-12:00	**Workshops II at INTERNATIONAL CONF. ROOM**					
	TA1-1 Signal and Image Processing (I)	TA1-2 Medical, Biomedical and Rehabilitation Systems (I)	TA1-3 Control Theory and Application (I)	TA1-4 Neuro,Fuzzy,and Intelligent Control	TA1-5 Elements,Structures,and Mechanisms (I)	TA1-6 Human-System Interaction and Interface
12:15-13:30	**Lunch Break**					
13:30-15:00	TP1-1 Signal and Image Processing (II)	TP1-2 Medical, Biomedical and Rehabilitation Systems (II)	TP1-3 Control Theory and Application (II)	TP1-4 Industrial,Manufacturing Process and Automation (I)	TP1-5 Elements,Structures,and Mechanisms (II)	TP1-6 Modeling, Simulation Techniques and Methodologies (I)
15:00-15:30	**Afternoon Break**					
15:30-17:00	TP2-1 Signal and Image Processing (III)	TP2-2 Medical, Biomedical and Rehabilitation Systems (III)	TP2-3 Control Theory and Application (III)	TP2-4 Industrial,Manufacturing Process and Automation (II)	TP2-5 Signal and Image Processing (IV)	TP2-6 Modeling, Simulation Techniques and Methodologies (II)
18:30-21:00	**Award Banquet at BANQUET HALL**					

IEEE ICMA 2025 Technical Program, Wednesday, August 6, 2025

08:30-12:00	**Technical Tour**

Monday
August 4, 2025

Morning Sessions

MA1-P Poster Session (Intelligent Mechatronics and Automation)

Monday
August 4, 2025

Afternoon Sessions

MP1-1 Intelligent Mechatronics and Application (I)
MP1-2 Intelligent Mechatronics and Application (IV)
MP1-3 Intelligent Biomedical Instrument Technology (I)
MP1-4 Manipulator Control and Manipulation (I)
MP1-5 Mobile Robot System (I)
MP1-6 Robot Navigation and Control Algorithm (I)
MP2-1 Intelligent Mechatronics and Application (II)
MP2-2 Intelligent Mechatronics and Application (V)
MP2-3 Intelligent Biomedical Instrument Technology (II)
MP2-4 Manipulator Control and Manipulation (II)
MP2-5 Mobile Robot System (II)
MP2-6 Robot Navigation and Control Algorithm (II)
MP3-1 Intelligent Mechatronics and Application (III)
MP3-2 Intelligent Mechatronics and Application (VI)
MP3-3 Intelligent Biomedical Instrument Technology (III)
MP3-4 Biomimetic Systems
MP3-5 Mobile Robot System (III)
MP3-6 Sensor Networks,Distributed Sensor Systems

MA1-P Poster Session (Intelligent Mechatronics and Automation) 1

Session Chairs: Chong Yang, SUSTech
Sheng Cao, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Monday, 4 August 2025

MA1-P (1) 11:00 - 12:00

Path planning and target recognition of intelligent greenhouse agricultural multifunctional robot

Lin Zhang, Yuke Ma, Liang Zheng, Weixuan Zheng, Jing Ren, Qiang Cheng, Ziqi Luo
School of the Electrical and Information Engineering, Jilin Agricultural Science and Technology University, 77 Hanlin Road, JiLin,132101, Jilin, China

- Develop robots that are adapted to greenhouse environments to facilitate agricultural automation
- Tomato target detection model
- Design of the path planning method combining A* algorithm and genetic algorithm

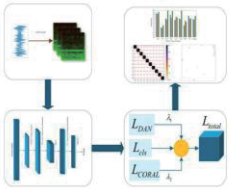
Structural Annotation of Intelligent Robots

MA1-P (2) 11:00 - 12:00

GAF-Wavelet Fusion and SENet-Driven Domain Adaptation for Bearing Fault Diagnosis

Bo Pang[1,3], Xin Wang[2,3,*], Yi Zhao[1,3], Songze Wu[1,3], and Jifeng Zou[1,3]
[1] School of Electrical Engineering and Automation, Tianjin University of Technology
[2] National Demonstration Center for Experimental Mechanical and Electrical Engineering Education Tianjin University of Technology, Tianjin, China
[3] Institute of Intelligent Control and Fault Diagnosis, Tianjin University of Technology

- Data preprocessing using a combination of CWT and GAF
- Senet attention mechanism is introduced to dynamically adjust the feature weight, which enhances the feature extraction ability of the model
- Using the domain adaptive weight strategy to reduce the difference of feature distribution and realize feature alignment
- The model has been tested on the rolling bearing dataset of Case Western Reserve University for many times, obtaining a excellent average accuracy of 99.5% finally

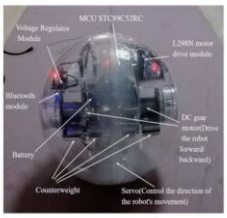


MA1-P (3) 11:00 - 12:00

Design and Analysis of a Pendulum Driven Spherical Robot

Jialu Yu, Xiang Li, and Yunde Shi
School of Mechanical Engineering, Southeast University
Nanjing, China

- A kinematic model (plane-sphere system) and dynamics model (Euler-Lagrange method) are established to decouple linear and steering motions.
- Velocity control algorithms are validated in MATLAB, and trajectory tracking experiments are conducted in ADAMS.
- Experimental results confirm the robot's scientifically sound structure and fully functional linear/steering capabilities.



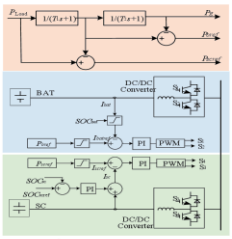
The Spherical Robot

MA1-P (4) 11:00 - 12:00

An Improved Power Allocation Strategy for Multi-Type Power Sources in Shipboard Integrated Power System

BohaiShipbuildingVocationalCollege
Yunsi Qi, China

- A second-order-filter based strategy is proposed to allocate the power between the generator and the HESS.
- The SOC recovery control of SC is adopted to make fully use of it.
- Both the SOC and the current limit are adopted to protect HESS from overcharge and over-discharge.
- The proposed strategy is verified through simulation.



Control diagram

MA1-P (5) 11:00 - 12:00

Research on Distributed Flow Shop Scheduling Technology

Niansong Zhang,Zeqing Jiao,Yan Ge,Aimin Wang,Hui Tang,Leyu Wei
Department of Mechanical Engineering，Nanjing University of Science and Technology，Nanjing City, Jiangsu Province, China

- Combining ACO and MODE algorithms
- Using the pheromone in the ant colony algorithm, and then based on MODE to carry out scheduling
- It has theoretical and practical significance for optimizing distributed flow shop scheduling and improving production efficiency.

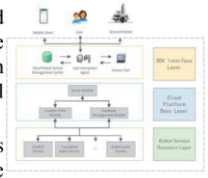
Steps of the aco-mode algorithm

MA1-P (6) 11:00 - 12:00

Cloud robot indoor and outdoor service scheduling decision based on expanded A* and Gaode map navigation

Haibo Zhou, Yunbo Jia, Jianjun Zhang, Xin Wang, Jifeng Zou
Tianjin University of Technology
Tianjin, China

- This paper based on SOA architecture of cloud, the service type, the latitude and longitude of the ratings and service as the index, USES the circular area search algorithm(CAS),to determine the optimal service.
- The outdoor path planning of cloud robot is carried out by amap navigation, and the indoor path planning is carried out by extended A* algorithm to realize the indoor and outdoor service scheduling of cloud robot.



Overall Architecture

MA1-P Poster Session (Intelligent Mechatronics and Automation) 2

Session Chairs: Chong Yang, SUSTech
Sheng Cao, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Monday, 4 August 2025

MA1-P (7) 11:00 - 12:00

LHF-YOLO: A Lightweight Network for the Detection of Safety Equipment for Working at Height

Dahua Li,Bokun Liu[1], Qiang Gao[1], Jinliang Yin[1] Zhongli Bai[1] and Enhong Xing[2]
1.School of Electrical Engineering and Automation Tianjin University of Technology , Tianjin, China
2. Tianjin Rongxinjia Machinery Co.Ltd, Tianjin, China

- A lightweight detection model-LHF-YOLO
- To address the challenge of real-time detection of safety equipment usage during work at height
- The enhanced model achieves a 1.8% increase in mAP@0.5 while reducing computational load and complexity by 41.2% and 42.7%, respectively.

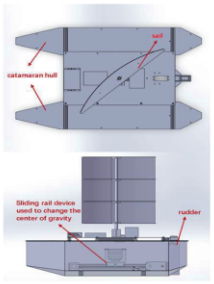
HAF-YOLO Structural diagram

MA1-P (8) 11:00 - 12:00

Efficient self-turning sailboat via adaptive center of gravity adjustment system

Zhongjie Li1, Longteng Wu1, Fan Shen2, Hao Wu1*, Yan Peng2
1 School of Mechatronic Engineering and Automation, Shanghai university, Shanghai, China
2 School of Future Technology, Shanghai University, Shanghai, China

- Research on New Unmanned Sailboats
- Optimizing steering performance by changing the center of gravity
- Double hulled sailboat structure equipped with guide rail device
- Significant optimization in turning time and turning radius



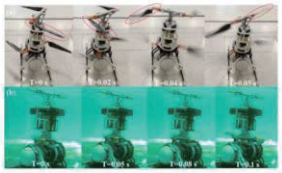
Unmanned sailboat

MA1-P (9) 11:00 - 12:00

YingLong-Hel: Design and Implementation of a Hybrid Aerial Underwater Vehicle with Integrated Adaptive Rotor Module

Le Huang, Shuxiang Guo, Chunying Li, Qirong Lei, Guoheng Ma, Haotian Sun, Shuaixin Peng
Southern University of Science and Technology
Shenzhen, China

- A coaxial counter-rotating rotor system aimed at enhanced thrust efficiency and maneuverability, overcoming limitations of conventional designs.
- An integrated adaptive rotor module featuring unified aerial and underwater blades for efficient propulsion in both mediums, reducing system volume, weight, and complexity compared to independent systems.



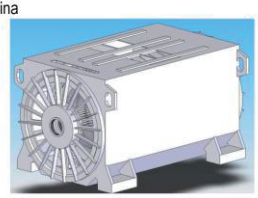
(a) Aerial blade deployment during flight. (b) Aerial blade folding during underwater navigation.

MA1-P (10) 11:00 - 12:00

Study on High Frequency Electromagnetic Vibration Suppression of Marine Generator

CHEN Lei, ZHU Changsheng, Yao Jiayi, Li Shan, Zhang Jaiyu, Yang Zhi
Shanghai Marine Equipment Research Institute
Shanghai, China

- Suppression measures are proposed, and intermediate and principle prototype tests are conducted for verification.
- The results show that by optimizing the structure of the generator base and using damping components reasonably, high-frequency electromagnetic vibration can be effectively suppressed.
- The vibration acceleration value of frequency of the first-order tooth harmonic is 104.5dB, which is more than 10dB lower than that of the conventional structure marine generator.



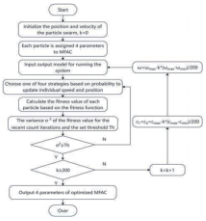
Principle Prototype 3D Model

MA1-P (11) 11:00 - 12:00

MFAC Parameter Optimization Based on Adaptive Multi-Strategy Behavioral Particle Swarm Optimization

Jielian Li, Yonghong Lan
School of Automation and Electronic Information,Xiangtan University
Xiangtan,China

- Objective: Proposes an adaptive multi-strategy behavioral PSO algorithm to optimize MFAC parameters (η, μ, ρ, λ) for enhanced control performance.
- Method: Integrates linear reduction of inertia weights/acceleration factors and multi-strategy behavior selection to improve optimization speed and accuracy.
- Innovation: Introduces UCB-based future value calculation and probabilistic variation to avoid local optima and enhance particle diversity.
- Results: Reduces overshoot to 0.7% and eliminates oscillations, achieving faster response and stronger anti-interference in nonlinear systems.



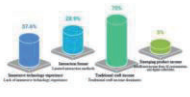
Parameter Optimisation Flowchart

MA1-P (12) 11:00 - 12:00

AI empowered Innovation of Cultural and Creative Design in Industrialized Cities

Ying Zhang*, Chang Guo, Zhigang Kan
Changchun University of Science and Technology,
Changchun, Jilin, China,
*Corresponding author

- 1.Based on the development of industrial tourism cultural and creative products, which is currently undergoing a critical transition period of deep integration between technological empowerment and cultural heritage, despite the fact that cities in Northeast China have accumulated rich industrial cultural heritage based on their unique genes as old industrial bases, the development of cultural and creative products still faces core issues such as insufficient conversion of technical aesthetics, lagging immersive experience facilities, and low technical content.
- 2.Under the backdrop of accelerated iteration of artificial AI and AIGC technologies, the upgrading path of industrial tourism should be centered on the core axis of "cultural decoding, technological reconstruction, and experiential innovation" to construct a new cultural tourism ecosystem where reality and virtuality coexist.
- 3.Taking industrial tourism cultural and creative products as a link, and relying on four strategies—innovative thinking to activate scene narratives, deep cultural cultivation to strengthen emotional resonance, technological empowerment to optimize the experience dimension, and industrial integration to expand the value space—we activate industrial cultural resources, empower the upgrading of the cultural tourism economy, and construct an industrial ecosystem that integrates culture, technology, and consumption. This provides a practical model and referenceable development strategy for industrial tourism and cultural and creative product design innovation in industrial cities.



Satisfaction and Revenue Distribution of Industrial Tourism Programs in Industrial Cities

AI-generated guided tour digital man

MA1-P Poster Session (Intelligent Mechatronics and Automation) 3

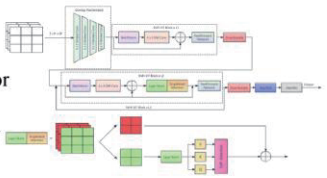
Session Chairs: Chong Yang, SUSTech
Sheng Cao, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Monday, 4 August 2025

MA1-P (13) 11:00 - 12:00

YOLOv11-Based Split Large-Kernel MBConv with Channel-Gated Slimmed Attention: A HarmonyOS Embedded Framework for Efficient Crowd MOT

Yanji Zhu
Shenzhen Kaihong Digital Industry Development Co., Ltd.
Shenzhen, China

- YOLO-MGNet's Innovative Architecture
- Cascade Feature Matching for Robust Tracking
- Edge Deployment Efficiency
- Unified Detection-Tracking Framework

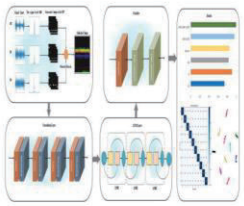


MA1-P (14) 11:00 - 12:00

Rolling bearing fault diagnosis based on VMD-CNN-SLSTM model

Kehan Ma 1,3 , Songze Wu 1,3 , Dezheng Kong 1,3 , Xin Wang 2,3,*
1 School of Electrical Engineering and Automation, Tianjin University of Technology
2 National Demonstration Center for Experimental Mechanical and Electrical Engineering Education Tianjin University of Technology, Tianjin, China
3 Institute of Intelligent Control and Fault Diagnosis, Tianjin University of Technology

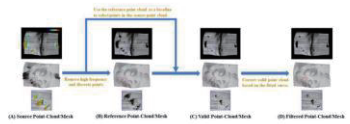
- VMD is harnessed to decompose the original signal
- The reconstruction was carried out according to the Pearson correlation coefffcient and the envelope entropy
- The CNN-SLSTM model is used to study the high-dimensional features of the speciffed data set
- The model is validated on the rolling bearing vibration signal dataset from Case Western Reserve University (CWRU) in the United States, demonstrating excellent recognition accuracy of 99.2%



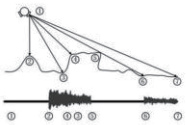
MA1-P (15) 11:00 - 12:00

Shadow-Based Data Fusion Method for Side-Scan Sonar and Multibeam Bathymetry Sonar

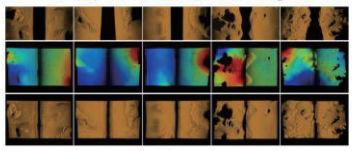
Hanjie Huang, Xiufen Ye*
College of Intelligent Systems Science and Engineering Harbin Engineering University



(A) Point cloud denoising



(B) Terrain scanning



(C)Data fusion result

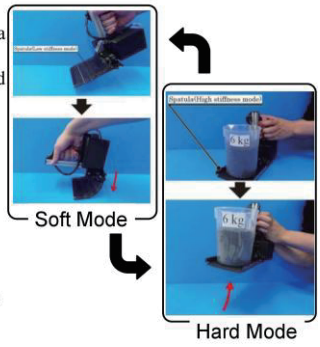
(D) Underwater map

MA1-P (16) 11:00 - 12:00

Variable Stiffness Spatula Mechanism that can be made Highly Stiff by Deformed into a U-shape for High Stiffness

Takumi Saeki[1], Yu Kaneda[1], Issei ONDA[1], Kazuki ABE[1], Masahiro WATANABE[1], KenjiroTADAKUMA[1*], 1. Osaka University

- Proposed a variable stiffness spatula mechanism capable of U-shaped deformation for object scooping and lifting.
- Utilizes increased cross-sectional second moment to enhance lifting stiffness of a thin-plate structure.
- Described principle, prototype configuration, basic operation, and experimental validation of stiffness performance.



MA1-P (17) 11:00 - 12:00

Study of Quadruped Robot Dog Gait Simulation Control

Guo Yaqin, Shan Zhangxu
Electrical and Energy Engineering College, Nantong Polytechnic College
Nantong, China

- By observing movement patterns of dogs, designing three-dimensional model of quadruped robot dog in SOLIDWORKS software.
- Take one leg as an example, establish the single-leg coordinate system using geometric methods.
- According to the theoretical analysis,plug the known parameters into the corresponding formulas, the robot dog foot position and the rotation angle can be obtained.

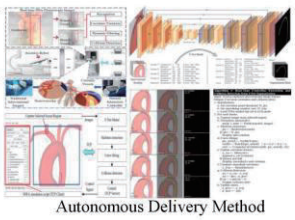
SOLIDWORKS model figure

MA1-P (18) 11:00 - 12:00

Design of an Autonomous Delivery System for Vascular Intervention Robots Based on Curvature Variation

Sheng Cao[1], Shuxiang Guo[1,2,3,4*], Jian Guo[2], Jian Wang[2], Chunying Li[3], Huiyin Xu[4], Bin Wang[1] and Mingchao Ding[1]
[1] *Aerospace Center Hospital & the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, School of Life Science & Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing 100081, China*
[2] *Shenzhen Institute of Advanced Biomedical Robot Company Limited, Shenzhen 518000, Guangdong Province, China.*
[3] *Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China*
[4] *National Engineering Laboratory of Computer Technology for Big Data Systems, Shenzhen University, Shenzhen, Guangdong 518060, China*
E-Mails: Caosheng@bit.edu.cn; guo.shuxiang@sustech.edu.cn
*Corresponding author

- This study focuses on the problem of collision perception during the guidewire delivery phase and proposes a novel autonomous delivery system design based on curvature variation of the interventional instrument. The goal is to enable real-time collision detection and responsive control, offering a new paradigm for advancing the intelligence of vascular interventional robotic systems.



Autonomous Delivery Method

MA1-P Poster Session (Intelligent Mechatronics and Automation) 4

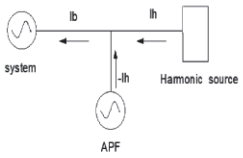
Session Chairs: Chong Yang, SUSTech
Sheng Cao, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Monday, 4 August 2025

MA1-P (19) 11:00 - 12:00

Summary of Active Power Filters in Power System Harmonic Control

Hongjian Zhao
School of Mechanical and Electrical Engineering, Qingdao Engineering Vocational College
Qingdao City, China

- Active power filters achieve dynamic compensation.
- Active power filters simultaneously compensate for harmonics and reactive power.
- Active power filters are not significantly affected by grid impedance and are less likely to resonate with grid impedance.



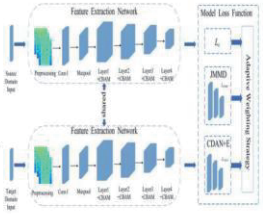
active power filter

MA1-P (20) 11:00 - 12:00

STFT-CBAM Hybrid Domain Adaptation for Bearing Fault Diagnosis Under Varying Conditions

Yi Zhao, Xin Wang*, Bo Pang, Zheng Song, and Xingchi Hu
Tianjin University of Technology, Tianjin, China

- Novel Hybrid Method: Proposes STFT-CBAM-DAMS for bearing fault diagnosis under varying conditions.
- Effective Domain Alignment: Integrates JMMD and CDAN+E for superior cross-domain feature migration and distribution alignment.
- Superior Diagnostic Accuracy: Achieved 99.4% on CWRU and 93.9% on JNU, outperforming traditional ResNet.

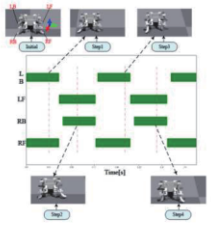


MA1-P (21) 11:00 - 12:00

Learning and Control of Terrestrial Gait for a Bionic Turtle

Mingjie Xue, Songtao Zhang, Lihua Liang, Yuming Hu, Xinlei Yuan
College of Intelligent Systems Science and Engineering
Harbin Engineering University, Harbin, China

- A biologically inspired 12-DOF bionic turtle robot was developed and trained for terrestrial gait control using PPO-Clip in IsaacGym.
- The trained gait showed stable tracking under command switches and smooth turning and walking maneuvers.
- Results demonstrate the potential of DRL in achieving low-torque and stable gait control for bionic turtle locomotion.



Learned Terrestrial Gait

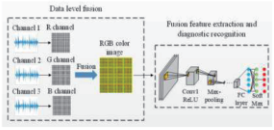
MA1-P (22) 11:00 - 12:00

Fault Diagnosis of Rotating Machinery System Based on Multi-source Fusion Using RP-RGB-HLCNN Model

Xin Wang, Xiaomin Zhu, Yuanwu He, Kehan Ma, Jinquan Lv, Wenxue Xu, Jingkai Xiao, Chaoqun Li
School of Mechanical, Electronic and Control Engineering, Beijing Jiaotong University
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology
Transcend Communication Beijing Co, Ltd., Beijing, China
Institute of Intelligent Control and Fault Diagnosis, Tianjin University of Technology

(1) A rotating mechanical system diagnosis method based on multi-source information fusion based on RGB color image fusion technology is proposed.

(2) The method is tested on the dataset of CWRU with multi-channel synchronous acquisition process.



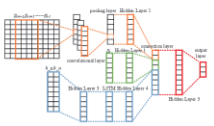
Flowchart of fault diagnosis model

MA1-P (23) 11:00 - 12:00

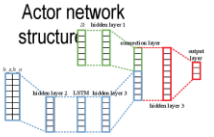
Improved DDPG Algorithm for Autonomous Driving

Li Caozheng;Lv Xiao
Tiandi Shanghai Mining Equipment Technology Co.
Building 1, No. 168, Huan Cheng East Road, Fengxian District, Shanghai, China

- Introducing Convolutional Deterministic Strategies to Learn More Robust Control Strategies from Inputs via Spatial Feature Extraction.
- Introducing temporal modeling of long and short-term memory accelerates experience reuse.
- Improved Deep Deterministic Policy Gradient Algorithm Significantly Enhances the Stability and Learning Efficiency of Autonomous Driving Decision Systems.



Actor network structure



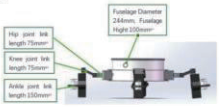
Critic network structure

MA1-P (24) 11:00 - 12:00

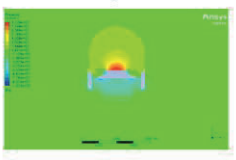
Development and Implement of a Novel Quadruped Amphibious Robot

Qixiang Peng1, Jinjie Wu1, Yufei Hu1, Shuoxin Gu12*, Zechen Wu1, Peixin Yang1, Shuhao Wang1, Xiaoyan Huang1
1School of Automation, Chengdu University of Information and Technology
No. 24, Section 1, Xuefu Road, Chengdu, Sichuan, China
2Sichuan International Joint Research Center for Robotics and Intelligent Systems,
No. 24, Section 1, Xuefu Road, Chengdu, Sichuan, China
*Corresponding author: gsx@cuit.edu.cn

- A fully symmetrical structure amphibious robot has been designed, which can achieve multiple free movements and zero turning radius in both water and land.
- Completed CAE simulation of the robot, including simulation of propeller compression and simulation of underwater pressure at different degrees of freedom of the robot



Structure design of the robot



CAE simulation of the robot

MA1-P Poster Session (Intelligent Mechatronics and Automation) 5

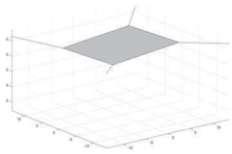
Session Chairs: Chong Yang, SUSTech
Sheng Cao, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Monday, 4 August 2025

MA1-P (25) 11:00 - 12:00

Design of Floating Test Platform for Offshore Floating Photovoltaic System

Zekuan Dai, Chaoyue Lin, Zhe Xu, Qiang Fu, Bin Wang
Tianjin University of Technology Binshui Xidao Extension 391
Tianjin, China

- Floating test platform with rotating boom for offshore PV.
- The platform achieves 3D positioning and angle adjustment via mathematical modeling and simulation to mimic real-wave impacts on objects.
- The research findings provide valuable references for similar experiments on offshore floating photovoltaic systems.



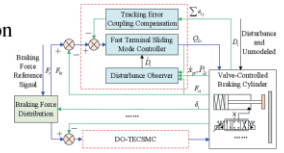
The model established in MATLAB

MA1-P (26) 11:00 - 12:00

Collaborative Controller for Braking Force of Multi-Channel Braking System of Mine Hoist Based on Braking-shoe Wear

Menglei Ding, Hui Xie, Yuanjing He, Gang Shen, Yu Tang
713th Research Institute of China State Shipbuilding Corporation Limited, Zhengzhou, Henan, China
Anhui University of Science and Technology, Huainan, Anhui, China
China University of Mining and Technology, Xuzhou, Jiangsu, Chia

- A wear detection method and dynamic braking force distribution strategy address uneven multi-channel braking-shoe wear.
- A fast terminal sliding mode controller with disturbance observer and error compensation handles nonlinear uncertainties.



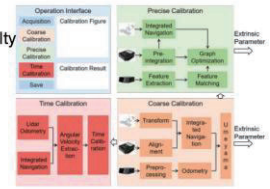
The structure of the DO-TECSMC

MA1-P (27) 11:00 - 12:00

HFT-LIC: Hierarchical Fast Targetless Lidar and Inertial Measurement Unit Online Calibration based on Global Navigation Satellite System

Xiaoni Zheng[1], Yanpeng Dong[1], Yufei Zhao[1], Xianyu Qi[1], Lei Han[2], and Ning Yan[3]
1:Beijing Institute of Mechanical Equipment,Beijing, China;
2:Dalian University of Technology,Dalian, China ;
3:CICT Mobile Communication Technology,Beijing, China

- Proposing a hierarchical calibration method that can provide fast, low difficulty coarse calibration results and accurate high-precision calibration results separately;
- Proposing a GNSS-assisted Lidar-IMU calibration method to reduce sensor excitation and calibration environment dependence;
- Comparing and analyzing the effectiveness of HFT-LIC based on



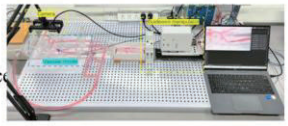
The overview of HFT-LIC

MA1-P (28) 11:00 - 12:00

A Deep Reinforcement Learning Approach for Autonomous Guidewire Navigation in Vascular Interventional Surgery

Chong Yang, Shuxiang Guo, Haoyu Xie, Weihao Wu, Sihan Gao, Chunying Li, Yudi Zhou
The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong, China

- An autonomous guidewire navigation system for vascular interventional surgery.
- Utilizing Deep Reinforcement Learning to enhance surgical succe rate and efficiency.
- Utilized a Deep Q-Network algorithm to control guidewire movement.

