



IEEE

IEEE ICMA 2018



Robotics and Automation Society

# 2018 IEEE International Conference on Mechatronics and Automation

AUGUST 5-8, 2018  
CHANGCHUN, CHINA

Conference Proceedings

# Conference Digest

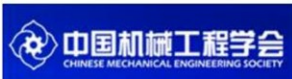


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# **Conference Digest**

## **2018 IEEE International Conference on Mechatronics and Automation**

### **IEEE ICMA 2018**

**Changchun, China**

**August 5 - 8, 2018**

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IEEE Catalog Number:	CFP18839-PRT
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IEEE Catalog Number (CD-ROM):	CFP18839-CDR
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# Foreword

On behalf of the IEEE ICMA 2018 Conference Organizing Committee, it is our great pleasure, an honor, and a privilege to welcome you to Changchun for the 2018 IEEE International Conference on Mechatronics and Automation. This conference reflects the growing interests in the broad research areas of mechatronics, robotics, sensors and automation.

ICMA 2018 marks the 15<sup>th</sup> edition of the IEEE ICMA annual conference series. We are proud to announce that a high number of **635** papers were submitted from **28** countries and regions, including **611** contributed papers, **24** papers for organized sessions, and **422** papers were accepted for oral or poster presentation at the conference after a rigorous full-paper review process, achieving an acceptance rate of less than **67%**. Presentations at ICMA 2018 are organized in **7** parallel tracks, for a total of **62** sessions, including **1** poster 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 glad that you are joining us at IEEE ICMA 2018 in Changchun to live this unique experience. The main objective of IEEE ICMA 2018 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 2018 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 Changchun, China.



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# Welcome Remarks

It is my honor to welcome you to attend the 2018 IEEE International Conference on Mechatronics and Automation (IEEE ICMA 2018) on behalf of Changchun Institute of Optics, Fine Mechanics and Physics, CAS. We are delighted to host the Conference which marked as the 15th 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 Changchun Institute of Optics, Fine Mechanics and Physics. Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) was founded in 1952 focusing on luminescence, applied optics, optical engineering, and precision mechanics and instrumentation. There are currently 2,056 professionals working at CIOMP, including 3 CAS academicians, 256 professors and 638 associate professors. CIOMP has formulated an integrated “Research, Industry, and Education”, and is increasing its abilities to realize the full potential of a wide range of endeavors. CIOMP now hosts an International Optoelectronic Innovation Cluster, 6 State Key Laboratories and research centers, and 2 CAS Key Laboratories. There are more than 20 high-tech companies in the CAS Changchun Optoelectronics Industrial Park with investment support from CIOMP and total assets of 403 million USD.

It is sincerely hoped that IEEE ICMA 2018 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 Changchun Institute of Optics, Fine Mechanics and Physics, 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 and keynote speakers, exhibitors for contributing their research works and making IEEE ICMA 2018 a successful and fruitful event. To all participants, I extend my heartfelt welcome and thanks for attending this event, wish your stay here in Changchun, China, is very pleasant and enjoyable.



Ping Jia, Professor

President of CIOMP

Advisory Council Chair of IEEE ICMA 2018

# IEEE ICMA 2018 Conference Digest

## Table of Content

Foreword	
Welcome Remarks	
IEEE ICMA 2018 Conference Committees.....	i
Organizing Committees.....	ii
International Program Committee.....	iv
IEEE ICMA 2018 Cosponsors.....	xi
General Information.....	xii
Conference Information.....	xviii
Conference Venue.....	xviii
Conference Registration.....	xx
Internet Access.....	xx
Social Events.....	xxi
Technical Program	
Keynote Speech and Plenary Talks.....	xxiii
World Youth Development Workshops on Opto-Mechatronics.....	xxxi
Program at Glance.....	xxxix
Technical Session Schedule.....	xl
Floor Map of Conference Rooms.....	xlii
Technical Sessions	
Monday, 6 August 2018.....	1
Tuesday, 7 August 2018.....	37
Wednesday, 8 August 2018.....	65
Index of Session Chairs.....	77
Index of Authors.....	80
IEEE ICMA 2019 CFP	
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Xu, Fen	Xu, Honghai	Xu, Jianan	Xu, Lixin
Xu, Mengguo	Xu, Qingsong	Xu, Shijie	Xu, Yaoqun
Xue, AnKe	Xue, Dingyu	Yakou, Takao	Yamada, Takayoshi
Yamaguchi, Tomomi	Yamamoto, Manabu	Yamamoto, Motoji	Yamamoto, Yoshio
Yamashita, Atsushi	Yamaura, Hiroshi	Yan, Shaoze	Yan, Shengyuan
Yanagihara, Mamoru	Yang, Enxia	Yang, Erfu	Yang, Fang
Yang, Guiliin	Yang, Hyun Suck	Yang, Jianwu	Yang, Jing
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	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	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, 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	Zhang, Zhaohui	Zhang, Zhe	Zhao, Cangwen
Zhao, Chunhui	Zhao, Lin	Zhao, Qing	Zhao, Xin
Zhao, Xinhua	Zhao, Yuxin	Zhao, Zhijun	Zheng, Fei
Zheng, Guibin	Zheng, Jinyang	Zheng, Yuanfang	Zhong, Ning
Zhou, Xunyu	Zhu, Chi	Zhu, Chunbo	Zhu, George
Zhu, Jianguo	Zhu, Qidan	Zhu, Xiangyang	Zhu, Xiaorui
Zhu, Xilin	Zhu, Yu	Zu, Jean	Zyada, Zakarya

# **IEEE ICMA 2018 Conference**

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**State Key Laboratory of Robotics and System (HIT)**

# General Information

## Changchun

Changchun is the capital of Jilin province and although Changchun has been more than 200 years old, it is still a young city comparing other historical cities in China, like Xian. It is located the central part of Songliao Plain, covering a total area of 20,571 square kilometers (about 8,012 square miles). Being the capital city of Jilin Province with a population of more than 6 million, it is one of the major cities in Northeast China and is the largest center for China's automotive industry. If territory of China is in a shape of rooster, therefore Changchun is one eye of this huge rooster. You can imagine its important position. Changchun has long, cold winters with the temperature dropping as low as  $-30^{\circ}\text{C}$ ; there is little snow, but the city is very windy and the air is dry. The present Changchun is charming city with several fine names which can give you a general impression of this big city.

Spring City of Northland: Changchun is of monsoon climate, locating in the transitional belt from wet area to sub-dry area. The four seasons varies a lot and the climate is rather pleasant, therefore Changchun is honored Spring City of Northland

Forest City: Woods, forest, people, city interweave together to show you a distinctive characteristic of Changchun. 39% of Changchun ground has been clothed with greenage, which makes Changchun one of top cities in this aspect. Green plants in and around Changchun make the city become a big oxygen bar, providing people to enjoy real fresh air.

Barn: Spring is dry and windy; summer is wet and rainy; autumn is sunny and cool; winter is cold. Generally speaking rain and heat come in the same season. Besides, favorable climate and enough sunshine provide very good condition for the growth of crops. Changchun teems with corn and soybean; therefore, it is praised as barn.

City of Automobiles: Changchun is the cradle of Chinese automobile industry, a famous auto city in China. On July 13, 1956, a truck branded with Jiefang was produced, which opened a new age for Chinese auto industry. This truck was the first automobile entirely made by Chinese. Famous and Changchun International Automobile Fair makes Changchun a real City of Automobiles.

City of Films: Changchun Film Studio was the first one after the found of People's Republic of China. It is praised as the cradle of Chinese film industry. For dozens of years, a great many excellent domestic films and dubbed films were produced here which gained a good fame for Changchun Film Studio both at home and abroad. As a calling card of Changchun, ceremonious Changchun Film Festival has enhanced its honor.

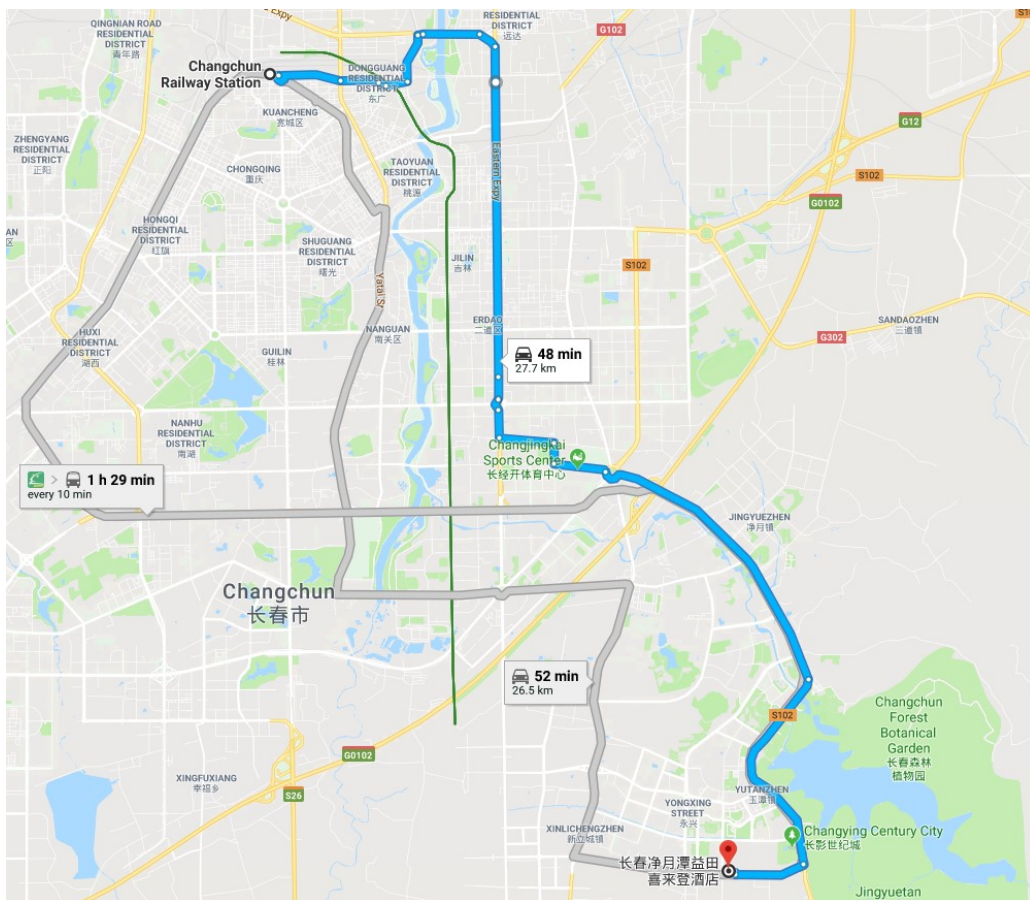
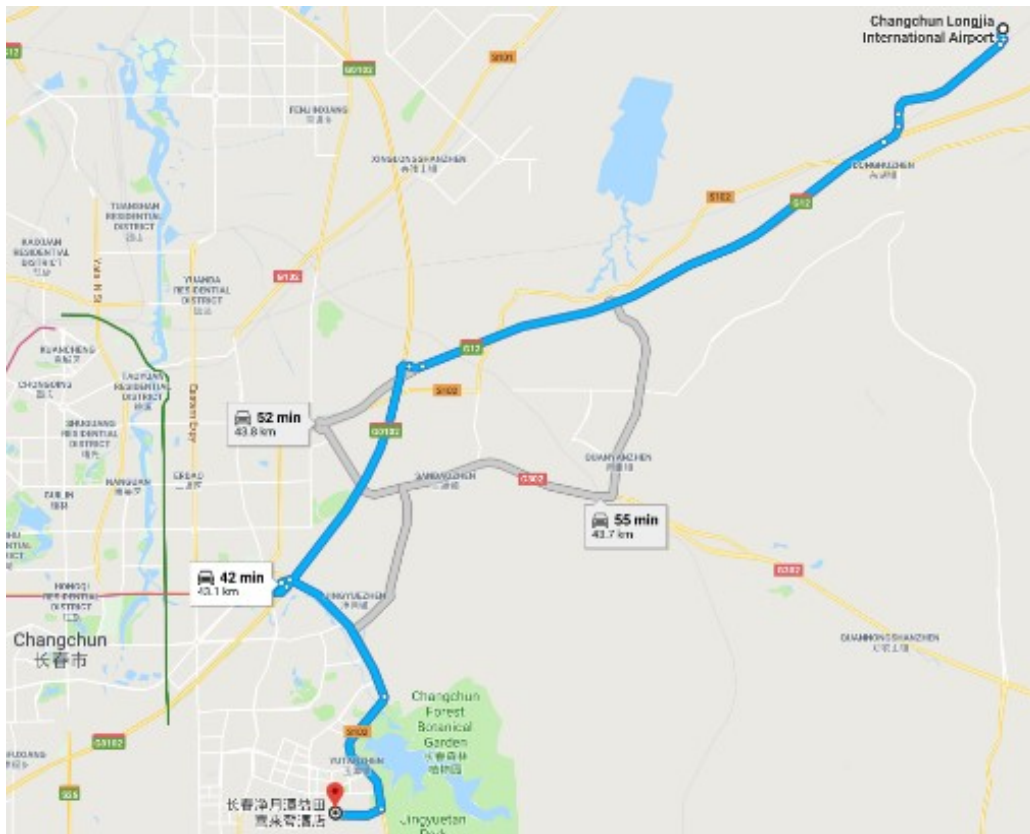
## Hotel Information

- **Sheraton Changchun Jingyuetan Hotel as the IEEE ICMA 2018 official hotel**

The Sheraton Changchun Jingyuetan Hotel is located at the intersection of Wu Tong Street and Ding Er Shi Er Road in the Jingyuetan Tourism Economic Development Zone. Easily accessible via metro, Sheraton Changchun Jingyuetan Hotel is just 18 kilometers from the city center and 19 kilometers from the Changchun Railway Station. Additionally, Changchun Longjia International Airport (CGQ) is 37 kilometers away.



- The way to IEEE ICMA 2018 Conference site



➤ It takes about one hour by taxi from Changchun Railway Station and Changchun Longjia International Airport to IEEE ICMA 2018 Conference site.

## Attractions

### ● Changbai Mountains

The Changbai Mountains Nature Reserve in east Jilin Province should be the first natural scenery of Jilin Province. Because there are a lot of white pumices and snow on the chief mountain-"Bai Tou Shan", it got its name "Changbai Shan". To the people of north China, Changbai Mountains is a "Mother Mountain", because it is not only the origin of Manchu, but also the cradle of Songhua, Tumen and Yalu rivers. It is the supporting living environment of diverse northeast generations. Now, this "Holy Mountain" has been a protection screen for the eco- environment of some northeast areas. The Tianchi Lake is the most famous spot of Changbai Mountains which was formed by the volcano. Because of its high elevation (more than 2,194 meters), people called it "Lake of Heaven".



### ● Xiang Hai

Another nature preserve in Jilin is Xianghai on the edge of the Songliao Plain and in Tongyu County in eastern Horqin Grassland. This preserve contains more than 100 swamps of varying sizes, a wide variety of fish, more than 250 different herbal plants, and a wide variety trees. Xianghai Nature Reserve is the natural habitat for 293 kinds of precious birds, including six breeds of cranes. The idyllic prairie and the local Mongol folklore combine to make this bird watching place a very fascinating place.



### ● Imperial Palace of Puppet Manchurian State

Pu Yi, the last Emperor of the Qing Dynasty, lived in Chang Chun, the capital city of Jilin, in an Imperial Palace for 14 years (1931 - 1945). This luxurious palace, which also was the administrative departments of the 'Puppet Manchurian Government', has hills, gardens, ponds, swimming pools, and various other forms of recreational facilities. The architecture and design of this 12-hectare (30-acre) palace is a worthy site to visit for its beauty and unique historical importance. Photographs of the emperor, his weddings, wives, parents, and English teacher are on display in the museum.



## Weather

The climate of Changchun is in the transition belt between the eastern humid hilly region and the western semiarid flat region, a continental sub humid monsoon climate of medium latitudes.

The east and the south are not far away from the sea, yet Changbai Mountain obstructs and slacks down summer monsoon; the west and the north are the flat Songliao Plain, continental polar airs from Siberia proceed without hindrance and various monsoons have serious effect here.

So the climate characteristics here are: it is very long and extremely cold in winter; it is dry and windy in spring; it is very short and warm in summer; and it is sunny and cloudless but the difference in temperature is very large in autumn. Usually, the maximum temperature 33°C in August and the minimum temperature -29°C in February. Annual temperature changes significantly, with distinctive four seasons.

The best time for traveling is in summer and autumn.

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Daily	-13	-8	1	12	21	25	29	27	20	12	0	-10
Nightly	-25	-22	-11	0	7	14	18	18	9	0	-11	-21

## Transportation

### ● Changchun Longjia International Airport

Changchun Longjia International Airport, is around 35 km east of Changchun's city center. The airport is large and clean, and passengers can find standard amenities such as restaurants, cafes, shops, lounges, credit card acceptance, etc. The major routes throughout the day are to domestic destinations Shanghai (2:20h) and Beijing (1:40h). There are also some international flights to various destinations in Korea (Seoul; ICN - with Asiana) and Japan (Nagoya with CZ).

From the airport there are some regular coach services (RMB 20 each way) available to the center (e.g. People's Square). The travel time takes around 45 minutes. A Taxi to/from the city costs RMB 80-100 including the toll.

### ● Public Bus Service

Changchun has an extensive bus network and most of the buses cost only RMB 1. However, if those who can't read Chinese will find it nearly impossible to use the network as the signage is all in Chinese characters. Most buses go to the bus station outside the train station, and other central areas such as Guilin Lu Chongqing Lu and Hongqi Jie. Be aware that the buses are often extremely crowded and especially uncomfortable during the hot summers as there is no air conditioning.

Taxis are cheaper than most in other Chinese cities and the fare starts at RMB 5 up to 2.5km, then RMB 2 per kilometer respectively. Changchun has lots of one-way streets, so don't panic if it seems your driver is lapping the block.

## 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 and fen. The conversion among the three is: 1 yuan = 10 jiao = 100 fen. Paper notes are issued in denominations of 1, 5, 10, 20, 50 and 100 yuan. Coins are issued in denominations of 1 yuan, 5 jiao and 1 jiao.  
Money exchanges by cash or traveler's cheques can be made at the branches of Bank of China at Changchun Longjia 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, Friendship and 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 RMB3. 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 Changchun, such as hospitals, office buildings, theatres, cinemas, museums, planes, and trains
- **Emergency telephone number:** 110 - Police; 119 – Fire; 120 – Ambulance



# Conference Information

## Conference Venue

IEEE ICMA 2018 will be held in the city of Changchun, at Sheraton Changchun Jingyuetan Hotel, Changchun, which serves as both the official conference hotel and the venue for the technical program.



## ***Location of Sheraton Changchun Jingyuetan Hotel***



## ***Chinese Address Cards***

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### **Sheraton Changchun Jingyuetan Hotel**

长春净月潭益田喜来登酒店

住所：吉林长春永顺路 1777 号，

净月经济开发区

Tel: (86) (431) 8181 1111

Fax: (86) (431) 8181 1616

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## Conference Registration

A conference registration desk will be set up and opened near the Room 2 on 1 F of Sheraton Hotel from August 5 (13:30) to August 8 (11:00) as followings.

August 5, 2018: 13:30 ~ 18:30 (near the Room 2 on 1 F)

August 6, 2018: 07:30 ~ 18:00 (near the Room 2 on 1 F)

August 7, 2018: 08:00 ~ 18:00 (near the Room 2 on 1 F)

August 8, 2018: 08:00 ~ 11:00 (near the Room 2 on 1 F)

## Internet Access

Free internet access will be provided during the conference period, to the IEEE ICMA 2018 participants at the Conference Room on 1 F and -1 F of Sheraton Hotel, Changchun. 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 2018 include the conference reception, the awards banquet, the conference registration, the farewell party, etc.

## Conference Reception

The Conference Reception will be held from 17:30 to 18:30 on August 5, 2018 in Conference Room 2, 1F of Sheraton Hotel (长春净月潭益田喜来登酒店 1 楼 2 会议室). All the Conference participants are welcomed to join this event.

## Awards Banquet

The Awards Banquet will be held from 18:30 to 21:00 on August 7, 2018 in Yitian Convention Center, 1F, **Sheraton Changchun Jingyuetan Hotel** (长春净月潭益田喜来登酒店、1 楼益田会议中心). All the conference participants are welcomed to join this event.

## Farewell Party

The Farewell Party will be held from 12:30 to 13:30 on August 8, 2018 in Conference Room 2, 1F of Sheraton Hotel(长春净月潭益田喜来登酒店 1 楼 2 会议室). All the conference participants are welcomed to join this event.



# IEEE ICMA 2018 Conference

## Keynote Speech

Human Interactive Service Robots

**Toshio Fukuda, Ph.D**

Professor

Department of Micro-Nano Systems Engineering

Nagoya University

Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan

E-mail [fukuda@mein.nagoya-u.ac.jp](mailto:fukuda@mein.nagoya-u.ac.jp)

<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. Thus human will be able to work interactively with robots together in future and will receive assistance and support from robot, in terms of physical, skill and intelligence levels. Some examples of the on-going projects will be shown in this presentation.

**Toshio Fukuda** (M'83-SM'93-F'95) received the B.A. degree from Waseda University, Japan, in 1971, and the M.S and Dr. Eng. from the University of Tokyo, Japan, in 1973 and 1977, respectively. In 1977, he joined the National Mechanical Engineering Laboratory. In 1982, he joined the Science University of Tokyo, Japan, and then joined Nagoya University, Nagoya, Japan, in 1989. Currently, he is Professor of Department of Micro-Nano System Engineering at Nagoya University, and Director of Center for Micro and Nano Mechatronics, where he is mainly involved in the research fields of intelligent robotic and mechatronic system, cellular robotic system, and micro- and nano-robotic system.

Dr. Fukuda was President of IEEE Robotics and Automation Society (1998-1999), Director of the IEEE Division X, Systems and Control (2001-2002), and Editor-in-Chief of IEEE / ASME Transactions on Mechatronics (2000-2002). He was Founding President of IEEE Nanotechnology Council (2002-2005) and President of SOFT (Japan Society for Fuzzy Theory and Intelligent Informatics) (2003-2005). He is a member of Japan Council of Science (2008-).

He received the IEEE Eugene Mittelmann Award (1997), IEEE Millennium Medal (2000), Humboldt Research Prize (2003), the IEEE Robotics and Automation Pioneer Award (2004), IEEE Robotics and Automation Society Distinguished Service Award (2005), Award from Ministry of Education and Science in Japan (2005). IEEE Nanotechnology Council Distinguished service award (2007). George Saridis Leadership Award (2009), IEEE Robotics and Automation Technical Field Award (2010), Best Googol Application paper awards from IEEE Trans. Automation Science and Engineering (2007). Best papers awards from RSJ(2004) and SICE(2007), Special Funai Award from JSME(2008), IEEE Fellow (1995), SICE Fellow (1995), JSME Fellow (2001), RSJ Fellow (2004).