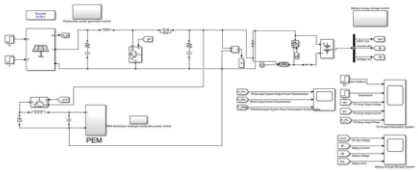


Experimental environment

MA1-P (29) 11:00 - 12:00

Evealuation Performance of an Offshore Photovoltaic Coupled Hydrogen Production System

Xingyu Li1, Chaoyue Lin2, Qiang Fu3, Lishan Ma*
1School of Electrical Engineering and Automation, Tianjin University of Technology Binshui Xidao Extension 391Tianjin, 300384, China
2Tianjin Key Laboratory of New Energy Power Conversion, Transmission and Intelligent Control, Tianjin University of Technology
3National Ocean Technology Center, Ministry of Natural Resources, Tianjin, China



Photovoltaic Energy Storage Hydrogen Production Model

MA1-P (30) 11:00 - 12:00

Evaluation of Current Carbon Capture, Utilization and Storage Technologies Under the Climate Change Circumstance

Yuewen Cui
Tianjin Yaohua High School, No. 106 Nanjing Road, Tianjin, China

- This paper evaluates CCUS technologies, naming post-combustion capture, membrane separation, pipeline transport, and EOR as category leaders.
- It guides practical application for environmental professionals, noting research gaps in comparative analysis.
- Uses secondary data and suggests future country-specific, quantitative evaluations with policy insights.

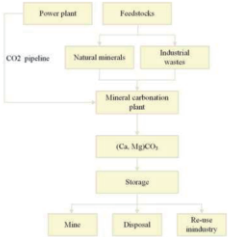


Illustration of CCMC technology steps

MA1-P Poster Session (Intelligent Mechatronics and Automation) 6

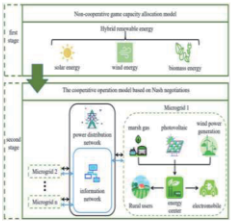
Session Chairs: Chong Yang, SUSTech
Sheng Cao, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Monday, 4 August 2025

MA1-P (31) 11:00 - 12:00

Capacity Configuration and Operation Optimization of Rural Microgrid Clusters Based on Electric Vehicle Charge-Discharge Characteristics and Mixed Game

Yi Zhao[1], Luyuan Huang[1,*] Yuehui Ji[1,2], Junjie Liu[1,2], and Xin Zhuang[1,2]
[1] School of Electrical Engineering and Automation, Tianjin University of Technology
[2] Tianjin Key Laboratory of New Energy Power Conversion, Transmission and Intelligent Control, Tianjin University of Technology, Tianjin, China

- A two-stage optimization model of rural microgrid clusters based on Mixed game is established.
- The optimal capacity of renewable energy units in the microgrid is obtained by particle swarm optimization algorithm.
- The alternating direction method of multipliers (ADMM) is adopted to solve the optimal transaction scheme between microgrids.

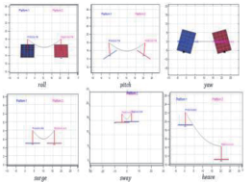


MA1-P (32) 11:00 - 12:00

Dynamic Response Evaluation of Jumper Cables for Offshore Photovoltaic Systems

Diandian Dai, Zhe Xu, Qiang Fu, Bin Wang
Tianjin University of Technology Binshui Xidao Extension 391
Tianjin, China

- It shows the states of jumper cables under six degrees of freedom.
- The figure visually demonstrates the deformation and position changes of jumper cables at various points under different motion degrees of freedom.
- These results provide important references for studying the dynamic response characteristics of jumper cables and optimizing their design in offshore photovoltaic systems.



Jumper Cable States

MA1-P (33) 11:00 - 12:00

Modeling and Simulation of Alkaline Electrolyzers in Photovoltaic Coupled Hydrogen Production Systems

Shan Jiang[1], Qiang Fu[1,2],Chunjie Wang[1,2], Lishan Ma[3*]
1School of Electrical Engineering and Automation, Tianjin University of Technology Binshui Xidao Extension 391, Tianjin, 300384, China
2Tianjin Key Laboratory of New Energy Power Conversion, Transmission and Intelligent Control, Tianjin University of Technology
3Nation Ocean Technology Center, Ministry of Natural Resources, Tianjin 300112, China

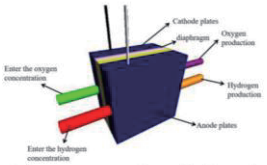


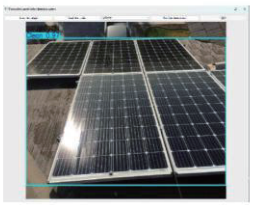
Diagram of the structure of an alkaline electrolyzert

MA1-P (34) 11:00 - 12:00

Intelligent Detection System for Dirty Photovoltaic Panels based on YOLOv8

Shirui Liu[1],Chaoyue Lin[1], Zhe Xu[1,2*],Qiang Fu[1,2*]
1School of Electrical Engineering and Automation, Tianjin University of Technology Binshui Xidao Extension 391, Tianjin, 300384, China
2Tianjin Key Laboratory of New Energy Power Conversion, Transmission and Intelligent Control

- A photovoltaic panel dirt level identification system.
- Establishing a six-level classification standard, training with a 3,862-image dataset, achieving an mAP@0.5 of 0.832.
- Providing an efficient solution for scheduling photovoltaic cleaning system.



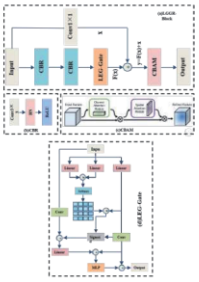
Photovoltaic panel testing system human-computer interaction interface

MA1-P (35) 11:00 - 12:00

An Efficient Local-Global Fusion Framework for Accurate Vascular Segmentation

Huiyin Xu, Sheng Cao, Shuxiang Guo, Chong Yang, Shaowen Tang, Chunying Li and Siying Pu
National Engineering Laboratory for Big Data System Computing Technology,
Shenzhen University, Shenzhen, China

- Proposed a efficient segmentation network for Vascular, balancing global semantics and local details.
- Introduced LGGR-Block to effectively fuse local-global features with attention and gated fusion.
- Achieved superior segmentation accuracy on three public retinal vessel datasets and one coronary angiography dataset.



Overview of the LGGR-Block

MP1-1 Intelligent Mechatronics and Application (I)

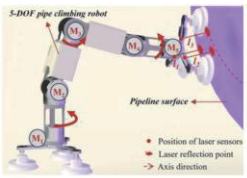
Session Chairs: ASLIHAN KARACA, The University of Nottingham
Qingsong Xu, University of Macau
UTC+8(Beijing Time): 13:30 - 15:00, Monday, 4 August 2025

MP1-1 (1) 13:30 - 13:45

Development of a Pipeline Surface Curvature Detection Method for Biped Climbing Robotic System

Zikang Li, Weijian Zhang, and Qingsong Xu
Dept. Electromechanical Engineering, University of Macau
Macao, China

- A novel low-cost pipeline curvature detection method is proposed for biped climbing robot.
- It is equipped with multiple laser sensors on suction modules to detect the curvature of various surfaces.
- Wireless communication system for remote control and monitoring, enhancing robot's operational efficiency and flexibility.



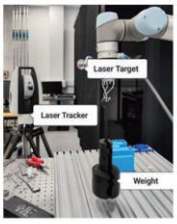
The biped curve-surface climbing robot

MP1-1 (2) 13:45 - 14:00

Force Estimation in a 6-DOF UR5 Robot Using Machine Learning Algorithms for Precise Force Control

Aslihan Karaca, Mojtaba A. Khanesar , Giovanna Martínez-Arellano and David T. Branson
Faculty of Engineering University of Nottingham Nottingham, United Kingdom

- Robot under loading
- Deflection data analysis
- Machine learning models
- Weight prediction accuracy



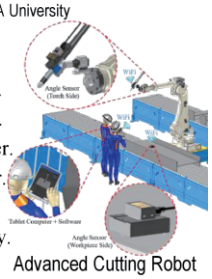
UR5 and Laser Target.

MP1-1 (3) 14:00 - 14:15

A Novel Plasma Cutting Articulated Robot System with Torch Angle Sensor and Its Applications in Industry

Kitti Suwanratchatamanee, Huei Ee Yap, Hideyuki Sawada, and Shuji Hashimoto
Robotics Research & Development Center, GOLDEN ROBOT Co., Ltd.
Rayong, Thailand
LP-RESEARCH Inc.
Tokyo, Japan
Faculty of Science & Engineering, WASEDA University
Tokyo, Japan

- Plasma cutting robot with torch angle sensor.
- Cutting the large structural steel instead CNC.
- Compact IMU-based wireless sensing system.
- Real time 3-D visualization on tablet computer.
- Achieve high-precision bevel cut at 0.03 error.
- 1.55 times faster than conventional teaching.
- Successfully applied to use in the real industry.



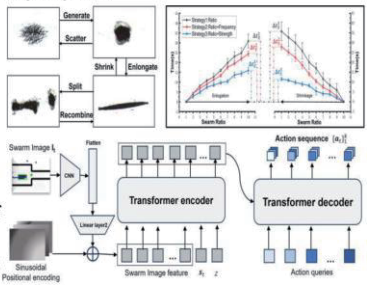
Advanced Cutting Robot

MP1-1 (4) 14:15 - 14:30

Fast Deformation and Imitation Learning-based Control for Microswarms in Unstructured Environments

Xiang Ji, Shihao Yang, Yihan Chen, Jialin Jiang, Lidong Yang and Li Zhang
Mechanical and Automation Engineering, The Chinese University of Hong Kong
Hong Kong, China

- A Fast Deformation Strategy for Microswarms (FDSwarm)
- Fast Deformation and Motion Control based on Imitation Learning (FDM-IL)
- Navigation experiments of microswarm in unstructured environments

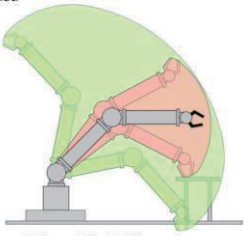


MP1-1 (5) 14:30 - 14:45

On Minimizing the Energy Cost of a Safe Spring-Assisted Modular and Reconfigurable Robot

Christopher Singh and Guangjun Liu
Aerospace Systems and Control Laboratory, Toronto Metropolitan University
Toronto, Canada

- Multiple-working-mode actuation strategy confines a spring-assisted robot to the envelope of its task
- Improves manipulation safety in collaboration workspaces
- Reduces the energy consumption up to 72 % in a simulated safety-critical task



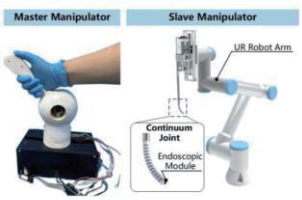
Enforced Spatial Separation

MP1-1 (6) 14:45 - 15:00

Development of a 3-DOF Serially Configured Master Manipulator for Laparoscopic Exploration

Yibo Han#, Xiangyu Luo#, Jichen Li, Pengyu Du, Zhengbao Yang and Chaoyang Shi*
School of Mechanical Engineering, Tianjin University
Tianjin, China

- A 3-DOF serially configured master manipulator has been proposed and implemented with force feedback capacity in a compact and easily assembled structure.
- Experiments for the laparoscopic exploration have been performed with the presented master-slave mapping strategy, demonstrating the excellent performance of the proposed master manipulator.



Master-slave Robotic System

MP1-2 Intelligent Mechatronics and Application (IV)

Session Chairs: Zixu Wang, Southern University of Science and Technology
Peng Shi, Henan University of Science and Technology
UTC+8(Beijing Time): 13:30 - 15:00, Monday, 4 August 2025

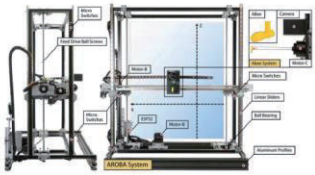
MP1-2 (1) 13:30 - 13:45

Towards an Embodied Biohybrid Robotic Platform for Interaction with Honeybees

Hang Wang[1], Mohsen Zahmatkesh[1], Martin Stefanec[2], Ali Emre Turgut[3], Jiří Ulrich[4], Tomáš Krajník[4], Farshad Arvin[1]

[1]Biohybrid Robotics Lab, Department of Computer Science, Durham University, UK
[2]Department of Zoology, Institute of Biology, University of Graz, Austria
[3]Mechanical Engineering Department, Middle East Technical University, 06800 Ankara, Turkey
[4]Artificial Intelligence Centre, Faculty of Electrical Engineering, Czech Technical University, Czechia

- A biohybrid robotic platform to detect and follow the position of a queen bee.
- The robot detects the queen's position and mimics retinue bee behavior.

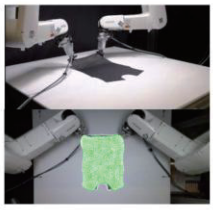


MP1-2 (2) 13:45 - 14:00

Fabric Flattening and Alignment System Using Real-time Mesh-based State Estimation and Visual Servoing

Edmund Lo[1], Xuzhao Huang[1,2], Kai Tang[1,2], and Kazuhiro Kosuge[1,2]
[1]Centre for Transformative Garment Production, Hong Kong S.A.R.
[2]JC STEM Lab of Robotics for Soft Materials, The University of Hong Kong, Hong Kong S.A.R.

- We propose a complete fabric flattening and alignment system.
- A novel visual servoing approach enforces non-holonomic constraints for wrinkle-free alignment.
- ARAP deformation framework is used for mesh-based state-estimation in real-time.



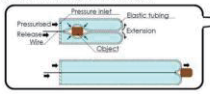
Mesh-base State Estimation and Visual Servoing

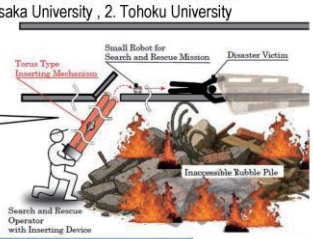
MP1-2 (3) 14:00 - 14:15

Torus Type Tip-Extending Insertion System and Incombustible Soft Actuator for Search and Rescue Mission

Masahiro WATANABE[1], **KenjiroTADAKUMA**[1*] , Satoshi TADOKORO[1],
* PI, corresponding author, 1. Osaka University , 2. Tohoku University

- Proposed a torus-type tip-extending mechanism that deploys objects into confined spaces without frictional contact with the environment.





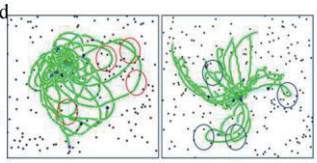
- Successfully inserted a small mobile robot into narrow passages using a prototype made of polyurethane membrane.
- Demonstrated both smooth deployment and impact protection; future work includes bending integration and complex environment testing.

MP1-2 (4) 14:15 - 14:30

Training Robot Swarms for Adaptive Foraging in Environments with Obstacles

Pigar Biteng, Tameem Uz Zaman, and Qi Lu
Department of Computer Science, The University of Texas Rio Grande Valley, Texas, USA

- NeuroEvolution of Augmented Topologies (NEAT) with a living cost generates adaptive swarm foraging behaviors.
- The evolved swarm behaviors are assessed on adaptability, efficiency, and scalability.



The search patterns of circular paths generated from NeatFA without/with living costs

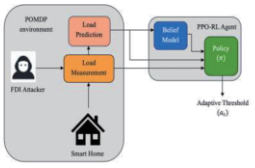
- The proposed NEAT-based foraging algorithm consistently had higher performance in resource retrieval within an obstacle environment.

MP1-2 (5) 14:30 - 14:45

A Deep Reinforcement Learning based Dynamic False Data Injection Detection in Load Prediction

Sima Hamedifar, Nahal Iliaee, Shichao Liu
Department of Electronics, Carleton University
Ottawa, Canada

- Modelling smart home load data false data injection (FDI) attack detection as a partially observable Markov decision process (POMDP) environment.
- Training a multi-head attention-based model as a Belief Model to obtain the attack probability.
- Solving the POMDP FDI attack detection problem via proximal policy optimization (PPO) reinforcement learning (RL) algorithm.



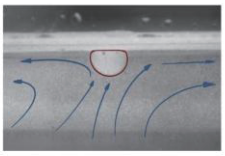
Smart home load data POMDP-based FDI detection

MP1-2 (6) 14:45 - 15:00

Relational Analysis between a Calcium Alginate Self-propelled Surfer and the Marangoni Convection for the Application of Waterborne Transporters

Shuting Yang, Renke Liu, Tamako Suzuki, and Hideyuki Sawada
Department of Pure and Applied Physics, Waseda University
Tokyo, Japan

- An oil droplet dropped into aqueous solution self-propels spontaneously.
- A rigid exoskeleton applied to a droplet determines the propulsion direction.
- The surface tension gradient generates Marangoni convection around and inside the self-propelled droplet.
- Relational analysis between a self-propelled surfer and the Marangoni convection was conducted and reported.



Marangoni convection observed around a droplet

MP1-3 Intelligent Biomedical Instrument Technology (I)

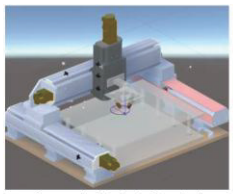
Session Chairs: Le Huang, Southern University of Science and Technology
ren zhong sheng, Jilin University
UTC+8(Beijing Time): 13:30 - 15:00, Monday, 4 August 2025

MP1-3 (1) 13:30 - 13:45

A Study on the Capsule Robot Control Simulation System Based on Complex Magnetic Field Coupling

Qi Zhang,Hongwei Pan,Jiabibng Liu, ZhiXuan Zhou,and Zhenyin Zhang
School of Electronic Engineering and Automation,Guilin University of Electronic Technology
Guilin, China

- Solving the problem of difficulties in training reinforcement learning in real - world environments.
- A capsule robot control simulation system was developed based on the Unity 3D platform.
- The simulation of complex coupled magnetic fields and the control of capsule robots were implemented.



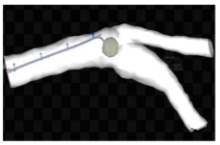
Capsule Robot Control Simulation System

MP1-3 (2) 13:45 - 14:00

Design and Implementation of a Plaque Detachment Prediction System Based on Guidewire Curvature Analysis

YiNing Shang, ShuXiang Guo, Sheng Chao
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry ofIndustry and Information Technology, Beijing Institute of Technology, China
The Department of Electronic and Electrical Engineering, Southern University of Science and Technology,China

- A SOFA-based simulation system was developed for plaque rupture prediction.
- Guidewire curvature is continuously monitored to assess rupture risk.
- Rupture is triggered when total curvature exceeds a predefined threshold.
- The system enables real-time VR training and preoperative risk evaluation.



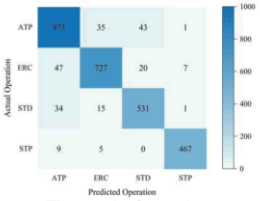
The Plaque Detachment Prediction

MP1-3 (3) 14:00 - 14:15

A Novel Method for Extracting Surgical Operating Skills through a Vascular Interventional Surgery Robot

Jintao Luo[1], Shuxiang Guo[1,2*], Yonggan Yan[1], Bingzhi Shen[1], Bin Wang[3], Mingchao Ding[3]
1.The Aerospace Center Hospital, School of Life Science and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing 100081, China
2. The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China
3.The Department of Peripheral Vascular Intervention, Aerospace Center Hospital, School of Life Science, Beijing Institute of Technology, Beijing 100081, China
*Corresponding author

- A multi-level surgical operation classification method.
- A surgical operation recognition algorithm based on the MultiRocket algorithm.
- The results of experiment simulating real surgeries demonstrated the effectiveness of our method with a classification accuracy of 92.56%.



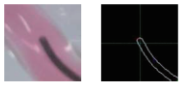
The result of experiment simulating real surgeries

MP1-3 (4) 14:15 - 14:30

Study on Path Planning Strategy for Vascular Interventional Surgery Based on Visual Information

Zimeng He, Chong Yang, Shuxiang Guo, Weihao Wu, Haoyu Xie, Chunying Li
The Department of Electronic and Electrical Engineering,
Southern University of Science and Technology, Shenzhen, China

- Guidewire Detection and Tracking: Real-time guidewire detection is achieved using a YOLOv11 trained model.
- Guidewire Tip Localization: A quadrant-based method is proposed, which locates the guidewire tip through edge detection, skeletonization, and Euclidean distance calculation.
- Path Planning: Introduces keypoint annotation and path simplification (RDP algorithm) to mark bifurcations and turns, improving clinical usability.



Guidewire Tip Localization

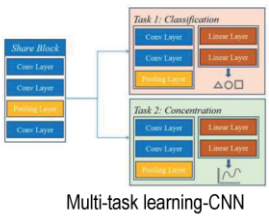
Keypoint Annotated Path

MP1-3 (5) 14:30 - 14:45

A Hybrid MTL-CNN Architecture for Simultaneous Mixed Gas Identification and Concentration Estimation

Zhongsheng Ren, Lihui Wang, Lidong Tan, Xiaohui Weng, Mo Li, Fuyan Gou, Ruochen An
School of Transportation, Key Laboratory of Bionic Engineering, Ministry of Education, Jilin University
Changchun, China

- The proposed shared backbone network extracts common gas response patterns.
- End-to-end automated feature extraction to simplify model training and deployment.
- A dual-loss function featuring dynamic task-weight adaptation.



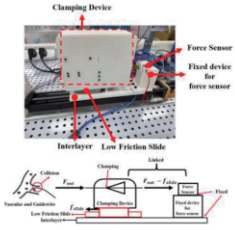
Multi-task learning-CNN

MP1-3 (6) 14:45 - 15:00

Design of a Vascular Interventional Surgery Platform Based on Clamping-Side Guidewire Force Feedback

Haoyu Xie[1], Chong Yang[1], Shuxiang Guo[1,2*], Weihao Wu[1], Sheng Cao[2], Chunying Li[1]
1. The Department of Electronic and Electrical Engineering,
Southern University of Science and Technology, Shenzhen, Guangdong 518055, China

- VIS demands precise guidewire control, the lack of real-time force feedback is problem demanding prompt solution
- We present a master-slave robotic platform featuring a clamping-side force sensing mechanism using a low-friction slide and a single-axis load cell.
- Experimental validation demonstrates ±4% force sensing accuracy and confirms the system's potential to enhance safety and enable future autonomous navigation.



VIS Platform & Guidewire Force Feedback

MP1-4 Manipulator Control and Manipulation (I)

Session Chairs: Tingjun Zeng, South China University of Technology
Zejia Zhang, Huazhong University of Science and Technology
UTC+8(Beijing Time): 13:30 - 15:00, Monday, 4 August 2025

MP1-4 (1) 13:30 - 13:45

Error Modeling and Calibration of a Novel 6-DOF Robot for Cross-scale Assembly

Tingjun Zeng, Hai Li, Shaoke Shi, and Xianmin Zhang
Guangdong Provincial Key Laboratory of Precision Equipment and Manufacturing Technology, South China University of Technology
Guangzhou, China

- A cross-scale assembly 6-DOF robot with end motion decoupling three translational and two rotational DOFs for large-stroke station switching.
- Calibrate 29 error parameters using a segmented error calibration method.
- After error compensation, position errors in three directions are reduced by over 85%, and posture errors by over 30%.

The 6-DOF Robot

MP1-4 (2) 13:45 - 14:00

Neural network-based robust synchronous computed torque control for redundant driven cutting arm

Liyan Liu[1], Gang Shen*[2], and Wei Wang[1]
[1]School of Mechatronic Engineering, China University of Mining and Technology, Xuzhou, China
[2]School of Mechatronic Engineering, Anhui University of Science and Technology, Huainan, China

- A complete cutting system dynamic model is constructed.
- A synchronous computed torque controller is designed to avoid internal force coupling caused by asynchronous drive cylinders.
- By introducing neural networks and robust integral terms, adaptive compensation for the estimation term of uncertainty disturbances is effectively achieved.

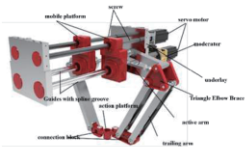
Experimental prototype of tunneling machine.

MP1-4 (3) 14:00 - 14:15

Dynamic Modeling and Trajectory Planning of a 4-DOF Parallel Manipulator

Yi Jia, Bin Li and Qi Liu*, Huixin Sun, Yunpeng Zhang and Hongze Yu
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China.
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin 300384, China

- A 3T1R high-speed parallel robot consisting of two branched chains, a robot structure containing three moving and one rotating vice, is investigated.
- In-depth kinematic analysis was carried out.
- The kinematics simulation and rigid body dynamics simulation.



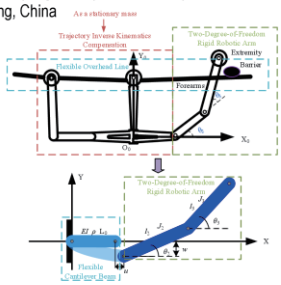
Two-Limb 4-DOF High-Speed Parallel Robot 3D Model

MP1-4 (4) 14:15 - 14:30

Dynamic Modeling and Vibration Suppression of Rigid-Flexible Coupled Overhead Line Mobile Robots

Guanghong Tao, Wenlong Pan, Yan Li
School of Mechatronics Engineering, Shenyang Aerospace University
Shenyang, Liaoning, China

- The overhead line was simplified as a flexible cantilever beam model, with a sag compensation strategy proposed based on static sag characteristics.
- A rigid-flexible coupled dynamic model was established, investigating the impact of robot motion on cable vibration.
- Comparative analysis of vibration suppression performance between fuzzy sliding mode control and PID control was conducted using the model.



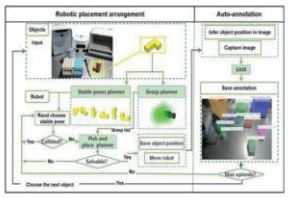
2-DOF-coupled flexible cantilever beam

MP1-4 (5) 14:30 - 14:45

Robotic Visual Data Acquisition System Using Automatic Object Rearrangement and Annotation

Xiaoxuan Qi, Sheng Bao, Yixuan Su, Zhengtao Hu, Liang Du, Mahmoud Magdy, Kensuke Harada, Jianjun Yuan
Shanghai Key Laboratory of Intelligent Manufacturing and Robotics, Shanghai University, Shanghai, China, Mechanical Engineering Department, The British University in Egypt, Cairo, Egypt, The University of Osaka, Osaka, Japan

- Develop a novel system where a manipulator repositions objects in stable poses while camera captures multi-view images.
- Address inefficiencies in traditional manual annotation by automatic labeling into the acquisition process.
- Demonstrate the effectiveness of the system in a laboratory environment of chemistry.



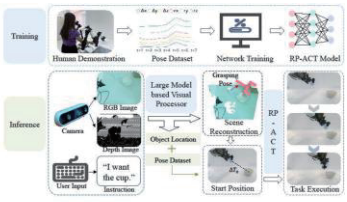
The Robotic Visual Data Acquisition System

MP1-4 (6) 14:45 - 15:00

A Robotic Manipulation Framework Based on Large Model and Behavior Cloning

Zejia Zhang, Hongliang Lei, Weizhuang Shi, Haoyuan Wang, Qihui Jiang, Wei Luo and Jian Huang
School of Artificial Intelligence and Automation, Huazhong University of Science and Technology, Wuhan, China
Graduate School of Engineering Science, the University of Osaka, Osaka Fu, Japan
Science and technology innovation center, China ship development and design centre, Wuhan, China

- A robotic manipulation framework that combines vision-language-grasping large models with behavior cloning network.
- Deployed on a real robotic platform to execute five typical manipulation tasks, validating its effectiveness.



Robotic operating framework

MP1-5 Mobile Robot System (I)

Session Chairs: Zhaoxu Wang, Harbin Institute of Technology
shuaixin peng, SUStech

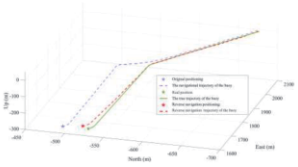
UTC+8(Beijing Time): 13:30 - 15:00, Monday, 4 August 2025

MP1-5 (1) 13:30 - 13:45

AUV Positioning Method based on the Reverse Navigation Solution using Buoys

Zhaoxu Wang, Xingxiang Rong, Fei Yu Ya Zhang, Shiwei Fan, Wei Gao
School of Instrumentation Science and Engineering
Harbin Institute of Technology
Harbin, Heilongjiang Province, China

- INS error accumulates, lacks GNSS underwater, hard to get positioning info.
- Use buoy for GNSS, reverse navigation with IMU data for AUV positioning.
- Simulation verifies algorithm, positioning accuracy up by 53.36% average.

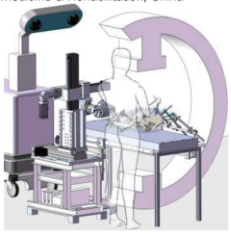


MP1-5 (2) 13:45 - 14:00

Design and In Vitro Reduction Experiments of A Novel Closed Reduction Robot for Pelvic Fracture

Qinglong Lun1, Mingjie Dong1, Jiachen Sun1, Shiping Zuo2, 3*, Jingxin Zhao4, 5*, Jianfeng Li1
1. School of Mechanical and Energy Engineering, Beijing University of Technology, China
2. School of Information Science and Technology, Beijing University of Technology, China
3. Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, China
4. Department of Orthopaedics, The Fourth Medical Center, Chinese PLA General Hospital, China
5. National Clinical Research Center for Orthopedics, Sports Medicine & Rehabilitation, China

- The design requirements and layout constraints of the closed reduction robot have been summarized.
- A new closed reduction robot for pelvic fracture with remote center of motion features is proposed.
- The interrelationships between robot space, image space and camera space have been delineated.
- The reduction of a Tile-C1 type fracture is simulated in vitro.



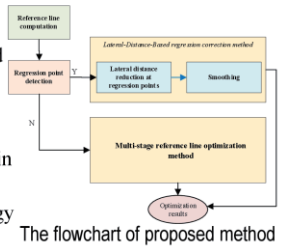
The Closed Reduction Robot for Pelvic Fracture

MP1-5 (3) 14:00 - 14:15

Vehicle Formation Reference Line Smoothing Method Based on Improved FemPosDeviation Algorithm

Haoyang Zhang, Yanpeng Dong, Xianyu Qi, Bin Lian, Zhe Zhao, Jianyi Zhu
Beijing Institute of Mechanical Equipment
Beijing, China

- An enhanced FemPosDeviation-based reference line smoothing method is proposed for unmanned vehicle formations.
- A formation lateral distance-optimized method is proposed to prevent reference line regression in follower vehicles.
- A multi-stage optimization strategy is proposed to mitigate reference line jitter.



The flowchart of proposed method

MP1-5 (4) 14:15 - 14:30

A Novel Spherical Robot featuring Rolling and Hexapodal Locomotion

Jinglei Nie, Shuxiang Guo, Chunying Li and Zixuan Lyu
The Department of Electronic and Electrical Engineering, Southern University of Science and Technology
Shenzhen, Guangdong 518055, China

- This A Novel Spherical Robot combines the advantages of spherical robots, such as rapid movement and suitability for long-distance travel, with the fine operation capabilities of hexapod robots in complex terrains, providing a powerful solution for various ground exploration tasks.

The proposed spherical robot.

MP1-5 (5) 14:30 - 14:45

Pipe-Climbing Robot Based on a Novel Mecanum Wheel

Guanghong Tao, Kewei Guo, Fengchi Tian, Zhengxing Cao
School of Mechatronics Engineering, Shenyang Aerospace University
Shenyang, Liaoning, China

- Developed and designed a Pipe-Climbing Robot Based on a Novel Mecanum Wheel.
- The robot was modeled and kinematic analysis was conducted.
- Hertz contact theory analysis confirms that the novel Mecanum wheel exhibits significant advantages over conventional designs in pipe string applications.

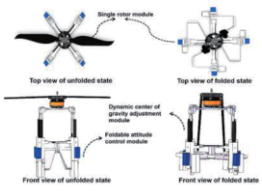
Robot model

MP1-5 (6) 14:45 - 15:00

YingLong-SF: A Single-Rotor Foldable UAV with Morphing Center-of-Gravity

Shuaixin Peng, Le Huang, Shuxiang Guo, Chunying Li1, Qirong Lei, Guoheng Ma, Ziyi Zhu, Haotian Sun
Southern University of Science and Technology
Shenzhen, China

- YingLong SF adopts a foldable single rotor module, which significantly reduces storage volume, improves portability, provides sufficient lift, and reduces operating noise.
- Drones achieve dynamic center of gravity adjustment through a sliding rail structure. Lowering the center of gravity can enhance flight stability, while raising the center of gravity can improve maneuverability.



Overview of YingLong-SF's unfolded and folded state.

MP1-6 Robot Navigation and Control Algorithm (I)

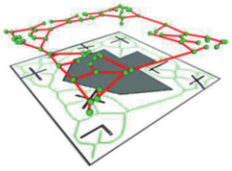
Session Chairs: Sheng Cao, Beijing Institute of Technology
Chunying Li, Southern University of Science and Technology
UTC+8(Beijing Time): 13:30 - 15:00, Monday, 4 August 2025

MP1-6 (1) 13:30 - 13:45

Clean Generalized Voronoi Diagram: An Efficient Algorithm for Path Planning in Robotics

Haoyue Tian, Zhiyong Tang, ..., and Zhongcai Pei
School of Automation Science and Electrical Engineering, Beihang University
Beijing, China

- **Clean GVD Construction**: Proposes a pruning pipeline to eliminate weak edges in GVD.
- **Computational Efficiency**: Achieves significant speedup (27 ms) compared to pre/post-pruning methods.
- **Experimental Validation:** Demonstrates superior performance in real-time applicability compared to A* and RRT.



Clean GVD and GVG

MP1-6 (2) 13:45 - 14:00

CURE: A Cable-Driven Upper-Limb Rehabilitation Exoskeleton for Assisting ADLs in Home-Based Environment

Pengcheng Li[1], Shuxiang Guo[1,2*], Jun Leng[1], Weiyu Chen[1]
1. Department of Electronic and Electrical Engineering, Southern University of Science and Technology
2. The Aerospace Center Hospital, School of Life Science and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology, Beijing Institute of Technology

1. A lightweight cable-driven home-based wrist-elbow rehabilitation exoskeleton for ADL-oriented training has been designed and developed.
2. Experiments with healthy subjects validated its effectiveness in assisting patients to perform ADLs accurately.
3. The root mean square error (RMSE) of the tracking error was less than 3° for all DoFs.

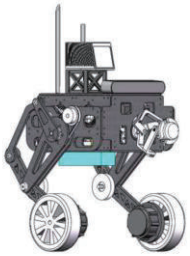
CURE

MP1-6 (3) 14:00 - 14:15

A Wheel-legged Robot Capable of Autonomous Docking

Chaojun Chen[1], Feng Cao[1], Huaye Wu[2], Hao Ni[2], Haibo Li[3], Huiming Xing[2]
[1]School of Future Technology, Harbin Engineering University,
No.145, Nantong Street, Nangang District, Harbin 150001, Heilongjiang Province, China
[2]College of Intelligent Systems Science and Engineering, Harbin Engineering University, No.145, Nantong Street, Nangang District, Harbin 150001, Heilongjiang Province, China
[3]College of Information and Communication Engineering, Harbin Engineering University, No.145, Nantong Street, Nangang District, Harbin 150001, Heilongjiang Province, China

- Propose a wheel-legged robot capable of autonomous docking and undocking operations.
- Complete both forward and inverse kinematic solutions and experimentally validate the control precision.
- Using ROS2-Gazebo platform, simulate and verify the motion of a single robot, and then performed physical prototype tests to verify the control algorithm.

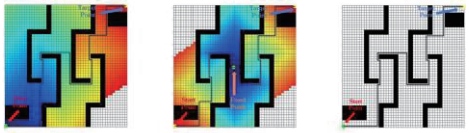


MP1-6 (4) 14:15 - 14:30

A Hybrid Path-Planning Algorithm Combining the Improved A-Star Algorithm with the DWA

Yichu Zhang, Xiangyin Meng and Huafeng Wen
Department of Mechanical Engineering, Southwest Jiaotong University
Chengdu, Sichuan, China

A. Improving Search Strategy: set the reference point to guide the direction of the search.
B. Path Optimization: elimination of redundant nodes; optimization of critical nodes; path smoothing.
C. Hybrid Path-Planning Algorithm: combine the improved A-star algorithm with DWA.

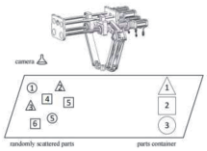


MP1-6 (5) 14:30 - 14:45

Path planning of parallel robots based on RRT*-APF algorithm

Huixin Sun, Bin Li , Qi Liu*,Yi Jia, Yunpeng Zhang and Hongze Yu
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin 300384, China

- A grabbing system for high-density disordered and scattered parts has been designed.
- The improved algorithm reduces the total search path length 10.6%.
- Maximum curvature is reduced by 97.8%.
- Search time is reduced by 72.6%.



Robotic sorting systems

MP1-6 (6) 14:45 - 15:00

Research on Production Balance Technology of Robotic Assembly Line Based on Fruit Fly Optimization Algorithm

Guanquan Liu,Ying Jiao,Kun Liu,Yibo Wu
College of Management Engineeringm Qingdao University of Technology
Qingdao, Shandong, China

- This study addresses robotic two-sided assembly line balancing via a mixed-integer programming model minimizing cycle time and energy consumption under constraints.
- The Improved Self-adaptive Fruit Fly Optimization Algorithm (ISFOA) integrates tent chaotic mapping for initialization, an 80% global optimum-guided/20% individual-perturbation mechanism, simulated annealing-based mutation rules, and a four-layer coding scheme .
- Test cases validate its superiority in optimizing dual objectives over benchmark algorithms.

MP2-1 Intelligent Mechatronics and Application (II)

Session Chairs: Pengcheng Li, Dept. Electronic and Electrical Engineering, SUSTech
Xiaoliang Jin, Southeast University

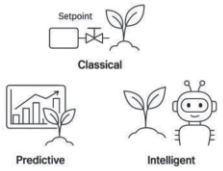
UTC+8(Beijing Time): 15:15 - 16:45, Monday, 4 August 2025

MP2-1 (1) 15:15 - 15:30

Automatic control strategies in fertigation systems: A technical review

Paul Daza Barzola*, Efrén Herrera Muentes, Washington Medina Moreira
Facultad de Ingeniería en Electricidad y Computación (FIEC)
Escuela Superior Politécnica del Litoral (ESPOL)
Km 30.5 Vía Perimetral, Guayaquil, Ecuador

- Comparative study of control strategies for fertigation systems, including classical, predictive, and intelligent approaches.
- Analysis of methods based on the variables addressed and application conditions.



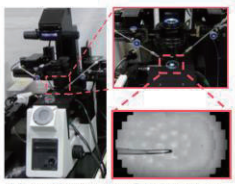
Fertigation control models

MP2-1 (2) 15:30 - 15:45

Enhancement of Imaging Algorithm for View Expansion Microscope System Through Thread Synchronization and Parallelization

Kazuki Miyajima[1], Takuya Hara[1], Tadayoshi Aoyama[2]
[1]Dept. of Micro-nano Mechanical Science and Engineering,
[2]Dept. of Mechanical Systems Engineering
Nagoya University, Japan

- View expansion microscope achieves wide-range and high-resolution imaging, however it has low frame rate and high display latency.
- The proposed method involving thread synchronization and parallel processing enhanced imaging algorithm.
- The method improved the frame rate by 36% and reduced latency by 44%.



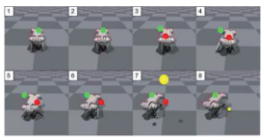
View Expansion Microscope

MP2-1 (3) 15:45 - 16:00

Deep Reinforcement Learning with PSO Algorithm in Agile Dodge Actions of Quadruped Robot

Jiayu Zeng, Jianan Xie, Yilin Zhang, and Kenji Hashimoto
Graduate School of Information, Production and System, Waseda University
Kitakyushu City, Japan

- Quadruped robot dodgeball locomotion.
- Collision-free PSO generation of commands in parallel DRL training.
- Achieves over 90% success within 800ms reaction time.



Dodge Locomotion

MP2-1 (4) 16:00 - 16:15

EEG and Eye-Tracking Signal Fusion for Mild Depression Identification under Visual Illusion Stimulation

Yuhui Pan[1], Yuze Zhang[1], Zhongliang Yu[2], Lili Li[1]*
[1]College of Health Science and Environmental Engineering, Shenzhen Technology University
[2]College of Integrated Circuits and Optoelectronics Chips, Shenzhen Technology University
Shenzhen, Guangdong Province, 518118, China

- Multimodal fusion for depression diagnosis using EEG and eye-tracking.
- Dual-stream deep learning model based on feature-level fusion.
- Achieved 88.30% accuracy, 90.27% precision, and 88.43% recall.
- Outperformed unimodal EEG and eye-tracking models.

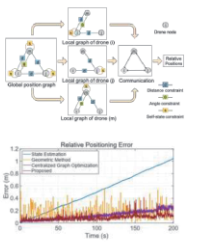
Dual-stream EEG and eye-tracking classification model based on feature-level fusion.

MP2-1 (5) 16:15 - 16:30

UAV Swarm Autonomy through Cooperative Positioning: A Unified Approach with Distributed Graph Optimization and Decentralized MPC

ChengsongXiong, and Zheng You
Department of Precision Instrument, Tsinghua University, Beijing, China

- This study proposes a distributed graph optimization (DGO)-based relative positioning framework for UAV swarm.
- This study develops a decentralized model predictive control (DMPC) scheme for swarm formation maintenance.
- The developed framework demonstrates superior accuracy compared to conventional inertial-based pose estimation methods and geometric approaches.



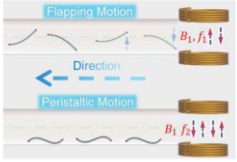
The DGO and simulation results

MP2-1 (6) 16:30 - 16:45

A Novel Flexible Soft Robotic-bandage for Gastrointestinal Wound Coverage Function

Zixu Wang[1], Miaozhang Shen[1,2], Shuxiang Guo[1,2,*]
[1]Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, 518055, China.
[2]Advanced Institute for Ocean Research, Southern University of Science and Technology, Shenzhen, 518055, China.

- The flexible soft robotic-bandage for the applications of the Minimally Invasive Gastrointestinal Surgery.
- By switching excitation magnetic fields of varying intensity, direction, and frequency, different motion postures of the soft robot can be achieved.
- The maximum speed in an ideal environment is 12.1 mm/s, and it can traverse obstacle clusters with heights of 3–5 mm.



Selective motion control of the soft robot

MP2-2 Intelligent Mechatronics and Application (V)

Session Chairs: Li Ming Yu, Harbin Institute of Technology
Jinguo Huang, Beijing University of Posts and Telecommunications
UTC+8(Beijing Time): 15:15 - 16:45, Monday, 4 August 2025

MP2-2 (1) 15:15 - 15:30

A Geomagnetic Matching Navigation Algorithm Based on VDDTW-AICCP

Mingyu Li, Ya Zhang, Li Ren, Fei Yu, Shiwei Fan, Kefei Yuan
School of Instrumentation Science and Engineering Harbin Institute of Technology Harbin, Heilongjiang Province, China

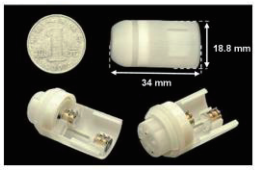
- Geomagnetic navigation is an important method for underwater vehicles to navigate accurately.
- This paper proposes a combined matching method based on the VDDTW algorithm and AICCP algorithm.
- The results show that compared with the traditional ICCP geomagnetic matching algorithm, the proposed approach reduces average positioning errors by 55.6%. When compared with the MSD-ICCP algorithm, the average positioning error is reduced by 66.1%.

MP2-2 (2) 15:30 - 15:45

Development of An Ingestible Device with Biopsy and Drug Delivery Functions

Jian Hu[1], Haowen Deng[1], Kai Qiao[1], Chaoyang Shi[2] and Chengzhi Hu[1*]
1 Department of Mechanical and Energy Engineering, Southern University of Science and Technology, Shenzhen, China
2 School of Mechanical Engineering, Tianjin University, Tianjin, China

- We introduce a capsule robot incorporating a "roulette wheel-like" structure that leverages a DC motor to dynamically switch between biopsy and drug delivery modes.
- In vitro validation studies demonstrate the capsule robot's successful execution of complete biopsy and drug delivery procedures in both liquid-free and liquid environments.



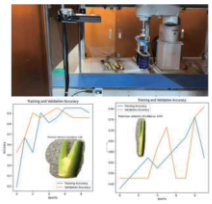
The Ingestible Device

MP2-2 (3) 15:45 - 16:00

An Automated Equipment Design for Visual Inspection and Rapid Sorting of Agricultural Products

Jinguo Huang*, Yuxin Hu, Yuhan Zhou
School of Intelligent Engineering and Automation, Beijing University of Posts and Telecommunications, China

- This paper delved into the design and application of an automated visual inspection and sorting system for agricultural products using machine vision and mechatronics integration technology.
- The sorting efficiency and accuracy are improved significantly compared with traditional manual sorting.



- The automated sorting equipment proposed in this paper can achieve high-precision grading and efficient sorting of Zizania latifolia by integrating visual recognition and mechanical sorting technologies, which has practical value for promoting intelligent agricultural development and rural industrial revitalization.

MP2-2 (4) 16:00 - 16:15

A Novel Multi-scale Depth and Spatial-Energy joint Optimization Approach for External Marker Selection in Respiratory Motion Tracking

Shuo Yang, Shan Jiang*, Zhiyong Yang, Shuangying Wang, Bei Jiang, Zeyang Zhou
Mechanical Engineering Department, Tianjin University, Tianjin City, China

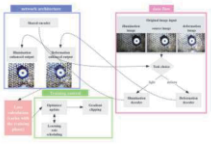
- A novel external marker selection method based on multi-scale depth features and spatial-energy joint optimization.
- A spatial-energy joint optimization algorithm refined marker placement .
- Foffering a promising approach for precise respiratory motion tracking in clinical applications.

MP2-2 (5) 16:15 - 16:30

Automated Adhesive Injection Localization in Aerospace Composites via CLIP-Guided Multimodal Image Enhancement and Adaptive Contour Reconstruction

Xinglong Gong, Jingzhou Song*,Jinshan Liu, Jiaxiu Wang, Liansheng Sun,Yimei Tan
School of Intelligent Engineering and Automation, Beijing University of Posts and Telecommunications
Haidian District, Beijing, China

- 1) Multimodal augmentation framework generating realistic illumination/deformation variants of composite inserts.
- 2) Irregular-edged image object contour reconstruction method. For irregular honeycomb panel cell centroid calculation.



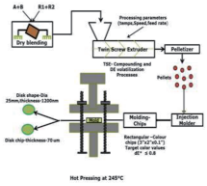
Schematic diagram of the overall architecture of the image enhancement module

MP2-2 (6) 16:30 - 16:45

Simulating Polycarbonate Processing Interactions: A Comparative Study of RSM Design Techniques

Jamal AlSadi
Renewable Energy Engineering
jadara University
P.O.Box 733 Irbid 22110, Jordan
i.alsadi@jadara.edu.jo, jamal.alsadi@ontariotechu.net

- This study employed Statistical and numerical optimization were both made possible by the Design Expert software, which also helped with experimental design.
- We used this technique to generate a statistical equation for simulated regression models.
- Regarding the BBD. The processing circumstances indicate that, overall, the lowest deviation=0.26 while 87% is the maximum design attractiveness



Schematic diagrams of process methods of plastic

MP2-3 Intelligent Biomedical Instrument Technology (II)

Session Chairs: Xinming Li, Guangzhou Maritime University
Mei Feng, Jilin University

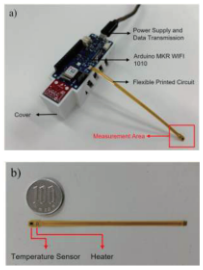
UTC+8(Beijing Time): 15:15 - 16:45, Monday, 4 August 2025

MP2-3 (1) 15:15 - 15:30

Heat Transfer-based Monitoring System for Sap Flow in Plants

Yan Zhao, Yingzhe Wang, Xiangli Zeng, and Keisuke Morishima*
Department of Mechanical Engineering, The University of Osaka
Osaka, Japan

- Propose a new thermal-based sap flow sensor capable of non-invasive, real-time monitoring.
- Through heat conduction simulations and controlled experiments, we demonstrate that the downstream temperature of the sensor decreases as flow rate increases
- Establishing a negative correlation between temperature and sap flow



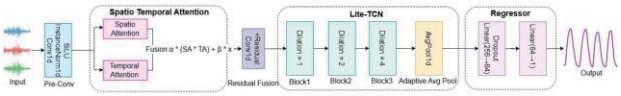
Prototype of integrated sensor

MP2-3 (2) 15:30 - 15:45

Continuous Motion Prediction for Upper Limb Rehabilitation Robotics Based on Surface Electromyography: A Spatio-Temporal Attention and Lightweight TCN Approach

Weiyu Chen, Pengcheng Li, Shuxiang Guo, Chunying Li, Jun Leng
The Department of Electronic and Electrical Engineering, Southern University of Science and Technology Shenzhen, Guangdong 518055, China

- STA-TCN: Spatio-Temporal attention mechanisms with a lightweight network for subject-independent continuous motion prediction.
- Experimental Results: MAE: 11.53° , $RMSE$: 14.77° , R^2: 0.91, Latency: 1.5 ms



Spatio-temporal Attention Network

MP2-3 (3) 15:45 - 16:00

Single Drive Multi-training Mode Adaptive Wrist Rehabilitation Device

Xuzeng Wu[1], Yihang Fu[2], Linfang Bian[3], Mei Feng[1*], Xiuquan Lu[1], Dong He[4], Yongqian Han[1], Shuxin Dong[1]
1.School of Mechanical and Aerospace Engineering, Jilin University, China
2.Yale School of Public Health, Yale University, USA
3.School of Basic Medical Sciences, Jilin University,China
4. College of Electronic Science and Engineering, Jilin University, China
*Corresponding Author: fengmei@jlu.edu.cn

- Only one drive is needed to achieve rehabilitation training of flexion /extension and radial/ulnar deviation.
- Enables adaptive adjustment of wrist joint position during rehabilitation training.
- Active and passive training modes can be selected.

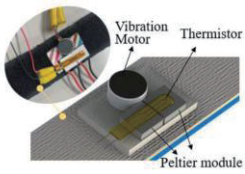
Wrist Rehabilitation Device

MP2-3 (4) 16:00 - 16:15

An Exploration Study of Thermal Feedback for Vascular Interventional Robot

Xinming Li[1], Shuxiang Guo[2], Ruiwei Liu[1,*], Haoyu Yang[1], Manjia Su[1]
[1] The School of Intelligent Manufacturing, Guangzhou Maritime University, China
[2] The Department of Electric and Electrical Engineering, SUSTech, China

- The exploration study for thermal feedback is conducted via the intelligent Peltier module.
- we design a bracelet to combine thermal feedback and vibration feedback in a small space to finish compact design for feedback perception.



The description of bracelet

MP2-3 (5) 16:15 - 16:30

Design and Performance Evaluation of a Parallel Wrist Exoskeleton for Home-based Rehabilitation

Ruijie He[1], Shuxiang Guo[1,2*], He Li[1], Bin Wang[3], Mingchao Ding[3]
1. The Aerospace Center Hospital, School of Life Science and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing 100081, China
2. The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China
3. The Department of Peripheral Vascular Intervention, Aerospace Center Hospital, School of Life Science, Beijing Institute of Technology, Beijing 100081, China
* Corresponding author: guoshuxiang@bit.edu.cn

- This paper aims to address the issue of existing wrist exoskeletons not effectively conforming to the structure of the human wrist or covering its entire physiological movement space.
- By analyzing the physiological structure of the wrist, this study proposes a wrist exoskeleton based on 6-UCU Stewart as an aid to home rehabilitation activities.
- The parallel wrist exoskeleton can effectively achieve three wrist movements, flexion/extension(F/E),radial/ulnar deviation(R/U) pronation/supination (P/S) and angles are -80°-80°, -30°-30°, -60°-60° respectively.

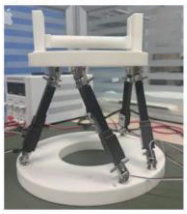


Fig.1 Diagram of platform

MP2-3 (6) 16:30 - 16:45

Conceptual Design and Theoretical Analysis of an Energy-Efficient Hybrid Passive-Active Wristband for Parkinson's Tremor Suppression

Badr Boughrara, Salma Sebbar, Adam Koubbi, Yassine Salih-Alj
School of Science and Engineering, Al Akhawayn University
Ifrane, Morocco

- Wearable wristband designed to reduce Parkinsonian resting tremor.
- Combines passive damping and active actuation for efficient suppression.
- Uses sensor fusion and real-time control to target 4–6 Hz tremor range.

Hybrid Wristband

MP2-4 Manipulator Control and Manipulation (II)

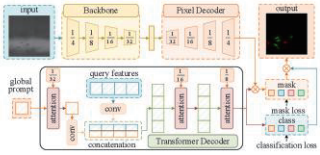
Session Chairs: Chong Yang, SUSTech
Zezheng Wang, Huazhong University of Science and Technology
UTC+8(Beijing Time): 15:15 - 16:45, Monday, 4 August 2025

MP2-4 (1) 15:15 - 15:30

GPESNet: Global Prompt-Embedded Segmentation Network for Weld Defect Detection

Yongqing Ye, Tiyu Fang, Yue Lu, Yang Li, Zhenhua Li, Ran Song*
School of Control Science and Engineering, Shandong University
Jinan, China

- Proposed GPESNet, introduces global prompt into Transformer decoder to enhance feature representation.
- Constructed a multi-scale weld defect dataset consisting of 7 categories.
- Achieved mIoU 82.22% and mPA 91.01% on the dataset, outperforming other methods.