# **IEEE ICMA 2018 Conference**

## **Plenary Talk 1**

### **Self-Optimization for Industry 4.0: An Effective Distributed and Asynchronous Method**

**Peter B. Luh, Ph.D.**

Professor

Department of Electrical and Computer Engineering

University of Connecticut

Storrs, CT, 06269-4157, USA

[peter.luh@uconn.edu](mailto:peter.luh@uconn.edu)





## **Abstract:**

Pushed by advancements in Internet of Things and Industry 4.0, recent trends of technological development in manufacturing include interoperability, virtualization, decentralization, and performance. A noble goal is effective “self-optimization” of autonomous systems consisting of multiple machining to process various parts. Such optimization, however, is difficult since discrete decision variables are generally involved, and problem complexity increases drastically as problem sizes increase. Coordination of asynchronous optimization processes then poses further theoretical as well as implementation challenges. In this talk, a distributed and asynchronous coordination approach is presented. In the approach, individual subproblems are solved by subsystems locally in an asynchronous manner, and prices are dynamically adjusted to balance supply and demand through a novel and accelerated updating process. The convergence of the method is proved by using a novel version of the Lyapunov stability theory. The method is then used to solve manufacturing planning and scheduling problems. Numerical testing on selected problems with or without sequence-depend setup times demonstrate that the method converges, is efficient and scalable, and that the dream of self-optimization for practical factories with near-optimal performance is achievable.

**Prof. Peter B. Luh** received his B.S. from National Taiwan University, M.S. from M.I.T., and Ph.D. from Harvard University. He has been with the University of Connecticut since 1980, and currently is the SNET Professor of Communications & Information Technologies. He is also a member of the Chair Professors Group, Center for Intelligent and Networked Systems (CFINS) in the Department of Automation, Tsinghua University, Beijing; and a member of the Thousand-Talent Program, the State Key Laboratory of Synthetical Automation for Process Industry, Northeastern University, Shenyang, China. Professor Luh is a Life Fellow of IEEE, and a member and the Chair (2018-2019) of IEEE TAB Periodicals Committee. He was the VP of Publications of the IEEE Robotics and Automation Society (RAS, 2008-2011), the founding Editor-in-Chief of the IEEE Transactions on Automation Science and Engineering (2003-2007), and the Editor-in-Chief of IEEE Transactions on Robotics and Automation (1999-2003). His research interests include intelligent manufacturing systems, smart power systems, and smart and green buildings. He received RAS 2013 Pioneer Award for his pioneering contributions to the development of near-optimal and efficient planning, scheduling, and coordination methodologies for manufacturing and power systems. He also received RAS 2017 George Saridis Leadership Award for his exceptional vision and leadership in strengthening and advancing Automation.

# **IEEE ICMA 2018 Conference**

## **Plenary Talk 2**

**The world is not a safe place!**

**Safe Robots for Dangerous Jobs**

**Prof. Darwin G Caldwell, FREng**

Deputy Director

Italian Institute of Technology (IIT)

Director, Department of Advanced Robotic IIT

Via Morego 30, 16163 Genoa, Italy

Email: [darwin.caldwell@iit.it](mailto:darwin.caldwell@iit.it)



## **Abstract:**

The world is not a safe place! It is a multifaceted, unstructured, dynamic and dangerous environment. Sometimes events occur, both through natural disaster e.g. earthquake, weather, volcanoes, climate, fire, etc. and following human intervention e.g. nuclear, chemical, biological, oil and gas refining/exploration, mining, excavation, etc. that place people at extreme direct and indirect risk. Under such circumstances there is a massive safety driven need for robots to enter the domain and assist, augment or replace humans.

But operation in these potentially devastated outdoor or human engineered environments, using tools designed for humans deployment, requires robots that have human or human/animal-like levels of agility, compliance, dexterity, robustness, reliability and movement/locomotion. The challenges for both the software and the mechatronics are therefore immense.

This presentation will explore the core mechatronic technologies needed to create and operate humanoid (COMAN, COMAN+ and WalkMan), quadruped (HyQ and HyQ-real) and “centaur” quadruped (HalfMan) robots in complex, unstructured and destructed environments, and will demonstrate how many key loco-manipulation tasks may be addressed.

**Prof. Darwin G Caldwell** is Deputy Director of the Italian Institute of Technology (IIT), and Director of the Dept. of Advanced Robotics at IIT. He is or has been an Honorary Professor at the Universities of Manchester, Sheffield, Bangor, Kings College London and Tianjin University, China. His research interests include; innovative actuators, force augmentation exoskeletons, medical, rehabilitation and assistive robotic technologies, dexterous manipulators, haptics, humanoid and quadrupedal robotics (iCub, cCub, COMAN, WalkMan, HyQ, HyQ2Max, HalfMan, COMAN+). He is the author or co-author of over 500 academic papers, and 19 patents and has received awards and nominations from many international journals and conferences. Caldwell is a past chair of the IEEE Robotics and Automation Chapter (UKRI), a past co-chair of the IEE (IET) Robotics and Mechatronics PN. He is on the editorial advisory board of Science Robotics, Senior Editor for the Journal of Medical Robotics Research, Editor for Frontiers in Robotics and AI, and on the editorial boards of the International Journal of Social Robotics and Industrial Robot. Prof. Caldwell is a Fellow of the Royal Academy of Engineering.

# **IEEE ICMA 2018 Conference**

## **Plenary Talk 3**

**Cell surgery Robotics**

**Dong Sun, Professor**

Chair Professor and Head

Department of Mechanical and Biomedical Engineering

Director of Center for Robotics and Automation

City University of Hong Kong

E-mail: [medsun@cityu.edu.hk](mailto:medsun@cityu.edu.hk)

<http://www.cityu.edu.hk/mbe/medsun/>



## **Abstract:**

There exists an increasing demand for developing new technologies that can have earlier diagnosis and treatment of diseases at cell level, thereby achieving long term patient survival. Cell surgery robotics is an entirely new emerging theme that is enabled with specially designed automated micromanipulation tools to perform surgical diagnosis and treatment with image feedback, and can be processed on large-scale single cells. This talk will introduce our recent development of using robotics combined with micro-engineering tools including optical tweezers, micro-needles and electromagnetic devices, as special end-effectors to accomplish various tasks of cell manipulation, diagnosis and micro-surgery at the single cell level. With this emerging technology, we have achieved numerous cell surgery operations such as single cell transportation and rotation, single cell biopsy and microinjection, and target delivery of cells using magnetic actuation. The new technologies for automated cell surgery will permit many new unforeseen applications previously thought impossible, and profoundly affect surgical treatment and precision medicine.

**Prof. Dong Sun** is currently a chair professor and head of the Department of Mechanical and Biomedical Engineering, City University of Hong Kong, where his current research focuses on bio/medical robotics for biological cell manipulation and cell surgery. He studied in Tsinghua University of Beijing and the Chinese University of Hong Kong, and then joined the University of Toronto, Canada for post-doc research. After short-time working experience in Canadian industry, he returned to Hong Kong in 2000 and became an Assistant Professor in the City University of Hong Kong.

Dr. Sun is among the leading contributors worldwide in pioneering work in robotic manipulation of biological cells, which has recently become an emerging area of robotics for biomedical applications and offered fundamental advances in precision medicine. His research has breakthrough in the use of combined robotics and various micro-engineering tools including optical tweezers, micro-needles and electromagnetic devices to achieve cell manipulation, diagnosis and micro-surgery at the single cell level. With his emerging technology, a new robotics theme “cell surgery robotics” has been recently formed, which will permit many new unforeseen applications previously thought impossible.

Dr. Sun received numerous awards, including best paper awards from the international journal and conferences as well as industrial awards such as Hong Kong Awards for Industry. His patented research of intelligent sensor has been used in the E-Channel auto-pass systems of customs in Hong Kong. He serves on the editorial boards of several academic journals, and organizes several international flagship conferences including the world largest intelligent robot conference (IROS). He is a member of the Biomedical Division, Science and Technology Committee of Education Ministry of China, and a member of Research Grant Council of Hong Kong. He is a fellow of the IEEE and a fellow of the Hong Kong Institute of Engineers.

# IEEE ICMA 2018 Conference Workshop

## World Youth Development Workshops on Opto-Mechatronics

Sunday, August 5, 2018

13:30 - 15:40

Conference Room 1, 1F

Sheraton Changchun Jingyuetan Hotel, Changchun, China

## Optical, Mechanical and Electronic Integration: Theory and Practice

**Venue:** Conference Room 1, 1F

Sheraton Changchun Jingyuetan Hotel, Changchun

**Date and Time:** 13:30 - 15:40, August 5, 2018

### Organizers:

Dr. Dapeng Tian, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China

Dr. Jianli Wang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China

### About the workshop:

Optical, Mechanical and Electronic integration technology is one of the core technologies of advanced manufacturing. It is the basis of robots, machine tool and several industrial devices. Youth is the backbone of future research. The Youth Innovation Promotion Association is a new force in the scientific and technological innovation of the Chinese Academy of Sciences. We assemble a group of Youth Innovation Promotion Association members who engage in the front-line research in the field of optics and mechatronics. Their latest research results will be introduced and presented.

## List of Speakers and Schedule

Time	Topics	Speaker List
13:25-13:30	Welcome speech	
13:30-13:50	Diode-Pumped Alkali-Vapor Lasers	Fei Chen, State Key Laboratory of Laser Interaction with Matter
13:50-14:10	Researches on space structural dynamics and space robot in CIOMP	Zhenbang Xu, Innovation Lab of Space Robot System, Space Robotics Engineering Center, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
14:10-14:30	Advanced Motion Control and Its Applications	Dapeng Tian, Key Laboratory of Airborne Optical Imaging and Measurement, Chinese Academy of Sciences
14:30-14:50	Motion Compensation of TDI CCD Camera in Remote Sensing System	Dejiang Wang Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
14:50-15:10	Computer Vision and Robots Design	Ye Zhang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences.
15:10-15:30	Experiment analysis of adaptive optics based free space optic communication system with a 349-element deformable mirror	Kainan Yao Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
15:30-15:40	Panel Discussion	Moderators: All speakers

# IEEE ICMA 2018 Conference

## World Youth Development Workshops on Opto-Mechatronics

### Talk 1

## Diode-Pumped Alkali-Vapor Lasers

### Fei Chen

Associate Professor, State Key Laboratory of Laser Interaction with Matter,

Innovation Laboratory of Electro-Optical Countermeasures Technology,

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science

E-mail: [feichenny@126.com](mailto:feichenny@126.com)

#### **Abstract**

The diode-pumped alkali-vapor lasers (DPALs) have the preferred properties of solid-state lasers and gas lasers, such as higher quantum efficiency, larger stimulation emission cross-section, small refractive index perturbation, easy heat elimination and good optical characteristics. The DPALs are expected to obtain near-infrared laser output with high power, high efficiency and high beam quality, which has potential applications in military and civilian. In addition, it is a new way to achieve blue-violet laser with high efficiency and high power by frequency doubling of DPALs, which has important applications in scientific research, medical treatment, environmental monitoring, laser displays and underwater communication. In addition, cascade output of mid-infrared and visible laser could be obtained employing two-photon excitation.

The experimental investigations on a diode-pump cesium-vapor laser (Cs-DPAL) and its frequency doubling to obtain blue-violet laser are carried out. A Cs-DPAL is constructed. By optimizing the parameters, the CW Cs laser with fundamental transverse mode is obtained. Then the researchers on blue-violet laser by extra-cavity and intra-cavity frequency doubling are presented by using the phase matching method with LBO crystal. In order to obtain the dual-wavelength emission of mid-infrared and blue-violet laser, a model on the absorption cross-section of the simultaneous two-photon excitation in Rb-vapor four-wave mixing process is established. Additionally, two approaches to improve absorption efficiency are proposed.

**Dr. Chen** is an associate professor and a doctoral supervisor. He received his Doctoral degree in physical electronics from Harbin Institute of Technology in 2011. At the same year, he joined the State Key Laboratory of Laser Interaction with Matter in Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences. His research interests include novel lasers and laser frequency conversion. He has been publishing 108 papers (38 papers as the first author or corresponding author) in top journals and international conferences such as "Light: Science & Applications", "Optics Letters", "Optics Express" and ASSP, CLEO, ICOP, etc. Among them, 69 papers are recorded in SCI, and 30 papers are recorded in EI. The cited time of his papers recorded in SCI has reached more than 1200 times. He holds 3 academic books and 4 patents. He organized or participated in over 10 projects, including the Natural Science Foundation of China, the Major State Project, the Major Science and Technology Project, and the Major Science and Technology Biding Project of Jilin Province, etc. He was elected in the Youth Innovation Promotion Association of Chinese Academy of Sciences in 2017, and received the financing of the Youth Science and Technology Innovation Leaders and Team Project of Jilin Province at the same year.



# IEEE ICMA 2018 Conference

## World Youth Development Workshops on Opto-Mechatronics

### Talk 2

## Researches on Space Structural Dynamics and Space Robot in CIOMP

**Zhenbang Xu**

Innovation Lab of Space Robot System, Space Robotics Engineering Center, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun

Email: xuzhenbang@gmail.com

### **Abstract**

The presenters' group has been studying on space structural dynamics and space robot in CIOMP. In space structural dynamics, the main research work concentrates on the analysis and control of the jitter of the space device, including the integrated opto-mechanical analysis of the space optical device, passive and active micro-vibration control and the ground experiments technique of the jitter and so on. Some achievements have been applied to the multifunctional optical facilities on chinese space station, which is a flagship project of the china aerospace. In space robot, we have researched the space parallel robot and the space series robot. The space parallel robot is mainly used to be the adjustable mechanism of the large space telescope. The space series robot is used to construct ultra-large space telescope in orbit. This report introduces some recent works and main achievements in the above-mentioned areas.

**Dr. Xu** received doctor degree from the university of science and technology of china (USTC) in 2010. After his career, he is currently a professor at Changchun Institute of Optics Fine Mechanics and Physics (CIOMP). His research interests include space structural dynamics, passive and active micro-vibration control and space robot. He has been publishing more than 30 journal papers in these areas.

# IEEE ICMA 2018 Conference

## World Youth Development Workshops on Opto-Mechatronics

### Talk 3

#### Advanced Motion Control and Its Applications

**Dapeng Tian**

Associate Professor

Key Laboratory of Airborne Optical Imaging and Measurement, Chinese Academy of Sciences,

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences,

E-mail: [d.tian@ciomp.ac.cn](mailto:d.tian@ciomp.ac.cn)

#### **Abstract**

Motion control theory and technology is one of the cores of industrial practice. Controlling the motion of an object means that the acceleration, velocity and position follow the orders accurately. Advanced motion control contains three aspects. Firstly, signal processing algorithm should be improved. The quality of feedback signal and also command signal directly influence the performance of the whole system. Secondly, an internal loop robust control should be added. Such a control loop improves disturbance rejection of a motion control system and even the overall performance. Thirdly, control algorithm in application lays should be focused on. The presenter has been investigating motion control for several years. An idea of designing the differentiator is proposed based on feedforward. Disturbance observer based internal loop control is also investigated combining sliding mode control. A haptic bilateral teleoperation is focused on in the application lay. Transparency haptic transmission is achieved with and without communication delay between a master robot and a slave robot.

**Dr. Tian** received B.E and Dr. E. from Beijing Institute of Technology in 2007 and Beihang University in 2012, respectively. From 2009 to 2012, he was with Keio Advanced Research Center, Keio University as a co-research fellow supported by Chinese Scholarship Council. From 2012 to 2014, he was with Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences (CAS) as an assistant professor. He is currently an associate professor and member of the Youth Innovation Promotion Association, CAS. His research interests include high speed and high accuracy control, bilateral teleoperation and haptics. He has published over 40 papers and achieved 5 patents for invention. He is an editorial board member of the journal of optics and precision engineering. The First prize for the academic achievements of Natural Science in Jilin, 2017's Outstanding Science and Technology Achievement Prize of the Chinese Academy of Sciences (Major Contributor) are presented to him.

# IEEE ICMA 2018 Conference

## World Youth Development Workshops on Opto-Mechatronics

### Talk 4

## Motion Compensation of TDI CCD Camera in Remote Sensing System

**Dejiang Wang**

Associate Professor

Key Laboratory of Airborne Optical Imaging and Measurement, Chinese Academy of Sciences,

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences,

E-mail: [wangdj04@ciomp.ac.cn](mailto:wangdj04@ciomp.ac.cn)

### **Abstract:**

Clock smear caused by charge transfer of time delay and integration charge coupled device is the natural component in remote sensing system, and it could not be eliminated by traditional motion compensation schemes. After researching on the operation of a typical TDI CCD, we give a thorough understanding on causes of clocking smear. Then an elaborate mathematical model describing the charge transfer procedure is developed, and the modulation transfer function losses due to charge transfer is also presented, which shows that nearly one pixel smear will be introduced by traditional phased timing. Therefore we proposed a novel charge transfer method, a series of image simulations are made for two, three and four phase TDI CCD in which clocking smear is caused by our and conventional charge transfer methods respectively. The experimental results confirm that image quality improvement can be achieved by our method.

**Dr. Wang** received B.E and Dr. E. from Nankai university in 2004 and Qsinghua University in 2007, respectively. From 2007 to 2014, he was with Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences (CAS) as an assistant professor. He is currently an associate professor and member of the Youth Innovation Promotion Association, CAS. His research interests include dim point detection using infrared camera and motion compensation in remote sensing cameras. Published more than 20 articles, such as Optics Express, Applied Optics, Optics Communication, etc. Authorized more than 5 patents, as a tutor or assistant tutor of optical engineering discipline doctoral, master of 4 graduate students. He has hosted or participated in a number of national, provincial or ministerial funds or projects.

# IEEE ICMA 2018 Conference

## World Youth Development Workshops on Opto-Mechatronics

### Talk 5

## Computer Vision and Robots Design

**Zhang Ye**

Associate Professor

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences.

E-mail: [zhangye@ciomp.ac.cn](mailto:zhangye@ciomp.ac.cn)

### **Abstract:**

In this work, we propose a nurturance robot system. The robot system follows a modularize design style which is consists of several interrelated functions modules, including vision, auditory, and speech. This system design enables us easily to be able to integrate other functions. Combining some existing state-of-art approaches, the Nurturance robot system integrates face recognition, human computer interaction and facial expression display. We elaborate the design and implementation of the system from two aspects, software and hardware, respectively. Includes two aspects. Firstly, we propose a method for combining several software modules of speech recognition and vision. Secondly, we construct a simple and effective experimental system to realize our design and design a pretty and smart nurturance robot.

**Zhang Ye** received PhD. degree from Changchun Institute of Optics, fine Mechanics and Physics, Chinese Academy of Sciences in 2008. Previously engaged in ground, aviation, aerospace and military related computer vision and artificial intelligence work, with the team transferred to the State Key Laboratory of Applied Optics, engaged in the design and research and development of artificial intelligence-related civil products. Published more than 20 articles, including a study about deep learning with an SCI impact factor 6.387, authorized more than 10 patents, as a tutor or assistant tutor of artificial intelligence discipline doctoral, master of 8 graduate students. She has hosted or participated in a number of national, provincial or ministerial funds or projects. In 2018, she will complete a transformation of scientific and technological achievements, and planned to set up a business, taking artificial intelligence as the core, to serve industrial and civilian.

# IEEE ICMA 2018 Conference

## Talk 6

### World Youth Development Workshops on Opto-Mechatronics

#### Experiment analysis of adaptive optics based free space optic communication system with a 349-element deformable mirror

**Kainan Yao**

Associate Professor

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences,  
China

E-mail: yaokainan001@126.com

#### **Abstract:**

Due to the influence of atmospheric turbulence, the decrease of fiber coupling efficiency leads to the decline of free space optical communication (FSOC) system performance. Adaptive optics (AO) can reduce atmospheric turbulence effect and improve fiber coupling efficiency effectively. To improve the performance in FSOC system, AO system must be designed to compensate both high spatial and temporal frequency wavefront aberrations. In this paper, we describe an AO system with a 349-element deformable mirror used for FSOC system and evaluate its performance under different Greenwood frequency. The simulative and experimental results show that the coupling efficiency can be significantly improved after AO correction. And more element number of deformable mirror and higher close-loop control bandwidth can offer more enhancements for FSOC performance. This experiment analysis provides a reference for the design of FSOC system.

**Kainan Yao** was born in December 1987, received the Doctor's degree from University of China Academy of Sciences in 2015. He is currently an associate professor at Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Member of the Youth Innovation Promotion Association of the Chinese Academy of Sciences. His major research directions include adaptive optics technology and the novel wave front sensing method. He has more than 10 journal papers, including the first author or corresponding author in Optics Express, Applied Optics, IEEE Photonics Journal. Based on the related work, he got fundings, such as National Natural Science Foundation of China, National Defense Science and Technology Innovation Fund Project of Chinese Academy of Sciences and Military Commission Science and Technology Committee Innovation Project. He won the Chinese Academy of Sciences President award in 2015.

# IEEE ICMA 2018 Program at a Glance

August 5-8, 2018

[Sheraton Changchun Jingyuetan Hotel](#), Changchun, Jilin, China

## Sunday, August 5, 2018

- 13:30 - 18:30 Registration Desk Open on 1F  
13:30 - 15:40 **World Youth Development Workshops on Opto-Mechatronics at Conference Room 1**  
16:00 - 17:00 [Keynote Speech](#) (Prof. Toshio Fukuda) (Conference Room 1)  
17:30 - 18:30 Reception at Conference Room 2

## Monday, August 6, 2018

- 8:30 - 9:00 Opening Ceremony (Yitian Convention Center)  
9:00 - 9:50 [Plenary Talk #1](#) (Dr. Peter B. Luh) (Yitian Convention Center)  
9:50 - 10:40 [Plenary Talk #2](#) (Dr. Darwin G. Caldwell) (Yitian Convention Center)  
10:40 - 11:00 Morning Break  
11:00 - 12:00 Technical Sessions MA1 (Poster Session) (Yitian Convention Center)  
12:00 - 13:30 Lunch Break  
13:30 - 15:00 Technical Sessions MP1 (Conference Room on -1F and 1F)  
15:00 - 15:15 Afternoon Break  
15:15 - 16:45 Technical Sessions MP2 (Conference Room on -1F and 1F)  
17:00 - 18:00 Technical Sessions MP3 (Conference Room on -1F and 1F)

## Tuesday, August 7, 2018

- 8:30 - 10:00 Technical Sessions TA1 (Conference Room on -1F and 1F)  
10:00 - 10:30 Morning Break  
10:30 - 12:00 Technical Sessions TA2 (Conference Room on -1F and 1F)  
12:00 - 13:30 Lunch Break  
13:30 - 15:00 Technical Sessions TP1 (Conference Room on -1F and 1F)  
15:00 - 15:30 Afternoon Break  
15:30 - 17:00 Technical Sessions TP2 (Conference Room on -1F and 1F)  
18:30 - 21:00 Award Banquet, [Yitian Convention Center, 1F in Sheraton Changchun Jingyuetan Hotel](#).