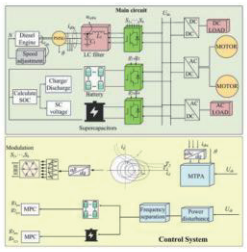
The overall framework of the proposed network

MP2-4 (2) 15:30 - 15:45

Model Predictive Control for Voltage Regulation in DC Vehicular Microgrids under Load Disturbances

Yang Chu, Taiping Yang, Shenlong Li, Wei Wu ,and Baoshan Huang
Division of Energy Mobility Convergence, Beijing Institute of Technology, Zhuhai
Zhuhai, China

- DC-VMG bus voltage instability under load disturbances.
- Establish models of the engine–generator set,battery,supercapacitor, and traction motor.
- MTPA and dual-MPC frequency decoupling.
- Superior bus voltage stability, faster response, and improved energy scheduling.



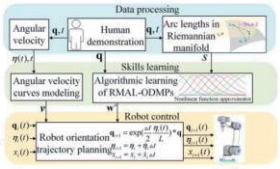
DC-VMG overall control structure

MP2-4 (3) 15:45 - 16:00

RMAL-ODMPs: Orientation Skills Learning and Generalization Method for Robotic Manipulation

Zezheng Wang, Yu Wang, Chen Chen, Fangyu Peng, Yong Hong, Zichen Ai, Xiaowei Tang, Rong Yan
School of Mechanical Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, China

- RMAL-ODMPs learn a single orientation trajectory via Riemannian manifold arc length instead of time.
- A theoretical framework for the accurate learning of multi-orientation trajectories by RMAL-ODMPs is proposed.
- Specific parameter estimation methods of RMAL-ODMPs are proposed.



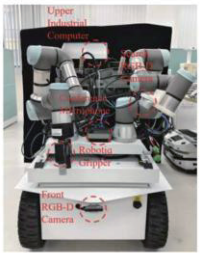
Robotics orientation skills learning framework

MP2-4 (4) 16:00 - 16:15

Mobile Robotic Manipulation for Search-and-Fetch Tasks by Integrating Human-Robot Interaction

Yuning Cao, Iek Wang Tam, Xianli Wang, Zehao Wu, and Qingsong Xu
Dept. Electromechanical Engineering, University of Macau
Macao, China

- A unified mobile manipulation system is developed for autonomous search-and-fetch operations.
- It incorporates face recognition, gesture recognition, and voice commands to enhance human-robot interaction.
- Hybrid learning-optimization grasping algorithm is proposed to generate robust and precise grasping poses for target object manipulation.

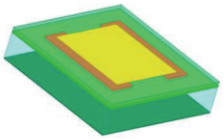


MP2-4 (5) 16:15 - 16:30

Design of a Stacked Low-Profile Broadband Phased Array Antenna

Junjie Wang, Bo Wang
Department of School of Automation , Xi'an University Of Posts and Telecommunications
Xi'an, Shaanxi, China

- Adopting laminated microstrip structure to generate double resonance, realizing 5.15 GHz operating bandwidth (44.3% relative bandwidth)
- At 0.16λ_0 profile height, the antenna achieves 7 dBi peak gain at 10.96 GHz and maintains more than 6 dBi gain over 28.6% relative bandwidth.
- The 6-element linear phased array exhibits gain fluctuations of only 1.1 dB over the 0° to 45° scan range, with a radiation efficiency of over 92%.



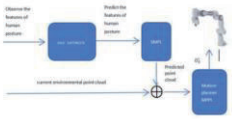
The Stacked Antenna

MP2-4 (6) 16:30 - 16:45

Model Predictive Path Integral with Integrated Human Pose Prediction Network for Robotic Arm Motion Planning

Zhonglong Ren, Lelai Zhou*,Xu Sun, Xincheng Tian, and Yibin Li
School of Control Science and Engineering, Shandong University
Jinan, China

- A human pose prediction network architecture primarily based on a multilayer perceptron
- An obstacle avoidance system integrated with the model predictive path integral (MPPI) and human pose prediction network



Architecture of the system

MP2-5 Mobile Robot System (II)

Session Chairs: Farshad Arvin, Durham University
BAYANJARGAL DONIDDORJ, Toyohashi University of Technology
UTC+8(Beijing Time): 15:15 - 16:45, Monday, 4 August 2025

MP2-5 (1) 15:15 - 15:30

Morphing Swarm Coordination for Autonomous Queen Tracking in Complex Hive Environments

Mazen Bahaidarah[1], Mohsen Zahmatkesh[2], Hang Wang[2], Ognjen Marjanovi[1], Fatemeh Rekabi-bana[2], Ali Emre Turgut[3], Farshad Arvin[2]
[1]*Department of Electrical and Electronic Engineering, University of Manchester, Manchester, UK*
[2]*Biohybrid Robotics Lab, Department of Computer Science, Durham University, Durham UK*
[3]*Mechanical Engineering Department, Middle East Technical University, Ankara, Turkey*

- This paper introduces a dynamic formation control strategy for a multi-arm robotic manipulator designed to operate inside active honeybee hives.
- The utilisation of a collective motion model with the Leader-Follower method for fast navigation and obstacle avoidance.
- 50 simulations for six agents in both hexagonal and oval formations were conducted to examined the robustness of the proposed morphing mechanism.

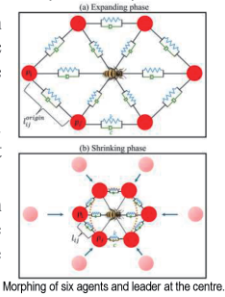


Fig1. Morphing of six agents and leader at the centre.

MP2-5 (2) 15:30 - 15:45

Research on Path Planning Algorithms for Campus Guide Robots

ZhongLi Ma[1,2], XingYang Song[1], HangTian Zhang[1],Qiao Zhou[1],Jun Jie Huang[1], JuiShuang Dai[3] and Ying Geng[3]
1Department of Automation Chengdu University of Information Technology Chengdu, China
2School of Electronic Information Engineering Preparatory Office of Chengdu University of TechnologyChengdu, China
3Process Innovation Center Luzhou North Chemical Industry Co., Ltd Luzhou, China

- Combines global and local planning for better coordination between A* and dynamic window methods.
- Uses point cloud reduction for efficient 2D mapping and improves path smoothness and safety.
- Solves speed oscillation and deadlock issues with a dual-mode speed strategy.

Actual image of the campus explanation robot

MP2-5 (3) 15:45 - 16:00

Safe and Efficient Multi-Robot Path Planning for Warehouse Environments

Doniddorj Bayanjargal, Haruaki Ikushima, Takuma Nakao, Junji Takahashi, and Naoki Uchiyama
Mechanical Engineering, Toyohashi University of Technology
Toyohashi, Aichi, Japan

- Goal: Safe and Efficient Multi-Robot Path Planning in Real-World Environments
- Problem: MAPD (collision-free delivery)
- Approach: We used Elastic-PIBT(improves PIBT) and Sequential A* for better safety and efficiency
- Localization: Robots navigate using the Ceiling-VGM system

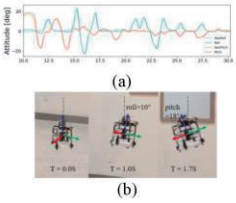
Multi-Agent Pickup and Delivery

MP2-5 (4) 16:00 - 16:15

Design and Implementation of a Dual-Mode UAV Combining Single-Rotor with Coaxial-Rotor for Indoor Applications

Guoheng Ma, Le Huang, Shuxiang Guo, Chunying Li, Qirong Lei, Haotian Sun, Shuaixin Peng
Southern University of Science and Technology
Shenzhen, China

- A new type of unmanned aerial vehicle based on a coaxial dual-blade structure has been proposed, which can adapt to special flight modes such as single rotor use according to requirements.
- To address the ground startup failure issue of the unmanned aerial vehicle driven by the control surfaces, a special solution based on the coaxial configuration was proposed.



(a) Control tracking effect
(b) Flight experiment

MP2-5 (5) 16:15 - 16:30

Design of swing arm crawler robot for variable cross-section pipes operation

Ziqing Gu, Jianjun Yuan, Mingyuan Wang, Jiawei Ni,Zhengtao Hu, Sheng Bao, Liang Du
Shanghai Robotics Institute, School of Mechatronic Engineering and Automation
Shanghai Key Laboratory of Intelligent Manufacturing and Robotics, School of Mechatronic Engineering and Automation
Shanghai, China

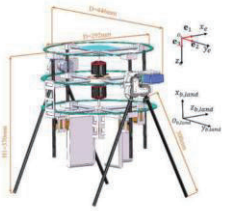
- A robot suitable for variable cross-sectional shape pipelines is proposed.
- The mechanical structure and working principle of the robot are introduced, and the dynamics are analyzed
- Simulation and prototype tests of the robot in a pipeline were carried out.
- The results show that the robot has a better ability to move inside a pipe with a variable cross-section

MP2-5 (6) 16:30 - 16:45

Design and Analysis of an Amphibious Aerial-Ground Robot

Haotian Sun, Le Huang, Shuxiang Guo, Chunying Li, Qirong Lei, Guoheng Ma, Shuaixin Peng
Southern University of Science and Technology
Shenzhen, China

- A lightweight coaxial counter-rotating propulsion system with a single-motor deformable mechanism mimicking penguin sliding dynamics, enabling full utilization of propeller thrust for terrestrial locomotion;
- A ground locomotion model based on coaxial dual-rotor counter-rotation and rudder control.



Overview of the amphibious aerial-ground robot system

MP2-6 Robot Navigation and Control Algorithm (II)

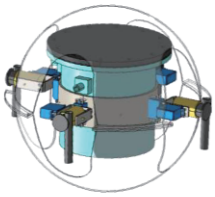
Session Chairs: Sheng Cao, Beijing Institute of Technology
Howard Li, University of New Brunswick
UTC+8(Beijing Time): 15:15 - 16:45, Monday, 4 August 2025

MP2-6 (1) 15:15 - 15:30

Design and Development of a Parallel Multi-Cascaded PID Control Method for the Novel Spherical Underwater Robot

Zixuan Lyu[1], Chunying Li[1]* and Shuxiang Guo[1,2]*, Jinglei Nie[1], Weihao Wu[1]
[1]The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China
[2]The Aerospace Center Hospital, School of Life Science and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing 100081, China

- Proposes a novel parallel multi-cascaded PID control for robust underwater motion.
- Enables precise 6-DOF control via cross-symmetric multi-vector thruster design.
- Demonstrates strong disturbance rejection under nonlinear simulations.
- Validates high-accuracy tracking performance in real-world underwater tests.



The Novel SUR

MP2-6 (2) 15:30 - 15:45

Unmanned Aerial Vehicles and Edge AI for Power Line Inspection

Youping Fu, Jun Meng, Howard Li

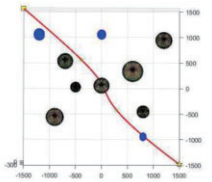
- Develops autonomous UAVs with onboard **Edge AI computing** for real-time sensor data processing and AI model execution.
- Uses **YOLO and YOLACT algorithms** for multi-object detection, instance segmentation, and anomaly detection in power grid components.
- Integrates **deep learning and augmented reality** for enhanced inspection capabilities.
- Employs **Intel RealSense cameras** and **RTAB-Map SLAM** to generate 3D maps for autonomous navigation.
- Implements the **3DVFH*** algorithm for obstacle avoidance and path planning in complex 3D environments.

MP2-6 (3) 15:45 - 16:00

AUV Path Planning based on Improved Fireworks Algorithm

Juan Li, Donghao Sun
College of Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin, China

- This paper proposes an improved Fireworks Algorithm to solve the path planning problem of AUV in a 3D underwater environment.
- This paper addresses the problem of path planning for AUV in 3D underwater environments



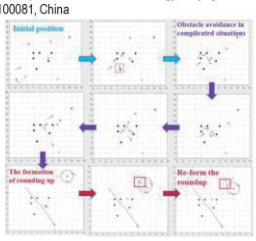
Path Planning of AUV

MP2-6 (4) 16:00 - 16:15

Collaborative Hunting Strategy for Multi-Robots in Complicated Underwater Environments

Jipeng Long[1], Shuxiang Guo[1,2,3*] and Chunying Li[2*]
1. National Engineering Laboratory for Big Data System Computing Technology, Shenzhen University, Shenzhen, Guangdong, 518060, China
2. The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China
3. The Aerospace Center Hospital, School of Life Science and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing 100081, China

- Handling of both static and dynamic obstacles is provided.
- A smooth transition between different task phases is achieved.
- Scalability to larger robot teams is supported.



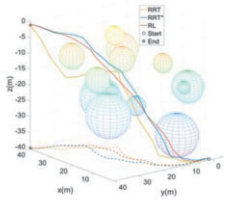
The trajectory of the robot

MP2-6 (5) 16:15 - 16:30

Study on 3D Path Planning of AUV Based on the Reinforcement Learning Method

Haotian Li [1], Shuxiang Guo [1,2], Chunying Li[2] and Le Huang[2]
1. Shenzhen University, Shenzhen, Guangdong, 518060, China
2. Southern University of Science and Technology, Shenzhen, Guangdong 518055, China

- Proposing a DDPG-based RL framework with 6-DOF AUV dynamics and environmental disturbances.
- Designing a reward function to balance goal convergence, collision avoidance, and smoothness.
- Employing progressive training with curriculum learning and prioritized experience replay.
- Achieving superior performance over RRT and RRT* in both calm and disturbed underwater settings.



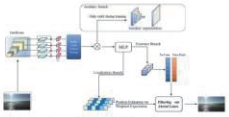
Comparative experiments with disturbances

MP2-6 (6) 16:30 - 16:45

A Lightweight Deep Learning-Based Fast Detection Algorithm for Waterway Navigation

Yifu Lv, Siting Lu, Yang Li, Chun jia
Harbin Engineering University
Harbin, Heilongjiang, China

- This solution achieves real-time processing through the integration of a computationally efficient deep learning architecture with multi-modal image enhancement techniques.
- The framework incorporates multi-component loss functions, achieving 33ms/frame processing at 1080p resolution with a 52% F1-score improvement over the UFLD baseline.
- Stereo accuracy: 5.6cm (fav)/11.7cm (adv)



network architecture

Comparison of Results

MP3-1 Intelligent Mechatronics and Application (III)

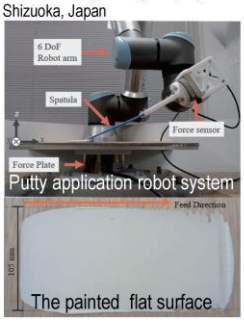
Session Chairs: Pengcheng Li, Dept. Electronic and Electrical Engineering, SUSTech
junwei chen, University of Electronic Science and Technology of China
UTC+8(Beijing Time): 17:00 - 18:30, Monday, 4 August 2025

MP3-1 (1) 17:00 - 17:15

Skill-Informed Putty Coating with a Force-Controlled Robot Arm on Cast-Like Surfaces

Munehiro Nakayama*, Shinichi Ishikawa*, Takumi Nishiwaki**,
Ryunoshin Oba**, Akihide Kimura**, Ryosuke Tasaki*
*Department of Mechanical Engineering, Aoyama Gakuin University, Kanagawa, Japan
**KIMURA FOUNDRY CO.,LTD., Shizuoka, Japan

- A force-controlled robot, informed by analysis of skilled human motions (trowel angle/force), automates putty.
- The proposed method demonstrated good coating uniformity and stable force control on plywood and actual cast iron.
- This research indicates the feasibility of skill-informed robotic putty coating for industrial applications.

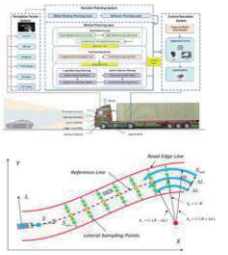


MP3-1 (2) 17:15 - 17:30

Planning and Tracking Control Algorithm for Autonomous Truck with Trailer

Ranfei Xia, Hu Guo, ..., and Shengwu Xiong
School of Computer Science and Artificial Intelligence, Wuhan University of Technology,China

- A road reference line model is established based on the global navigation path, which the autonomous truck can search the posture relationship with the reference line in real time.
- a Quintic Bezier lateral candidate trajectories generation algorithm and a Quintic Polynomial longitudinal candidate speeds generation algorithm are designed based on the road longitudinal and lateral adaptive sampling strategy in SL coordinates.
- Moreover, a tracking control algorithm is designed to realize the real-time tracking strategy of the optimal trajectory to ensure the tractor and trailer to reach the destination safely, comfortably and smoothly.



The autonomous truck algorithm architecture

MP3-1 (3) 17:30 - 17:45

Multidimensional Impact Characterization in Collaborative Robotics: A Gazebo-Based Collision Testing System

Xu Sun, Lelai Zhou*, Zhonglong Ren, Baining Chen and Yibin Li
School of Control Science and Engineering, Shandong University, Jinan 250061, China

- Developed a comprehensive collaborative robotics collision testing system aligned with ISO/TS 15066 safety standards.
- Implemented multi-modal sensing and dynamic collision analysis to quantitatively measure peak collision force and contact duration.
- Validated system efficacy through Gazebo simulations and experiments.

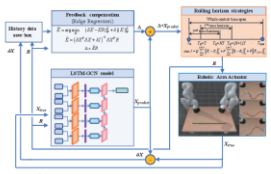
The Collision Testing System

MP3-1 (4) 17:45 - 18:00

LSTM-GCN Hybrid Architecture for Model Predictive Control of Deformable Linear Objects

Zongyan Yue,Xuehe Zhang*,Yiding Wang,Shu Jiang,Jie Zhao
State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, China

- A novel method that integrates GCN and LSTM for model learning, enabling the fusion of spatio-temporal features to more accurately predict DLO deformation.
- The establishment of an MPC controller augmented with a real-time feedback correction mechanism.
- Simulation experiments that validate the effectiveness of the proposed method.



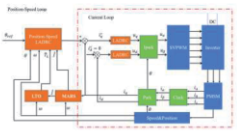
The Cable Manipulation Framework

MP3-1 (5) 18:00 - 18:15

ADRC with Adaptive Parameter Identification and Feedforward Compensation for Motion Systems

Junwei Chen, Xuesheng Li,Haochen Xu,Chuan Yang
School of Aeronautics and Astronautics, University of Electronic Science and Technology of China, Chengdu, Sichuan, China

- Proposing ADRC with adaptive identification and feedforward to address PID's disturbance-variation limitations.
- ILADRC enhances dynamics and disturbance rejection via co-designed observers.
- Under 15N·m load, ILADRC maintains 25.1° ±0.3° phase lag via ESO feedforward, outperforming PI's 33.9° shift.



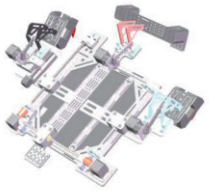
Schematic Diagram of the Enhanced ADRC System with Load Disturbance Estimation and Compensation

MP3-1 (6) 18:15 - 18:30

Design of Marine Cage Climbing Robot and Dynamic Compensation of Attitude

Youchang Xia, Zitong Liao, Shengqian Qu, Siyuan Han, Ziyang Mei, Pei Su ,Yang Zhao
Pen-Tung Sah Institute of Micro-Nano Science and Technology, Xiamen University
Xiamen , China

- Marine cage climbing robot with autonomous attitude correction function on flexible mesh surface.
- The XZ axis orthogonal motion mechanism is combined with the hook claw module to realize the flexible motion and stable grasping on the surface of the flexible netting.
- Attitude correction of sensor data feedback in climbing process.



Ocean cage coating cleaning robot.

MP3-2 Intelligent Mechatronics and Application (VI)

Session Chairs: jialin He, Harbin Engineering University
Bin Liu, ABB Research Center

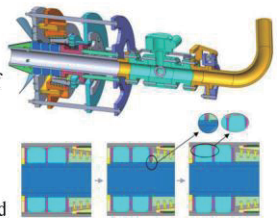
UTC+8(Beijing Time): 17:00 - 18:30, Monday, 4 August 2025

MP3-2 (1) 17:00 - 17:15

Design and Fretting Characteristics Behavior Analysis of the Deep-sea Pipe Plug

Jing Wen, Lan Zhang, Guoqiang Zhang*, Wenyu Tang, Zhongyang Wang, and Feihong Yun
College of Mechanical and Electrical Engineering, Harbin Engineering University
Harbin, China

- An external anchoring-internal plugging deep-sea pipe plug is designed.
- The fretting wear characteristics of the sealing rubber barrel under different operating conditions is investigated.
- Fretting wear test and surface morphology observation are carried out to study the influence of fretting parameters.



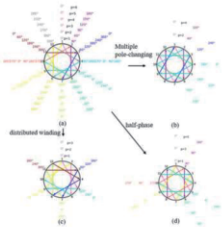
The plugging deep-sea pipe plug

MP3-2 (2) 17:15 - 17:30

Topological Synthesis Methodology of Symmetrical Winding Configurations for Multi-phase Pole-Phase Modulation Motors

Jirong Yu, Shuguang Zuo*, Bin Yin, Haijun Zhuang
Department of Automotive Engineering , Tongji University
Shanghai, China

- Topological synthesis methodology
- Design paradigm of 36 stator slots using methodology
- Validation of FEA (finite element analysis)



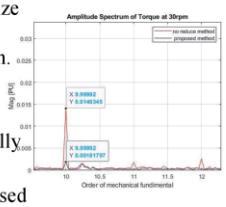
Topological Synthesis Methodology

MP3-2 (3) 17:30 - 17:45

Torque ripple minimization of PMSM using resonant controller in robot applications

Jieqiong Wang, Bin Liu, Peter Fransson and Mikael Norrlof
ABB Corporate Research, ABB Robotics
Vasteras, Sweden

- A novel scheme is proposed to minimize torque ripples by a resonant controller based on speed harmonic minimization.
- The proposed scheme is simpler to implement in robotic systems.
- It has been simulated and experimentally validated under two test benches.
- The results demonstrate that the proposed scheme enhances servo system control accuracy.



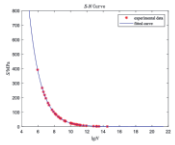
Torque Ripple Minimization

MP3-2 (4) 17:45 - 18:00

Fatigue Life Analysis of Outdoor Large-Scale Test Bench Based on S-N Curve Fitting Using Crack Propagation Life

Xintao Tang 1, Peng Zhang 2 , Xuelong Zhang 3, Yanchong Xue 4,Lingtao Yu 5
College of Mechanical and Electrical Engineering, Harbin Engineering University
Harbin, Heilongjiang Province, China

- For large-scale engineering equipment with complex and harsh working environments, a targeted fatigue life prediction method is proposed.
- Both the internal damage of the structure and the crack growth at the dangerous point are considered for life prediction.
- This method fits the S-N curve based on the crack growth life and integrates the fatigue damage theory.



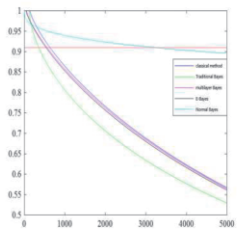
fitted S-N curve at the crack defect

MP3-2 (5) 18:00 - 18:15

Research on reliability assessment methods based on zero-failure data

Sichen Ou 1, Peng Zhang 2, Yanchong Xue 3, Xuelong Zhang 4 and Lingtao Yu 5
Mechanical and Electronic Engineering College, Harbin Engineering University, China

- A new reliability method has been proposed for data without failure.
- Research based on Bayesian thinking and the basic principles of normal distribution
- The normal Bayes method was proposed based on experimental data.
- The normal Bayes method has good feasibility and accuracy.



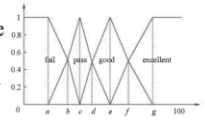
Reliability curves for five methods

MP3-2 (6) 18:15 - 18:30

Fuzzy comprehensive evaluation of effectiveness based on improved membership function

Jialin He 1, Xuelong Zhang 3, Yanchong Xue 4 and Lingtao Yu 5
College of Mechanical and Electrical Engineering, Harbin Engineering University
Harbin City , China
Peng Zhang 2
Beijing Institute of Tracking and Telecommunication Technology , Beijing, China

- This paper proposes an improved broken line-type membership function.
- The indicator types of the actual system were divided in detail, and then a different broken line-type membership function is established for each indicator.
- Based on the improved fuzzy comprehensive evaluation method, the effectiveness of the actual system is evaluated, and the rationality and feasibility of the improvement are verified.



Membership function diagram of qualitative indicators

MP3-3 Intelligent Biomedical Instrument Technology (III)

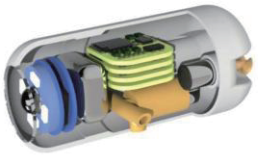
Session Chairs: Le Huang, Southern University of Science and Technology
Shan Jiang, School of Mechanical Engineering, Tianjin University
UTC+8(Beijing Time): 17:00 - 18:30, Monday, 4 August 2025

MP3-3 (1) 17:00 - 17:15

Active Propulsion of Capsule Robot Through Internal Water Jet System

Xue Yang, Yi Zhang, Yunzhe Li, Chaoyang Shi and Chengzhi Hu
Mechanical and Energy Engineering, Southern University of Science and Technology, China

- Core Propulsion: Capsule robot with internal water jet system for active, flexible underwater maneuvering.
- Efficiency: Centimeter-scale validated water jet thrust and motion capabilities.
- Future Applications: Offers advanced propulsion solutions for capsule endoscopes.

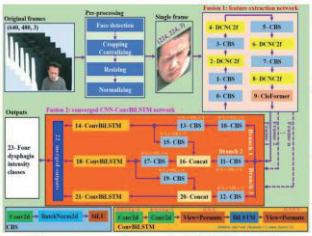


The Capsule Robot Integrated Water Jet System

MP3-3 (2) 17:15 - 17:30

An Integrated Neural Network Model for Classifying Dysphagia Intensity from Facial Expressions

Yuhe Fan, Lixun Zhang, Keyi Wang, Yi Liu, Jinghang Li, Zhenhan Wang, Feng Xue, and Huaiyu Che
College of Mechanical and Electrical Engineering, Harbin Engineering University, Harbin, Heilongjiang, China.



The proposed integrated INNM model

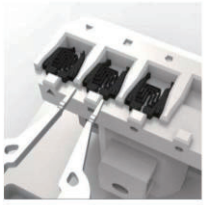
A The proposed integrated neural network model (INNM) combining CNN for feature extraction and BiLSTM for sequential comprehension.
B The INNM enhances YOLOv8s-cls with deformable convolutions and incorporates CloFormer attention for better information perception.
C The model convergence in CNN-ConvBiLSTM improves sequence memory and spatial integration, surpassing baselines and state-of-the-art methods with validated enhancements.

MP3-3 (3) 17:30 - 17:45

A Vision-Guided Vibrational Mating for Interchangeable Tools in Cross-Scale Assembly

Wenxuan Huang, Yilong Wu, Xianmin Zhang*
Guangdong Provincial Key Laboratory of Precision Equipment and Manufacturing Technology,
South China University of Technology
Guangzhou, China

- Use vibration to solve the jamming issue in mating between microgripper and interchangeable tools.
- Use an enhanced edge-based template matching for object recognition.
- A success rate of 100% was achieved in 50 trials with the proposed mating approach.



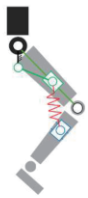
The microgripper and the modular tools

MP3-3 (4) 17:45 - 18:00

Proposal and Verification of Support Device for Knee Joints based on a Link Mechanism and Spring Component

DU XIANCHEN, IMAMURA TAKASHI
Faculty of Engineering, Niigata University, Niigata, Japan

- In order to maintain natural walking ability of elderly people, support mechanism for their walking motion has been proposed.
- Support process does not required the extra energy source during walking in proposed system.
- Validity and effectiveness of proposed system have been confirmed through the simulation.



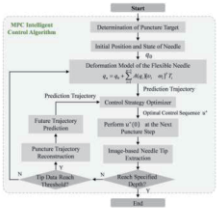
Proposed Mechanism

MP3-3 (5) 18:00 - 18:15

An Intelligent Control of Flexible Needle Insertion based on Model Predictive Control for Soft Tissue Intervention

Jiale Zhang, Shan Jiang*, Zhiyong Yang, Zeyang Zhou, Yihan Gao
Mechanical Engineering Department, Tianjin University, Tianjin, China.

- An intelligent control algorithm based on Model Predictive Control (MPC) for flexible needle insertion into soft tissue.
- The reconstructed insertion trajectory is integrated with the needle deformation model to predict the future path.
- A polyvinyl alcohol (PVA) -based hydrogel synthetic biomaterial phantom to mimic the mechanical behavior of real pulmonary soft tissue.

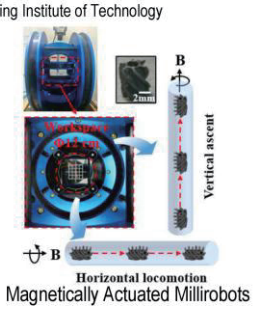


MP3-3 (6) 18:15 - 18:30

Dual-Modal 3D Locomotion of Magnetically Actuated Millirobots in Elongated Narrow Conduits

: Jiabao Du, Haotian Yang, Wenbo Li, Heng Wang, Yaozhen Hou, Qing Shi, Qiang Huang, Huaping Wang
School of Mechatronical Engineering, Beijing Institute of Technology
Beijing, China

- Topology optimization and density regulation enable gravity-resistant 3D locomotion in elongated narrow conduits.
- Dual-modal propulsion switches between horizontal motion and vertical ascent under rotating magnetic fields.
- Biomedical potential for navigating complex tubular anatomy, such as intestinal drug delivery



Magnetically Actuated Millirobots

MP3-4 Biomimetic Systems

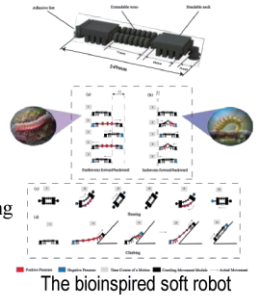
Session Chairs: Wu Shaohang, Sun Yat-sen University
Yuyao Li, School of Mechanical Engineering, Southeast University
UTC+8(Beijing Time): 17:00 - 18:30, Monday, 4 August 2025

MP3-4 (1) 17:00 - 17:15

Bioinspired Soft Robot: Earthworm-Inchworm Actuation for Complex Environments

Shaohang Wu*, Yimu Liu, Hang Huang, Enpei Peng, Yuquan Zheng
School of Aeronautics and Astronautics , Sun Yat-sen University
Shenzhen, China

- Three flexible components: telescopic torso, flexible neck, and adhesive feet
- Modular pneumatic actuation facilitates adaptive transition between locomotion modes
- Hybrid probe integrates extensible protrusion and SMA-driven steering for enhanced maneuverability



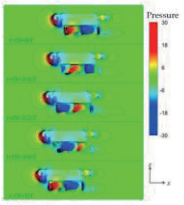
The bioinspired soft robot

MP3-4 (2) 17:15 - 17:30

Hydrodynamic Study of the Self-Propulsion Performance of an Individual Module in a Modular Underwater Robot with Undulating Fin Propulsion

Yuyao Li, Zhengxuan Wang, Tianwen Liu, Dan Xia*
School of Mechanical Engineering, Southeast University
Nanjing, Jiangsu, China

- The self-propulsion performance of a single module of a modular underwater bionic robot based on fluctuating fin actuation is investigated.
- The hydrodynamic characteristics of underwater self-propulsion of a robot are analyzed with the help of CFD methods.
- The transient evolution of the flow field around the robot during self-propulsion is analyzed.
- The effects of different frequencies and amplitudes of fins on the underwater propulsion performance of the robot are obtained by a variable parameter study.



Evolution of pressure contours around the robot during self-propulsion

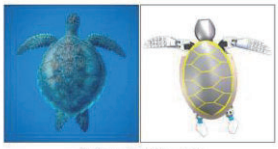
MP3-4 (3) 17:30 - 17:45

Design, Implementation and Experiment Validation of the Turtle-inspired Robot

Zhekun Peng[†], Han Zhang[†], Zhongde Chen[†], Huan Dong[2], Can Liu[3], Gang Yang[4], Hongbo Niu[5],Haibo Li[6], Huiming Xing[7]*
Harbin Engineering University, No.145, Nantong Street, Nangang District,Harbin 150001, Heilongjiang Province, China
[†]These authors contributed equally as first authors;* Corresponding author

Abstract **- This paper designed, implemented, and experimentally validated a turtle robot inspired by sea turtles. Compared with existing turtle-like robots using rigid/semi-rigid hydrofoils and lacking real-time variable stiffness mechanisms, this design features modular structure with forelimbs' variable stiffness hydrofoils for adaptive thrust, hindlimbs' flexible hydrofoils for control, and integrated a center of gravity (COG) adjustment mechanism and a pump-driven buoyancy control system. These innovations enable seamless mode switching between high-thrust flapping and low-power gliding, enhancing hydrodynamic performance and stability. Experiments validated its COG/buoyancy control, limb coordination, and overall mobility in water.**

Index Terms **– modular structure; variable stiffness hydrofoils; center of gravity (COG) adjustment; pump-driven buoyancy control.**



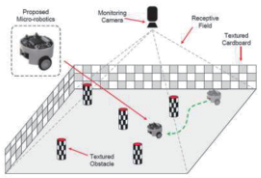
Design of turtle robots based on sea turtles in nature

MP3-4 (4) 17:45 - 18:00

Bio-plausible Collision Detection in Micro-Robots: A Comparative Study of LGMD-inspired Models

Yaowei Li[1], Lihui Jin[1], Yuhao Lin[1], Weikun Chen[1], Yangjuan Yao[2], Peng Shi[3] , Hao Luan[1*]
[1]Tianjin Key Laboratory of Information Sensing and Intelligent Control, Tianjin University of Technology and Education, Tianjin, China.
[2]TIANJIN HUANBO SCIENCE AND TECHNOLOGY CO.,LTD, Tianjin, China.
[3]School of Medical Technology and Engineering, Henan University of Science and Technology, Luoyang, China.

- This study implements an on-line horizontal comparison of three representative LGMD-inspired models (inspired by the locust's Lobula Giant Movement Detector neuron) on a lightweight, low-cost, low-power micro-robot platform.
- Despite differences in their performance, all three models demonstrate the feasibility of bio-plausible collision detection systems in resource-constrained scenarios.

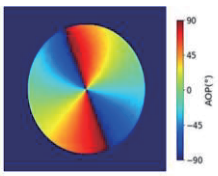


MP3-4 (5) 18:00 - 18:15

Heading Angle Measurement Algorithm for Polarized Light Based on a Berry Model Optimized by PSO

Taotao He,Xinzhao Yin,Ya Zhang,Shiwei Fan , Fei Yu, Dong Hu
School of Instrumentation Science and Engineering Harbin Institute of Technology
Harbin, Heilongjiang Province, China

- Polarized light navigation technology uses the atmospheric polarization mode to measure the heading Angle and has advantages such as no error accumulation and anti-interference.
- The parameters of the Berry model are optimized based on the particle swarm optimization algorithm to improve the characterization accuracy of the actual atmospheric polarization mode.



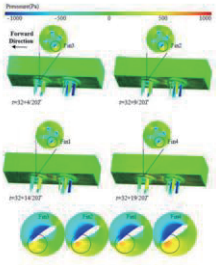
Actual AOP image.

MP3-4 (6) 18:15 - 18:30

Simulation Study of Composite Propulsion Mechanism of Cycloidal Propellers

Tianwen Liu, Han Yan, Yuyao Li, Dan Xia*
School of Mechanical Engineering Southeast University
Nanjing, Jiangsu, China

- Kinematic analysis is performed to determine the computational parameters of the hydrodynamic performance of the vehicle and to establish a simulation model
- Simulation analysis of the vehicle under different conditions is carried out using CFD methods.
- The results show that the vehicle equipped with pairs of propellers can travel stably



MP3-5 Mobile Robot System (III)

Session Chairs: Ruosong Wang, Beijing Institute of Technology
Kenjiro Tadakuma, Osaka University

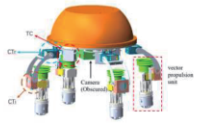
UTC+8(Beijing Time): 17:00 - 18:30, Monday, 4 August 2025

MP3-5 (1) 17:00 - 17:15

An Integrated Leg-Arm Underwater Robot Capable of Sensorized Grasping

Yizhou Su[1], Tingxuan Ge[1], Zhen Wang[1] , Guojian Feng[1] , Huiming Xing[1*], Haibo Li[2], Zhenxu Li[1]
[1] College of Intelligent Systems Science and Engineering, Harbin Engineering University, No.145, Nantong Street, Nangang District, Harbin 150001, Heilongjiang Province, China
[2] College of Information And Communication Engineering, Harbin Engineering University, No.145, Nantong Street, Nangang District, Harbin 150001, Heilongjiang Province, China

- Aiming at underwater operation, such as grasping and transportation, this paper proposed an integrated leg-arm underwater robot capable of sensorized grasping.
- In order to adjust the thrust direction of vector propulsion after capturing the target and thus maintain the underwater maneuverability of the robot, a flexible gripper was designed.



The leg-arm underwater robot

The vector propulsion and flexible gripper

MP3-5 (2) 17:15 - 17:30

Fire-Resistant Soft Actuators for Search and Rescue Robots

— A Drive Mechanism for Robots Operable in Fire-Exposed Environments —

Kazuma SHIMOMURA[1], Shubo YANG[1], Atsunori HASHIMOTO[1], Naoto KIKUTA[1], Yuto KEMMOTSU[1], Josephine GALIPON[2], Kazuki ABE[1], Masahiro WATANABE[1], KenjiroTADAKUMA[1*] , 1. Osaka University , 2. Yamagata University

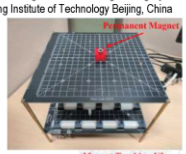
- Developed two types of flame-resistant soft actuators: pouch-type and spiral-type for use in fire-disaster environments.
- Prototypes successfully operated under direct flame exposure, demonstrating durability and repeatable actuation.
- Confirmed feasibility for lightweight robotic deployment, with future work focusing on integration with mobile robots and flame-resistant subsystems.

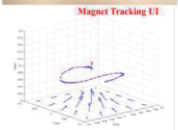
MP3-5 (3) 17:30 - 17:45

Differential Magnetic Sensing with Dynamic Background Calibration for the Capsule Robot Localization in Dynamic Environments

Miaozhang Shen1, Shuxiang Guo1,2,3*, Zixu Wang2* and Chunying Li2
1. Advanced Institute for Ocean Research, Southern University of Science and Technology, Shenzhen, Guangdong, China
2. The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong, China
3. The Aerospace Center Hospital, School of Life Science and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology Beijing Institute of Technology Beijing, China

- Novel differential sensing and Kalman filter calibration cancel noise effectively.
- Hybrid LM-GN optimization boosts convergence speed by 40.6%.
- Achieved 2.52mm RMS positioning accuracy in dynamic interference, outperforming traditional methods.





MP3-5 (4) 17:45 - 18:00

Dynamic Slippage and Trajectory Deviation Analysis of Omnidirectional AGVs with Diagonal Dual 2-DOF Wheels

Xing Hou, Hang Xu, Mengshen Yang, Fuhua Jia, Adam Rushworth, Guilin Yang
Faculty of Science and Engineering, University of Nottingham Ningbo China, Ningbo, China
Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, Ningbo, China
Ningbo Innovation Center, Zhejiang University, Ningbo, China

- Developed a kinematic model for the AGV with dual 2-DOF wheels
- Analyzed slip dynamics and its impact on trajectory deviation
- Conducted real-world tests validating power use and yaw drift
- Observed instability during speed transitions due to slippage
- Proposed solutions for reducing slip and improving control

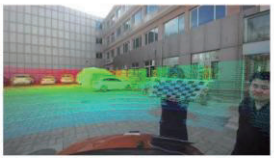
the AGV with dual 2-DOF wheels

MP3-5 (5) 18:00 - 18:15

A Robust Target-Based Camera-LiDAR Extrinsic Calibration Method Using Planar Constraints

Ruosong Wang, Guang He, Yilei Huang, Yipan Cheng, De Cai and Zhenhai Zhang*
School of Mechatroical Engineering, Beijing Institute of Technology
Beijing, China

- Solely utilizing planar features to calibrate camera and LiDAR, eliminating edge artifacts caused by bleeding points and scanning gaps in LiDAR systems.
- Relaxed requirements on complete target visibility in point clouds, being robust in scenarios with insufficient field-of-view (FoV) overlap between sensors to be calibrated.



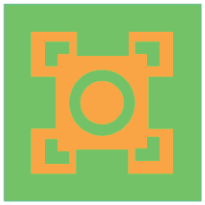
Reprojection visualization

MP3-5 (6) 18:15 - 18:30

Design of Ku-band one-dimensional Wideband Microstrip Antenna array

Xin Zhao, Bo Wang
Control Engineering, School of Automation, Xi 'an University of Posts and Telecommunications
Xi 'an, China

- Broadband microstrip antenna array operating in Ku band with single-layer FR4 substrate.
- Multimode resonance achieved via circular, L-shaped, and rectangular slits.
- Return loss < -10 dB in 12.67-15.87 GHz (22.2% relative bandwidth).
- 1 × 4 array achieves 12.57-15.79 GHz bandwidth and 12.28 dB max gain.



Ku-band antenna unit

MP3-6 Sensor Networks,Distributed Sensor Systems

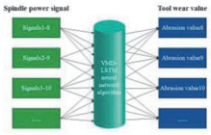
Session Chairs: Sheng Cao, Beijing Institute of Technology
Chen Xi, Nanjing University of Science and Technology
UTC+8(Beijing Time): 17:00 - 18:30, Monday, 4 August 2025

MP3-6 (1) 17:00 - 17:15

Tool Wear State Identification Technology Based on Spindle Power Signal

Niansong Zhang ,Xi Chen, Yan Ge , Aimin Wang, Yingjie Zhao
Department of Mechanical Engineering
Nanjing University of Science and Technology

- In this study, an LSTM neural network model optimized by variational modal decomposition algorithm is proposed to realize the tool wear state recognition technology.
- Compared with the single LSTM model (77.78% accuracy), the recognition accuracy of this model at 0.2mm wear reaches 96.3%.



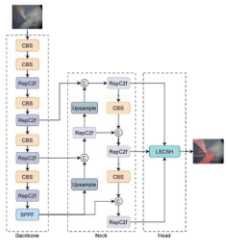
Technical scheme diagram

MP3-6 (2) 17:15 - 17:30

Real-Time Instance Segmentation Method for Submarine Pipeline Leakage Detection Based on YOLOv8-seg

Mengjia Zhang, Tao Bai, Suo Zhou, and Yuntao Han
Harbin Engineering University, Harbin China
Nanhai Institute of Harbin Engineering University, Sanya, China

- Redesign C2f into RepC2f modules based on structural re-parameterization
- Introducing the Inner-EIoU loss function to enhance segmentation accuracy for small leakage targets.
- Design a lightweight shared convolutional segmentation head using Group Normalization and shared convolution.



Architecture of RLSC-YOLOv8s-seg

MP3-6 (3) 17:30 - 17:45

Multi-sensor Data Fusion for PM2.5 Concentration Prediction based on Machine Learning

Jiayi Xin, Hongyan Xing

Propose a physically constrained CGAN data augmentation method to solve the problem of sample imbalance in regression tasks.

Fusion of multi-sensor data (SO_2, CO, PM10, NO_2) with meteorological parameters to enhance prediction robustness.

Dynamic pruning and depth constrained random forest, balancing computational efficiency and overfitting control.

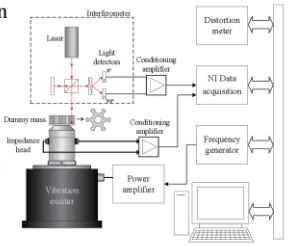
The experimental MAE decreased by 35.9% (compared to baseline), and the inference delay was only 2.3 ms/sample.

MP3-6 (4) 17:45 - 18:00

An Automatic Calibration System for Impedance Head

Song Anqi, Zhong Bo, Hu Hongbo, Cai Chenguang, Feng Xiujuan
National Institute of Metrology ,China

- Introduced an automatic calibration system for impedance heads based on ISO 16063-11.
- Integrated laser interferometer, excitation unit, and DAQ module; controlled by LabVIEW.
- Supports multi-point measurement with automatic report generation.
- Preliminary tests on B&K 8001 show high accuracy, repeatability, and efficiency.



The hardware structure of the system

MP3-6 (5) 18:00 - 18:15

Control Method and Implementation of Multi-component Calibration High Impact Test System

Ke Tong[1], Yipan Cheng[1], Yang Li[1], Zhenhai Zhang*[1], Tao Zeng[2], Guang He[1], De Cai[1]
1.School of Mechatronical Engineering, Beijing Institute of Technology, Beijing, China
2.Xi'an Institute of Electromechanical Information Technology, Xi' an, China

- To address the issues of low efficiency and complex operation in uniaxial calibration devices, a multi-component calibration high-impact testing system has been designed and implemented.
- Data acquisition and processing are managed via a MATLAB program, enabling precise calibration of the triaxial high-impact accelerometer's sensitivity.
- Repeated impact tests conducted with this system demonstrated that it meets the required calibration standards.

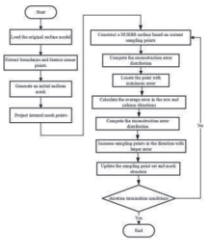
Photograph of the experimental apparatus

MP3-6 (6) 18:15 - 18:30

Adaptive Grid Sampling Strategy for Free-form Surface Measurement Based on Reconstruction Bias Constraint

Niansong Zhang ,Xianzhi Zhang, Long Wu, Aimin Wang
Department of Mechanical Engineering
Nanjing University of Science and Technology

- This study proposes an adaptive grid sampling strategy based on reconstruction bias constraint for efficient and accurate measurement of free-form surfaces.
- This method reduces the number of sampling points by approximately 17.9%~24.0% compared to traditional uniform sampling.



Algorithm flow

Tuesday
August 5, 2025

Morning Sessions

Tuesday
August 5, 2025

Afternoon Sessions

TP1-1 Signal and Image Processing (II)
TP1-2 Medical, Biomedical and Rehabilitation Systems (II)
TP1-3 Control Theory and Application (II)
TP1-4 Industrial,Manufacturing Process and Automation (I)
TP1-5 Elements,Structures,and Mechanisms (II)
TP1-6 Modeling, Simulation Techniques and Methodologies (I)
TP2-1 Signal and Image Processing (III)
TP2-2 Medical, Biomedical and Rehabilitation Systems (III)
TP2-3 Control Theory and Application (III)
TP2-4 Industrial,Manufacturing Process and Automation (II)
TP2-5 Signal and Image Processing (IV)
TP2-6 Modeling, Simulation Techniques and Methodologies (II)

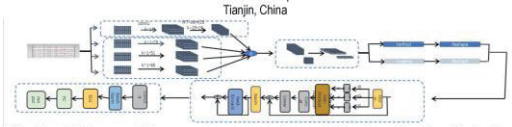
TA1-1 Signal and Image Processing (I)

Session Chairs: Jiawang Yang, Tianjin University of Technology
Shizhuo Zhang, Changchun University of Science and Technology
UTC+8(Beijing Time): 11:00 - 12:00, Tuesday, 5 August 2025

TA1-1 (1) 11:00 - 11:15

Wavelet-enhanced temporal convolution and Transformer encoder for motor imagery EEG signal classification

Jiawang Yang, Jigang Tong, Sen Yang, Shengzhi Du and Yinghui Chang
Tianjin Key Laboratory for Control Theory & National Clinical Research Center for Chinese Medicine Acupuncture
Tianjin, China



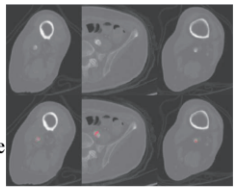
1. After the 1 × 1 convolution, a custom wavelet convolution is applied to efficiently extract temporal features from the input signa
2. The proposed Flash Attention mechanism is integrated into the self-attention module to enhance computation speed and reduce memory usage.
3. A signal segmentation and recombination method is proposed to augment data and alleviate limited sample availability.

TA1-1 (2) 11:15 - 11:30

Segmentation of Calcified Lesions in Lower Limb Artery CTA

Mingyu Zou, Shuxiang Guo, Bingzhi Shen, Hongchen Ren, Yonggan Yan, Bin Wang, Mingchao Ding
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing, 100081, China

- A neural network-based method was proposed for the segmentation of calcified plaques in lower limb CTA scans.
- A custom dataset of 23 annotated lower limb CTA scans was prepared, and three nnUNet variants were evaluated.
- The results suggest that 3D fullres models are more effective in capturing the spatial complexity of lower limb vascular calcifications.



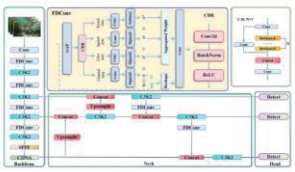
CTA images containing calcification

TA1-1 (3) 11:30 - 11:45

HAD-Net: A Hybrid Attention Driven Dynamic Network for AUV-Based Underwater Object Detection

Xueting Liu[1], Shuxiang Guo[1,2,3*], Chunying Li[1*], Sihan Gao[1,2], Qirong Lei[1], Weizhi Wu[1]
1. The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China

- FDConv module introduces four-way dynamic attention across spatial, channel, filter, and kernel dimensions for precise feature modulation.
- Achieves AP50 of 88.5 and AP75 of 76.8 on URPC2020 dataset, outperforming all existing methods in accuracy and robustness.
- Maintains real-time performance with only 3.4M parameters and 6.2 GFLOPs, suitable for AUV deployment. with >300 dpi resolution.



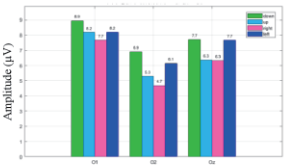
The overall framework of HAD-Net

TA1-1 (4) 11:45 - 12:00

Neural Processing Mechanisms of Visual Symmetry Across Different Visual Fields: an Event-related Potential Study

Meng Wang, Shizhuo Zhang, Jingjing Yang, Fengxia Wu
School of Artificial Intelligence, Changchun University of Science and Technology
Jilin, China

- ERP-EEG analysis of symmetric stimuli in four fields revealed highest amplitudes in lower vs. upper/left/right fields, with left > right responses.
- This demonstrates field-specific neural processing mechanisms, advancing symmetry perception neuroscience.



Mean amplitudes of the P2 component across the three electrodes.

TA1-2 Medical, Biomedical and Rehabilitation Systems (I)

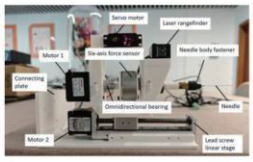
Session Chairs: Linshuai Zhang, Chengdu University of Traditional Chinese Medicine
Xiaochuan Li, Beijing University of Posts and Telecommunications
UTC+8(Beijing Time): 11:00 - 12:00, Tuesday, 5 August 2025

TA1-2 (1) 11:00 - 11:15

Development and Validation of a Real-Time Force/Torque Sensing System for Precision Acupuncture Robots

Xin Tian[1#], Zhihang Yuan[2#], Linshuai Zhang[1,2*], Tao Jiang[1*], Shuoxin Gu[2,3], Yujie Zhang[1], Lin Xu[1]
[1] School of Intelligent Medicine, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan, China
[2] School of Automation, Chengdu University of Information Technology, Chengdu, Sichuan, China
[3]International Joint Research Center of Robotics and Intelligence System of Sichuan Province, Chengdu University of Information Technology, Chengdu, Sichuan, China

- Structural design of end effector
- Mathematical modeling of end effector
- Control simulation of acupuncture robot
- Needle force and torque calibration test



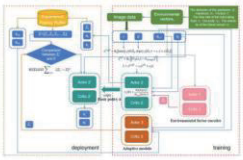
Novel Intelligent Acupuncture Robot

TA1-2 (2) 11:15 - 11:30

Study on the Autonomous Guidewire Navigation Method Utilizing the Generalization of Reinforcement Learning

Xiaochuan Li, Jingzhou Song,Tengfei Zhang, Jiachen Duan
School of Intelligent Engineering and Automation,Beijing University of Posts and Telecommunications
Beijing, China

- Propose a reinforcement learning generalization framework based on environmental factor encoding and an asynchronous adaptive module.
- Design an ex vivo simulated vascular experimental platform.



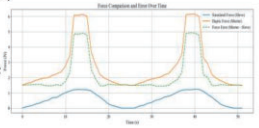
The Framework of Algorithm

TA1-2 (3) 11:30 - 11:45

Design and Implementation of a PWM-Controlled Controllable Current Source for Robotic Catheter Force Feedback Applications

Kaixiang Zheng[1#], Yuyang Luo[1#], Linshuai Zhang[1,2*], Tao Jiang[1*], Dai Qiu[3]
[1]School of Intelligent Medicine, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan, China
[2]School of Automation, Chengdu University of Information Technology, Chengdu, Sichuan, China
[3]Chengdu Neusoft University, Chengdu, Sichuan, China

- A controllable current source (BUCK) based on PWM is proposed
- Detailed design and analysis are carried out to verify the performance of the power supply
- It has the characteristics of fast response, strong stability and compact integration



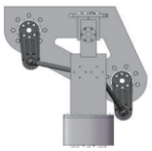
Tactile Force Curve for the Main and Distal Ends(With FCNN)

TA1-2 (4) 11:45 - 12:00

Design and experimental study of parallel hip joint

Quan Wang, Yongqi Zhu, Juan Li, Weida Li, Gai Liu and Dianhao Zhu
Robotics and Micro-systems Center, Soochow University
Soochow, China

- Humanoid robots are widely used in human-machine interaction and service fields. But most humanoid robots use serial hip joint mechanisms, which face insufficient drive under high loads, leading to interference during movement and unnatural gait. This paper proposes a novel parallel hip joint mechanism. By combining drive units in the sagittal and coronal planes in parallel, higher torque output can be achieved in two degrees of freedom without changing the drive unit model.