## Wednesday, August 8, 2018

- 8:30 - 9:20 [Plenary Talk #3](#) (Dr. Dong Sun) (Yitian Convention Center)  
9:30 - 11:00 Technical Sessions WA1 (Conference Room on -1F and 1F)  
11:00 - 11:15 Morning Break  
11:15 - 12:15 Technical Sessions WA2 (Conference Room on -1F and 1F)  
12:30 - 13:30 Farewell Party at Conference Room 2

\* 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 2018 Technical Program, Sunday, August 5, 2018

Room Time	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
13:30-18:30	<b>Registration Desk Open</b>				Location: Registration Area on 1 F		
13:30-15:40	<b>World Youth Development Workshops on Opto-Mechatronics</b>				Location: Conference Room 1 on 1 F		
16:00-17:00	<b>Keynote Speech</b>		Human Interactive Service Robots Prof. Toshio Fukuda, Nagoya University, Japan		Location : Conference Room 1 on 1 F		
17:30-18:30	<b>Reception</b>				Location: Conference Room 2 on 1 F		

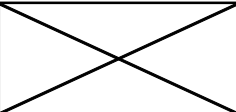
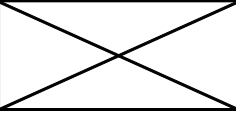
## IEEE ICMA 2018 Technical Program, Monday, August 6, 2018

8:30-9:00	<b>Opening Ceremony</b>				Location: Yitian Convention Center			
9:00-9:50	<b>Plenary Talk #1</b>		Self-Optimization for Industry 4.0: An Effective Distributed and Asynchronous Method Dr. Peter B. Luh, University of Connecticut, USA					Location: Yitian Convention Center
9:50-10:40	<b>Plenary Talk #2</b>		The world is not a safe place! Safe Robots for Dangerous Jobs Dr. Darwin G. Caldwell, Italian Institute of Technology, Italy					Location: Yitian Convention Center
10:40-11:00	Morning Break							
11:00-12:00	Technical Sessions MA1 Poster Session (Intelligent Mechatronics and Automation)							
							Location: Yitian Convention Center	
12:00-13:30	Lunch Break							
13:30-15:00	<b>MP1-1</b> Mechanism Design of Robots	<b>MP1-2</b> Medical Robots for Minimal invasive surgery I	<b>MP1-3</b> Manufacturing Process & Automation I	<b>MP1-4</b> Modeling, Simulation Techniques and Methodology I	<b>MP1-5</b> Vision System & Image Processing	<b>MP1-6</b> Mobile Robot System I	<b>MP1-7</b> Control Theory and Application I	
15:00-15:15	Afternoon Break							
15:15-16:45	<b>MP2-1</b> Micro & Nano Systems I	<b>MP2-2</b> Medical Robots for Minimal Invasive Surgery II	<b>MP2-3</b> Manufacturing Process & Automation II	<b>MP2-4</b> Modeling, Simulation Techniques and Methodology II	<b>MP2-5</b> Vision System and Robotic Vision	<b>MP2-6</b> Mobile Robot System II	<b>MP2-7</b> Control Theory and Application II	
17:00-18:00	<b>MP3-1</b> Micro & Nano Systems II	<b>MP3-2</b> Medical Robots for Minimal Invasive Surgery III	<b>MP3-3</b> Humanoid Robots	<b>MP3-4</b> Intelligent Control I	<b>MP3-5</b> Vision System & Application	<b>MP3-6</b> Actuator Design	<b>MP3-7</b> Medical & Rehabilitation Systems	

## IEEE ICMA 2018 Technical Program, Tuesday, August 7, 2018

Time \ Room	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
8:30-10:00	<b>TA1-1</b> Signal and Image Processing I	<b>TA1-2</b> Intelligent Mechatronics	<b>TA1-3</b> Mechatronic Systems I	<b>TA1-4</b> Intelligent Control II	<b>TA1-5</b> Modeling, Simulation Techniques and Methodology IV	<b>TA1-6</b> Mobile Robots	<b>TA1-7</b> Control Theory and Application III
10:00-10:30	Morning Break						
10:30-12:00	<b>TA2-1</b> Signal and Image Processing II	<b>TA2-2</b> Intelligent Mechatronics and Application I	<b>TA2-3</b> Mechatronic Systems II	<b>TA2-4</b> Multiple Robot Control	<b>TA2-5</b> Opto-electronic Element and Materials	<b>TA2-6</b> Biomimetic Measurement and Control in Robotics	<b>TA2-7</b> Control Theory and Application IV
12:00-13:30	Lunch Break						
13:30-15:00	<b>TP1-1</b> Signal and Image Processing III	<b>TP1-2</b> Intelligent Mechatronics and Application II	<b>TP1-3</b> Mechanism & Design	<b>TP1-4</b> Biomimetic Systems	<b>TP1-5</b> Element, Structures and Mechanisms I	<b>TP1-6</b> Space and Telerobotics	<b>TP1-7</b> Control Theory and Application V
15:00-15:30	Afternoon Break						
15:30-17:00	<b>TP2-1</b> Signal and Image Processing IV	<b>TP2-2</b> Intelligent Mechatronics and Application III	<b>TP2-3</b> Manufacturing Systems & Automation	<b>TP2-4</b> Intelligent Biomedical Technology	<b>TP2-5</b> Element, Structures and Mechanisms II	<b>TP2-6</b> AUV & Space Robots	<b>TP2-7</b> Control Theory and Application VI
18:30-21:00	<b>Award Banquet</b>				Location: Yitian Convention Center		

## IEEE ICMA 2018 Technical Program, Wednesday, August 8, 2018

Time \ Room	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
8:30-9:20	<b>Plenary Talk #3</b>		Cell surgery Robotics <b>Dr. Dong Sun, City University of Hong Kong, Hong Kong</b>		Location: Yitian Convention Center		
9:30-11:00	<b>WA1-1</b> Signal and Image Processing V	<b>WA1-2</b> Manipulator Control I	<b>WA1-3</b> Sensor Design and Sensing System		<b>WA1-5</b> Modeling, Simulation Techniques and Methodology III	<b>WA1-6</b> Control Theory and Application VII	<b>WA1-7</b> Human-System Interaction
11:00-11:15	Morning Break						
11:15-12:15	<b>WA2-1</b> Signal and Image Processing VI	<b>WA2-2</b> Manipulator Control II	<b>WA2-3</b> Signal Measurement and Process in Automatic Control		<b>WA2-5</b> Rotor Dynamics, Vibration Analysis and Vibration Control	<b>WA2-6</b> Manipulation Sensing & System	<b>WA2-7</b> Robot Navigation and Control Algorithm
12:30-13:30	<b>Farewell Party and Lunch Break</b>				Location: Conference Room 2 on 1 F		

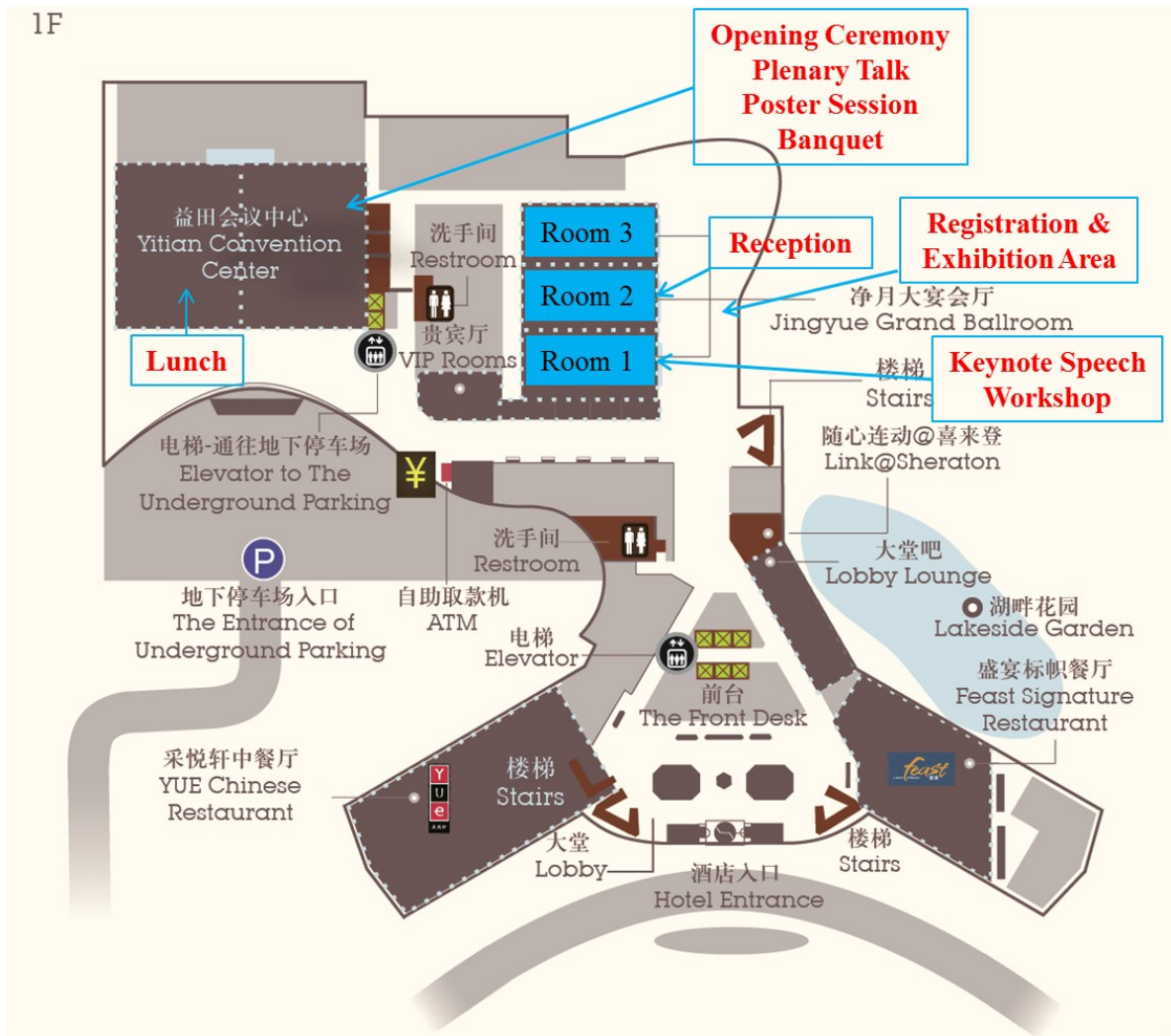


# IEEE ICMA 2018

## Floor Map of Conference Rooms

-1F and 1F, Sheraton Hotel, Changchun

Conference Room 1-7 and Yitian Convention Center



酒店-1楼  
-1F





Monday  
August 6, 2018

## Morning Sessions

MA1-P Poster Session (Intelligent Mechatronics and Automation)

# Monday

# August 6, 2018

## Afternoon Sessions

MP1-1	Mechanism Design of Robots
MP1-2	Medical Robots for Minimal invasive surgery I
MP1-3	Manufacturing Process & Automation I
MP1-4	Modeling, Simulation Techniques and Methodology I
MP1-5	Vision System & Image Processing
MP1-6	Mobile Robot System I
MP1-7	Control Theory and Application I
MP2-1	Micro & Nano Systems I
MP2-2	Medical Robots for Minimal invasive surgery II
MP2-3	Manufacturing Process & Automation II
MP2-4	Modeling, Simulation Techniques and Methodology II
MP2-5	Vision System and Robotic vision
MP2-6	Mobile Robot System II
MP2-7	Control Theory and Application II
MP3-1	Micro & Nano Systems II
MP3-2	Medical Robots for Minimal Invasive Surgery III
MP3-3	Humanoid Robots
MP3-4	Intelligent Control I
MP3-5	Vision System & Application
MP3-6	Actuator Design
MP3-7	Medical & Rehabilitation Systems

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

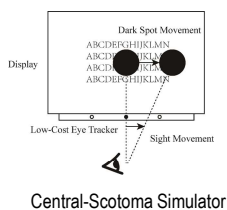
Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

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

**A Central-Scotoma Simulator Based on Low-Cost Eye Tracker**

Yiyang Yu, Qiong Wu, Yang Feng, Ting Guo, Jijia Yang, Satoshi Takahashi, Yoshimichi Ejima and Jinglong Wu  
The Graduate School of Natural Science and Technology, Okayama University  
Okayama, Japan

- Firstly, we explained the role of the central-scotoma simulator in scientific research about central vision loss.
- secondly, we chose the suitable hardware and software to implement a low-cost simulator.
- Lastly, we used this simulator to simulate the symptom of patients with macular diseases, which resulted in the normal vision subjects achieved similar results same as macular degeneration in natural oral reading test.



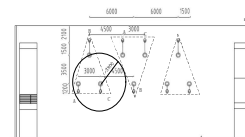
Central-Scotoma Simulator

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

**A Study on Outlet Schemes of Indoor Substation based on AGA-AHP Algorithms**

Tian Tian<sup>1</sup>, Jianbo Yu<sup>1</sup>, Ran Ren<sup>1</sup> and Junli Chen<sup>2</sup>  
1 Chongqing Electric Power Design Institute, Chongqing, China  
2 The State Key Laboratory of Power Transmission Equipment & System Security and New Technology (Chongqing University) Chongqing, China

- This paper proposes a new outlet scheme named positive and negative triangle outlet.
- AGA-AHP algorithms are used to perform quantitative evaluation for weight of various outlet.
- The algorithms can realize the quantification of qualitative indicators and the output of the optimal outlet scheme.



Positive and negative triangle outlete

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

**Research on Cooperative Work Path Planning Method Based on Double 6 - DOF Manipulators**

Chengtao Cai and Boyu Wang  
College of Automation, Harbin Engineering University Harbin, China  
Yi Li  
Harbin No.703 Research Institute Harbin, China

- For the six-freedom dual-arm, this paper proposes a new path planning method combining linear interpolation method and artificial potential field method.
- This new method not only considers the continuity and displacement of the manipulator, but also ensures that the path is the shortest on the premise that the arms do not collide.



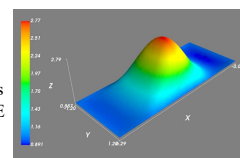
Double Manipulators Path Planning

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

**Model Driven Method of the Static Performance Calculation for Gas Journal Bearing by Python**

Tang Sixun, Geng Haipeng, LiHao and Qi Lei  
State Key Laboratory for Strength and Vibration of Mechanical Structures, Xian Jiaotong University Shanxi, China

- A numerical method for the static performance of gas journal bearing is developed based on FEM by python programming.
- The compressible Reynolds equation is transformed into Standard Elliptic PDE form and the FEM solver for it is developed.
- An OOP based finite element method model is created to solve the Reynolds equation for gas journal bearing in steady state more easily and briefly.



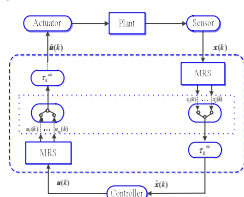
The pressure distribution of the gas foil bearing

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

**Model-Reference Scheduling and Control Co-design with Two Paths**

Shunli Zhao, Yuehui Ji  
1. Tianjin Key Laboratory for Control Theory & Applications in Complicated System, Tianjin University of Technology, Tianjin, China  
2. School of Electrical and Electronic Engineering, Tianjin University of Technology, Tianjin, China

- There have been growing concerns in networked control system with communication constraints..
- A novel scheduling strategy, model-reference scheduling scheme, is proposed.
- The network exists not only in forward path but also in feedback path.



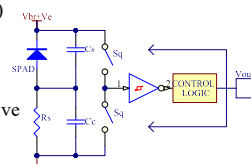
The MRS diagram

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

**A Review of Quencher Circuit Design Based on Geiger-Mode APD**

Yue Yu, Chunyang Wang, Xuelian Liu, Hongwei Shi\* and Bo Yang  
Department of Electronics and Information Engineering, Changchun University of Science and Technology, Changchun, China

- The Avalanche Photon Diode (APD) in the Geiger-mode is also called Single Photon Avalanche Diode (SPAD).
- The quenching circuit, plays a decisive role in the performance of the single photon detection system.
- This review first introduces the basic content of SPAD. Then, the design of the quenching circuit for the APD needed for different detection requirements is analyzed.



Main passive mixture quenching circuit.

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

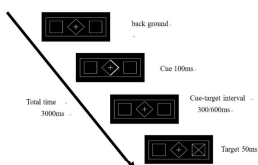
MA1-P(7) 11:00-12:00

**Cognitive Psychological Study on The Occurrence of Microsaccades in Visual Spatial Attention**

Ritsu Go<sup>1</sup>, Jinglong Wu<sup>1,2</sup>, Yang Liu<sup>2</sup>, Yusuke Kuroda<sup>2</sup> and Qiong Wu<sup>2</sup>

<sup>1</sup> Intelligent Robotics Institute, Beijing Institute of Technology  
<sup>2</sup> Graduate School of Interdisciplinary Science and Engineering in Health Systems Okayama University

- In this study, we investigated whether there is a change in the occurrence of microsaccades in spatial attention tasks.
- It was confirmed that the occurrence of microsaccades was changed according to the condition of spatial attention task.
- A significant difference of the main effect was seen by the difference depending on condition (between valid and invalid) after the target stimulus presented.



Experimental time course

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

**Automatic Application of LabVIEW on Electron Beam Analysis System**

Wei Shi<sup>1,2</sup>, Linlin Cao<sup>1,2</sup>, Xianxia Li<sup>1</sup>, Jinyue Liu<sup>3</sup> and Mingguang Huang<sup>1,2</sup>

<sup>1</sup>.Institute of Electronics, Chinese Academy of Sciences  
<sup>2</sup>. University of Chinese Academy of Sciences  
<sup>3</sup>. College of Mechanical Engineering, Hebei University of Technology  
 Beijing, Tianjin, China

- A brand new LabVIEW-based system is established to measure the current density of electron beams.
- LabVIEW VISA is applied to control the probe's position.
- LabVIEW DAQ is used to control the data acquisition.
- Tests were done and satisfactory performance was manifested in test results.



Electron Beam Analyzer

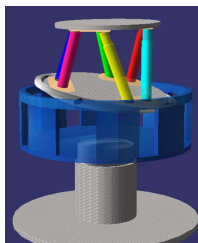
MA1-P(9) 11:00-12:00

**Wave Compensator Design Based on Adaptive FFT Prediction Algorithm and H<sup>∞</sup> Filtering**

MingXi Zhang, Qi Li, XiangDong Meng, YuQing He, HaiTao Luo

State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China

- A wave compensation system was investigated based on adaptive the fast Fourier transform (FFT) prediction algorithm and H<sup>∞</sup> filtering.
- The FFT was adopted to construct an adaptive wave prediction algorithm in order to compensate the waves as synchronously as possible
- The H<sup>∞</sup> filter was used to eliminate the high-frequency wave interference and make the compensation platform move more smoothly.



The Co-simulation System

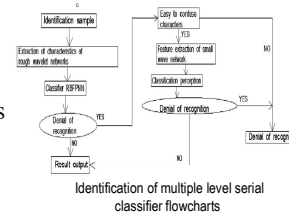
MA1-P(10) 11:00-12:00

**Research on intelligent and digital recognition system and character recognition of electrical instruments**

Wang Xiaoyuan; Wang jianping; Wang hongfei

Hefei University teaching and experimental center, Hefei, Anhui, China

- I. INTRODUCTION
- II. THE EXTRACTION OF THE FIELD PART OF THE AMMETER AND VOLTMETER
- III. RECOGNITION OF NUMBERS
- IV. MULTIPLE LEVEL IDENTIFICATION DESIGN PROCESSES - SERIAL CLASSIFIERS.



Identification of multiple level serial classifier flowcharts

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

**Algorithm of Ship Collision Risk Based on Improved BP Neural Network**

XiaoGong Lin<sup>1</sup>, YuQi Yuan<sup>2</sup>

(1.Department of Automation,Harbin Engineering University, Harbin 150001,China)

- Improved BP neural network
- Calculate ship collision risk
- On the basis of the traditional adaptive learning rate algorithm, an optimized adaptive learning rate method is proposed, and the momentum term is added.



USV

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

**Optimal Design Method of Low Noise Amplifier Circuit**

WU Jie<sup>1, 2</sup>, Chenxiaojuan<sup>1</sup>, ZHANG Xinchao<sup>1</sup>, JIANG Shan<sup>3</sup>, DU Yao<sup>4</sup>

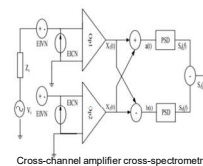
<sup>1</sup>.College of Electrical and Information Engineering, Changchun University of Science and Technology, Changchun 130022, China;

<sup>2</sup>.College of electrical and information engineering, Beihua University, Jilin 132013, China

<sup>3</sup>.Jilin Power supply Company of State Grid, Jilin 132000, China

<sup>4</sup>.School of Information engineering, Northeast Electric Power University, Jilin 132012, China)

- The accuracy of low frequency noise measurement has been concerned because it is an important technique for evaluating the reliability of components. An improved method for measuring low frequency noise is presented in this paper. The influence of the background noise of the amplifier on the measurement results is eliminated by using the characteristics of the two channel amplifier and the amplifier circuit designed by discrete components.



Cross-channel amplifier cross-spectrometry

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

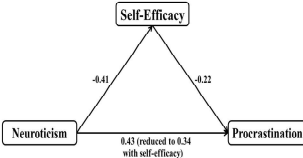
Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

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

### The Mediating Role of Self-Efficacy between Neuroticism and Procrastination among Undergraduates

Wu Wang<sup>1</sup>, Ruiqing Han<sup>2</sup>, Yuluo Luo<sup>3</sup>, Zehua Wu<sup>2</sup>, Yin Jin<sup>2</sup>, Qingqing Li<sup>1</sup>, Bing Li<sup>2\*</sup>  
<sup>1</sup>The Graduate School of Natural Science and Technology, Okayama University, Okayama, Japan  
<sup>2</sup>School of Philosophy and Sociology, Jilin University, Changchun, China  
<sup>3</sup>Juvenile Court, People's Court in District Chengzhong, Xining, China

- Neuroticism directly affected procrastination, and self-efficacy partly mediated the relationship between neuroticism and procrastination.
- Low level of neuroticism might decrease procrastination through possibly fostering self-efficacy.