Parallel Hip Joint Structure

TA1-3 Control Theory and Application (I)

Session Chairs: Le Huang, Southern University of Science and Technology
Yanhui Wei, Harbin Engineering University

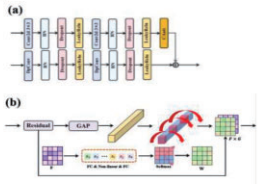
UTC+8(Beijing Time): 11:00 - 12:00, Tuesday, 5 August 2025

TA1-3 (1) 11:00 - 11:15

A Deep Learning-Based Multi-Branch Network for Accurate Vascular Segmentation

Sihan Gao[1,2], Chong Yang[1], Shuxiang Guo[1,3*], Xueting Liu[1], Huiyin Xu[4], Chunying Li[1]
The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, China

- Proposes a novel dual-branch convolutional module (DBCM).
- The proposed DBCM is capable of capturing both global and local information, thereby improving the model's segmentation performance.
- The method was evaluated on the DRIVE and CHASE DB1 datasets, with experimental results demonstrating superior performance



Dual-branch convolutional module

TA1-3 (2) 11:15 - 11:30

Control Method of Multi-Agent Formation and Obstacle Avoidance

Li Ren, Mingyu Li, Shiwei Fan, Ya Zhang, Fei Yu, and Jian Yang
School of Instrumentation Science and Engineering, Harbin, Heilongjiang Province, China

- The current formation control suffers from poor adaptability to the dynamic environment.
- This paper proposes a multi-agent formation control strategy combining the Particle Swarm Optimization (PSO) algorithm, consensus algorithm and artificial potential field (APF) method.
- It effectively navigates obstacle avoidance within a 2-meter detection radius and regulates system convergence time to within 30 seconds.

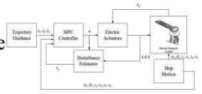
Multi-Agent Formation

TA1-3 (3) 11:30 - 11:45

Research on control method of hybrid mechanism based on DOB and MPC

Tianyi Zhang1, Yanhui Wei1,2*,Fei Song1 and Lingfan Zhang1
1College of Intelligent Science and Engineering, Harbin Engineering University, No.145 Nantong Street, Harbin, China
2Nanhai Institute of Harbin Engineering University ,Sanya, China

- Derive the DC motor mathematical model and the transfer function for motor position control.
- Design a disturbance observer to observe the torque disturbance of each actuator.
- Complete the design of the MPC controller.
- Controller performance is verified using Matlab-Adams co-simulation.



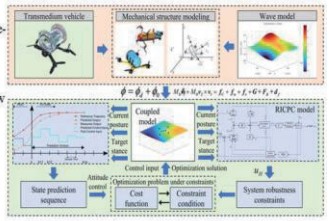
Hybrid mechanism
System Control Flow Chart

TA1-3 (4) 11:45 - 12:00

Attitude Control of Hybrid Aerial Underwater Vehicle based on Robust Incremental Constraint Predictive Control

Qi Guo, Gehan Zhu, Zhaoyang Wang, Bo Xu, Han Zhao, Xiangqian Xing
Unmanned intelligent system, Control theory and application, Harbin Engineering University Harbin, China

- Achieve dynamic compensation by real-time estimation of external disturbances such as wave-induced forces and viscous drag through a Nonlinear Disturbance Observer (NDO);
- Construct a Robust Incremental Constrained Predictive Control by integrating H∞ control law with incremental constrained Model Predictive Control;
- Validate the effectiveness through simulation experiments, validating its ability to enhance attitude tracking accuracy and robustness;
- The algorithm can be extended to scenarios including offshore platforms and wave-energy converters.



Algorithm flowchart

TA1-4 Neuro,Fuzzy,and Intelligent Control

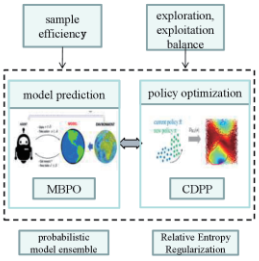
Session Chairs: Chong Yang, SUSTech
Qizhe Cui, Nanjing University of Science and Technology
UTC+8(Beijing Time): 11:00 - 12:00, Tuesday, 5 August 2025

TA1-4 (1) 11:00 - 11:15

Efficient Model based Reinforcement Learning Control using Relative Entropy Regularization

Huilin Wang, Mohammad Mohammadi, Wenjun Huang, Yidong Chen and Yunduan Cui
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China
University of Chinese Academy of Sciences, China

- Integrate dynamic relative entropy regularization into MBPO to address performance limitations caused by model bias.
- Automatically adjust the relative entropy constraint strength based on the predicted uncertainty, aiming to prevent misleading policy updates, MBPO-CDPP successfully enhances the learning capability and stability compared to related baseline.



TA1-4 (2) 11:15 - 11:30

Experimental study and flow prediction of solenoid valve performance under the coupled temperature field

Ningning Liu,Yanhong Wu, Kesheng Wang*
School of Mechanical and Electrical Engineering University of Electronic Science and Technology of China Chengdu, China

- The test platform coordinates the control of temperature ring and medium temperature to realize the measurement and control of flow, pressure and current.
- Degradation of proportional solenoid valve control characteristics due to high temperature
- Machine learning model accurately predicts current-flow relationships under complex conditions

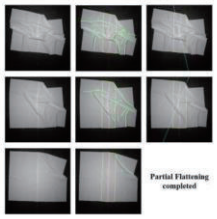
The Performance Test Platform

TA1-4 (3) 11:30 - 11:45

Partial Fabric Flattening for Seam Line Region Using Dual-Arm Manipulation

Youchun Ma[1], Fuyuki Tokuda[2,3], Akira Seino[2,3], Akinari Kobayashi[2,3],
Mitsuhiro Hayashibe[1], Bingchen Jin[2,3], Kazuhiro Kosuge[2,3]
1. Department of Robotics, Tohoku University, Sendai, Japan
2. Centre for Transformative Garment Production, Hong Kong S.A.R.
3. JC STEM Lab of Robotics for Soft Materials, The University of Hong Kong, Hong Kong S.A.R.

- Wrinkle and seam line detection based on U-net
- Partial flatten strategy based on dual-arm manipulators
- Manipulation points selection based on wrinkle and seam line detection



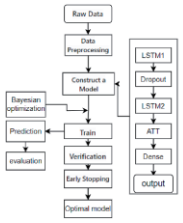
Example of the flattening experiments

TA1-4 (4) 11:45 - 12:00

Data-Driven Product-Oriented Quality Performance Prediction

Niansong Zhang[1*], Qizhe Cui[1], Yan Ge[2], Aimin Wang[3], Hui Tang[4]
[1]Department of Mechanical Engineering,Nanjing University of Science and Technology, Nanjing City, Jiangsu Province, China

- Bayesian optimization-based dual-layer Long Short-Term Memory network integrated with an attention mechanism.
- The Bayesian optimization algorithm significantly reduces parameter prediction errors.
- The attention-enhanced dual-layer LSTM model demonstrates advantages in dynamic feature focusing, noise robustness, and model interpretability.



Workflow diagram of the model

TA1-5 Elements,Structures,and Mechanisms (I)

Session Chairs: Xiaodong Wang, University of Alberta
Yige Peng, Shanghai university

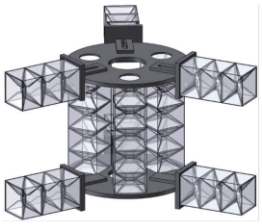
UTC+8(Beijing Time): 11:00 - 12:00, Tuesday, 5 August 2025

TA1-5 (1) 11:00 - 11:15

Bio-inspired Soft Pipeline Robot with Origami-Based Adaptive Guidance

Xia Huang,Chang Wu,Haomin Xiang,Rui Liang,Yuki Funabora,Yanhong Peng
College of Mechanical Engineering, Chongqing University of Technology
Chongqing, China

- A bionic soft pipeline robot utilizing negative-pressure-driven origami modules.
- The integrated design of the topologically reconfigurable origami module realizes the coupling of structural passive adaptability and active drive adjustment.
- Establish a mathematical model to analyze the relationship between the air pressure and deformation of the module.



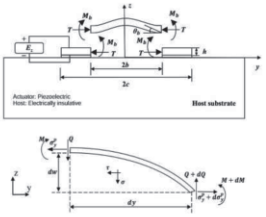
The Pipeline Soft Robot

TA1-5 (2) 11:15 - 11:30

Modelling of a Piezoelectric Actuator under Large Deformation for Smart Structure Applications

Mostafa Alizadeh, Xiaodong Wang
Department of Mechanical Engineering, University of Alberta
Edmonton, Canada

- Modelling Piezoelectric thin-sheet actuators under general electromechanical loads.
- Formulation and analysis of integrated actuator systems under large deformation.
- Simulation and prediction of the general nonlinear electromechanical response of integrated actuator systems.



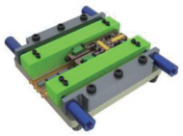
The Integrated Actuator

TA1-5 (3) 11:30 - 11:45

Design and Simulation of a Dual Piezoelectric-Actuated Stepping Linear Actuator

Jizheng Wang, Yuntao Li, Hailong Li, Deen Bai, and Chaoquan Tang
School of Mechanical and Electrical Engineering China University of Mining and Technology
University Road, Xuzhou, China

- This study proposes an innovative dual piezoelectric-stack-driven inchworm actuator architecture that integrates a clamping switching mechanism with a flexible displacement amplification unit.
- Experimental results demonstrate a displacement amplification ratio of 7.1 which correlates with the bridge arm's inclination angle and hinge radius but remains independent of input displacement.



Dual-Piezoelectric Inchworm Actuator

TA1-5 (4) 11:45 - 12:00

A Soft Robotic Gripper with Variable Grasping Force Based on Jamming Phenomenon

Yige Peng[1], Jianjun Yuan[1] , Zhengtao Hu[1], Liang Du[1] , Sheng Bao[1] , Mahmoud Magdy[2] ,* Senior Member, IEEE
[1]Shanghai Key Laboratory of Intelligent Manufacturing and Robotics, Shanghai University, Shanghai, China
[2]Mechanical Engineering Department, The British University in Egypt, Cairo, Egypt
**Corresponding author: Zhengtao Hu, huzhengtao14z@gmail.com*

- A novel dual-layer gripper structure is proposed that decouples deformation actuation and stiffness control.
- A repeatable and scalable fabrication process is developed using 3D printing, silicone casting, and granular filling.
- A linear stiffness model is established and validated through experiments, supporting future developments in feedback control and real-time grasp planning.

The Soft Robotic Gripper with Variable Grasping Force

TA1-6 Human-System Interaction and Interface

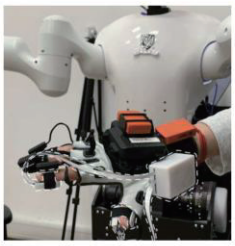
Session Chairs: Mark Lester Francisco Padilla, CUHK
Pan Qinxue, School of Mechanical Engineering, Beijing Institute of Technology
UTC+8(Beijing Time): 11:00 - 12:00, Tuesday, 5 August 2025

TA1-6 (1) 11:00 - 11:15

Wearable Fluid Haptics for Enhanced Robotic Teleoperation with MANUS Quantum Metagloves

Mark Lester F. Padilla, Zixin Tang, and Fei Chen
Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong Sha Tin, Hong Kong

- Fabricated a fluid haptic device that is based on electroosmotic pumps.
- Integrated with existing robotic teleoperation systems and with MANUS Quantum Metagloves.
- Used a haptic rendering algorithm to translate DIGIT's sensor output into useful tactile information.
- Compared the task completion time of the two cases: without and with haptics.



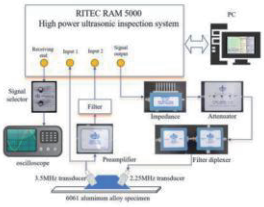
Fluid Haptics in Teleoperation

TA1-6 (2) 11:15 - 11:30

Research on micro-crack detection technology of aluminum alloy based on ultrasonic mixing nonlinear

Qinxue Pan, Guangyuan Zhao, Jiaqi Xu
School of Mechanical Engineering, Beijing Institute of Technology,Beijing, China

- Theoretical derivation of the propagation characteristics of ultrasonic mixing.
- Establishment of an ultrasonic mixing nonlinear detection system.
- Investigation of the feasibility of characterizing microcrack location using the ultrasonic mixing nonlinear coefficient.



Nonlinear ultrasonic testing system

TA1-6 (3) 11:30 - 11:45

Resistive Lower-Limb Exoskeleton for Fitness - Enhancing Metabolic Expenditure

Guangshan Wang, Shiquan Yu, Yixuan Guo, Chenglong Fu*
Department of Mechanical and Energy Engineering
Southern University of Science and Technology, Shenzhen, China

- Introduces a novel resistive lower limb exoskeleton that enhances metabolic expenditure.
- IMU-based gait recognition and cubic spline resistance trajectory planning.
- Results showed a 6-7% increase in respiratory quotient during resistance walking. Effectively enhances metabolic expenditure.
- Future works will include longer tests and EMG measurements

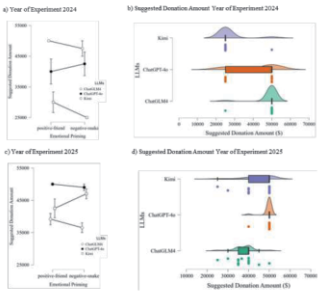
The prototype of the resistive exoskeleton

TA1-6 (4) 11:45 - 12:00

Across the Years, Closer to Us: Temporal Changes in Moral Caring by Large Language Models

Yiyang Yu1, Sihan Lu2
Laboratory of Psychological Testing and Behavior Analysis, Liaoning University, Shenyang, China
Institute of International Education, Liaoning University, Shenyang, China

- Whether the models were given a happy scenario or a scary one, it didn't really change how they made moral decisions. This shows that LLMs aren't easily swayed by brief emotional cues.
- Over time, updates to the model's structure, alignment training, and learning objectives had a clear and lasting effect on moral caring behavior. In other words, what the model is taught and how it's designed really matters.
- Some models that started off a bit selfish became more generous, while others that were too generous to begin with grew more balanced. This kind of fine-tuning shows how AI's sense of morality can be gradually shaped over time.



TP1-1 Signal and Image Processing (II)

Session Chairs: Pengcheng Li, Dept. Electronic and Electrical Engineering, SUSTech
Zhaohua Lu, Shandong University of Finance and Economics
UTC+8(Beijing Time): 13:30 - 15:00, Tuesday, 5 August 2025

TP1-1 (1) 13:30 - 13:45

Underwater Image Enhancement Algorithm Based on Transformer

Fengxu Guan, Yueteng Wang, Haitao Lai and Hao Chen
College of Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin,Heilongjiang Province,China

- An enhanced encoder-decoder module named CA-Swin Transformer incorporating channel attention mechanism.
- Implementation of nested dense skip connections with multi-level fusion.
- Adoption of a weighted multi-loss fusion function for model optimization.

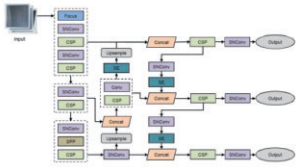
Overall Architecture Diagram

TP1-1 (2) 13:45 - 14:00

An Improved YOLOv5 Algorithm for Ultra-Thin Silicon Wafer Defect Detection

Weikun Chen[1*], Lihui Jin[2], Changjuan Yao[2], Bin Yang[1], Hua Yang[2], Zhigao Ren[2]
[1]School of Automation and Electrical Engineering, Tianjin University of Technology and Education, Tianjin, China.
[2]TIANJIN HUANBO SCIENCE AND TECHNOLOGY CO.,LTD, Tianjin, China.

In this study, we propose an enhanced YOLOv5 algorithm specifically designed for detecting defects in silicon wafers. Our dataset comprises 340 high-resolution images of large-sized ultra-thin photovoltaic wafers collected from manufacturing facilities, with all defective regions meticulously annotated. To address the unique characteristics of wafer defects, we augmented the original YOLOv5 architecture with an additional feature pyramid layer optimized for small object detection. This structural modification significantly improves the model's suitability for silicon wafer defect identification compared to the baseline algorithm.



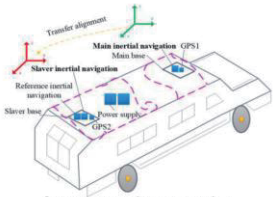
The improved Yolov5 network.

TP1-1 (3) 14:00 - 14:15

A Consistent Transfer Alignment Method for Large Misalignment Angles: Modeling and Implementation Based on Rodrigues Parameters

Xingxiang Rong, Zhaoxu Wang, Wei Gao, Ya Zhang, Shiwei Fan and Jian Yang
School of Instrumentation Science and Engineering, Harbin Institute of Technology
Heilongjiang Province, China

- A Consistent Transfer Alignment Method for Large Misalignment Angles
- Reduced-Order Nonlinear Attitude Formulation
- Marginalized Square-root Cubature Kalman Filter (MSCKF)



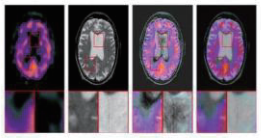
Schematic of the transfer

TP1-1 (4) 14:15 - 14:30

SPMRFusion: SPECT and MRI image registration and fusion based on TransGAN and self-attention mechanism

Siqi Ma, Mingliang Liu
Department of Automation, Heilongjiang University
Xuefu Road, Harbin, Heilongjiang Province, China

- A novel SPMRFusion network is proposed to unsupervised multimodal medical image registration and fusion.
- We introduce a combined GAN and Swin Transformer framework to promote image registration.
- The aligned SPECT and MRI images generate the network's output images through self-attention fusion.
- Qualitative and quantitative experimental results show the good performance of the method in the fusion of medical SPECT-MRI images.



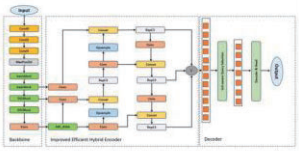
Multimodal Medical Image Fusion

TP1-1 (5) 14:30 - 14:45

AdaptiveFocus-DETR：Enhanced Real-Time Detection with Adaptive Feature Focus

Fengxu Guan, Yuzhu Zhang*, Tong Guo, Zhongkang Guan
of Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin,Heilongjiang Province,China

- A DSCBlockmodule is integrated into the backbone network of RT-DETR. Implementation of nested dense skip connections with multi-level fusion.
- The original AIFI module is integrated with an Adaptive Sparse Self-Attention mechanism.
- A hybrid loss function combining MPDIoU and Focaler-IoU is introduced to improve bounding box localization accuracy.



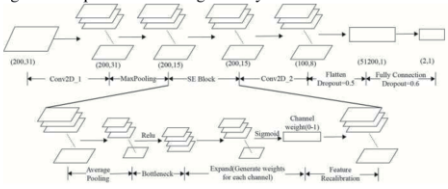
AdaptiveFocus-DETR structure

TP1-1 (6) 14:45 - 15:00

A Classification Model based on SEB-CNN for P300 Signal Recognition of P300 Speller

Zhaohua Lu[1*], Guanqun Li[1], Xiaowei Liu[1],Qi Li[2]
1 Shandong University of finance and economics, Jinan 250014, P.R. China
2 Changchun University of Science and Technology, Changchun 130022, P.R. China

- The lightweight channel attention module is introduced to dynamically enhance the spatiotemporal feature response of the target-related electrodes.
- It construct a multi-branch temporal convolution structure, which is compatible with neural response modes with different latency.
- The joint dynamic learning rate scheduling and hierarchical regularization strategy were designed to improve the training stability.



TP1-2 Medical, Biomedical and Rehabilitation Systems (II)

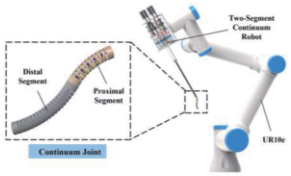
Session Chairs: chaoyang Shi, Tianjin University
Xiaoliang Jin, Southeast University
UTC+8(Beijing Time): 13:30 - 15:00, Tuesday, 5 August 2025

TP1-2 (1) 13:30 - 13:45

Design and Kinematics Analysis of a Two-Segment Continuum Robot for Flexible Exploration

Yang Li, Dezhi Song, Houyu Jin, Bo Zhang, Kaifeng Wang and Chaoyang Shi*
School of Mechanical Engineering, Tianjin University
Tianjin, China

- A 4-DOF two-segment continuum robot was proposed for flexible pelvic exploration.
- A PCC-based kinematic modeling was developed and validated, with inverse kinematics efficiently solved using a PSO method.
- Experiments validated positioning accuracy and workspace coverage.



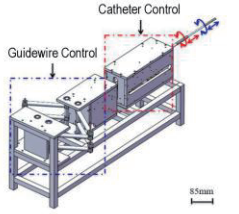
Two-Segment Continuum Robot

TP1-2 (2) 13:45 - 14:00

Preliminary Design Concept of a Haptic Interface for Coordinated Control of Guidewires and Catheters

Xiaoliang Jin[1], Aiguo Song[1]*, and Lifeng Zhu[1]
[1]State Key Laboratory of Digital Medical Engineering, Jiangsu Key Laboratory of Remote Measurement and Control, School of Instrument Science and Engineering, Southeast University, Nanjing, China.

- The proposed haptic interface not only achieves haptic feedback but also fully coverages the operational requirements of interventionists.
- The haptic interface was designed and developed based on a linkage mechanism, with an operation method that aligns with interventionists' clinical workflow. Besides, Its intuitive usability significantly reduces the operating difficulty and learning curve for novice interventionists.



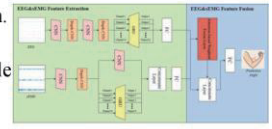
The concept of the proposed haptic interface

TP1-2 (3) 14:00 - 14:15

Attention-Enhanced sEMG-EEG Fusion Network for Continuous Joint Angle Estimation in Home-based Rehabilitation

Jun Leng1, Pengcheng Li1*, Shuxiang Guo1,2*, Weiyu Chen1, Chunying Li1
1. The Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China
2. The Aerospace Center Hospital, School of Life Science, and the Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing 100081, China

- Proposing a regression model based on channel-wise GRU and attention fusion.
- Investigate the practical potential of EEG–sEMG fusion for continuous angle estimation.
- The fusion model achieving higher prediction accuracy compared to sEMG-only model.



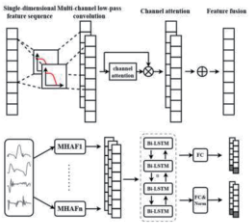
sEMG-EEG Fusion Network

TP1-2 (4) 14:15 - 14:30

Adaptive Filtering Multi-Task Gait Network for Gait Phase Detection in Patients with Lower Limb Movement Disorders

Yize Zheng, Kehan Xu, Yongkai Liao, Xinrun He, Jian Huang
School of Artificial Intelligence and Automation, Huazhong University of Science and Technology, Wuhan, China

- Proposed AFMG-Net for multi-task gait phase detection in foot-drop patients.
- Introduced MHAF Block for adaptive multi-scale filtering and feature enhancement.
- Supports classification and regression tasks on abnormal gait data.
- Validated with LOGO-CV on clinical dataset, achieving superior performance.



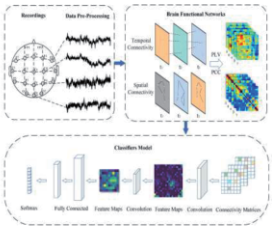
MHAF and AFMG-Net

TP1-2 (5) 14:30 - 14:45

Altered Functional Brain Connectivity in Gaming Disorder: Insights from EEG and Machine Learning

Yuze Zhang, Yuhui Pan, Lili Li, Zhongliang Yu
Shenzhen Technology University
Shenzhen, Guangdong Province, 518118, China

- CNN-LSTM on game-cue EEG classified addicted vs. non-addicted gamers with >99 % accuracy.
- Group differences evident even during resting-state;
- Addicted gamers show suppressed, localized occipital activity; controls exhibit wide, long-range connectivity
- Results indicate disrupted network integration and altered visual attention in gaming disorder.



flowchart

TP1-2 (6) 14:45 - 15:00

Combined wind-BESS-assisted thermal unit primary frequency modulation strategy

Hongzhi Zhang, Zhongli Bai, Yu Song, Zemin Mao*
Department of the School of Electrical Engineering and Automation, Tianjin University of Technology, Tianjin, China

- Combined wind-BESS-assisted thermal unit primary frequency modulation.
- The DFIG implements an integrated control strategy that combines inertia and droop..
- The BESS adopts the integrated control strategy, in which the coefficients of inertia control and droop control will be adaptively adjusted according to the SOC.

The Combined wind-BESS primary frequency regulation

TP1-3 Control Theory and Application (II)

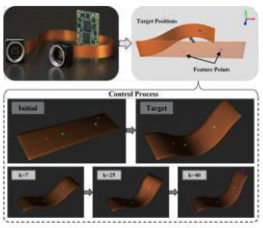
Session Chairs: Le Huang, Southern University of Science and Technology
Peng Shi, Henan University of Science and Technology
UTC+8(Beijing Time): 13:30 - 15:00, Tuesday, 5 August 2025

TP1-3 (1) 13:30 - 13:45

Multi-Point Positioning Control of Small Plate-Like Flexible Objects Using FEM-Based Constrained QP

Ang Chen, and Hai Li*, Nuo Xu, Yanjiang Huang, Xianmin Zhang
South China University of Technology, Guangzhou, China

- Precise multi-point positioning of plate-like flexible objects is vital yet challenging for automated assembly.
- Efficient FEM-based kinematics derived through corotational formulation and static condensation, integrated with constrained QP and adaptive damping, enables precise and stable control.
- Simulations achieve <0.01 mm RMS error, outperforming pseudo-inverse baseline.



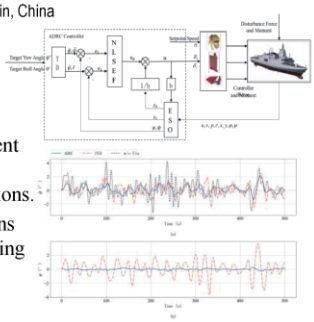
Flexible Plate Multi-Point Positioning

TP1-3 (2) 13:45 - 14:00

Active Disturbance Rejection Control for Rudder-Fin Coordinated Heading Holding

Songtao Zhang, Leihong Qin*, Xiaofeng Nan, Qiming Zhong, Jingfu Wang and Lihua Liang
College of Intelligent Systerms Science and Engineering, Harbin Engineering University
Harbin, China

- Designed an ADRC-based coordinated rudder–fin control architecture for robust marine heading and roll stabilization.
- Achieved over 60% improvement in roll suppression, peaking at 64.40% under beam-sea conditions.
- Roll and yaw standard deviations are significantly reduced, ensuring stability.

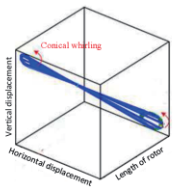


TP1-3 (3) 14:00 - 14:15

Influence of Electromagnetic Torque on Conical Whirl for Rigid Rotor Supported by Elastic Foil Gas Bearings

Hao Lin, Xin Wei, Leiming Song, Xiaojun Hu, Haipeng Geng, and Xu Li
Beijing Jiaotong University, and Xi'an Jiaotong University
Beijing & Shaanxi, China

- Dynamics Model of Rotor Conical Whirling.
- Modification of Dynamics Equations for Permanent Magnet Rotor.
- Eigenvalue solution of equations, considering the electromagnetic torque, elastic foil gas bearing's stiffness and damping coefficients.



Conical Whirling of Rotor

TP1-3 (4) 14:15 - 14:30

A Robust Adaptive Filtering Algorithm for PPP/INS Tightly Coupled Integration with Consideration of Satellite Number Variations

Puxi Wang , Siting Lu, Jinjian Shi, and Fuxin Yang
Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin, China

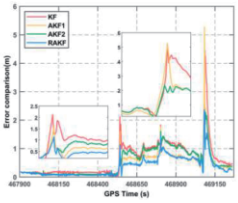
Core Issues:

- Fixed thresholds ignore satellite changes, hurting accuracy.
- Uncontrolled satellite fluctuations increase errors.