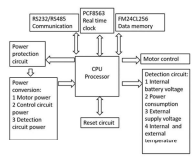
Mediating Analysis Model

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

### Control System of Deep-sea In-situ Test Device

Yang Chen, Ming Chen, Lixin Liu, Hailong Zhang  
 Institute of Deep-sea Science and Engineering, CAS  
 Sanya, China

- A driving control system for the deep-sea in-situ engineering geology test device is designed.
- The system hardware components, embedded program and host computer procedure are introduced respectively.
- High reliability and precision of the driving control system.
- The deep-sea long-term in-situ monitoring technology.
- It has great potential applications.



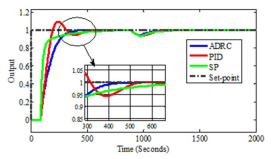
Hardware Diagram

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

### The Temperature Control of Blackbody Radiation Source Based on ADRC

Zhigang Wang, Zerong Yun, Lingling Wang, and Jinghui Wang  
 1. Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, 2. National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, 3. Tianjin University of Technology  
 Tianjin, China  
 National Institute of Metrology, China  
 Beijing, China

- The ADRC control algorithm is applied to the temperature of blackbody radiation source.
- The simulated results show that control performance of the ADRC method is better than traditional PID and Smith predictor.



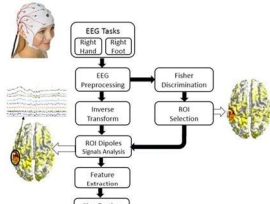
The Step Response Curve with Three Controlled Methods

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

### Classification of Motor Imagery Tasks in Source Domain

Li, Chunting Zhang, Songmin Jia, Yanjun Sun  
 Faculty of Information Technology, Beijing University of Technology, Beijing 100124, China

- ESI is applied to map signals in the scalp into cortex, the feature of MI-EEG is detected in source domain.
- A novel criterion based on the improved Fisher discriminant is applied to select Region of Interest. Results show that few dipoles perform well compare with sensor domain.



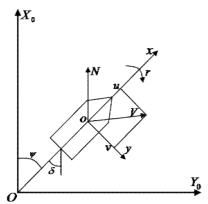
Analysis pipeline describing the proposed source-based approach

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

### Ship Course Active Disturbance Rejection Control

Huixuan Fu, Zhongliang Zhang, Yuchao Wang, Yi Li  
 College of Automation, Harbin Engineering University  
 Harbin, China

- In order to solve the nonlinear ship course control problem with uncertain sea wave disturbance.
- This paper designed a ship course control method of linear active disturbance rejection control (LADRC) based on linear extended state observer (LESO).
- The simulation experiments are compared ship course ADRC with the traditional PID controller under different speed conditions.



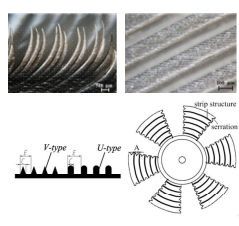
The reference frame of ship motion

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

### Experiment Research on the Efficiency of Bionic Blade of Axial Fan

Kun Chen<sup>1\*</sup>, Qing-ping Liu<sup>2</sup>, Wen-lei Sun<sup>1</sup>  
 1. School of Mechanical, Xinjiang University, Urumqi, China  
 2. The Key Laboratory of Engineering Bionics, Jilin University, Changchun, China

- By imitating the owl feather, a coupling bionic blade has been designed.
- A comparison experiment between the bionic blade and original blade were carried out.
- The influence of the bionic serration and strip structure on the efficiency of fan was studied.
- The bionic blade of axial fan can improve efficiency of blade.



Reconstruction of biological coupling characteristics



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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

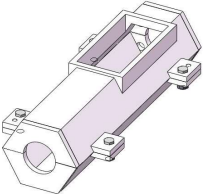
Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

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

### Design and Pouring Process of Packaging Mold for Electromagnetic Paraffin Preventer

Liwen Cao  
School of Mechanical and Electrical Engineering, Heilongjiang University  
Harbin, Heilongjiang Province, China

- Design the package mold.
- Analyze its processing technology.
- Choose the appropriate resin casting materials.
- Analyze the resin pouring process.
- Validate the product performance by prototype production.



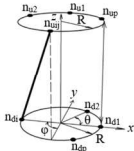
The Packaging Mold

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

### Mathematic Modeling for Configuration of Tensegrity Structure

Vumiliya Angelo, Song Zitong and Luo Ani  
Tensegrity Research Lab., Harbin Engineering University  
Harbin, China

- A set of members in single unit tensegrity define the stability.
- The configuration depends on the members. In fact, the twist angle is the most condition to satisfy the self-equilibrium.



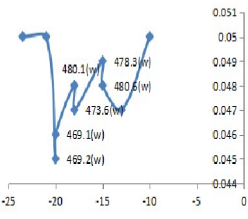
Class 1 single unit view

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

### Application of catastrophe theory in gas load forecasting

ChenHongLi, HuangPeng, LiQiang  
College of Automation, Harbin Engineering University  
Harbin, China

- Catastrophe theory and its application
- Gas load forecasting steps
- Analysis of results



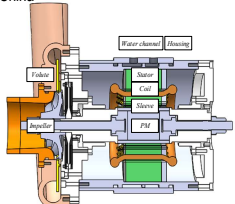
The prediction of gas load forecasting

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

### Design and Cogging Torque Analysis of Permanent Magnet Synchronous Motor for Vehicular Fuel Cell Air Compressor

Hao Lv, Haipeng Geng, Jian Zhou, Tingchen Du, Xiangming Xu and Hao Li  
State Key Laboratory for Strength and Vibration of Mechanical Structures  
Xi'an Jiaotong University  
Xi'an, Shaanxi Province, China

- The parallel magnetizing ratio of radial magnetization makes the air gap flux density waveform more sinusoidal for PMSM,
- Within a certain range, the longer the air gap, the smaller the cogging torque effect.



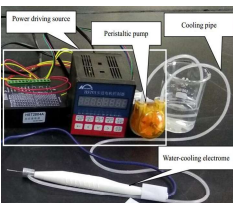
High-speed PMSM with cylindrical PM

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

### A water-cooling eletrome on reducing tissue thermal damage

Minggao Li, Xinggang Jiang\*, Wenshuai Wu and Deyuan Zhang  
School of Mechanical Engineering and Automation, Beihang University  
Beijing, China

- The water-cooling electrome is aimed to minimize tissue thermal damage.
- The coolant pours to the surgical tissue interface from the water-cooling electrome tip and takes away extra tissue heat.
- The experimental results show that the water-cooling electrome reduces the tissue damage at least 100 um compared with the ordinary electrome at the same output power.



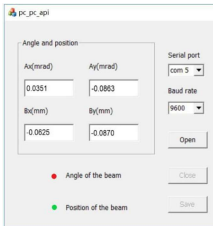
Water-cooling system

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

### Structural Optimization Design of a High-precision Compact Position Sensitive Detector

Ting Wang, Jingshi Shen, Xiaodong Zeng, Changqing Cao\*, Zhejun Feng, Rui Wang, Yutao Liu, Kun Chen  
School of Physics and Optoelectronic Engineering, Xidian University, Xi'an, China

- A new type of PSD structure is optimized designed. The position and angle of the beam can be measured at the same time.
- The experimental results show that the PSD can obtain the resolution of micro-meter and sub micro-rad.
- The precision of the angle of the PSD A is about one order of magnitude higher than that of the PSD chip.



Program interface

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

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

**Research on Low Energy Consumption Attitude of Foot Bionic Robot**

Juncheng Guo, Lei Zhang, Shuangshuang Gao  
Department of Automation and Control, Ocean University of China, Qingdao, China

- Obtain the output torque of each joint of leg through the statics analysis, and establish the energy consumption model of the robot.
- Introduce the performance index of maximum step-length, and establish the multi-objective function based on the energy consumption and the maximum step-length.
- Carry out simulation and prototype experiment to verify the validity of the method.



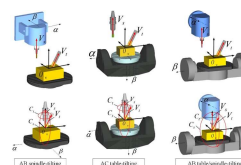
Six-legged Bionic Robot

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

**A convenient method to solve rotation angle in 5-axis machine tool post-processing**

Xinlei Cui, Qiang Liu, Qitong Liu  
School of Mechanical Engineering & Automation, Beihang University  
Beijing, China

- The post-processing algorithm was proposed for the rotation angle of five-axis machine tools.
- A deviation model of the tool axis vector in 5-axis linear interpolation was proposed.
- The post-processing algorithm was implemented by Visual Studio 2013.
- Modeling simulation and experiments were carried out on the "S" type specimen.



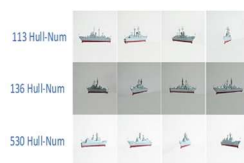
Angle solution of different machine tool types

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

**Ship Model Recognition Based on Convolutional Neural Networks**

Shihong Xing and Shaokang Zhang  
Navy Submarine Academy

- The deep convolutional neural network provides new approaches and methods for ship target recognition.
- This paper proposes an efficient training scheme for convolutional neural networks training on the small capacity of ship data sets.
- The effectiveness of the scheme is verified through experiments, and the accuracy is improved. It can reach 99%.



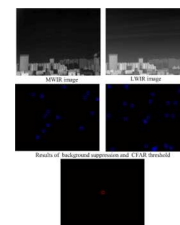
Ship Model Recognition

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

**Infrared Dual-band Point Target Detection Based on Gradient Convolution Template and CFAR Criterion**

Dejiang Wang, and Rang Liu  
Changchun Institute of Optics, Fine Mechanics and Physics  
Changchun, China

- Single-band target detection model under NP criterion is established.
- The probability of detection and probability of false alarm are deduced under dual-band model.
- The TNR is constantly adjusted to obtain the optimal fused probability of detection.
- Gradient convolution template and CFAR Criterion are adopted to suppress background and noise.



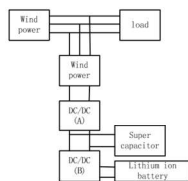
Detection results of complex background

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

**Research Review on Energy Storage Technology in Power Grid**

Xuesong Zhou<sup>1</sup>, Zhihao Fan<sup>1</sup>, Youjie Ma<sup>1</sup>, Zhiqiang Gao<sup>1</sup>, Xudong Zhang<sup>2</sup>, Jingping Zhang<sup>2</sup>  
Key Research Laboratory for Control Theory & Applications in Complicated Systems,  
Tianjin University of Technology, Tianjin, China

- The significance and value of energy storage technology research in Power Grid.
- Various types of storage technology.
- Demands on energy storage technology in Power Grid.
- The research status of energy storage technology in power grid.
- Some existing problems and the future development trend of energy storage technology in power grid.



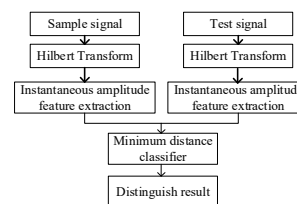
Configuration Diagram of Hybrid Energy Storage System for Wind Power Balancing

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

**Signal recognition method of X-ray pulsar based on instantaneous amplitude feature**

Yu Jiang, Longqi Wang, Xiaoyu Li and Jing Jin  
Department of Control Science and Engineering, Harbin Institute of Technology  
Harbin, Heilongjiang Province, China

- Effectively combines the instantaneous amplitude feature information of pulsars
- Effectively identifies the pulsar signal by designing the minimum distance classifier



The recognition algorithm of X-ray pulsar signal

**MA1-P: Poster Session (Intelligent Mechatronics and Automation)**

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

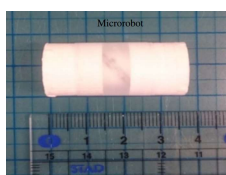
**Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018**

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

**Performance Evaluation of a Magnetically Actuated Microrobot with Screw Jet motion in Vertical Plane**

Qiang Fu<sup>1</sup>, Shuxiang Guo<sup>1,2</sup>, Jian Guo<sup>1</sup>,  
<sup>1</sup>Tianjin Key Laboratory for Control Theory & Application in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology,  
<sup>2</sup>Department of Intelligent Mechanical Systems Engineering, Kagawa University

Magnetically actuated microrobot controlled by magnetic field in biomedical applications. The medical safety, loading abilities and an effective propulsive performance are extremely important and challenging



Microrobot

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

**The Application of Multiple Ant Colony Algorithm to Cooperative Task Allocation in UUVs Swarm**

Wei Zhang, Jianku Zhang, Yanbin Teng and Shilin Wei  
 Department of Automation, Harbin Engineering University, Harbin, China

- Task allocation is a necessary part of the multi-UUV system.
- Multi-UUV task allocation strategy based on multi-ant colony algorithm



Multi-Underwater Unmanned Vehicle

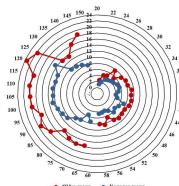
- The ultimate task allocation plan is according to the optimization index

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

**A Behavioral Study on Angle Discrimination and Sorting by Fingertip Touch**

Qiong Wu<sup>1</sup>, Yang Liu<sup>1</sup>, Jinglong Wu<sup>1,2</sup> and Ritsu Go<sup>2</sup>  
<sup>1</sup> Graduate School of Interdisciplinary Science and Engineering in Health Systems Okayama University  
<sup>2</sup> Intelligent Robotics Institute, Beijing Institute of Technology

- Research on tactile cognitive ability is a very important research field for early detection of dementia.
- In this research, we have studied aging effects in young people and the elderly with a simpler and inexpensive device called angle chip rearrangement device.
- Experiments showed that the elderly had greater errors than younger people.
- In addition, it was possible to shorten the experimental time as compared with the conventional apparatus.



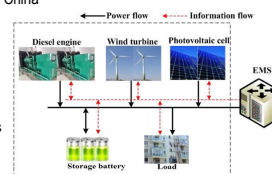
Graph of error score in two groups

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

**Multi-time Scale Energy Management Strategy for Isolated Micro-grid**

Huizhen Zhang, Li Xia, Gang Wang, Yi Wang, You Wu  
 National Key Laboratory of Science and Technology on Vessel Integrated Power System, Naval University of Engineering  
 Wuhan, China

- Due to deviation in the daily prediction, the uses a rolling optimization mode to rectify the deviation of the former to guarantee the effectiveness of the daily prediction.
- The simulation and experimental results show that the proposed strategy can effectively enhance the economy and reliability of the island MG systems.



The framework of IMG system

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

**Research on the Breakage Detection Technology of Fuel Assembly Based on Sip and Data Analysis Technology**

Gu Mingfei, Huang Dagui, Wen Hao and Wang Xuemeng  
 University of Electronic Science and Technology of China  
 Chengdu, China

- Fuel assembly is the core of nuclear reactor.
- If fuel assembly is broken, fission products will escape from the break, which may affect reactor operation and environmental safety.
- The method put forward by this article can feasibly detect and evaluate fuel assembly breakage.



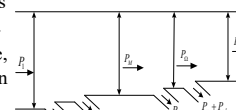
The Sony Aibo Dog

MA1-P(36) 11:00-12:00

**Research Review on the energy-saving technologies for asynchronous motors**

Xuesong Zhou, Bao Yang, Youjie Ma and Zhiqiang Gao  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems., Tianjin University of Technology  
 Tianjin, China

- The study of energy saving of motor is hot issues in shortage of energy today.
- Asynchronous motor in daily life, especially in the industrial production plays a very important role.
- If the energy saving of asynchronous motor is in control and the efficiency of the motor is improved, the lots of electricity quantity for increasingly energy conservation will have great significance for our society.



The power diagram of asynchronous motor.

**MA1-P: Poster Session (Intelligent Mechatronics and Automation)**

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

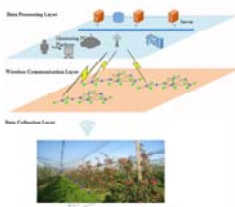
Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

MA1-P(37) 11:00-12:00

**Design and implementation of Apple Orchard Monitoring System based on wireless sensor network**

Xianglian Meng, Wang Cong, Hong Liang and Jin Li\*  
College of Automation, Harbin Engineering University  
Harbin, China

- Aiming at the requirements of apple orchard in China on environmental parameters.
- This paper proposed an apple orchard monitoring system based on wireless sensor network. Based on CC2530 chip, the establishment of wireless sensor network was completed.
- Use IOT, ZigBee wireless transmission and sensor-related technology to accurately obtain environmental parameters.



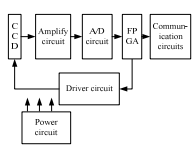
System architecture design diagram

MA1-P(38) 11:00-12:00

**A Sneak Circuit Solution for CCD Aerial Camera's Main Backup System**

Baolin Lv, Shoufeng Tong, and Dejiang Wang  
1. Changchun University of Sciences and Technology,  
2. Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences  
Changchun, China

- This paper presents an airborne camera system. In order to ensure the reliability of the camera, the main backup design is adopted for the whole.
- Considering the sneak circuit of the whole system, we propose a solution to eliminate the potential risk of the system.
- The design idea and the method of sneak circuit analysis are also valuable to design other similar systems.



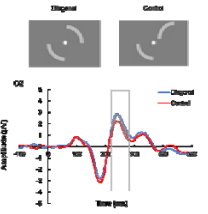
Schematic diagram

MA1-P(39) 11:00-12:00

**The time course of symmetry effect on shape perception: an event-related potential study**

Meng Wang, Qiong Wu, Fengxia Wu, Jiajia Yang, Satoshi Takahashi, Yoshimichi Ejima, Jinglong Wu  
The Graduate School of Natural Science and Technology, Okayama University

- Although symmetry is known to be an important determinant of visual processing and an appreciation of visual symmetry has been studied in several electroencephalography experiments, it remains not well clear the mechanism of visual symmetry processing.
- To investigate this, we measured the processing of symmetrical stimulus (diagonal) and asymmetrical stimulus (control) with two levels of intensity by measured visual evoked potential (VEP).



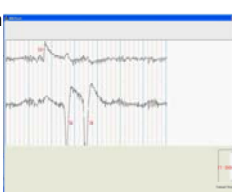
Grand averaged ERPs displayed between -100 and 500 ms and recorded at electrode of O2.

MA1-P(40) 11:00-12:00

**A Novel Human Computer Interface based on Electrooculogram Signal for Smart Assistive Robots**

Lei Sun, Sun'an Wang, Hua Chen and Yangquan Chen  
Xi'an Technological University Xi'an Jiaotong University  
University of California, Merced

- Medical research shows that the resting potential comes from between the cornea and the retina.
- This paper applies an autoregressive spectral entropy detection method to extract the feature.
- use the SVM to classify the five classes.
- For a sequence of characters with n processes, after all state transitions are completed, the final output result is obtained.



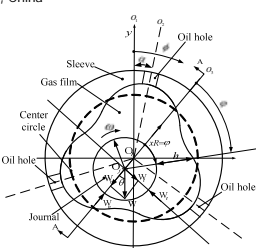
HCI based on EOG

MA1-P(41) 11:00-12:00

**Parameter Study on Dynamic Characteristics of Wave Journal Bearings**

Baisong Yang, Jigang Zhang, Sheng Feng, Jinxin Zhao, Haipeng Geng, Jian Zhou and Lie Yu  
State Key Laboratory for Strength and Vibration of Mechanical Structures, Xi'an Jiaotong University, Shaanxi, China

- The wave amplitude ratio plays an essential role on the wave bearing's stability performance.
- The wave position angle of the wave bearing with a periods of  $360/n_w$  relies to the applied load effects the bearing's stability.
- The wave bearing's dynamic stability is significantly influenced by the wave number.




Scheme of the Wave Bearing

MA1-P(42) 11:00-12:00

**Omnidirectional Mobile Robot Active Disturbance Rejection Control**

Huixuan Fu, Yuan Li, Yuchao Wang, Zhongliang Zhang  
College of Automation, Harbin Engineering University  
Harbin, China

- An attitude and position control system of omnidirectional mobile robot based on linear active disturbance rejection controller (LADRC) is designed.
- The "total disturbance" is estimated and compensated in real time by constructing an extended state observer (ESO).



Omnidirectional mobile robot

**MA1-P: Poster Session (Intelligent Mechatronics and Automation)**

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

**Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018**

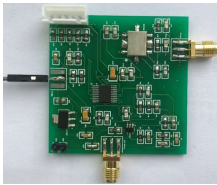
MA1-P(43) 11:00-12:00

### 2GHz PLL Frequency Synthesizer

Guohong Li, Yaozhong Wang

Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems, Tianjin University of Technology  
Tianjin, China

- This paper mainly introduces the design and testing for 2GHz PLL frequency synthesizer.
- The core component is LMX2430.
- The Loop Filter contains operational amplifier, it is an active filter.
- The design contains power module.




PLL Frequency Synthesizer

MA1-P(44) 11:00-12:00

### Research on Location Method of Pipe Climbing Robot based on Gyroscope

Lei Shao, Shuai Yang, Hongli Liu and Ji Li  
Tianjin University of Technology Tianjin Key Laboratory of Complex System Control Theory and Applications  
Tianjin University of Technology, Tianjin, China

- This paper introduce a new method to location the robot working on sea water desalination pipe.
- Most of reading errors of gyroscope has eliminated by kalman filter.
- Only use gyroscope and motor encoder to get the position and posture of the robot



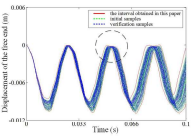
Robot Location System

MA1-P(45) 11:00-12:00

### Interval Analysis of Timoshenko Beam with Parameter Uncertainties Based on the Maximum Entropy Principle

Mingming Wang, Linfang Qian, Guangsong Chen and Wenyu Zhai  
School of Mechanical Engineering, Nanjing University of Science and Technology  
Nanjing, China

- The dynamic model of the beam is established by spectral element method and Timoshenko beam theory
- The parameters uncertainties are considered
- The intervals of outputs can be estimated through maximum entropy principle and first-order Taylor expansion
- The proposed method appears to be effective and can greatly decrease the computational expense



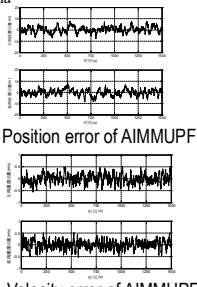
The analyzed interval including the real interval

MA1-P(46) 11:00-12:00

### Adaptive UPF Based Interacting Multiple Model Algorithm for Integrated Navigation

Yi Gao, Jinzhu Gao, Yanhui Mao, and Ya Gao  
School of Electronic Engineering, Xi'an Shiyou University  
Xi'an Shaanxi, China

- To resolve issues of particle filtering, this paper introduces an adaptive Unscented particle filter (UPF) based interacting multiple model algorithm.
- The main seven steps of AIMMUPF algorithm.
- AIMMUPF method for GPS/DR integrated navigation system simulation experiment and analysis.
- Conclusion.