Innovative Approach:

•Two-Stage Robust Adaptive Kalman Filter (RAKF):

- Stage 1: Detects abnormal observations based on prediction residual thresholds
- Stage 2: Monitors changes in satellite quantity → dynamically adjusts noise covariance

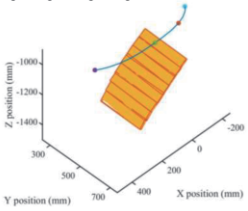


TP1-3 (5) 14:30 - 14:45

Modeling of Dynamic Fabric Motion Using Multiple Oriented Bounding Boxes

Letian Li[1,2], Fuyuki Tokuda[1,2], Akira Seino[1,2], Akinari Kobayashi[1,2],
Norman C. Tien[2,3], and Kazuhiro Kosuge[1,2]
1. JC STEM Lab of Robotics for Soft Materials,
Department of Electrical and Electronic Engineering,
Faculty of Engineering, The University of Hong Kong, Hong Kong SAR, China
2. Centre for Transformative Garment Production, Hong Kong SAR, China
3. Department of Electrical and Electronic Engineering,
Faculty of Engineering, The University of Hong Kong, Hong Kong SAR, China

- 3D dynamic fabric motion modeling
- Evenly segmented multiple oriented bounding boxes (ES-MOBB)
- ES-MOBB-Transformer prediction
- Better performance than GMM and K-Means based methods

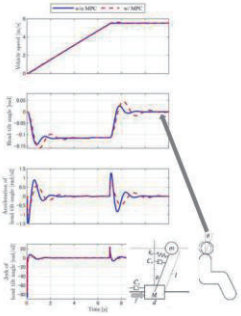


TP1-3 (6) 14:45 - 15:00

Driving Force Assistance Control for Enhancing Occupant Comfort in Vehicles

Minoru Miyakoshi[1], Yu Kawano[1], Yasuhide Yano[2], Tomohiko Adachi[2] and Nobutaka Wada[1]
[1]Hiroshima University [2]Mazda Motor Corporation
Hiroshima, Japan

- Design method for driver-assistance control system for comfort
- Occupant head tilt angle jerk as comfort index
- Formulation of the control problem as an MPC with quadratic constraints



TP1-4 Industrial,Manufacturing Process and Automation (I)

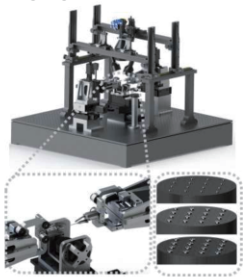
Session Chairs: Chong Yang, SUSTech
cheng yu wei, Tianjin University of Technology
UTC+8(Beijing Time): 13:30 - 15:00, Tuesday, 5 August 2025

TP1-4 (1) 13:30 - 13:45

Distributed Hierarchical Reinforcement Learning for Path Planning of Long-Horizon Micro-Assembly Tasks

Haiyang Zhao, and Hai Li*, Tingjun Zeng, Yutao Zhong, Zhixin Lin, Xianmin Zhang
Guangdong Provincial Key Laboratory of Precision Equipment and Manufacturing Technology
South China University of Technology, Guangdong, China

- Complex micro-assembly demands long-horizon planning with global constraints, challenging traditional methods.
- DHRL achieves efficient path planning by decomposing tasks and applying global policy optimization for globally constrained multi-stage planning.
- Experiments show DHRL successfully completes long tasks, with better convergence than baseline RL.



TP1-4 (2) 13:45 - 14:00

Development and Implementation of Tracked Unmanned Agricultural Machinery for Hilly and Mountainous Areas

Shuoxin Gu[1,3], Zhiyu Zhou[2*], Zutao Peng[1], Haiyang Wang[1], Sidong Wu[1], Yanxia Li[1], Jiajia Liu[1], Shuhao Wang[1]
[1]School of Automation, Chengdu University of Information and Technology, No. 24, Section 1, Xuefu Road, Chengdu, Sichuan, China
[2]Chengdu Chuanha Robotics and Intelligent Equipment Industry Technology Research Institute Co., Ltd., Chengdu, Sichuan, China
[3]Sichuan International Joint Research Center for Robotics and Intelligent Systems, Chengdu, Sichuan, China

- Crawler type unmanned agricultural machinery developed for hilly and mountainous areas.
- Multi functional tracked unmanned agricultural machinery integrating weeding, handling, and pesticide spraying.
- Realize high-precision positioning and navigation based on differential Beidou system and adaptive pure tracking algorithm, with an accuracy within 13cm.

Unmanned Agricultural Machinery

TP1-4 (3) 14:00 - 14:15

The Impact of power generation caused by dynamic Shading from Wind Turbine Blades in Hybrid Offshore Wind-Solar Systems

YuCheng Wei, ChunJie Wang,KaiXin Liu, ZhiHao Wang, YiLun Zhang, Peng Chen, Qiang Fu
School of Electrical and Electronic Engineering,
Tianjin University of Technology,
Tian jin,China

- The cumulative power generation loss rate rises gradually with the rotational speed, and the overall loss rate reaches 2.90%.
- The study reveals the negative impact of high-frequency time-varying characteristics of dynamic shading on the PV panels, and provides a theoretical basis for the optimal design of the layout of offshore wind-solar farms.

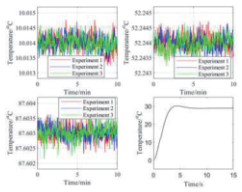
Dynamic shading on PV panels caused by rotating turbine blades

TP1-4 (4) 14:15 - 14:30

Implementation of Precise Temperature Measuring System using Different-arm Asymmetric Differential Bridge

Bing Qi*, Hao Tian, Jianhua Cheng, and Yunxi Xiao
College of Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin, Heilongjiang Province, China

- Different-arm asymmetric differential bridge and parameter optimal selection suppresses output nonlinearity to improve sensitivity.
- AD module with synchronous sampling and holding function eliminates the nonsynchronous sampling errors,
- Forward reverse excitation control calibrates measuring deviations caused by differential amplifier's offset voltage.
- Temperature measuring accuracy is much better than ±0.001℃ in 0~118℃.



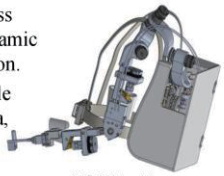
Temperature curves

TP1-4 (5) 14:30 - 14:45

Design of a Variable-Stiffness Exoskeleton for Upper Limb Rehabilitation

Zhonghua He[1], Yi Liu[1*], Yanan Bian[1], Ming Jiang[2*], Zihao Yi[1], Zikang, Xiao[1], Yuzhi Ma, Zhaoxuan Liu[1], Lan Wang[1], and Keyi Wang[1]
[1] College of Mechanical and Electrical Engineering, Harbin Engineering University, China
[2] Department of Mechanical Engineering, Institute of Science Tokyo, Japan

- 7DOF Wearable Exoskeleton Design. Covering shoulder, elbow, and forearm movements.
- The elbow joint adopts a variable stiffness cable-driven mechanism. Achieving dynamic stiffness control by adjusting cable tension.
- The elbow joint is driven by a chain-cable closed loop system, reducing limb inertia, achieving lightweight design and high reliability.
- Modular and wear-size adjustable design.



VSA-ExoU

TP1-4 (6) 14:45 - 15:00

Motion Analysis and Design on Pneumatic Actuators for Knee Assistive Devices

Junhao Sun, Lingtao Dai, Qianlu Yin, Shuxiang Guo, Liwei Shi
School of Medical Technology, Beijing Institute of Technology, Beijing

- Measure the human body motion data and analyze it in combination with the design of FPBAs.
- Derive the expression of the closed-loop torque for FPBA.
- Simulation experiments were conducted on the FPBA, the design requirements were summarized, and the specific torque expression of the rectangular structure FPBA was calculated.

Knee Assistive Device

TP1-5 Elements,Structures,and Mechanisms (II)

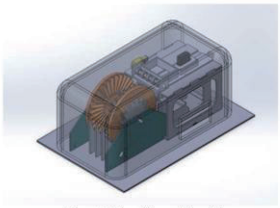
Session Chairs: Xinming Li, Guangzhou Maritime University
Chunying Li, Southern University of Science and Technology
UTC+8(Beijing Time): 13:30 - 15:00, Tuesday, 5 August 2025

TP1-5 (1) 13:30 - 13:45

Design and Implementation of a Prototype Card Shuffling Machine Using Unified Convergence Analysis Models

Phongchai Nilas* and Nilamit Nilas**
*Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang Bangkok Thailand
**Faculty of Engineering, Rajamangala University of Technology Phra Nakhon Bangkok Thailand

- Design and Implement an automatic card-suffering machine.
- This paper aims to bridge the gap by translating theoretical mathematical models into real-world applications for card shuffling.



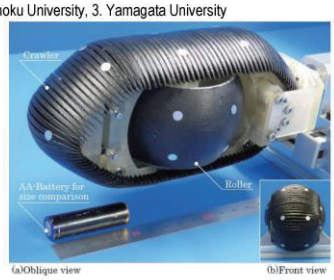
Card Shuffling Machine

TP1-5 (2) 13:45 - 14:00

Tapered Circular Cross Section Driving Mechanisms and the Omnidirectional Base Equipped with Units

Kenjiro Tadakuma[1*], Hirone Komats[2], Riichiro Tadakuma[3], Satoshi Tadokoro[2]
1. Osaka University, 2. Tohoku University, 3. Yamagata University

- We propose a tapered circular mechanism that reduces crawler resistance and improves step and gap traversal.
- A second prototype and a four-unit omnidirectional platform were developed based on initial tests.
- Experiments confirmed effective omnidirectional mobility over uneven terrain.



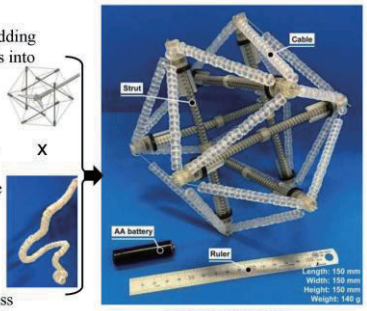
Omni-Loop Mechanism

TP1-5 (3) 14:00 - 14:15

Variable Stiffness Tensegrity Mechanism

Kazuma SHIMOMURA[1], Kazuki ABE[1], Issei ONDA[1], Masahiro WATANABE[1], Kenjiro TADAKUMA[1*], 1. Osaka University

- Proposed a variable stiffness tensegrity mechanism by embedding 1D stiffness-switching elements into tensile members.
- Enables adaptive shape transformation: flexible in low-stiffness mode, rigid in high-stiffness mode—ideal for drone protection.
- Concept was prototyped and experimentally validated, confirming feasibility of stiffness switching under practical conditions.



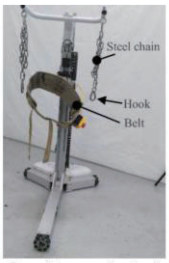
Variable Stiffness Tensegrity Mechanism

TP1-5 (4) 14:15 - 14:30

A waist operated assistive robot for cargo moving

Guocai Liu*, Jinsi Zhang, Huifang Bao and Zebin Li,
Electrical and Optoelectronic Engineering College, West Anhui University
Luan, China

- The assistive robot can be controlled by a human waist.
- The assistive robot can carry a load up to 90 kilograms.
- The assistive robot can provide assistance in four directions: front-back, left-right, vertical and rotation.
- The tests show that it can assistance method by walking or on-board, and has a significant effect in reducing human labor intensity.



A waist operated robot

TP1-5 (5) 14:30 - 14:45

Thermal characterization of dry frictional heat at the impeller-ball-sleeve interface in a magnetically coupled centrifugal blood pump

Yining Lu[1], Peipei Zhang[1] *, Kesheng Wang[1], Xiaoyan Zhao[1], Mingzhou Xu[2], Jinian Li[2]
School of Mechanical and Electrical Engineering[1] , University of Electronic Science and Technology of China[1] ,Medical Equipment Branch[2], Bejing Aerospace Changfeng CO., LTD[2] Chengdu[1], Bejing[2] ,China

- This study investigates frictional heat generation at the impeller-ball-sleeve interface of a centrifugal blood pump used for ECMO.
- The dry friction thermal measurement platform enables direct observation and analysis of thermal behavior under extreme conditions.

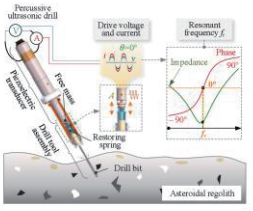
Dry friction thermal measurement platform

TP1-5 (6) 14:45 - 15:00

Reinforced learning based resonant frequency tracking for percussive ultrasonic drills

Qiukui Zhang, Qiquan Quan, Dewei Tang
State Key Laboratory of Robotics and System ,
Harbin Institute of Technology, Harbin, China

- The percussive ultrasonic drill is a drill tool that requires low drilling pressure, a wide range of temperature and high drilling capacity, making it suitable for anchoring tasks on asteroid surfaces.
- A reinforcement learning resonant frequency tracking control strategy is proposed to maintain efficient and long-lasting drilling and resist random disturbances .



Percussive ultrasonic drill anchoring

TP1-6 Modeling, Simulation Techniques and Methodologies (I)

Session Chairs: Sheng Cao, Beijing Institute of Technology
Chao Guan, Ningbo University of Technology
UTC+8(Beijing Time): 13:30 - 15:00, Tuesday, 5 August 2025

TP1-6 (1) 13:30 - 13:45

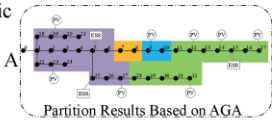
Multi-Objective Cluster Partitioning for Photovoltaic-Rich Distribution Networks

Dahua Li, Peng Zhang, He Tian, Qiang Gao, Zhongli Bai
School of Electrical Engineering and Automation Tianjin University of Technology
Tianjin, China

- This paper proposes a cluster partitioning method based on multi-indicator collaborative optimization.
- By integrating modularity, photovoltaic (PV) accommodation capacity, and active-reactive power balance indices, A comprehensive evaluation index was constructed.
- An improved adaptive genetic algorithm is designed to achieve efficient global optimization under complex constraints.

$$\rho=\frac{1}{2m}\sum_i\sum_j(e_{ij}-\frac{k_ik_j}{2m})\delta(i,j)$$

$$\Delta P=\sum_{k\in\Omega}\sum_{i\in T}P_{ki}^{\prime}\quad \beta_P=\frac{1}{k}\sum_{i=1}^{k}P_i\quad \beta_Q=\frac{1}{k}\sum_{i=1}^{k}Q_i$$



Partition Results Based on AGA

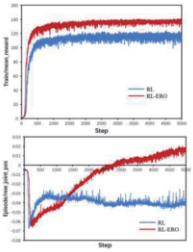
	K-means	GA	AGA
Modularity-p	0.6480	0.6771	0.7744
Comprehensive metric	0.6408	0.6779	0.7739
Time(s)	3.60	4.23	39.42

TP1-6 (2) 13:45 - 14:00

Hierarchical Curriculum Learning with Optimized Experience Replay for Sample-Efficient Humanoid Locomotion

Chao Guan, Qiubo Zhong and Fei Chen
Robotics Institute, Ningbo University of Technology, Ningbo, China
Department of Mechanical and Automation Engineering, T-Stone Robotics Institute, The Chinese University of Hong Kong, Hong Kong, China

- Hierarchical reinforcement learning framework integrating phased curriculum learning + diversity-driven experience replay + physics-guided reward shaping;
- Dual-criterion experience replay (TD-error + trajectory diversity) prioritizes high-impact samples.
- Performance Validation:↑14.9% reward gain vs. baseline, 97.5% kinematic fidelity on unlearned terrains (slopes/obstacles).

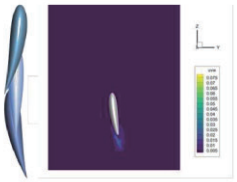


TP1-6 (3) 14:00 - 14:15

Design of A Fish-shaped Robot and Hydrodynamic Analysis

Ao Li, Yuan-Qing Xu
School of Medical Technology, Beijing Institute of Technology, Zhongguancun South Street, Beijing 100081, China

- Underwater robotic fish achieve more stable and concealed swimming by imitating the movements of fish.
- Designed an underwater robotic fish structure and its driving mode.
- Hydrodynamic characteristics were analyzed through hydrodynamic simulation.
- Relationship between the swing amplitudes and the propulsion speed of the robotic fish was studied.



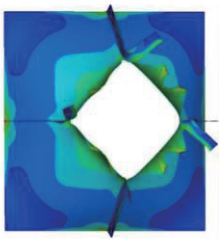
Robotic Fish

TP1-6 (4) 14:15 - 14:30

Numerical Investigation of Dynamic Failure in Perforated Square Plates under Near-Field Blast Loading

Qingyuan Wei[1]*, Dongyan Shi[1], Haoyang Duan[2], Meng Wang[1]
[1]College of Mechanical and Electrical Engineering, [2]College of Shipbuilding Engineering,Harbin Engineering University, China

- Numerical models were established using ANSYS/LS-DYNA, and the Load Blast Enhanced (LBE) method was applied to simulate the dynamic response of perforated plates under near-field blast loading.
- The failure mechanisms and strain distribution were compared among flat plates, centrally perforated plates, and centrally perforated stiffened plates.
- Results show that different plate structures exhibit distinct failure modes.



Blast-affected plate

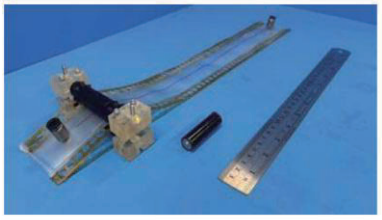
TP1-6 (5) 14:30 - 14:45

Geared Pinch Roller Mechanism

- Flexible Drive Mechanism to Suppress Axial Slip Shift of Flat Tubes -

Ryosuke TAMURA[1], Issei ONDA[1], Kazuki ABE[1], Masahiro WATANABE[1], Tetsuyou WATANABE[1], KenjiroTADAKUMA[1*], 1. Osaka University

- Proposed an improved pinch roller actuator design that prevents tube misalignment-induced failures.
- Validated performance through comparative experiments against conventional actuators.
- Introduced concept of an eversion robot integrating the anti-shift pinch roller mechanism.

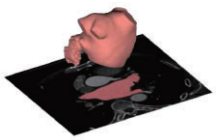


TP1-6 (6) 14:45 - 15:00

CFD-Based Prediction of the Risk of Thrombus Growth in left atrial appendage with Different Morphologies

Yuwen Zhang, Songling Fu，Pan SongJun Wen
Southwest University of Science and Technology,School of Computer Science and Technology Mianyang, China

- Computational Fluid Dynamics
- LAA Morphology
- Hemodynamics
- Thrombus Growth Model



left atrial appendage

TP2-1 Signal and Image Processing (III)

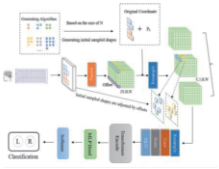
Session Chairs: Pengcheng Li, Dept. Electronic and Electrical Engineering, SUSTech
Cao Guo, China Mobile (Shanghai) Information and Communication Technology Co., Ltd
UTC+8(Beijing Time): 15:30 - 17:00, Tuesday, 5 August 2025

TP2-1 (1) 15:30 - 15:45

EEG Signal Classification Reinforced by LDConv and Transformer

Yan Yue, Xuehui Liang, Jigang Tong, Sen Yang, Yinghui Chang and Shengzhi Du
Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Intelligent Robot Laboratory,
Tianjin University of Technology
Tianjin, China

1The LDCT model integrates LDConv for dynamic spatial sampling and Transformer for global temporal modeling, reducing redundant information and enhancing EEG classification performance.
2. Label smoothing and flood loss control are added during training to optimize class distribution and prevent overfitting, improving the model's generalization ability.
3. Extensive experiments on Dataset A validate LDCT's effectiveness, achieving 92.13% (MI) and 91.63% (MA) accuracy, with significant improvements over existing methods.

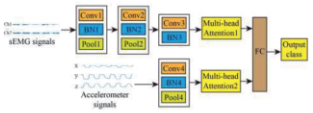


TP2-1 (2) 15:45 - 16:00

Dual Stream Attention Convolutional Neural Network for Motion Recognition using EMG-Accelerometer Fusion Signals

Anyuan Zhang, Ying He,Qunchao Lu, and Haowen Zheng
Changchun University of Science and Technology
Changchun, China

- Data scarcity limits model performance and cross-subject generalization
- Attention mechanisms improve robustness but statistical significance remains elusive
- DSACNN achieves superior performance with sufficient multi-subject data



The structure of DSACNN model

TP2-1 (3) 16:00 - 16:15

Foreign Object Detection for Transmission Lines Based on Multi-Site Federated Learning

Daohua Zhu, Wei Liang, Cao Guo, Sheng Zhang and Cuiliu Zhang
State Grid Jiangsu Electric Power Co., Ltd., Jiangsu, China
China Mobile (Shanghai) Information and Communication Technology Co., Ltd. , Shanghai, China

- We proposes a federated learning-based detection method.
- The method integrates a Vision Transformer (ViT)-based foreign object recognition model with a dynamic client gradient aggregation strategy.
- The proposed federated learning approach mitigates the impact of data heterogeneity across clients through dynamic gradient aggregation.

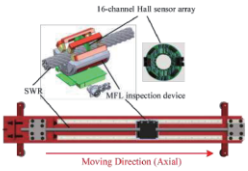
System architecture diagram

TP2-1 (4) 16:15 - 16:30

Signal Matrix-Based Local Flaw Detection Framework for Steel Wire Rope Using Convolutional Neural Network

Siyu You, Leilei Yang, Zixu Kuang, Huayi Gou, Longlong Zhang, Zhiliang Liu*
University of Electronic Science and Technology of China
Chengdu, China

- **Proposed Method**: A novel Signal Matrix-based CNN (SM-CNN) framework directly processes raw multi-channel MFL signal matrices, avoiding interpolation and preserving spatiotemporal features.
- **Performance:** Achieves **98.74%** accuracy, **97.85%** recall, and **87.72 FPS** with only **1.48M** parameters, outperforming both signal-based and image-based SOTA methods.



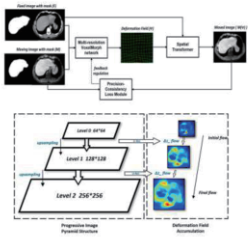
The MFL Inspection Equipment

TP2-1 (5) 16:30 - 16:45

Multimodal Medical Image RegistrationBased on Multi-Resolution VoxelMorph Network

Jixiao Jin, Shiyu Ding, Yang Zhou, Ruihong Zhang and Kuan Luan*
College of Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin, China

- Three-resolution architecture with coarse-to-fine deformation.
- Achieved higher overlap accuracy than affine, Elastix, and standard VoxelMorph.
- Liver-specific ROI mask improves region-aware registration.
- Designed for clinical feasibility in ablation surgery and treatment planning.



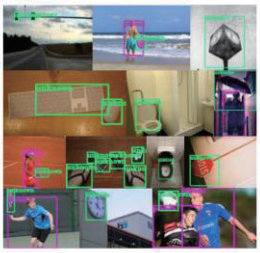
Accumulation of the deformation field

TP2-1 (6) 16:45 - 17:00

Fine-Grained Open-Set Object Detection with Discrepancy Enhancement and Detector-Driven Clustering

Xingyu Chen, Yue Lu, Zhuheng Song, Junzhi Yu
College of Engineering, Peking University, Beijing, China

- We propose FRPN and DEM for open-set object detection.
- FRPN can jointly utilize semantics and localization cues for the awareness of unknown objects.
- DEM is designed to suppress the representation confusion between known and unknown classes.
- We introduce a DetClust method to subdivide unknown objects into fine-grained novel categories.



Open-set detection

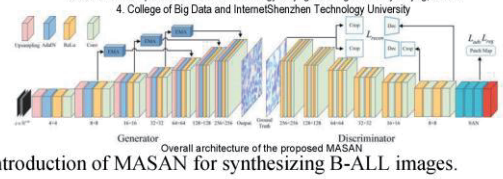
TP2-2 Medical, Biomedical and Rehabilitation Systems (III)

Session Chairs: Zhiyu Li, Jinan University
Yao Sheng Nan, Harbin Engineering University
UTC+8(Beijing Time): 15:30 - 17:00, Tuesday, 5 August 2025

TP2-2 (1) 15:30 - 15:45

MASAN: Multi-Attention Based Sliced Adversarial Network for Improved B-cell Acute Lymphoblastic Leukemia Classification

Hao Wang[1*], Wei Chen[2], Wei Zhou[3], Bingding Huang[4], Jiawan Zhang[1], and Peixuan Li[1]
1. College of Health Science and Environmental Engineering Shenzhen Technology University Shenzhen, China
2. School of Mathematics South China University of Technology Guangzhou, China
3. School of Computer Science and Technology Beijing Jiaotong University Beijing, China
4. College of Big Data and InternetShenzhen Technology University



Overall architecture of the proposed MASAN

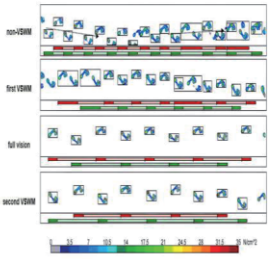
- Introduction of MASAN for synthesizing B-ALL images.
- Combination of EMA and Slicing Adversarial Network (SAN) to better align synthetic and real images.
- Using images augmented by MASAN can improve the classification effect.

TP2-2 (2) 15:45 - 16:00

The Influence of Visuo-Spatial Working Memory on Gait Characteristics in Blindfolded Healthy Adults

Yuzhou Fan, Guoying Zhang, Bo Zhang, Zhiyu Li, Wing-Kai Lam, Yifang Fan
School of Physical Education and Sport Science, Fujian Normal University
Fuzhou, China

- Participants exhibited smaller stride length and slower speed/cadence in blindfolded walking.
- Individuals adopt a safety-stepping strategy when limited visual feedback available.
- Blindfolded participants can return to the original walking direction after contacted tactile line (error feedback).
- Robots combined with robotic vision and other sensors can enable locomotion in new environments.



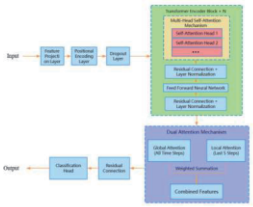
Plantar pressures in non-VSWM, first VSWM, full vision and second VSWM walking

TP2-2 (3) 16:00 - 16:15

Fatigue Driving Detection Based on Eye Features

Shengnan Yao, Xiaolong Liu, Lingfei Wang and Kuan Luan
College of Intelligent Systems Science and Engineering, Harbin Engineering University
Harbin, China

- Three-class fatigue classification: alert, semisleepy, and sleepy.
- Four features including blink duration, amplitude, speed, and frequency are calculated for fatigue detection.
- A Transformer-Attention model combining global and local attention mechanisms.