Position error of AIMMUPF

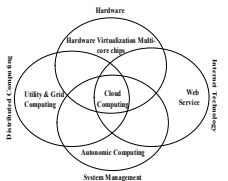
Velocity error of AIMMUPF

MA1-P(47) 11:00-12:00

### Summary of Cloud Computing Technology in Smart Grid

Youjie Ma, Faqing Zhao, Xuesong Zhou and Zhiqiang Gao  
Key Research Laboratory for Control Theory & Applications in Complicated Systems, Tianjin University of Technology  
Tianjin, China

- The cloud can be considered as a virtual device that can store energy as well as data in association with the required peripheral devices.
- Proposed cloud computing platform of the smart grid status data monitoring.
- Only authorized smart grid components can access different cloud services for providing adequate security to the end-users.



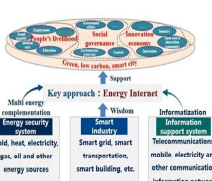
Cloud Computing Technology

MA1-P(48) 11:00-12:00

### Overview on Energy Router toward Energy Internet

Youjie Ma, Hongjin Liu, Xuesong Zhou and Zhiqiang Gao  
Key Research Laboratory for Control Theory & Applications in Complicated Systems  
Tianjin University of Technology  
Tianjin, China

- Introducing the present situation of energy and importance of building energy internet.
- Discussing classifications and applications of energy routers.
- Presenting several key technologies of energy routers.
- Analyzing design requirements of energy router based on the demand of energy internet.



Structure of Energy Internet

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

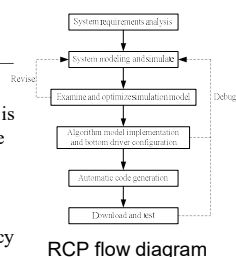
MA1-P(49) 11:00-12:00

**Development of Permanent Magnet Synchronous Motor RCP Based on Hardware-in-the-loop Simulation**

Gang Zhao<sup>1</sup>, Shizhong Zhang<sup>2</sup>

Tianjin University of Technology 391, Binshui Xidao, Xiqing District, Tianjin, 300384, China  
Tianjin, China

- This paper carries out a study on a high efficiency PMSM development method—rapid control prototype (RCP).
- Hardware in the loop simulation model is built by using the hardware and software environment of the system.
- The automatic code generation is downloaded to the hardware-in-the-loop simulation platform to verify the accuracy of the theoretical calculation.



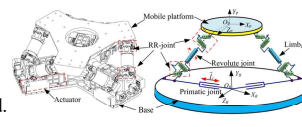
RCP flow diagram

MA1-P(50) 11:00-12:00

**Forward Kinematics Analysis of 6-PORO Secondary Mirror Alignment Mechanisms**

Chunyang Han, Hasiaoqier Han, Yang Yu, Mingchao Zhu, Ang Li and Zhenbang Xu  
Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China

- The numerical solution of the forward kinematics is presented.
- The simulation results are carried out to verify the accuracy and efficiency by the Newton-Raphson method.
- The prototype has been developed and the proposed procedure is verified by the experimental test.



The 3D model of secondary mirror alignment mechanism

MA1-P(51) 11:00-12:00

**Double Axes Equal-Distance Projection**

Cai Chengtao, Zhou Yueyuan, Li Yi  
Harbin Engineering University  
Harbin, China

- 1.66 times faster than Gauss-Kruger projection.
- 9.5% higher accuracy than classic Gauss-Kruger projection.
- No distortion on two vertical axes in theory.
- Advantages of mobile robots and unmanned vehicles, especially when they work on a crossroad area.



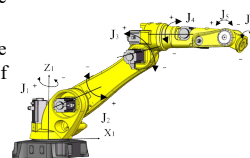
Applied to Crossroad

MA1-P(52) 11:00-12:00

**Static Simulation and Structure Optimization of Key Parts of Joint Welding Robots**

Xinle Li<sup>1</sup>, Haiyan Shao<sup>1\*</sup>, Guoping Li<sup>1</sup>, Weiping Liu<sup>2</sup> and Chuan Liu<sup>2</sup>  
1. School of Mechanical Engineering, University of Jinan, Jinan, Shandong Province, China  
2. Shandong Times New Era Robot Co., Ltd. Jinan, Shandong Province, China

- Introduce the overall structure of the welding robot.
- According to the structure of the robot, the main component load of the welding robot is calculated.
- CAE was used for static analysis to verify the strength and stiffness of the robot structure.
- Optimize the structure of the arm to further verify the reliability of the structure.



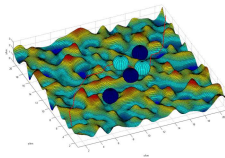
Structural model of welding robot

MA1-P(53) 11:00-12:00

**Study on Submarine Path Planning Based on Modified Ant Colony Optimization Algorithm**

Yuhao Shan  
Naval Submarine Academy  
Qingdao, China

- A new threat cost calculation method is proposed, and the pheromone update coalescing differential evolution algorithm is aimed to improve the performance of global search.
- With factors such as submarine sailing safety, concealment and endurance, simulation of submarine three-dimensional path planning under different tactical needs completed.



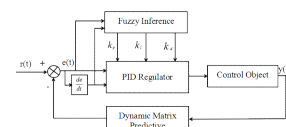
Concealed and Safe Path

MA1-P(54) 11:00-12:00

**Design of LT-MED Seawater Desalination Temperature Control System Based on Dynamic Matrix Predictive Fuzzy PID Control Algorithm**

Hongli Liu, Lulu Song, Lei Shao, Zhenhai Tan and Xiaoqi Chen  
Tianjin University of Technology Tianjin Key Laboratory of Complex System Control Theory and Applications, Tianjin University of Technology  
Tianjin, China

- Low temperature multi-effect seawater desalination control system.
- An effective combination of fuzzy PID and dynamic matrix control algorithm.
- Temperature control system simulation



Simple control block diagram

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

MA1-P(55) 11:00-12:00

### Prediction of User Behavior in Smart Home Based on Improved ARIMA Model

Hongjun Wang, Kaiying Wang, Hui Zhao and Youjun Yue  
Tianjin Key laboratory for Control Theory and Applications in Complicated System, Tianjin University of Technology Tianjin, China

- A predictive model for the turn-on time is created especially to predict when the water heater will be turned on.
- The prediction equation is established with the sample data and the time when the user turns on the water heater in the next week is predicted.
- The improved ARIMA model has the better performance in prediction, because the changes of the prediction process the measured process are basically consistent.

The flowchart shows the process from 'Historical behavior data' through 'Data screening' to 'How to identify behavior patterns', then to 'Recent user behavior', 'Bichao total prediction', and 'Establishing prediction model'. The graph plots 'Minutes' (0-60) against 'The Sample Forecast Time/Day' (1-7), comparing 'Actual Value' (blue squares), 'Older improvement' (green circles), and 'After improvement' (red triangles). The 'After improvement' series shows a much closer fit to the 'Actual Value'.

MA1-P(56) 11:00-12:00

### Research on Marine Autopilot and its Performance Test

Daidai Chen, Wanyou Li, Jianhua Cheng, Feng Xu and Liu Yan  
College of Power and Energy Engineering, Harbin Engineering University Harbin, China

- we present an effective hydraulic steering system upgrade solution.
- Rudder and heading angle sensors are installed to measure steering and ship turning parameters.
- Double close-loop control.
- The connect section of wheel and hydraulic steering gear mounts with a automatic wheel drive.
- Marine autopilot has an excellent steering and heading maintain performance.

The diagram shows a control loop starting with 'Heading sensor' and 'Rudder angle sensor' feeding into a 'Control unit'. The control unit outputs to a 'Wheel Drive', which is connected to a 'Wheel'. The wheel is linked to a 'Hydraulic steering gear', then a 'Hydraulic rudder driver', a 'Rudder', and finally the 'Ship'. The ship's 'Heading' is fed back to the 'Heading sensor'.

MA1-P(57) 11:00-12:00

### The Design of a Positioning Manipulator for Minimally Invasive Vascular Interventional Surgery Robot System

Hongbo Wang, Xusheng Wang, Bo Guan, Jingyuan Chang, Haoyang Yu and Hesuo Tian  
Parallel Robot and Mechatronic System Laboratory of Hebei Province, Yanshan University Qinhuangdao, China

- Based on the requirements of the system and the self-balancing conditions of the passive positioning manipulator, a configuration of the manipulator is proposed, and the degree of freedom and working space are verified to meet the requirements of the working conditions
- According to the characteristics of simultaneously locking and release of the joints when the manipulator works, a locking scheme of multi-joint is proposed, and the design of the mechanical structure is carried out in detail.

The 3D model shows a multi-joint robotic arm with components labeled: Tail wheel assembly, Big arm, Middle pulley assembly, Arm, Front wheel assembly, and Small connecting arm.

MA1-P(58) 11:00-12:00

### Estimation and analysis of multi-point soil moisture based on exponential filtering

Lei Shao, Zhaoze Wang, Xiaoqi Chen, Ji Li, Hongli Liu  
Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems School of Electrical and Electronic Engineering

- A virtual collection point of soil moisture is introduced to make up for the lack of actual soil collection points.
- The exponential filtering method is used to estimate the collection point of virtual soil moisture.
- The accuracy of the exponential filtering method decreases with the increase of soil depth.

The graph plots 'Soil moisture (%)' (0-10) against 'Soil depth (cm)' (3.0-6.3). It compares 'Virtual soil moisture' (dashed lines) and 'Actual soil moisture' (solid lines) at various depths. The virtual moisture values are smoother than the actual values.

MA1-P(59) 11:00-12:00

### A Four-channel Time Domain Passivity Approach for Bilateral Teleoperator

Shan Liu, Xiaoqian, Wei, Wenfeng Zheng, and Bo Yang  
School of Automation Engineering, University of Electronic Science and Technology of China Chengdu, Sichuan, China

- A four-channel time domain passivity approach (TDPA) is proposed for stable bilateral control of time-delay teleoperation systems.
- The passivity of the time delay power networks, the passivity observer and the passivity controller are proved, and the master controller and the slave controller are designed.

The diagram shows an 'Operator' (Master) connected to a 'Slave' through a 'Communication' channel. The system includes 'TDPN' (Time Domain Passivity Network) blocks and various control elements like  $F_h$ ,  $C_h$ ,  $Z_h$ ,  $F_s$ ,  $C_s$ ,  $Z_s$ , and  $F_e$ .

MA1-P(60) 11:00-12:00

### Application of the Hybrid Algorithm in Path Planning of Spherical Mobile Robot

Jian Guo, Chunying Li, Shuxiang Guo, Xujiie Yang  
Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology Tianjin, China  
Intelligent Mechanical Systems Engineering Department Faculty of Engineering, Kagawa University Kagawa, Japan

- The proposed hybrid algorithm is compared with ACO and GA, and the results of comparison and dynamic simulation are analyzed.
- Ultrasonic sensors are used to collect environmental information.
- The hybrid algorithm is applied to the spherical mobile robot and the experimental results are analyzed.

The grid shows the path planning results for three algorithms: ACO (red), GA (blue), and Hybrid Algorithm (green). The Hybrid Algorithm path is the most efficient, avoiding obstacles and reaching the goal.

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

MA1-P(61) 11:00-12:00

### Detection of Weld Defects Based on Incremental Two-Dimensional Principal Component Analysis

Yaohua Shen, Weimin Ge and Xiaofeng Wang  
School of Mechanical Engineering, Tianjin University of Technology  
Tianjin, China

- A recognition method based on the I2DPCA and the KNN is proposed for the detection of the weld defects.
- The system includes three parts: the preprocessing, feature extraction and recognition.
- The recognition rate based on the I2DPCA reaches 94% , which meets the requirements of the real-time detection of the weld defects.

A Block Diagram of The System

MA1-P(62) 11:00-12:00

### Application of Dynamic Vibration Absorber in Torsional Vibration Optimization of Transmission System

Hui Zhi, Sizhong Chen, Lin Yang  
School of Mechanical Engineering  
Beijing Institute of Technology

- Torsional vibration can give rise to a variety of complex vibration and noise problems.
- A dynamic vibration absorber is added to the drive system model to weaken the torsional vibration at the target frequency.
- The dynamic vibration absorber can effectively reduce the torsional vibration.

Torsional Vibration Equivalent Model of Transmission System With an Dynamic Vibration Absorber

MA1-P(63) 11:00-12:00

### Network-based analysis approach to prioritize GWAS of CSF in the ADNI cohort

Xianglian Meng, Wang Cong, Jin Li , Hong Liang \*  
College of Automation, Harbin Engineering University  
Harbin, China

- The cerebrospinal fluid (CSF) levels of total tau (t-tau) were potential early diagnostic markers for probable Alzheimer's disease (AD).
- We analyzed CSF t-tau from the AD Neuroimaging Initiative (ADNI) 843 (199 CN, 85 SMC, 239 EMCI, 207 LMCI, 113 AD).
- We constructed AD-network (containing PRKCB, ADCY8, RASGRP3, MYLK, PA2G4, CALM1 6 genes) by HotNet2

The flow of network analyses

MA1-P(64) 11:00-12:00

### Development of operating parameters Acquisition System on Marine Diesel Engine

Zhang Defu ,Liu Yuzheng and Gao Jinlong  
Maritime College Tianjin University of Technology  
Tianjin 300384

- In this paper, the operation parameter acquisition and analysis system was explored for marine diesel engine, model 4135. Combined hardware filtering method with program smoothing method improve the quality of data. The software is programmed with labview language.
- The cylinder pressure curve and heat release curve adapting to the change of crank angle are displayed. At the same time, the coordinate of the operating parameter can be showed on the curves.

comparison result

MA1-P(65) 11:00-12:00

### An optical system angle measurement accuracy detection method in lattice scanning form

Wenbo Jing, Xun Cui , Xuefeng Gao, Siyu Qian.  
School of Opto-electronics Engineering, Changchun University of Science and Technology

- Lattice scanning form is used to detect the angle accuracy of the optical system.
- Optical system theory measurement model is used to obtain angle measurement accuracy detection method.
- Variational Retinex enhances the image contrast ,and OTSU threshold segments the image , and projection algorithm and sub-pixel algorithm locates the cross-wire center.
- the measured angular accuracy of the optical system is improved by 0.015mrad.

Optical angle measurement accuracy detection system model

MA1-P(66) 11:00-12:00

### An Online Virtual Gyroscope Technique Using Convolutional Neural Network

Cong Liu,Huajian Li,Xiaojing Du,Zhaoyi Chen,Yang Liu and Junliang Yan  
Aircraft Synthesis Design Group, School of Aerospace Engineering, Beijing Institute of Technology, Beijing, China

- Use the information contained in the accelerometer calculating the angular velocity
- Establish the online training convolutional neural network model
- Verify the feasibility of the proposed virtual algorithm by mathematical simulation

Structure of virtual gyroscope A



**MA1-P: Poster Session (Intelligent Mechatronics and Automation)**

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

**Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018**

MA1-P(67) 11:00-12:00

**Design of Three-ring Nesting Cascade PID Controller of Full-auto Two-wheel Balance Vehicle**

Yi Kang, Jing She, Wenxin Xu, Qianqian Li, Hongyan Jin  
Department of Control Science and Engineering, Harbin Engineering University  
Harbin, China

- It's a full-auto two-wheel balance vehicle.
- Use a cascade PID controller.
- Suitable for industrial mass production.
- With high robustness.



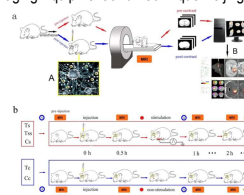
The Balance Vehicle

MA1-P(68) 11:00-12:00

**Transportation in the Brain Extracellular Space of the Rat Brain Can Be Regulated by Neuronal Activity**

Aibo wang, Yuanyuan Li, Guomei Zhao, Rui Wang, Yixing Han, Yinghui Liu, Jiabin Lu, Hongbin Han, Dehua Cui  
The Third Hospital of Peking University  
The Key Laboratory of Magnetic Resonance Imaging Equipment and Technique Beijing

- Using tracer-based method, water molecules in the interstitial fluid (ISF) could be specifically visualized by magnetic resonance imaging (MRI).
- With tracer based MRI we found that the substances transportation in the ECS can be regulated by a selective external stimulation.



Tracer Based MRI Detecting Substance transport in Brain ECS

MA1-P(69) 11:00-12:00

**Research on Aerial Image Splicing Technology of UAV**

Liuyang Kong, Hong Yu  
1.North China Electric Power University, Baoding, 10079, China  
2. Electrical Research Institute of Yunnan Electric Power Research Institute Co, Ltd, Kunming, 650051, China

- Using UAV to obtain transmission line visible light image;
- Perform the necessary image processing;
- Image evenness processing based on gray histogram
- Experiments and analysis



Image stitching

MA1-P(70) 11:00-12:00

**Study on the Calculation Method of Ice Thickness Calculation and Wire Extraction based on Infrared Image**

Liuyang Kong<sup>1</sup>, Liuyang Kong<sup>2</sup>  
1. North China Electric Power University Baoding, China  
2. Electrical Research Institute of Yunnan Electric Power Research Institute Co, Ltd, Kunming, China

- Get Icing Wire Infrared Image;
- Ice coating wire edge detection;
- Icing wire extraction;
- Experiments and analysis;



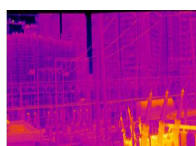
Ice Covered Wire

MA1-P(71) 11:00-12:00

**An optimization of video sequence stitching method**

Hong Yu<sup>1</sup>, Liuyang Kong<sup>2</sup>  
1. Electrical Power Research Institute of Yunnan Power Grid Co, Ltd, Kunming, China  
2. North China Electric Power University, Baoding, China

- Video streams are extracted into video frames;
- ORB detect the feature points;
- Match feature points;
- Uniform coordinate;
- Image fusion;
- Video frames are synthesized into video streams



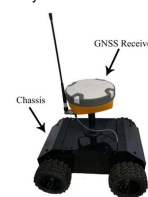
The Result Image

MA1-P(72) 11:00-12:00

**Autonomous Mobile Robot Based on Differential Global Positioning System**

Hong Yu, Liuyang Kong  
1. Electrical Research Institute of Yunnan Electric Power Research Institute Co, Ltd.  
2. North China Electric Power University

- Introduce the overall structure of the robot and the schematic of the adapter circuit board;
- A new algorithm are mainly introduced which is to confirm the position of the mobile robot with single high precision GPS and without compass.
- Give some relevant experimental data of the robot



The Robot Structure

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

Session Chairs: Jian Guo, Tianjin University of Technology

Liwei Shi, Beijing Institute of Technology

Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018

MA1-P(73) 11:00-12:00

### Research on Des skew Algorithm of Scanned Image

Yonggang Zhang<sup>1</sup>, Jianming Zhong<sup>1</sup>, Hong Yu<sup>2</sup>  
 1.Yunnan electric power technology Co.,LTD  
 2.Electrical Research Institute of Yunnan Electric Power Research Institute (Group) Co.,Ltd.

- Presents a Hough transform algorithm based on automatic scanning image correction and cropping;
- Determine whether the scanned image is a text or non-text image, the image preprocessing based on different types of scanned images of the image binarization;
- Compared with the traditional algorithm.

Specific flow of the algorithm

MA1-P(74) 11:00-12:00

### Using Fuzzy Neural Network Sliding Mode Control for Human-Exoskeleton Interaction Forces Minimization

Babak Esmaeili, Jalil Beyramzad, Mirkamal Seyyedrasuli  
 Mohammad-Reza Sayyed Noorani, Ahmad Ghanbari  
 School of Engineering-Emerging Technologies, Mechatronics Engineering Department, University of Tabriz, Tabriz, East Azerbaijan Province, Iran

- Exoskeleton Wearable Robot
- Sliding Mode Control
- Fuzzy Neural Network Control
- Uncertainty compensation

3-DOF swing leg model

MA1-P(75) 11:00-12:00

### A Digitized Visible Light Intensity Transducer Combined With Organic Dye-Sensitized Battery Coated on Outdoor Glass

Cheng-Ta Chiang and Liang-Yu Chien  
 Department of Electrical Engineering, National Chia Yi University  
 Chia Yi, Taiwan

- The proposed chip is simple and low-cost, furthermore, it can monitor the visible light intensity without influencing by real environmental influence.
- Reduce the non-linear effect by the proposed calibration technique.
- Being a visible light detector, it can measure the intensity of light easily in real time.

Block diagram of the proposed chip

MA1-P(76) 11:00-12:00

### A CMOS Citric Acid Concentration to Duty Cycle Converter with Adjustment Circuits for Detecting Citric Acid Concentration Applications

Cheng-Ta Chiang, Chin-Hu Huang, and Hsuan-Hao Huang  
 Department of Electrical Engineering, National Chia Yi University  
 Chia Yi, Taiwan

- The proposed chip is simple and low-cost, furthermore, it can monitor the citric acid concentration without influencing by real environmental influence.
- Widely used in other sensors with largest sensitivity effect by the proposed adjustment technique.
- Being a citric acid concentration detector, it can measure the citric acid concentration easily in real time.

Block diagram of the proposed chip

MA1-P(77) 11:00-12:00

### An Ergonomic Master Haptic Interface for the Robot-assisted Endovascular Catheterization System

Yu Song<sup>1</sup>, Shuxiang Guo<sup>1,2</sup>, Linshui Zhang<sup>1</sup>  
 1Kagawa University, 2Beijing Institute of Technology  
 s15d641@stu.kagawa-u.ac.jp, guo@eng.kagawa-u.ac.jp, s16d502@stu.kagawa-u.ac.jp

- The uniqueness of the proposed master haptic interface is that the operators can apply the natural motions (push, pull or twist) on the input catheter and perceive the haptic feedback through the input catheter during the manipulation.
- The VCSEL (vertical-cavity surface-emitting laser) was used to measure the linear and rotational displacement of input catheter.
- The radial motion of the input catheter is detected by the hollow encoder.

The master haptic interface

MA1-P(78) 11:00-12:00

### Voltage Stability Analysis of Power System Based on Bifurcation Theory

Youjie Ma<sup>1</sup>, Shaofeng Lv<sup>1</sup>, Xuesong Zhou<sup>1</sup> and Zhiqiang Gao<sup>1</sup>  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems, Tianjin University of Technology, Tianjin, China

- Mathematical description of bifurcation theory.
- Static Bifurcation Analysis of Voltage Stability.
- Dynamic Bifurcation Analysis of Voltage Stability.
- Conclusion and the issues for further research.

Saddle-node Bifurcation

**MA1-P: Poster Session (Intelligent Mechatronics and Automation)**

Session Chairs: Jian Guo, Tianjin University of Technology


Liwei Shi, Beijing Institute of Technology

**Yitian Convention Center, 11:00-12:00, Monday, 6 August 2018**

MA1-P(79) 11:00-12:00

**A Method for Locating Reading Area of Digital Instrument Based on Color Characteristics**  
 Tao Wang, Lei Shao, Xiaoqi Chen, Hongli Liu and Zhenhai Tan  
 Tianjin University of Technology Tianjin Key Laboratory of Complex System Control Theory and Applications., Tianjin University of Technology  
 Tianjin, China

- The goal of this work is to solve the positioning problems of the digital meter reading area under complicated background.
- Using a special grayscale empirical algorithm to locate the LCD screen by analyzing the color characteristics of the LCD screen.

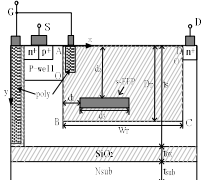


Binarization Results

MA1-P(80) 11:00-12:00

**A novel dual-gate SOI LDMOS with a source floating field plate**  
 Hongli Dai Hongdong Zhao Luoxin Wang Yanmei Shi Mingji Li and Yuhai Li  
 Hebei University of Technology; Tianjin University of Technology,  
 Tianjin, China

- A s-FFP SOI LDMOS is proposed in this paper.
- It modulates the distribution of the electric field in the drift region, which increases the BV.
- At the same time, the  $N_d$  is increased because of the assistant depletion effect of s-FFP and the  $R_{on,sp}$  is therefore obtained.




Structure schematic of s-FFP SOI LDMOS


MA1-P(81) 11:00-12:00

**Summary of Medical Robot Technology Development**  
 Xu Zhang<sup>1</sup>, Xu Ma<sup>2</sup>, Jinpeng Zhou<sup>3</sup>, and Qi Zhou<sup>4</sup>  
 Tianjin Key Laboratory of High Speed Cutting & Precision Maching, the School of Mechanical Engineering, Tianjin University of Technology and Education  
 Tianjin, China

- Medical robots have developed rapidly in the past years.
- Medical robot types : neurosurgery robots, orthopedic robots, endoscopic surgery robots, instrutive robots, rehabilitation -assisted robots and capsule robots
- Key technologies : Medical 3D Image Modeling, Virtual Surgery Simulation, Unified open-ource surgical systems and Remote surgery in complex environments



Da Vinci System

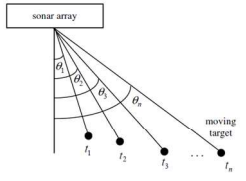


Sensei Xi system

MA1-P(82) 11:00-12:00

**Azimuth Tracking for Underwater Moving Target Based on MUSIC and Function Approximation**  
 Hongmei Zhang, Xiwei Sun and Mingjie Chen  
 College of Automation, Harbin Engineering University, Harbin, China

- For underwater moving targets tracking, Newton interpolation and polynomial fitting approximation algorithm are combined with MUSIC respectively, two azimuth tracking algorithms are designed.
- Simulation results show that the tracking method that based on polynomial fitting approximation is more effective than that based on Newton interpolation.



Moving target tracking diagram

*IEEE ICMA 2018 Conference Digest*  
**MP1-1: Mechanism Design of Robots**

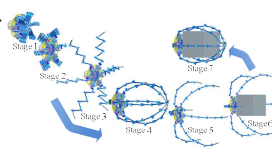
Session Chairs: Toshio Fukuda, Beijing Institute of Technology  
 Tohid Alizadeh, Nazarbayev University  
**Conference Room 1, 13:30-15:00, Monday, 6 August 2018**

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

**A Deployable End-effector with Caging-Based Grasp Capability for Capturing Free-Floating Objects**

XueAi Li, Yuanfei Zhang, Kui Sun and Hong Liu  
 State Key Laboratory of Robotics and System, Harbin Institute of Technology  
 Harbin, China

- A deployable end-effector captures objects by means of caging without precise positioning using a complex feedback control.
- Three mechatronic subsystems for capture, transmission and actuation are highly integrated with only 1 actuator.
- An optimal design for a larger envelope with weight reduction of the grippers is carried out.



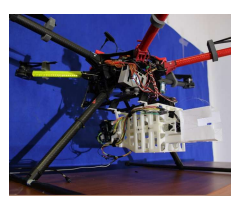
Capture Scenario

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

**A Net-Launching Mechanism for UAV to Capture Aerial Moving Target**

Xin Meng, Xilun Ding and Pin Guo  
 Robotics Institute, School of Mechanical Engineering and Automation, Beihang University  
 Beijing, China

- A four-bullets-traction net can be launched using four coil springs, which can be compressed and released by two cam-follower mechanism.
- Kinematic models are presented, and the mechanism design are optimized according to simulation results.
- Repeated ground experiments demonstrate the capability of the 850 g prototype to capture a target 3 m away accurately and reliably.



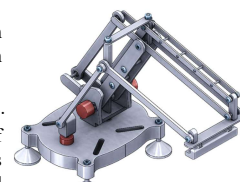
The Net-Launching Mechanism

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

**New 3D Translational Interconnected Manipulator for Industrial Applications**

Ahmed Sameh, Mohamed Fanni and Abdelfatah M. Mohamed  
 Mechatronics and Robotics Eng. Dept., Egypt-Japan University of Science and Technology, Alexandria, Egypt

- An interconnected manipulator which can carry out 3 translational motions in the 3D space with constant orientation.
- It Uses solely rotary joints and actuators.
- It possess the combined advantages of serial and parallel manipulators such as light weight, high speed, rigidity and accuracy as well as large workspace to size ratio.



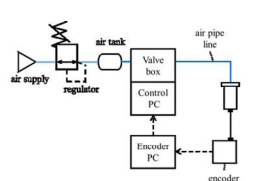
The proposed Manipulator

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

**Robotic Forceps Driven by Extension Type Pneumatic Soft Actuator**

Osamu Azami, Takahiro Kanno, Tetsuro Miyazaki, Kenji Kawashima  
 Department of Biomaterial and Bioengineering,  
 Tokyo Medical and Dental University  
 Tokyo, Japan

- We developed a robotic forceps driven by pneumatic soft actuators.
- The actuator made of silicone rubber and metal spring.
- The robotic forceps has not any sensors.
- The actuators are autoclavable. Therefore, the forceps is sterilizable.



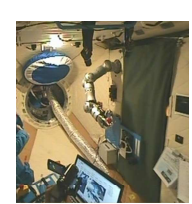
Experimental apparatus for dynamic characteristics measurement

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

**Research on the operation of the capture task in microgravity environment**

Chunguang Fan, Yuanfei Zhang Zongwu Xie, Zhiqi Li, Yiwei Liu, Chongyang Li and Hong Liu  
 State Key Laboratory of Robotics and System, Harbin Institute of Technology, China

- Introduction.
- System overview.
- Design of sliding mode controller.
- Experiment and conclusion.




The operation of the capture task

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

**6-PSS Precision Positioning Stewart Platform for the Space Telescope Adjustment Mechanism**

Xiaotao Cao, Weiguo Zhao, Haibo Zhao, Han Wang, Weifan Yang and Bin Zhang  
 Changchun Institute of Optics, Fine Mechanics and Physics Chinese Academy of Sciences,  
 Changchun, China

- Mechanical design and kinematics model of 6-PSS Stewart Platform.
- Design and performance of control system of 6-PSS Stewart Platform.
- Calibration of kinematic parameters.
- System performance test.



6-PSS Stewart Platform

**MP1-2: Medical Robots for Minimal Invasive Surgery I**

Session Chairs: Kosuge Kazuhiro, Tohoku University

Yong Yu, Kagoshima University

**Conference Room 2, 13:30-15:00, Monday, 6 August 2018**

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

**Pattern Recognition of Continuous Elbow Joint Movements Using Bispectrum-based sEMG**

Dongdong Bu<sup>1</sup>, Shuxiang Guo<sup>1,2\*</sup>, Baofeng Gao<sup>1</sup>, Hongdao Ma<sup>1</sup>, Hao Xu<sup>1</sup>, and Chao Weir<sup>1</sup>  
 1 Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology, No.5, Zhongguancun South Street, Haidian District, Beijing 100081, China  
 2 Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa 760-8521, Japan

- In this paper, we concentrated on the recognition of continuous elbow flexion and extension motion on sagittal plane with one channel surface EMG from the biceps muscle.
- The feature space ( $Bis\&T$ ) combined bispectrum integration and time-domain feature of surface electromyographic (sEMG) was constructed.
- A three-layer Artificial Neural Network to map the processed sEMG to human motion and the performance of feature space was verified by the output of Artificial Neural Network.

Flow block diagram of the whole bilateral rehabilitation system: sEMG sensor (Muscle sensor for acquiring the sEMG signal) outputs raw data, which goes through pre-processing and feature extraction. The feature extraction feeds into a pattern classifier, which is trained using a motion system. The pattern classifier outputs rehabilitation robot commands.

Muscle sensor for acquiring the sEMG signal

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

**Automated Hospital Ward Management System Interacting with Mobile Robot Platform WDBOT**

D.M.H.T Dasanayake, P.S Gunasekara, H.D Wickramasinghe, Shehan Fernando  
 Department Mechanical Engineering, General Sir John Kotelawala Defence University  
 Ratmalana, Sri Lanka  
 A.L. Kulasekera  
 Department Mechanical Engineering, University of Moratuwa  
 Moratuwa, Sri Lanka

- Problems occurred presently due to demanding work load in hospital wards.
- Implementation of ward management system interacting with WDBOT according to the health regulations.
- Efficiency and accuracy can be increased.

WDBOT

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

**Heading Attitude Drifts Controlled by the Angular Accelerations Instead of Using Magnetometers**

Tianqi Wang  
 Department of Electrical and Computer Engineering, Miami University, USA

- Without using magnetometers.
- The correlations of the accelerations of the gyroscope to the Euler angles to control the gyroscope bias.
- Useful to control the heading drift by the feedback of the angular accelerations.
- Expectable that MEMS IMU could find more applications in the future.

Accelerated velocities of the Euler angles in zero-drift

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

**A Transient FEA-based Methodology for Designing Soft Surgical Manipulators**

Mohamed Elkeran and Mohamed Fanni  
 Department of Mechatronics and Robotics Engineering, Egypt-Japan University of Science and Technology, Egypt

- Soft robots offer safety, compliance, and maneuverability, which make them promising candidates for surgical tasks.
- Traditionally, new developments in soft robotics have to come first through many real-world experiments.
- This work presents a general approach for designing soft robots based on transient FEA without the need to build them in advance.
- Experimental results show good agreement against FEA simulations.

Soft Robot Actuation vs FEA Simulation

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

**Improved level set model for color image segmentation**

Lei Wang, Sheng Wang, Yi Liao  
 Hubei Agricultural Machinery Engineering Research and Design Institute, Wuhan, Hubei, China  
 Xiufen Ye, Tian Wang  
 College of Automation, Harbin Engineering University, Harbin, Heilongjiang, China

- The k-means algorithm is used to process the grayed RGB images, and the initial segmentation is produced.
- RGB color space is transferred into HSV color space in the images.
- Three channels component of the images are processed according to the proposed algorithm.

The segmented result

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

**Spring Support Electromagnetic Induction-based Detection Sensor for the Coagulation Process**

Zhe Wang, Qimeng Chen, Xiao Li, Chunwei Wang, Xiangkai Meng, Lemin Shi, Ping Gong, Yuanhua Yu  
 Changchun University of Science and Technology  
 Changchun, China

- The vibration system constituted by support spring and electromagnetic induction device was theoretically analyzed through dynamic modeling of sensor.
- We conducted modal analysis and harmonic response analysis on the spring support group using finite element method, optimized the analysis results.
- We also tested the velocity spectral characteristics and displacement spectral characteristics of the sensor prototype, and compared its methodology with the imported POCT coagulometer system.

Spring Support modal analysis diagram

MP1-3: Manufacturing Process & Automation I

Session Chairs: Jianli Wang, Changchun Institute of Optics, Fine Mechanics and Physics  
Guojun Zheng, Dalian University of Technology

Conference Room 3, 13:30-15:00, Monday, 6 August 2018

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

### A Time-sensitive Networking (TSN) Simulation Model Based on OMNET++

Junhui Jiang, Yuting Li, Seung Ho Hong\*, Aidong Xu, Kai Wang  
Department of Electronic Systems Engineering Hanyang University  
Ansan, 15588, Korea

- Industrial and automation control systems require that data be delivered in a highly predictable manner in terms of time.
- Time-sensitive Networking (TSN) yields promising solutions for real-time and deterministic networks.
- Simulation verified that the model guaranteed deterministic end-to-end latency.

Topology of the TSN simulation model.

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

### A Curvature-Continuous Transition Method with Axis High-Order Kinematic Limitations along Linear Segments

Yong Zhang, Peiqing Ye, Jiaqi Wu, and Hui Zhang  
Department of Mechanical Engineering, Tsinghua University, Beijing, China

- The transition model is optimized to obtain faster machining time.
- A novel look-ahead algorithm is presented with JLAP.
- The axis jerk on all axes is bounded well with higher machining efficiency.
- The method is validated by simulations and experiments in efficiency and precision.

The process of the bidirectional scanning algorithm

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

### Prediction of cutting forces in circular corner milling process

Xin Tong and Qiang Liu  
School of Mechanical Engineering & Automation, Beihang University  
Beijing, China

- A new accurate approach for modeling the cutting force in corner milling is proposed.
- An analytical model of undeformed chip thickness in circular milling is presented.
- The engagement angle of the corner milling process is analyzed and the formulation of real instantaneous radial width of cut is given.
- The simulation and experimental results are provided to prove the accuracy of this model.

The simulation Result

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

### Formability study of the third generation automotive medium-Mn steel

Guojun Zheng, Ying Chang, and Xiaodong Li  
School of Automotive Engineering, Dalian University of Technology, Dalian, China

Cunyu Wang and Han Dong  
Central Iron & Steel Research Institute  
Beijing, China

- Studies on the formability and simulation method of medium-Mn steel have just been initiated.
- For the hot forming process of medium-Mn steel, the effect of IFT on the formability of parts is nonlinear.
- In the appropriate IFT range, the smaller the IFT, the more uniform of the thickness distribution of the hot-formed parts.

The engineering stress-strain curves of B-pillar under different IFTs.

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

### Research on intelligent monitoring system of greenhouse intensity and CO2 concentration based on STM32

Shuanzeng Li  
Tianjin Key Laboratory of complex system control theory and Application  
Tianjin, China

- Monitoring system based on STM32 single chip microcomputer.
- Use serial port communication to send test results to MCGS touch screen.

Intelligent monitoring system

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

### Atlas\_GcodeSender: a Graphical User Interface for Control of a Robotics Additive Manufacturing Platform

Juan Pablo Rodriguez, Cesar Peña and Efrain Rodriguez  
Department of Engineering and Architecture, University of Pamplona  
Pamplona, Colombia

- This work deals with the designing and developing a Graphical User Interface (GUI), called Atlas\_GcodeSender, for control of a 3D printer based on a 5R parallel robot.
- Atlas\_GcodeSender allows three control modes: manual, semiautomatic/MDI (Manual Data Input) and automatic.

Atlas\_GcodeSender

**MP1-4: Modeling, Simulation Techniques and Methodology I**

Session Chairs: Fankai Kong , Harbin Engineering University  
 Hao Li, Xi'an Jiaotong University

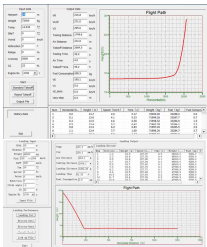
**Conference Room 4, 13:30-15:00, Monday, 6 August 2018**

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

**Research on Aircraft Take-off and Landing Performance Based on Flight Simulation**

Guo An, Zhou Zhou and Zhu Xiaoping  
 School of Aeronautics, Northwestern Polytechnical University  
 Xi'an China

- A systematic aircraft modelling.
- Different take-off modes simulation process design.
- Different landing periods simulation process design.
- Take-off and Landing performance calculation software development.



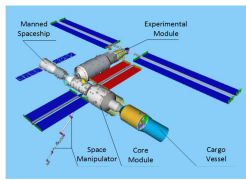
The Take-off and Landing GUI

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

**A Reconfigurable Virtual Modeling Method for Robot Simulation**

Jingdong Zhao, Yan Wang, and Zainan Jiang  
 State Key Laboratory of Robotics and System, Harbin Institute of Technology  
 Harbin, China

- Robot simulation.
- A reconfigurable virtual modeling method.
- A C++ container -- vector.
- Enhancing the flexibility and versatility.



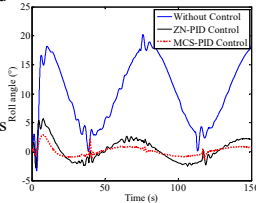
Virtual Models of the Space Station

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

**Roll Reduction Control during Ship Turns Using Fin Stabilizers with PID Controller Based on Monte Carlo Optimization**

Lihua LIANG, Peng ZHAO, and Songtao ZHANG  
 College of Automation, Harbin Engineering University  
 Harbin, China

- The nonlinear 4-DOF ship motion mathematical model for a naval vessel is established.
- The effect of fin stabilizers on ship roll control during turning motion is investigated.
- MCS-based PID controller is developed to control the fins to reduce the roll during ship turning.



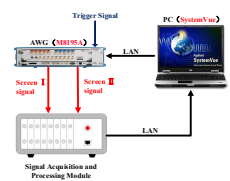
Simulation results with and without roll reduction control

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

**Evaluation Method for the Performance of Light Screen Array Using Semi-Physical Simulation**

Ding Chen<sup>1</sup>, Jinping Ni<sup>1</sup>, Lang Bai<sup>1</sup>, Rui Chen<sup>1</sup> and Dachuan Chen<sup>2</sup>  
 1.School of Optoelectronic Engineering, Xi'an Technological University, Xi'an China;  
 2.Faculty of Electronic Engineering, Aviation University of Air Force, Changchun China

- Light screen array is an instrument used in the measurement for barrel weapons.
- Its performance is directly determined by the estimation accuracy of the time interval between dynamic signals.
- A semi-physical verification platform is adopted to evaluate its performance.
- In the platform, the arbitrary waveform generator can generate the two dynamic signals with a specific time interval.
- This method is superior to the other previous ones.



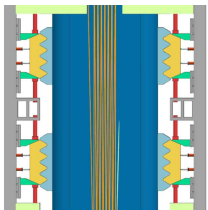
Block diagram of semi-physical verification platform

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

**Design and Analysis of Lock System of Hydraulic Turbine Lifting Device**

Fankai Kong, Huaqiu Ding, Zhenyang Wang, Hongli Pan and Binghan Wang  
 Department of Mechanical Engineering, Harbin Engineering University  
 Harbin, China

- According to the lifting and locking requirements of the floating turbine, a symmetrical rack locking system was designed.
- When the turbine is lowered to the working position, it can be fixed on the carrier without any gaps.
- The sub-modeling analysis method based on ANSYS simulates the locking system. The results show that the system meets the operating conditions.



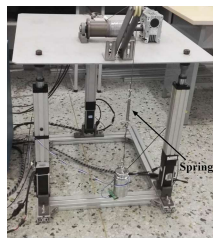
The Locking System

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

**Modeling and Analysis of Rope Flexibility in Deep Sea Lifting Operations**

Jian Xu , Mengliang Miao and Shanglong Zheng  
 Marine Mechanical and Electrical Lab, Harbin Engineering University  
 Harbin, China

- A continuous distributed parameter model of lifting system is presented.
- Time-domain simulations is performed to analyze the displacement change of the load and crane tip and the stress on the rope .
- Model experiment is carried out to prove the rope flexibility will increase hysteresis and unexpected large movement.



The Experimental Facility

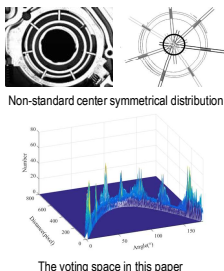
*IEEE ICMA 2018 Conference Digest*  
**MP1-5: Vision System & Image Processing**

Session Chairs: Shuoyu Wang, Kochi University of Technology  
 Hongbo Wang , Parallel Robot and Mechatronic System Laboratory of Hebei Province  
**Conference Room 5, 13:30-15:00, Monday, 6 August 2018**

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

**Defect Detection of Industrial Products based on Improved Hough Transform**  
 Qingcai Ge, Ming Fang\* and Jing Xu  
 School of Computer Science and Technology  
 Changchun University of Science and Technology  
 Changchun, China

- The method starts from the central area of the industrial product and performs directional clustering towards the direction in which the detection target is located.
- We use Hough transform on the points on the contour of the Region Of Interest(ROI).
- Voting is performed according to the constraint rule that only passes through the direction of central area.
- The peak corresponding to the detected object is obtained in the voting space, and the defect of the industrial product component is obtained by estimating the peak position.

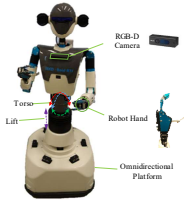


Non-standard center symmetrical distribution  
 The voting space in this paper

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

**Active Pose Estimation of Daily Objects**  
 Guang Yang, Shuoyu Wang, Junyou Yang and Bo Shen  
 School of Systems Engineering, Kochi University of Technology  
 Kochi, Japan  
 School of Electrical Engineering, Shenyang University of Technology  
 Shenyang, China

- Accurate pose estimation is essential for a life support robot to perform daily tasks.
- The active pose estimation pipeline could provide accurate pose estimation even under partial occlusions.
- Experiments involving actual daily scenarios were conducted to evaluate the performance of the proposed approach.



The Life Support Robot  
 KUT-LSR

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

**Research and Application of Online Quality Detection System Based on 3D Vision in Rectangular Steel Production Line**  
 Dahua Li, Shaoyang Wang, Xiao Yu  
 Tianjin Key Laboratory for Control Theory & Applications In Complicated Systems, Tianjin University of Technology, Tianjin, China

- The software and hardware design of the system
- The design of camera calibration method
- The design of 3D reconstruction for point cloud images
- Actual operation experiment of the system




Online Quality Detection System

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

**Sidescan sonar image target extraction method based on variable initial signed distance function-based active contour CV model**  
 Xue Du<sup>1</sup>, Qiuting Gong<sup>1</sup>, Renfeng Jia<sup>2</sup> and Hongzhou Liao<sup>1</sup>  
 1. Department of Automation Harbin Engineering University Harbin, Heilongjiang Province, China  
 2. Harbin Marine Boiler & Turbine Research Institute. Harbin, Heilongjiang Province, China

- Using active contour C-V model to extractive sidescan image target
- Choosing circle as initial signed distance function(denote SDF circle)
- Selecting the right SDF circle position
- selecting the target center as the initial center of the circle
- selecting the length that cover the target body as much as possible as the initial circle radius




Slected initial SDF circle

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

**Research on Automatic Locating Method for Large Hydraulically-Driven Loading Arm Based on Visual Servo**  
 Yuqi Zheng, Jianghai Zhao\*, Shihui Fang, Meiling Wang and Qiang Zhang  
 Department of Precision Machinery and Precision Instrument.,  
 University of Science and Technology of China  
 Hefei, China

- Kinematics modeling of the loading arm.
- Design of the loading arm control system.
- The visual servo system.
- Experiments.