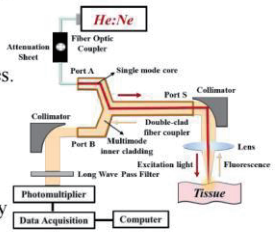

The Transformer-Attention model

TP2-2 (4) 16:15 - 16:30

Fluorescence Detection System for Diagnosing Atherosclerotic Plaque

Hongjia Wang[1*], Jin Guo[1]
[1]School of Medical Technology, Beijing Institute of Technology
Beijing, China

- Identify plaque autofluorescence, particularly distinguishing between vulnerable and non-vulnerable plaques.
- System shows excellent sensitivity and linear concentration dependence.
- The fluorescence detection method has great potential to be combined with IVOCT to improve the efficiency of vulnerable plaque detection and clinical risk stratification.



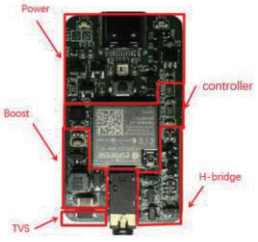
Fluorescence Detection System

TP2-2 (5) 16:30 - 16:45

H-Bridge Bipolar Stimulation System with Real-time GSR Sensor Feedback

Xiaoming Teng, Yibo Liu
School of Advanced Technology, Xi'an Jiaotong-Liverpool University

- Closed-loop Neurostimulation System Architecture
- High-fidelity and Stable H-bridge AC Pulse Output Design
- Real-Time GSR Feedback Mechanism
- Miniaturized and Wearable Hardware Integration
- Experimental Validation and Comparative Advantages



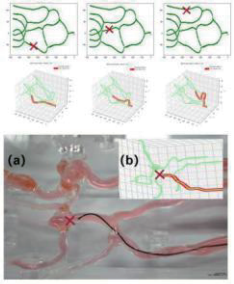
Electrical Stimulation Module with Sensors

TP2-2 (6) 16:45 - 17:00

Autonomous Path Planning for Vascular Interventional Surgical Robots:From Virtual Simulation to Physical Validation

Weihao Wu[1], Chong Yang[1], Shuxiang Guo[1,2*], Haoyu Xie[1], Sheng Cao[2], Chunying Li[1]
1. The Department of Electronic and Electrical Engineering,
Southern University of Science and Technology, Shenzhen, Guangdong 518055, China

- VIS navigation requires accurate spatial planning, and robust path quality metrics remain an unmet necessity.
- We present a fully autonomous framework integrating centerline-based A* planning with quantitative geometric evaluation.
- Experimental results from SOFA and physical trials confirm high path reliability and strong real-world adaptability.



Planning, Simulation, Validation

TP2-3 Control Theory and Application (III)

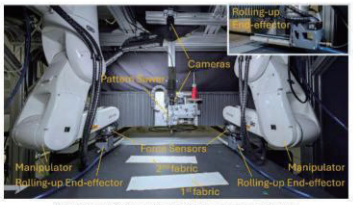
Session Chairs: Fuyuki Tokuda, Centre for Garment Production Limited
Akira Seino, Centre for Transformative Garment Production
UTC+8(Beijing Time): 15:30 - 17:00, Tuesday, 5 August 2025

TP2-3 (1) 15:30 - 15:45

Robotic Sewing System for Fully Automated Fabric Picking, Stacking, Loading, Sewing, and Unloading

Fuyuki Tokuda1,2, Akira Seino1,2, Akinari Kobayashi1,2, Kazuhiro Kosuge1,2
1. Centre for Transformative Garment Production, Hong Kong S.A.R.
2. JC STEM Lab of Robotics for Soft Materials, The University of Hong Kong, Hong Kong S.A.R.

- We propose a fully automated sewing system for automating the whole sewing process, including fabric picking, stacking, loading, sewing, and unloading.



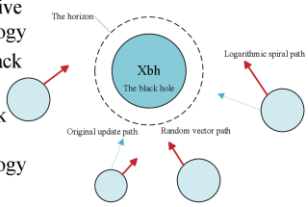
Proposed fully automated sewing system

TP2-3 (2) 15:45 - 16:00

Research on Selective Harmonic Elimination Technology Based on Improved Black Hole Algorithm

Jiaxu Guo, Wenyi Zhang
College of Intelligent Systems Science and engineering, Harbin Engineering University
Harbin, P.R. China

- Mathematical model of selective harmonic elimination technology
- Principles of the improved black hole algorithm
- Application of improved black hole algorithm in selective harmonic elimination technology
- Simulation results



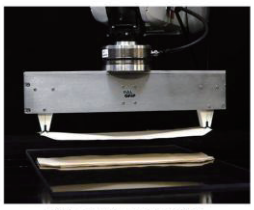
The Improved black hole algorithm

TP2-3 (3) 16:00 - 16:15

PALGRIP-Twin for Handling a Piece of Fabric

Akira Seino[1,2], Akinari Kobayashi[1,2], Fuyuki Tokuda[1,2], and Kazuhiro Kosuge[1,2]
[1]Centre for Transformative Garment Production, Hong Kong S.A.R.
[2]JC STEM Lab of Robotics for Soft Materials, The University of Hong Kong, Hong Kong S.A.R.

- We propose the new design of Passive Actuator-Less Gripper (PALGRIP), PALGRIP-Twin.
- PALGRIP-Twin enables the pick-and-place operations of a fabric while keeping it flat.
- PALGRIP-Twin does not require any actuator to move fingers.
- We demonstrate the effectiveness of PALGRIP-Twin through experimental results.



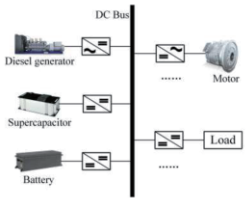
Pick-and-place operation using PALGRIP-Twin

TP2-3 (4) 16:15 - 16:30

Stability Analysis of Electric Vehicle DC Bus Based on Middlebrook Impedance Criterion

Taiping Yang1, Wei Wu1,2, Shenlong Li3, Yang Chu1 and Shihua Yuan1,2
1. Division of Energy-Mobility Convergence, Beijing Institute of Technology, Zhuhai, China
2.School of Mechanical Engineering, Beijing Institute of Technology, Beijing, China
3.China North Vehicle Research Institute, Beijing, China

- Full-spectrum source-side power-electronics model for precise stability constraints.
- Middlebrook-based full-band DC-link vs. inverter–motor impedance stability criterion with explicit power limits.
- Impedance-matching via DC-link capacitance and damping resistance tuning for enhanced robustness.



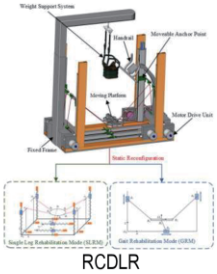
The DC microgrid system

TP2-3 (5) 16:30 - 16:45

Load Capacity-Oriented Reconfiguration Planning for a Reconfigurable Lower Limb Rehabilitation Robot

Jinghang Li, Keyi Wang, Yi Yuan, Yi Liu
College of Mechanical and Electrical Engineering, Harbin Engineering University
Harbin, Heilongjiang, China

- The Reconfigurable Cable-driven Lower Limb Rehabilitation Robot (RCDLR) can provide multiple training motions.
- The proposed reconfiguration planning method can maximize the load capacity during rehabilitation training.
- The proposed method also shows good cable tension distribution performance in simulation.



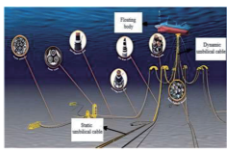
RCDLR

TP2-3 (6) 16:45 - 17:00

Analysis of Electro-Hydraulic Servo Control System Characteristics for Umbilical Cable Fatigue Testing Machine

Zenghui Xing[1], Fang Ma[2], Jianjun Yao[1*],Xiao Zhang[1],Shuai Zhang[1]
[1]College of Mechanical and Electrical Engineering Harbin Engineering University
Harbin, Heilongjiang Province, China
[2]Science and technology information center (of Beijing Institute of Aerospace Information)
Beijing, China

- Analyzed the deformation law of the simplified loading model of umbilical cable under tension bending combined load
- Established a dynamic model for the electro-hydraulic servo system
- Analyzed the influence of stiffness changes in umbilical cable springs on the characteristics of electro-hydraulic servo systems



Floating Subsea Production System

TP2-4 Industrial,Manufacturing Process and Automation (II)

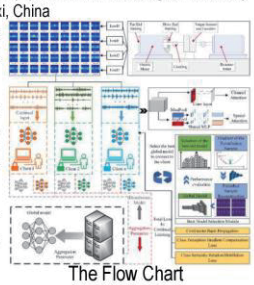
Session Chairs: Chong Yang, SUSTech
Wei Wang, Nanjing University of Science and Technology
UTC+8(Beijing Time): 15:30 - 17:00, Tuesday, 5 August 2025

TP2-4 (1) 15:30 - 15:45

A Novel Federated Continual Learning-Based Intelligent Framework for Rolling Bearing Fault Diagnosis

Xiang Xu, Feng Jia*, Jianjun Shen, Changhai Yan
Key Laboratory of Road Construction Technology and Equipment of MOE Chang'an University
Xi'an, 710064, Shaanxi, China

- we proposed an intelligent fault diagnosis method based on federated continual learning.
- we designed a dual-loss optimization strategy that incorporates channel attention and spatial attention mechanisms.
- We incorporated a continuous back-propagation strategy to solve the problem of forgetfulness



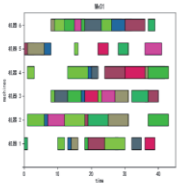
The Flow Chart

TP2-4 (2) 15:45 - 16:00

Research on Modeling and Reinforcement Learning Scheduling Approaches for Flexible Job Shop Systems

Niansong Zhang ,Wei Wang, Yan Ge ,Aimin Wang
Department of Mechanical Engineering
Nanjing University of Science and Technology

- This study focuses on the Flexible Job Shop Scheduling Problem (FJSP) and proposes an improved Proximal Policy Optimization (PPO) algorithm
- A new state space, action space and reward function are designed
- Enhance the traditional PPO algorithm by introducing a prioritized experience replay mechanism.



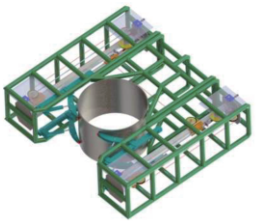
The Gantt chart

TP2-4 (3) 16:00 - 16:15

Design and cutting parameter optimization of a diamond wire special-shaped cutting robot

Zihang Guo[1], Xueyi Liu[2], Jian Zhou[2], Lan Zhang[1]*, Yuchen Jiang[1], Feihong Yun[1]
[1]College of Mechanical and Electrical Engineering, Harbin Engineering University
Harbin, China
[2]CNOOC Shenzhen Offshore Engineering Solutions Co.,Ltd. Shenzhen, China

- A diamond wire special-shaped cutting robot for jacket dismantling has been designed.
- Through low-temperature friction experiments, the effects of cutting parameters on tool wear and material removal capacity were analyzed.
- Based on the grinding ratio data, the optimal cutting parameters are recommended



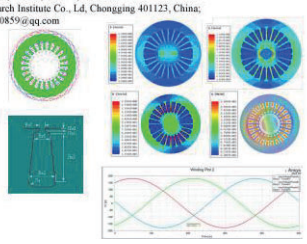
Diamond Wire Special-shaped Cutting Robot

TP2-4 (4) 16:15 - 16:30

Electromagnetic Design of 30kw High-speed Permanent Magnet Synchronous Motor for 300kW fuel cell stack

Author: Jingyi Sun[1],Geng Haipeng[1],Xu Li[2],Lu Gan[2],Hao Li
[1]Key Laboratory of Education Ministry for Modern Design and Rotor-Bearing System, Xi'an Jiaotong University, Xi'an, Shaanxi, 710049, P.R. China
[2]CSSC southwest (Chongqing) Equipment Research Institute Co., Ld, Chongqing 401123, China;
Email:3061430859@qq.com

- The purpose of this paper is to develop a 30kW high-speed drive motor for the 100kW-300kW fuel cell stack.
- Based on the traditional design process of electric motors, a new design process for high-speed permanent magnet synchronous motors is proposed.
- Provide the main parameters of the motor, conduct electromagnetic design using Ansoft Maxwell finite element software, and perform simulation analysis of no-load and load characteristics using the time-stepping finite element method. Verify that the motor can meet the design requirements and the design is reasonable.

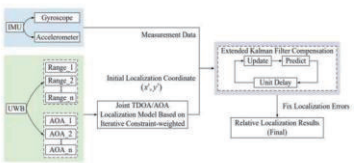


TP2-4 (5) 16:30 - 16:45

Relative localization algorithm for UWB/IMU loose combination unmanned ground vehicles based on EKF model compensation

Ximing Ma[1], Jingmin Wang[2]*, Cheng Lu[2], and Bing Xue[2]
[1]Optical Countermeasures Department, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China; [2]College of Intelligent Systems Science and Engineering, Harbin Engineering University, Harbin, China

- Relative Localization of Clustered UGVs
- Multi-Sensor Data Fusion
- Fixing Localization Errors Based on EKF Model
- Experimental Analysis of Algorithm Simulation and Actual Scenario Testing



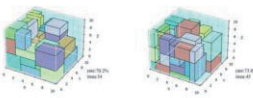
Relative Localization System for UGVs

TP2-4 (6) 16:45 - 17:00

Online 3D Bin Packing Algorithm Based on Heuristic Deep Reinforcement Learning

Baoxin Zhang, Hui Zhao
School of Electrical Engineering and Automation, Tianjin University of Technology
Tianjin, China

- A study on solving the online three-dimensional bin packing problem.
- A deep reinforcement learning method combined with a heuristic algorithm is proposed.
- Effectively improves the space utilization rate of packing.



Visualization of Packing Results

TP2-5 Signal and Image Processing (IV)

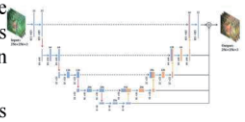
Session Chairs: Peng Shi, Henan University of Science and Technology
Kaiheng Dai, Harbin Engineering University
UTC+8(Beijing Time): 15:30 - 17:00, Tuesday, 5 August 2025

TP2-5 (1) 15:30 - 15:45

A Novel Multi-scale Fused Generative Adversarial Network for Underwater Image Enhancement

Qirong Lei, Shuxiang Guo, Chunying Li, Pengcheng Li, Le Huang, Xueting Liu, Sihan Gao
The Department of Electronic and Electrical Engineering,
Southern University of Science and Technology, Shenzhen, Guangdong, China

- In generator part, a U-Net architecture is used and the multi-scale feature fusion module effectively address spatially heterogeneous degradation patterns inherent.
- In discriminator part, this paper designs a multi-resolution codetermination by difference resolution scales.

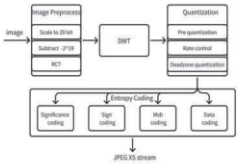


TP2-5 (2) 15:45 - 16:00

FPGA-Based Visually Lossless JPEG XS Image Encoder Architecture Design and Hardware Verification

Qi Zhang, Fan Shen, Shaowen Li, and Yongzhen Lu
School of Electronic Engineering and Automation, Guilin University of Electronic Technology
Guangxi,China

- The JPEG XS encoder implemented on the Xilinx FPGA achieves real-time 4K 70fps encoding with an end-to-end latency of fewer than 8 line cycles
- A multi-stage pipelined architecture with parallel processing schemes.
- A low-power implementation.



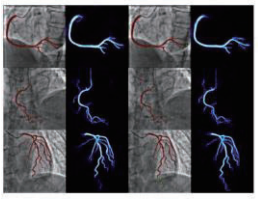
JPEG XS encoder

TP2-5 (3) 16:00 - 16:15

Interactive Angiography Image Segmentation

Bingzhi Shen1, Shuxiang Guo1,2*, Yonggan Yan1, Hongchen Ren3, Jintao Luo1, Bin Wang3, Mingchao Ding3
1 School of Life-Science and the Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, The Aerospace-Center Hospital, Beijing Institute of Technology, Beijing, 100081, China
2The Department of Electronic and Electrical Engineering, Southern University of Science and Technology Shenzhen, Guangdong, 518055, China
3The Department of Peripheral-Vascular Intervention, Aerospace Center Hospital, School of Life Science, Beijing Institute of Technology, Beijing, 100081, China

- Evaluated the performance of existing classic interactive segmentation algorithms on angiography images across two distinct datasets. This study provides baseline performance metrics for future research.
- Analysis of specific challenges and failure cases in angiography image segmentation, identifying domain-specific limitations.
- Detailed characterization of the gap between current IIS methods and the requirements of angiography image analysis, offering insights for future algorithm development directions.



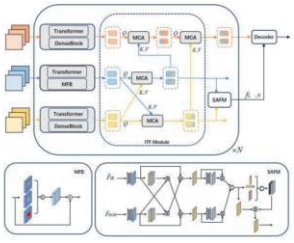
Segmentation Result

TP2-5 (4) 16:15 - 16:30

Triple-Stream Network for Infrared and Visible Image Fusion

Chenglong Wang, Haoli Chen, Kaiheng Dai, Alexander Inyutin and Yuanhui Wang
College of Intelligent Systems Science and Engineering,
Harbin Engineering University, Harbin, China

- A triple-stream Transformer-CNN architecture for infrared and visible image fusion.
- Independently extracting features from infrared and visible images.
- An Interactive Transformer Fusion (ITF) module and a Spatial Attention Fusion Module (SAFM) to deeply integrate features from different modalities.



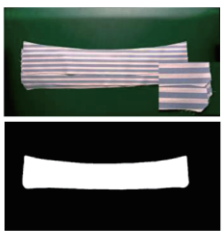
Architecture of The Neural Network

TP2-5 (5) 16:30 - 16:45

Precise Top-Layer Fabric Segmentation for Fabric Destacking with Edge- and Shape-Aware Deep Networks

Wenbo Dong, Dipankar Bhattacharya, Akinari Kobayashi, Akira Seino, Fuyuki Tokuda,
Xuzhao Huang, Kai Tang, Norman C. Tien, Kazuhiro Kosuge
Faculty of Engineering, The University of Hong Kong, Hong Kong SAR, China

- Precise segmentation of the topmost fabric layer is difficult due to subtle boundaries and high visual similarity between layers.
- We propose an encoder-decoder network with edge-aware and shape-aware branches to improve boundary detection and global shape alignment.

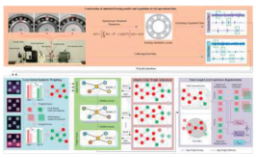


Fabric stack image and top-layer segmentation

TP2-5 (6) 16:45 - 17:00

Simulation Model-Based Adaptive Graph Information Aggregation Method for Bearing Fault Diagnosis

Lifei Hao, Feng Jia, Jianjun Shen, Yilong Guo
Key Laboratory of Road Construction Technology and Equipment of MOE, Chang'an University
Xi'an, Shaanxi, China



Adaptive Graph Information Aggregation Fault Diagnosis Framework Based on Simulation Model

- Developed a simulation-based bearing fault model to address real data scarcity.
- Constructed graph structures using local-global similarity thresholding.
- Introduced adaptive edge weight adjustment and node-graph consistency regularization to enhance GNN feature aggregation.
- Tackled fault diagnosis by jointly improving data quality and model design.

TP2-6 Modeling, Simulation Techniques and Methodologies (II)

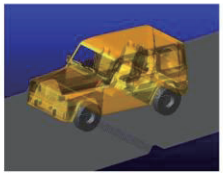
Session Chairs: Yuxiao Zhang, Beijing Institute of Technology
haijun zhuang, tongji university
UTC+8(Beijing Time): 15:30 - 17:00, Tuesday, 5 August 2025

TP2-6 (1) 15:30 - 15:45

Research on the Design and Simulation of Jumping Suspension System for Light Off-road Vehicle

Yuxiao Zhang, Zhicheng Wu, Lin Yang, Yuzhuang Zhao, Shengze Cong
School of Mechanical Engineering
Beijing Institute of Technology
Beijing, China

- Aiming at the light wheeled off-road vehicles on overcoming obstacles or crossing the ditches at high speed by jumping.
- A jumping suspension system design scheme is proposed.
- A modeling simulation is carried out in Amesim.



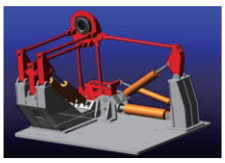
Suspending Stage

TP2-6 (2) 15:45 - 16:00

Kinematic and Dynamic Analysis of a 6-DOF Spindle-Coupled Road Simulator

Gu Yunhao,Wang Xiao,Zhang Guohua,Jin Haoshan
College of Electrical and Mechanical Engineering, Shandong Jianzhu University
Jinan,China

- Designed a completely new structure of the spindle-coupled road simulator.
- Performed inverse kinematic analysis based on vector closed-loop constraint relationships.
- A rigid-body dynamic model is established using the Kane's method.
- ADAMS-SIMULINK co-simulation is employed for model validation, achieving an force error rate of less than 0.04%.



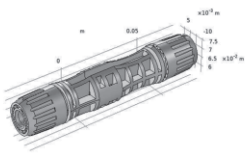
The 6-DOF Spindle-Coupled Road Simulator

TP2-6 (3) 16:00 - 16:15

Research on the Corrosion Mechanism and Performance Degradation of Photovoltaic Connectors in Marine Environments

Qiuyue Xu, ChunJie Wang,Jiajin Zou,Peng Chen
Tianjin University of Technology
Takamatsu, Japan

- Marine environments corrode PV connectors via salt spray and Cl^-. COMSOL modeling and tests show tin-plated copper's resistance rises 79.8 mΩ ($SnCl_2$), while AgCl passivation limits silver-plated copper to 23.5 mΩ. Joule heating at 10A exceeds thermal limits, risking fires. Findings guide corrosion-resistant designs for safer offshore PV systems.



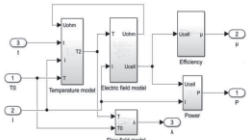
photovoltaic connectors

TP2-6 (4) 16:15 - 16:30

Dynamic Characteristics Analysis of Multi-physical Field Coupling in Alkaline Electrolyzer

Qiang Bi, Chunjie Wang, Qiang Fu
School of Electrical Engineering and Automation, Tianjin University of Technology, Tianjin, China
Tianjin University of Technology
Tianjin Key Laboratory of New Energy Power Conversion, Transmission and Intelligent Control,

- A refined alkaline electrolyzer model was constructed by using multiphysics coupling simulation.
- When multi-field coupling is considered, the influence of dynamic performance of electrolyzer on different working characteristics should be considered, and different working characteristics have an impact on the dynamic performance of electrolyzer.
- The multi-field coupling model of electrolytic cell was built by simulation platform to analyze the influence of voltage, temperature and flow field on the dynamic characteristics of electrolytic cell.



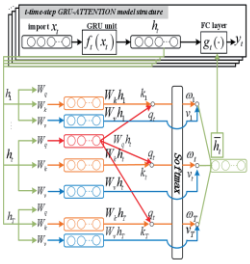
Multi-physical coupling simulation model of electrolytic cell

TP2-6 (5) 16:30 - 16:45

Research on Optimal Dispatch of Thermal Power Units Integrated with Security Constraint Identification

Dahua Li, Penglong Gao, He Tian, Qiang Gao, and Zhongli Bai
School of Electrical Engineering and Automation, Tianjin University of Technology
Xiqing, Tianjin, China

- Propose an active constraint identification method based on GRU.
- The effectiveness of the proposed constraint identification model is validated on the IEEE 30-bus system using YALMIP and the CPLEX solver.
- Comparative experiments between the constraint identification-based model and iterative solution methods.

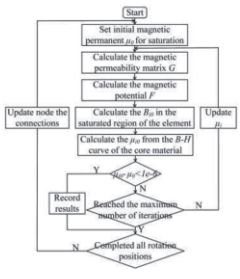


TP2-6 (6) 16:45 - 17:00

Analytical Modeling of Interior Permanent Magnet Mators Considering Rotor Magnetic Bridge Saturation

Haijun Zhuang, Shuguang Zuo, Zhengnan Wu
School of Automotive Studies Tongji University Shanghai, China

1. For IPMSM, this paper proposes a novel equivalent magnetic network model.
2. Focusing on the dynamic magnetic network construction of the airgap and the nonlinear iteration of rotor magnetic bridge saturation.
3. Then, the electromagnetic characteristics are solved using the proposed dynamic magnetic network model.



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IEEE ICMA 2026

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Call for Papers

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The topics of interest include, but not limited to the following:

- Intelligent mechatronics, robotics, biomimetics, automation, control systems,
- Opto-electronic elements and Materials, laser technology and laser processing
- Elements, structures, mechanisms, and applications of micro and nano systems
- Teleoperation, telerobotics, haptics, and teleoperated semi-autonomous systems
- Sensor design, multi-sensor data fusion algorithms and wireless sensor networks
- Biomedical and rehabilitation engineering, prosthetics and artificial organs
- Control system modeling and simulation techniques and methodologies
- AI, intelligent control, neuro-control, fuzzy control and their applications
- Industrial automation, process control, manufacturing process and automation

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Organized Sessions: Proposals with the title, the organizers, and a brief statement of purpose of the session must be submitted to an OS Chair by April 10, 2026.

Tutorials & Workshops: Proposals for tutorials and workshops that address related topics must be submitted to one of the Tutorial/Workshop Chairs by May 1, 2026.

Important Dates:

April 10,	**2026**	**Full papers and organized session proposals**
May 1,	**2026**	**Proposals for tutorials and workshops**
May 15,	**2026**	**Notification of paper and session acceptance**
June 1,	**2026**	**Submission of final papers in IEEE PDF format**

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IJMA is a fully refereed international journal that presents state-of-the-art research in the area of mechatronics and industrial automation. The intention of *IJMA* is to provide an international forum to report latest developments from interdisciplinary theoretical studies, computational algorithm development and practical applications. It particularly welcomes those emerging methodologies and techniques which bridge theoretical studies and applications and have significant potential for real-world applications.

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IEEE ICMA 2025
Program at a Glance

August 3-6, 2025

Beijing Empark Grand Hotel, Beijing, China

https:// en.empark.com.cn/

Sunday, August 3, 2025	
13:30 - 18:30	Registration Desk Open
13:30 - 15:40	World Premium Workshops on Robotics Organized by Prof. Prof. Kazuhiro Kosuge, The University of Hong Kong
16:00 - 17:00	Keynote Speech (Prof. Hidekuni Takao)
18:00 - 20:00	Reception
Monday, August 4, 2025	
08:30 - 09:00	Opening Ceremony
09:00 - 09:50	Plenary Talk 1 (Prof. Toshio Fukuda)
09:50 - 10:40	Plenary Talk 2 (Prof. Blake Hannaford)
10:40 - 11:00	Morning Break
11:00 - 12:00	Technical Sessions MA1 (Poster Session)
11:00 - 12:30	Invited Session
12:00 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions MP1
15:00 - 15:15	Afternoon Break
15:15 - 16:45	Technical Sessions MP2
17:00 - 18:30	Technical Sessions MP3
Tuesday, August 5, 2025	
08:30 - 09:30	Plenary Talk 3 (Prof. Bradley Nelson)
09:30 - 10:45	Medical Robot Forum
10:45 - 11:00	Morning Break
11:00 - 12:00	Workshop II Technical Sessions TA1
12:15 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions TP1
15:00 - 15:30	Afternoon Break
15:30 - 17:00	Technical Sessions TP2
18:30 - 21:00	Award Banquet in Beijing Empark Grand Hotel
Wednesday, August 6, 2025	
08:30 - 12:00	Technical Tour

* 15 minutes (Speech: 12 minutes, Q&A:3 minutes) are scheduled for oral presentation including discussions for each paper.

*30 minutes (core time) are scheduled for poster presentation