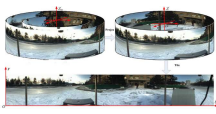


The Hydraulically-Driven Loading Arm Based on Visual Servo

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

**Research on Imaging Model and Unwrapping Algorithm of Catadioptric-omnidirectional Vision System**  
 Junxian Dong<sup>1</sup>, Hong Yu<sup>2</sup>  
 1.Chuxiong Power Supply Bureau, of Yunnan Power Grid Co, Lt.  
 2.Electrical Research Institute of Yunnan Electric Power Research Institute (Group) Co,Ltd.

- Discuss some key techniques of the single view point (SVP) catadioptric-omnidirectional Vision System;
- The unified imaging model based on spherical projection is analyzed and deduced;



Cylindrically expanded image



**MP1-6: Mobile Robot System I**

Session Chairs: T. J. Tarn, Washington University

James K Mills, University of Toronto

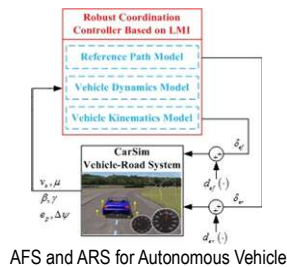
**Conference Room 6, 13:30-15:00, Monday, 6 August 2018**

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

**Robust Coordination Control of AFS and ARS for Autonomous Vehicle Path Tracking and Stability**

Xiangkun He, Yulong Liu, Kaiming Yang, Jian Wu and Xuewu Ji  
The State Key Laboratory of Automotive Safety and Energy, Tsinghua University  
Beijing, China

- Considering uncertain external disturbance, a novel robust coordination control strategy of active front steering (AFS) system and active rear steering (ARS) system is proposed to simultaneously suppress lateral path tracking deviation while maintaining autonomous vehicle stability under dynamic driving situations at handling limits.
- The satisfying performance of the proposed strategy is verified via Matlab/Simulink-CarSim co-simulation on the dry asphalt pavement ( $\mu = 1.0$ ).

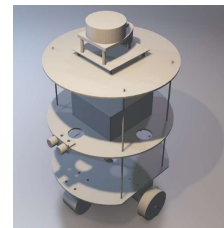


MP1-6(2) 13:45-14:00

**Plantbot: A New ROS-based Robot Platform for Fast Building and Developing**

Liulong Ma, Yibo Gao, ChuanMing Zhu and Yanjie Liu \*  
State Key Lab of Robotics and System, Harbin Institute of Technology  
Harbin, China

- A Robot Platform Used for Education or Scientific Research.
- Remote Control, Routing Inspection, SLAM and Navigation
- Low-cost, easy to extend and develop.



Plantbot

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

**Research on the Key Technology of Crawler Robot Orbiting on Space Solar Power Station**

Yuetian Shi, Xuyan Hou\* and Xiaoshan Rao  
Harbin Institute of Technology Aerospace Manufacturing Engineering Department  
Harbin, Heilongjiang Province, China

- A foot robot that can crawl on the surface of thin-film and truss surfaces of space solar power plants is proposed.
- Based on bionic theory, the analysis and simulation of the foot-end microstructure with high climbing ability in nature
- Simulated research on robot crawling process on truss structure and thin film structure.



Assembly and positioning work diagram

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

**Multi-link Articulated Wheeled In-pipe Robot with Underactuated Twisting Joints**

Atsushi Kakogawa, Yoshimichi Oka, and Shugen Ma  
Department of Robotics, Ritsumeikan University, Japan

- This study proposes an in-pipe robot that can drive the wheels and roll-joints by only a single actuator mounted in each link.
- The robot can not only move forward/backward but also move helically in pipes to change its orientation while twisting the body shape.
- Experiments in horizontal and vertical straight pipes, as well as a bent pipe, were conducted.



The Proposed In-pipe Robot with Underactuated Twisting Joints

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

**Control System Design Based on CANopen Network for a Transformable Multimodal Robot**

Yukang Chang, Zhiyong Zhang, Chunlei Wang  
National University of Defense Technology  
Hunan, China

- Control system architecture was designed based on CANopen protocol.
- The user interface and the control software were written by LabWindows/CVI.
- The differential steering algorithm
- The communication of CAN-bus was analyzed.



The Transformable Multimodal Robot

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

**Adaptive Image-based Visual Servoing with Reinforcement Learning for Wheeled Mobile Robots**

Haobin Shi, Gang Sun, Renyu Zhang  
School of Computer Science, Northwestern Polytechnical University  
Xi'an, Shaanxi Province, China  
Xuanwen Chen

China Electronic Product Reliability and Environmental Testing Research Institute  
Guangzhou, Guangdong Province, China

- A systematic method for determining a series of servoing gains is proposed to realize more efficient IBVS control.
- The proposed method addresses problems associated with IBVS, such as slow convergence, low stability.
- In simulation and practice, the complete IBVS control system is validated by several experiments on a wheeled mobile robots.



The Wheeled Mobile Robots

IEEE ICMA 2018 Conference Digest  
**MP1-7: Control Theory and Application I**

Session Chairs: Liang Zheng, Kagawa University

Xiaoshuang Zhang, Jiangsu Automation Research Institute

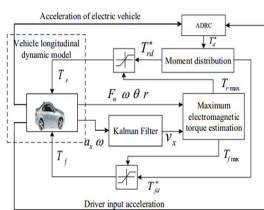
**Conference Room 7, 13:30-15:00, Monday, 6 August 2018**

MP1-7(1) 13:30-13:45

**Longitudinal anti-skid control of electric vehicle based on Kalman filter and ADRC**

Huang kai , Cao Xuanhao ,Wang Xiaoyu and Tian Yantao  
 College of Communication Engineering, Jilin University  
 Changchun, China

- Active Disturbance Rejection Controller (ADRC) is designed to realize the traction control of the electric vehicle.
- Kalman filter is used to estimate longitudinal speed of electric vehicle.
- Control experiments of ADRC and PID controller were compared under the same experimental conditions.



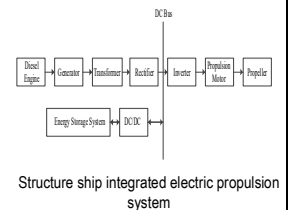
A block diagram of longitudinal anti-skid control for electric vehicles

MP1-7(2) 13:45-14:00

**Control Strategy of Hybrid Energy Storage System in Ship Electric Propulsion**

Zhang Jingnan, Zou ying  
 Department of Electrical Engineering., Harbin Engineering University  
 Harbin, China

- In ship electric propulsion and other energy storage applications, in order to ensure continuous and smooth output of energy.
- We use batteries and super capacitor device as mixed energy storage system.
- This paper focuses on the super capacitor and battery energy storage control strategy.



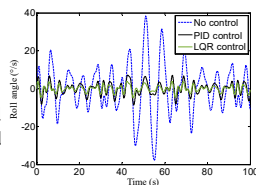
Structure ship integrated electric propulsion system

MP1-7(3) 14:00-14:15

**LQR-based Ship Roll Reduction Control Using Fin Stabilizer**

Songtao ZHANG, Peng ZHAO, and Lihua LIANG  
 College of Automation, Harbin Engineering University  
 Harbin, China

- Large roll motion causes crew sickness, working interruption and even ship capsizing.
- Fin stabilizers are equipped to ships to reduce the roll motion.
- PID controllers are mainly designed to minimize ship roll motion around its resonance frequency.
- A LQR controller is developed, and the effectiveness of the designed LQR controller is obtained through simulations and comparisons.



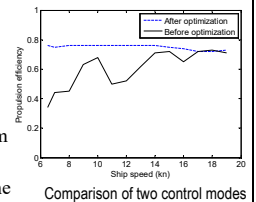
Ship roll motion at encounter angle of 90°

MP1-7(4) 14:15-14:30

**Design and Optimization of Control System for Controllable Pitch Propeller with Load Protection**

Ming Ji, Peng ZHAO, Lihua LIANG, and Runqi LIU  
 College of Automation, Harbin Engineering University  
 Harbin, China

- A joint controller with load protection for controllable pitch propeller is proposed.
- The control subsystems of speed and pitch are built and well tuned.
- An optimal matching control algorithm is developed based on standare PSO.
- The effectiveness and superiority of the proposed control algorithm is proved by simulations and comparisons.



Comparison of two control modes

MP1-7(5) 14:30-14:45

**Adaptive-sliding-mode trajectory tracking control for underactuated surface vessels based on NDO**

LIN Xiaogong, JIANG Huai and NIE Jun  
 College of Automation, Harbin Engineering University  
 Harbin, China

- Trajectory tracking control is important to the USV operation.
- The NDO can effectively observe the external environment disturbance and the parametric perturbation of the system.
- The Sigmoid function and adaptive method are used to adjust the thickness of the boundary layer on line to eliminate the chattering of sliding mode.



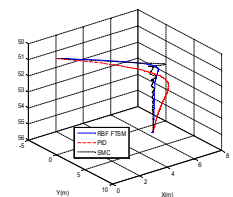
USV

MP1-7(6) 14:45-15:00

**Adaptive Neural Network Fast Terminal Sliding Mode Controller for Hovering Motion of Underwater Vehicles**

Xiaoshuang Zhang and Baoqi Wu  
 Jiangsu Automation Research Institute  
 Jiangsu, China

- Improved the conventional fast terminal sliding mode control method.
- Composed to solve the problem of the dependence on the parameters of the system by using RBF Neural Network .
- The stability of the closed-loop system was proved using Lyapunov function.



The simulation of different controller for hovering motion

*IEEE ICMA 2018 Conference Digest*  
**MP2-1: Micro & Nano Systems I**

Session Chairs: Jian Guo, Tianjin University of Technology  
 Aiguo Ming, University of Electro-Communications

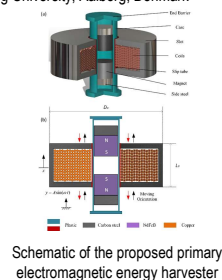
**Conference Room 1, 15:15-16:45, Monday, 6 August 2018**

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

**Ring Magnets Used for Improving the Vibration Response of a Micro Electromagnetic Energy Harvester**

Yecheng Shen, Kaiyuan Lu and Yongming Xia  
 Department of Energy Technology, Aalborg University, Aalborg, Denmark

- The resonant frequency has been almost reduced to 25% of the primary one.
- Avoiding the unstable operating point, and enhance the performance of vibration response.

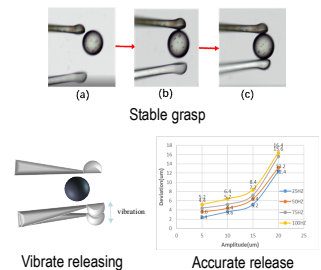


MP2-1(2) 15:30-15:45

**Stable Grasp and Accurate Release of Microbeads by a Two-finger Microhand**

Junnan Chen, Xiaoming Liu, Yuqing Lin, Pengyun Li, Xiaoqing Tang,  
 Masaru Kojima, Tatsuo Arai  
 Department of Mechatronical Engineering, Beijing Institute of Technology  
 Beijing, China

- Use hemispherical shape two-finger microhand to achieve stable grasp.
- Coat one of the end with gel to ensure the microbeads always stick to one finger.
- Combine vibration to achieve accurate release.
- Achieve assembly of a line.

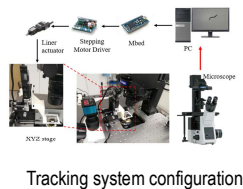


MP2-1(3) 15:45-16:00

**Automated Tracking System for Time Lapse Observation of C. elegans**

Shengnan Dong, Xiaoming Liu, Yuqing Liu, Masaru Kojima and Tatsuo Arai  
 Department of Mechatronical Engineering, Beijing Institute of Technology  
 Beijing, China

- To overcome the limitation of the microscopic field and limited workspace
- An automatic platform with three degrees of freedom that can move in XYZ axis respectively.
- The system can track the particular region of C. elegans for a time-lapse observation.

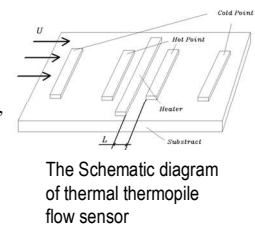


MP2-1(4) 16:00-16:15

**Numerical Study of the Thermal Thermopile Flow Sensor**

Chaozhan Chen, Hong Hu\* and Jin-Jin Wang  
 Harbin Institute of Technology Shenzhen Graduate School  
 Shenzhen, China

- This paper presents a numerical study of thermopile flow sensor.
- According to the existing analysis model for verifying numerical results
- The effects of substrate thickness, flow channel height, distance between the hot point of the thermopile and the heater on the working range, and sensitivity was studied.

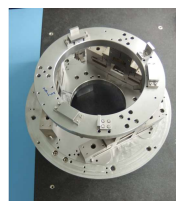


MP2-1(5) 16:15-16:30

**A Flexure-Based 3-PRPS Parallel Micro-/Nanopositioning System**

Defu Zhang, Huanan Chen, Pengzhi Li, Kang Guo, Mingyang Ni, Xianling Li,  
 Yongxin Sui and Jianguo Zhang  
 SKLAO, CIOMP, Chinese Academy of Sciences, Changchun, China

- A flexure-based 3-PRPS positioning mechanism was proposed in the paper.
- The compliance model of was established using the compliance matrix method.
- The x-axis load capacity is 600N.
- The stroke is more than  $\pm 40\mu\text{m} \times \pm 40\mu\text{m} \times \pm 30\mu\text{m} \times \pm 200\mu\text{rad} \times \pm 200\mu\text{rad} \times \pm 300\mu\text{rad}$ .
- The development micro-/nanopositioning platform is effective and can be applied to the six-DOF spatial positioning.

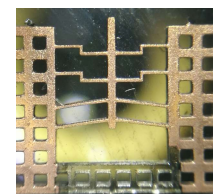


MP2-1(6) 16:30-16:45

**Experimental Testing and Performance Comparisons between V- and Z-shaped Electrothermal Microactuators**

Zhuo Zhang, Yueqing Yu, and Xuping Zhang  
 Beijing University of Technology; Aarhus University

- This work presents comprehensive experimental studies on performance comparisons between V- and Z-shaped electrothermal microactuators.
- The steady-state output displacement and dynamic responses of V- and Z-shaped actuators are compared.
- A unique actuator with mixed V- and Z-shaped beams is designed and tested to further compare the force of the V- and Z-shaped beams.



MP2-2: Medical Robots for Minimal Invasive Surgery II

Session Chairs: Fei Chen, Changchun Institute of Optics, Mechanics and Physics  
Xianqiang Bao, Beijing Institute of Technology

Conference Room 2, 15:15-16:45, Monday, 6 August 2018

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

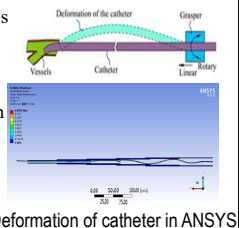
**Simulation Analysis of Catheter Bending in Vascular Intervention Robot Based on ANSYS**

Shuxiang Guo<sup>1, 2\*</sup>, Jinxin Cui<sup>1</sup>, Nan Xiao<sup>1\*</sup>, Xianqiang Bao<sup>1</sup>

<sup>1</sup>Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology, No.5 Zhongguancun South Street, Haidian District, Beijing 100081, China

<sup>2</sup>Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa 760-8521, Japan

- This paper presents the simulation analysis of the catheter bending in vascular intervention robot based on ANSYS software. The purpose is to avoid the bad catheter bending for vascular intervention robot which may cause the danger.
- Geometrical modeling of catheter and sleeve has been established and finite element analysis (FEA) is performed in ANSYS.

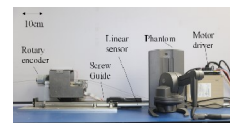


MP2-2(2) 15:30-15:45

**A Novel Master-slave Robotic System with Close Loop Control for Vascular Interventional Surgery**

Shuxiang Guo, Yuxin Wang, Nan Xiao, Yan Zhao, Yuwen Zeng, Jiaqing Wu  
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology,

- Proposes a device and control system based on guidewire motion information
- The average error of the linear control is relative to the system without guidewire motion feedback was reduced by 63.96%, and the rotation accuracy was reduced by 43.47% compared to the system without guidewire motion feedback.



Master-slave system

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

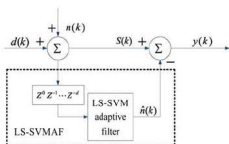
**Study on Physiological Tremor Recognition Algorithm in the Vascular Interventional Surgical Robot**

Shuxiang Guo, Rui Shen, Nan Xiao, Xianqiang Bao, Cheng Yang, and Jinxin Cui

<sup>1</sup>Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, School of Life and Science, Beijing Institute of Technology, Beijing 100081, China

<sup>2</sup>Faculty of Engineering, Kagawa University, Takamatsu, Kagawa 760-8521, Japan

- This paper proposes a moving-window-least-square-support-vector-machine (MWLSSVM) recognition algorithm to predict the physiological tremor.
- Comparison among different algorithms was conducted and identified by the accuracy of the prediction.
- The accuracy rate of our proposed algorithm reach up to 83% classification.



The Mathematical Model of the Proposed MWLSSVM.

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

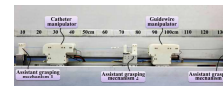
**Study on Inhibition of Inaccurate Operation for Remote-controlled Vascular Interventional Robot**

Xianqiang Bao<sup>1</sup>, Shuxiang Guo<sup>1, 2\*</sup>, Nan Xiao<sup>1\*</sup>, Yangming Guo<sup>1</sup>

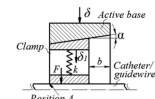
<sup>1</sup>Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, the Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology, No.5, Zhongguancun South Street, Haidian District, Beijing, China.

<sup>2</sup>Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa, Japan.

- Remote-controlled vascular interventional surgery robots (RVIR) are being developed to reduce the occupational risk of the intervening physician, such as radiation, chronic neck and back pain, and increase accuracy and stability of surgery operation.
- Inaccurate replicated motion on slave side will result in incorrect operation, or even medical accident.
- A novel RVIR integrated with a bimodal gripping mechanism was designed and its performance was evaluated by experiment.



Physical prototype of the RVIR.



Principle of bimodal gripping mechanism.

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

**Vessel Enhancing for a Continuous DSA Method towards Endovascular Interventional Surgery**

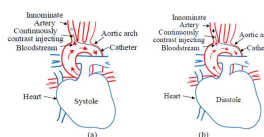
Yan Zhao, Shuxiang Guo, Nan Xiao, Yuxin Wang, Yuwen Zeng, Xinke Liu, Huijian Ge, Yuhua Jiang, Peng Liu and Youxiang Li

<sup>1</sup>Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing, China

<sup>2</sup>Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa, Japan

<sup>3</sup>Department of Interventional Neuroradiology, Beijing Neurosurgical Institute and Beijing Tiantan Hospital, Capital Medical University, Beijing 100050, China

- A vessel shadow enhancing algorithm is proposed for a continuous DSA method during EIS for providing full time visual navigation information.
- A heart-and-breathe-rate based subtracting method is proposed to obtain the subtracted image.
- The processing speed in the experiments is 1.25fps.



Contrast concentration change in continuous DSA

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

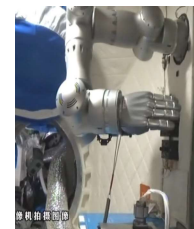
**Research on Flexible Joint Friction Identification of Space Lab Manipulator**

Dongyu Liu<sup>1,2</sup>, Hong Liu<sup>1</sup>, Yu He<sup>2</sup>, Baining Zhang<sup>2</sup>, Yechao Liu<sup>1</sup>, Zhiqi Li<sup>1</sup> and Chao Luo<sup>2</sup>

<sup>1</sup>State Key Laboratory of Robotics and System, Harbin Institute of Technology

<sup>2</sup>Institute of Manned Spacecraft System Engineering, China Academy of Space Technology  
China

- Flexible joint friction identification experiment was carried out in Tiangong-2.
- By using the experimental data on orbit, three models are compared and analyzed.
- Experiment proves that the quasi-linear model can be used in engineering.
- The flexible joint model and on orbit identification method are helpful to develop large scale space manipulator and recognize the joint friction characteristics more clearly in the orbital application.



Friction Identification Experimentation On-orbit of Flexible Joint Manipulator

IEEE ICMA 2018 Conference Digest  
**MP2-3: Manufacturing Process & Automation II**

Session Chairs: Lie Yu, Xi'an Jiaotong University  
 Xihuan Hou, Beijing Institute of Technology

**Conference Room 3, 15:15-16:45, Monday, 6 August 2018**

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

### Error Estimation of Circular Arc Interpolation Cutter Path Due to NC Servo Characteristic of Machining Center

Hua QIU  
 Department of Mechanical Engineering, Kyushu Sangyo University  
 Fukuoka, Japan

- A simple circular motion error model due to NC servo axis characteristics.
- Two simple methods to identify the values of essential parameters in the error model.
- A simple and convenient algorithm to simulate the trajectory of cutter path in detail.
- Comparison of the measured and simulated trajectories with the profile errors of machined workpiece to confirm the effectiveness of developed approach.

Comparison example

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

### Proposal of New Rotary Swaging Automation Process using 6 Step Creativity of TRIZ

Dong Jae Lim, Dae Young Kim, Won Jee Chung, Sang Seok Seol, Hyeon Min Jo and Jeong Kweon Kim  
 Robotics & System Lab., Changwon National University of South Korea

- This paper aims to propose of new rotary swaging automation process using 6 step creativity of TRIZ.
- This paper proposed a method to obtain quality, productivity, and power saving by reducing the number of striking hammers used in forging to two while one hammer is fixed and two hammers strike.
- We analyzed the simulations for the 3-hammer forging method and the 2-hammer forging method using ANSYS®

Simplified forging method

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

### Analysis of Electromagnetic Force Waves of Solid Cylindrical Permanent Magnet Synchronous Motors

Yanyan Zhang, Haipeng Geng, Jian Zhou and Lie Yu  
 State Key Laboratory for Strength and Vibration of Mechanical Structures  
 Xi'an Jiaotong University  
 Xi'an, Shaanxi Province, China

- Solid cylindrical permanent magnet synchronous motors (SCPMs) are taken as the study objects.
- The analytical expressions of radial electromagnetic force waves are deduced.

Solid Cylindrical Permanent Magnet Synchronous Motor

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

### An Improved Genetic Algorithm for Optimization of Operation Sequencing

Jianping Dou, Xia Zhao, and Chun Su  
 School of Mechanical Engineering, Southeast University, Nanjing, China

- An Improved Genetic Algorithm (IGA) is proposed to solve the operation sequencing problems in CAPP.
- In the IGA, an elitist-based parent selection instead of standard roulette wheel selection is designed to enhance the global search ability and accelerate convergence speed.
- The designed genetic operators and maintain the feasibility of the chromosomes.
- The computational comparisons indicate that IGA outperform existing ACO, PSO and GA with respect to solution quality.

Convergence curves of three GAs for case 1

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

### Rotor Design of Ultra-high Speed PM Motor with Self-starting Ability

Wenjie Cheng, Wei Li, Ling Xiao, Ming Li, Bin Zhong and Hongwei Fan  
 College of science., Xi'an University of Science and Technology  
 Shaanxi, China

- Three different rotor structures are proposed, and the ultra-high PMSM equipped with above designed rotors obtains self-starting ability.
- For the part of hysteresis ring/cylinder in the PM magnetization direction, their B-H loop area is large, but for the part perpendicular to magnetization direction, their B-H loop area will be small.
- Premagnetization effects of the hysteresis material by the PM is useful to increase the hysteresis torque. However the structure of PM-hysteresis rotor should be carefully designed.

The permanent magnetic hysteresis motor

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

### Study on Design of Experiments based Kriging Model for Tool Life Prediction

Peipei Zhang, Bo Wang and Zixuan Zhang  
 School of Mechanical and Electrical Engineering, University of Electronic Science and Technology of China  
 Chengdu, China

- For the tool life prediction, it is hard to obtain the exact model to do prediction.
- The establishment of surrogate model for the prediction or optimization of complex issues is a useful way.
- The accuracy of surrogate model mostly depends on the arrangement of samples.

Kriging model

**MP2-4: Modeling, Simulation Techniques and Methodology II**

Session Chairs: Liwen Cao, Heilongjiang University

Ye Zhang, Changchun Institute of Optics, Fine Mechanics and Physics

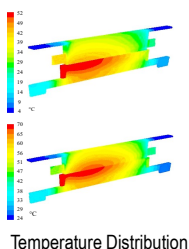
**Conference Room 4, 15:15-16:45, Monday, 6 August 2018**

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

**Analysis of influence factors of underwater motor temperature field based on magneto-thermal-flux coupling**

Zengliang Li, Qi Zhang, Ran Yu, Le Zhang and Chaozheng Xu  
College of Mechanical Electronic Engineering, China University of Petroleum (East China) Qingdao, China

- The change law of the loss is obtained by loss calculation.
- Based on the inlet temperature variation which is obtained according to the temperature drop between inlet and outlet, the influence of inlet temperature and inlet velocity variation on the motor temperature is analyzed.
- The temperature distribution of the motor is obtained under the condition of local variation of internal flow field.

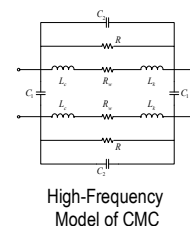


MP2-4(2) 15:30-15:45

**High-Frequency Modeling of Common-Mode Chokes Based on the Identification of Frequency-Varying Parameters**

Zhang Lanyong, Zhang Lei, Christos Papavassiliou, Wang Wugui and Li Bing  
College of Automation, Harbin Engineering University Harbin, China

- Presents a high-frequency modeling method of common-mode chokes based on frequency-varying parameters.
- Using traditional least-square method, the forgetting factor and rectangular window was introduced to estimate the frequency-varying parameters.

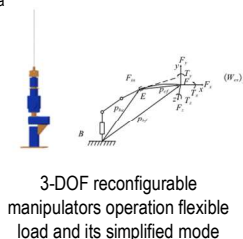


MP2-4(3) 15:45-16:00

**Dynamic Modeling and Simulation of Flexible Load System Operated by Reconfigurable Manipulators under Different Constraints**

Huidong Ma, Jinjin Guo, Weimin Ge, and Xiaofeng Wang  
School of Mechanical Engineering, Tianjin University of Technology Tianjin, China

- Built the equation of motion of the entire system according to the interaction of the end effector.
- Set up the dynamic model of the manipulator system.
- Performed the dynamic modeling of a manipulator under the certain known environmental constraints.

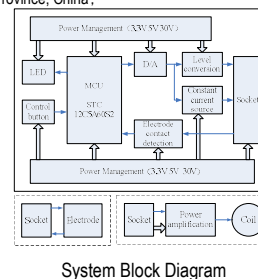


MP2-4(4) 16:00-16:15

**System Design of Transcranial Electromagnetic Stimulator Combined with tDCS and rTMS**

Dongbin Xu<sup>1</sup>, Minghui Liang<sup>1</sup>, Datong Chen<sup>1</sup>, Yueming Lin<sup>1</sup>, Qiuyang Wang<sup>2</sup>, Xiaodong Wang<sup>1</sup>, Weibin Mu<sup>1</sup>, Ke Zhang<sup>3</sup>  
1. Medical Technology Department, Qiqihar Medical University, Qiqihar, Heilongjiang Province, China;

- This paper presents an electromagnetic stimulator that can achieve two functions: tDCS and rTMS.
- The stimulator can realize the key input and display of the stimulus parameters.
- The stimulator can select the corresponding electrode and magnetic stimulation coil through socket.

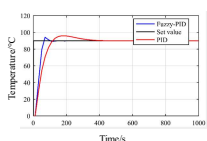


MP2-4(5) 16:15-16:30

**Temperature Control Based on Fuzzy-PID Algorithm for the Blackbody Radiation**

Zhigang Wang, Lingling Wang, Zerong Yun, Jinghui Wang  
1、Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, 2、National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, 3、Tianjin University of Technology Tianjin, China  
National Institute of Metrology, China Beijing, China

- In this paper, two different learning algorithms of conventional PID and Fuzzy-PID are applied for the temperature control of the blackbody radiation source.
- The fuzzy-PID control algorithm is superior to the conventional PID control algorithm.

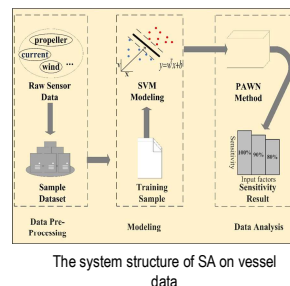


MP2-4(6) 16:30-16:45

**A SVM-based Sensitivity Analysis Approach for Data-Driven Modeling of Ship Motion**

Chunlin Wang, Xu Cheng, Shengyong Che, Guoyuan Li, Houxiang Zhang  
Tianjin University of Technology Tianjin, China  
Norwegian University of Science and Technology Aalesund, Norway

- Method: PAWN method integrated with SVM is used to carry out sensitivity analysis(SA) on ship sensor data for data-driven modeling of ship motion.
- Contribution: The proposed method can be applied for investigating how input factors contribute to ship model output



*IEEE ICMA 2018 Conference Digest*  
**MP2-5: Vision System and Robotic Vision**

Session Chairs: Liwei Shi, Beijing Institute of Technology

Huiming Xing, Beijing Institute of Technology

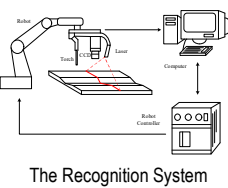
**Conference Room 5, 15:15-16:45, Monday, 6 August 2018**

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

**Weld Seam Type Recognition System Based on Structured Light Vision and Ensemble Learning**

Zhe Wang, Fengshui Jing and Junfeng Fan  
 Institute of Automation, Chinese Academy of Sciences  
 University of Chinese Academy of Sciences  
 Beijing, China

- The proposed system consists of an industrial robot, a structured light vision sensor and a computer.
- The recognition procedures include weld seam feature extraction and classification.
- The noises from welding process are filtered out by optical filter and proposed image filtering method.
- The ensemble learning classification model is able to recognize the weld seam type precisely even under severe noises.



The Recognition System

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

**Research on a technology of automatic assembly based on uncalibrated visual servo system**

Jinlin Gu, Wenrui Wang, Mingchao Zhu, Yaoyu Lv, Qi Huo and Zhenbang Xu  
 Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China  
 University of Chinese Academy of Sciences, Beijing, China

- Overall design of control system.
- Design of target and its recognition and processing algorithm.
- Online estimation of image jacobian matrix.
- Simulation and experiment.



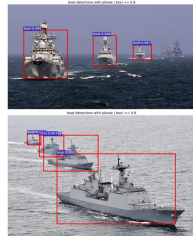
Uncalibrated Visual Servo System

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

**Maritime Target Detection Method Based on Deep Learning**

Huixuan Fu, Yuan Li, Yuchao Wang, Liangliang Han  
 College of Automation, Harbin Engineering University  
 Harbin, China

- The detection framework of maritime target based on Faster RCNN is given.
- Using Resnet to extract the feature of target.
- Using the batch normalization layer to optimize the Faster RCNN network.
- Using online hard-examples-mining algorithm to improve the training process.



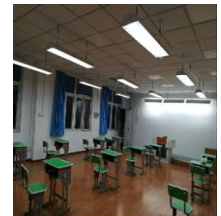
Improved Faster RCNN Detection

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

**Research on Visual Comfort Based on Fuzzy Neural Network**

Qiang Gao, Kun Zhang and Dahua Li  
 Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems, Tianjin University of Technology  
 Tianjin, China

- Research on Visual Comfort Based on Fuzzy Neural Network.
- The paper build a comparative light source test system.
- The article carried out a subjective evaluation experiment based on visual comfort.
- Using the visual comfort evaluation model to explore the application strategy of the optimal LED light source.



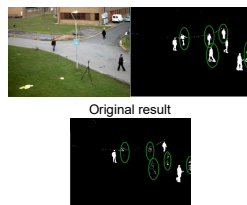
The experiment scene of Visual comfort

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

**An Improved VIBE Algorithm for Fast Suppression of Ghosts and Static Object**

Dawei Zhao, Jingjing Tan, Wenbo Yang and Fuguang Ding  
 College of Automation, Harbin Engineering University  
 Harbin, China

- presents an improved VIBE algorithm to suppress ghosts and static objects faster and more completely.
- only replace elements that are judged as background pixels. This method is more objected, and can speed up the update process of background models
- The experimental results show that the improved algorithm can suppress ghosts faster and more completely, and solve the problem of static objects to a certain extent.



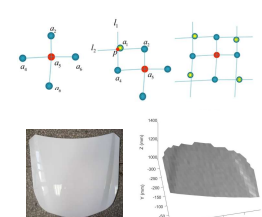
Comparison of the effect of initial ghost suppression

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

**Multi-view Shape Reconstruction Based on M-array Image Decoding with Adaptive Local Window**

Chen Luo<sup>1</sup>, Zhijie<sup>1</sup>, Yijun Zhou<sup>1</sup> and Jian Wang<sup>2</sup>  
<sup>1</sup>School of Mechanical Engineering, Southeast University, Nanjing, China  
<sup>2</sup>Dept. of Research and Development, NanTong Memtech Technology CO., LTD, Nantong, China

- Reconstruct 3D object surface under multi-camera system using coded structured light.
- Propose the decoding method based on local dynamic window to address correspondence problem.
- Improve decoding accuracy by considering local information (edges, corners and discontinuity)



Adaptive Local Window

*IEEE ICMA 2018 Conference Digest*  
**MP2-6: Mobile Robot System II**

Session Chairs: Ming Wang, Shandong Jianzhu University  
 Yong Ling, Tsinghua University

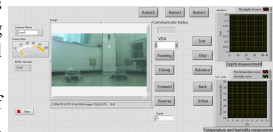
**Conference Room 6, 15:15-16:45, Monday, 6 August 2018**

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

**Design of Wireless Mobile Environment Monitoring System Based on Spherical Amphibious Robots**

Shuxiang Guo<sup>1,2</sup> and Xujie Yang<sup>1</sup>, Jian Guo<sup>1\*</sup> and Chunying Li<sup>1</sup>  
 1. Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology  
 Tianjin, China  
 2. Intelligent Mechanical Systems Engineering Department, Kagawa University  
 Kagawa, Japan

- This paper proposed a wireless mobile environmental monitoring system based on spherical amphibious robots.
- For the environmental monitoring of aquaculture, such as temperature, water level, scene picture, etc.
- The effectiveness of the system was verified by experiment and simulation.



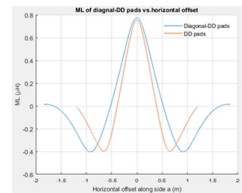
Environment Monitoring System

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

**Analyses on Superposition Action in Diagonal DD coils to Intensify IPT Power Capacity**

Tianqi Wang<sup>1</sup>, Changhai Zhao<sup>2</sup>  
 1 Department of Electrical and Computer Engineering, Miami University, USA  
 2 Precision instrument and equipment research and development center, CIOMP, CAS, China

- Diagonal-DD coils may improve a little in the alignment in the offset width.
- The intensified superposition action show a new view in the design of IPT pads.
- The advantages of Diagonal-DD coils is obvious to use the intensified action energized in the Diagonal-DD coils theoretically.



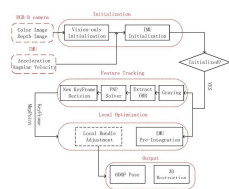
ML of Diagonal-DD coils vs. horizontal offset at air gap = 200mm

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

**RGB-D Inertial Odometry for Indoor Robot via Keyframe-based Nonlinear Optimization**

Yong Ling, Houde Liu, Xiaojun Zhu, Jiang Jun and Bin Liang  
 Graduate School of Shenzhen, Tsinghua University  
 Shenzhen, China

- Use a nonlinear optimization method fusion rgb-d sensor and inertial sensor to estimate robot trajectory.
- Propose a cost function for other type sensors fuse in this system.
- Complete a offline dense reconstruction part and convert the pointcloud to octree map.



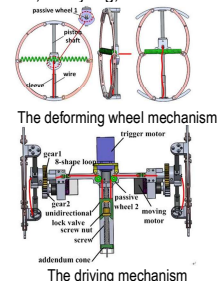
A flowchart of proposed algorithm

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

**Modeling and Analysis of a Jumping Robot with Deforming Wheeled Mechanism**

Changlong Ye<sup>1</sup>, Bohan Wang<sup>1</sup>, Bing Wei<sup>2</sup>, Biao Tang<sup>2</sup>  
 1. Shenyang Aerospace University, Shenyang, China  
 2. Liaoning Province Shiyuan High School, Shenyang, China

- A kind of deforming wheeled mechanism is put forward by combining the design method of wheeled and jumping mechanism.
- The jumping mechanism is designed based on the principle of frog legs jumping.
- Wheeled movement, wheeled obstacle climbing and robot jumping experiment are carried out.

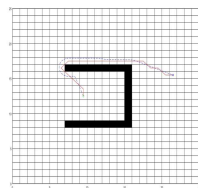


MP2-6(5) 16:15-16:30

**A Hybrid Algorithm For Robot Path Planning**

Hui Wang, Zhengang Wang, Lijun Yu, Qiang Wang, Chaoda Liu  
 College of Automation, Harbin Engineering University, Harbin, 150001, China

- This paper focuses on reducing the oscillation of the path planned by artificial potential field method in presence of obstacles and in narrow passages.
- A\* algorithm is combined with artificial potential field method.
- This hybrid algorithm takes the best of both methods to reduce the overall path cost as well as time complexity.



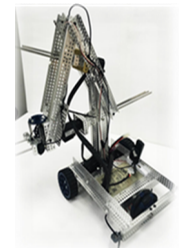
Path planned by hybrid algorithm (blue) and unimproved (red)

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

**Development of a Tetris Playing Robot Controlled by KNR**

Ming Wang<sup>1</sup>, Yanlu Zhang<sup>1</sup>, Huifang Dong<sup>1</sup>, Xu Li<sup>1</sup>, Junzhi Yu<sup>2</sup>  
 1. School of Information and Electrical Engineering, Shandong Jianzhu University, Jinan 250100, China  
 E-mail: xclwm@sdjzu.edu.cn  
 2. State Key Laboratory of Management and Control for Complex Systems, Institute of Automation  
 Chinese Academy of Sciences, Beijing 100190, China

- A vision-based wheeled robot for playing Tetris had been developed in this paper. It contains mechanical structure, a RC servo motor, DC servo motors, a CCD sensor, and photoelectric sensor.
- The robot adopted a KNR controller as its core controller. All algorithms are programmed with LabVIEW.
- With a CCD sensor, it identified colored blocks, lines and the destination.
- The front arm driven by a RC servo motor, which is applied to make the robot pick and place blocks.



The vision-based wheeled robot for playing Tetris



*IEEE ICMA 2018 Conference Digest*  
**MP2-7: Control Theory and Application II**

Session Chairs: Li Yang, school of electrical & electronic eng. Tianjin Univ of Tech.  
 Xiuping Yu, Harbin Engineering University

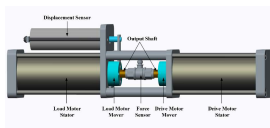
**Conference Room 7, 15:15-16:45, Monday, 6 August 2018**

MP2-7(1) 15:15-15:30

**Modeling and Control of an Electric Load Simulator**

Lingling Zhang, Liang Liu, Zhaoping Xu, Haicheng Zhou, Dong Liu  
 School of Mechanical Engineering, Nanjing University of Science and Technology  
 Nanjing, China

- The structure of the electric load simulator is designed to exert load force to the exhaust valve.
- The simulation model of the electric load simulator is established based on PID algorithm to reproduce gas force.
- Simulation results verify the proposed load system can meet performance requirements and satisfy robust stability.



Structure of electric load simulator

MP2-7(2) 15:30-15:45

**A Method of Reducing Bus Transmission Errors of Stepping Motor Driver**

Li Yang, Chunhong Wang  
 Tianjin University of Technology  
 Tianjin, China

Zhanjun Chen  
 Shenzhen autospark-tech Co.,Ltd.  
 Shenzhen, Guangdong Province, China

- RS485 bus is used to realize stepper motor master and slave control.
- The data are transmitted between upper computer and stepping motor via the RTU mode in Modbus protocol.
- Use self-checking technique to check, correct and discard erroneous data.
- Provides hardware and software design for self-correction control method.



Stepping Motor Driver

MP2-7(3) 15:45-16:00

**Fourier Series Analysis Applied in Linear Compressor Vibration Analysis**

Mingsheng Tang, Huiming Zou, Min Wang and Changqing Tian  
 Key Laboratory of Cryogenics, Technical Institute of Physics and Chemistry, CAS  
 Beijing China

- The linear compressor is designed in resonance condition to reduce the input current and energy required
- Fourier Series Analysis is applied in linear compressor vibration analysis, including for the gas force linearization and the signal processing, to deal with higher harmonics
- Then a model for the natural frequency estimation is propose in frequency domain
- The linear motor efficiency achieves a value of 95% in the refrigerator by tracking the estimated nature frequency



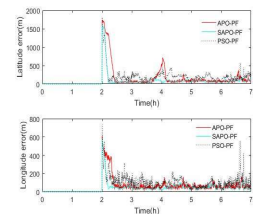
The linear compressor

MP2-7(4) 16:00-16:15

**Application of Self-Adaptive Artificial Physics Optimized Particle Filter in INS/Gravity Gradient Aided Navigation**

Fanning Liu, Fangming Li  
 College of Automation, Harbin Engineering University  
 Harbin, Heilongjiang, China

- The APO-PF has some defectives, such as slowly converging and acquiring positioning inaccurately.
- The SAPO-PF through improving position update expression, adding new mechanical rules and remain elite particle to overcome theses shortcomings.
- Compared with APO-PF and PSO-PF, the SAPO-PF has better performance in the INS/gravity gradient aided navigation system.



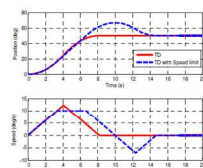
Positioning error curve of APO-PF, PSO-PF and SAPO-PF

MP2-7(5) 16:15-16:30

**Accurate and Efficient Positioning of Ground Based Telescope using Tracking Differentiator with an Adaptive Parameter**

Xiaoxia Yang, Bin Zhang, Shuai Wang, Yongting Deng  
 Changchun Institute of Optics, Fine Mechanics and Physics,  
 Chinese Academy of Sciences, Changchun, China

- An accurate and efficient positioning method for the ground based telescope has been proposed.
- Speed loop reject the total disturbance using a 2<sup>nd</sup> order ESO.
- A tracking differentiator with an adaptive parameter (ATD) has been proposed to give the transitional process for the position loop and the speed feed forward information for the speed control loop.



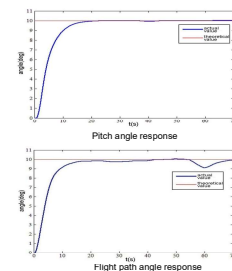
Position and Speed outputs of TD and TD with speed limit

MP2-7(6) 16:30-16:45

**Design of Aircraft Active Disturbance Rejection Tracking Controller**

Xiuping Yu, Hong Liu, Zhen Shi and Tao Liu  
 College of Automation, Harbin Engineering University  
 Harbin, China

- Aircraft dynamics modeling under wind disturbance conditions.
- Active disturbance rejection attitude controller design.
- Maneuver generator design.
- Finally, a simulation test is made.



*IEEE ICMA 2018 Conference Digest*  
**MP3-1: Micro & Nano Systems II**

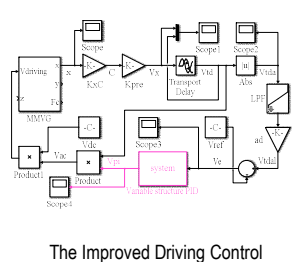
Session Chairs: Qiang Fu, Tianjin University of Technology  
 Defu Zhang, Changchun Institute of Optical, Fine Mechanics and Physics  
**Conference Room 1, 17:00-18:00, Monday, 6 August 2018**

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

**An Improved Driving Control Method for Micro-Machined Vibratory Gyroscope**

Su Xin and Lixin Xu  
 School of Mechanical Engineering, Beijing Institute of Technology  
 Beijing, China

- The performance of MMVG is affected by a variety of factors.
- The structural model of MMVG which can describe those factors is established.
- The closed-loop driving control based on the variable structure PID is applied to improve the performance of MMVG.
- The control system can stabilize the amplitude and track the resonant frequency of the driving mode.

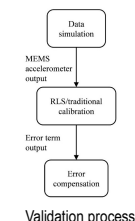


MP3-1(2) 17:15-17:30

**Research on the Calibration Method of MEMS Accelerometer Based on Recursive Least Squares**

Zhaoyi Chen, Huajian Li, Xiaojing Du, Junliang Yan  
 Aircraft Synthesis Design Group., Beijing Institute of Technology  
 Beijing, China

- This paper proposes a calibration method based on recursive least square (RLS) estimation to reduce the sampling points.
- Establish the error model of accelerometer and carried out the simulation experiment under the condition of considering external noise.
- RLS calibration method has higher calibration accuracy and reduces the calibration time, which has certain engineering value.

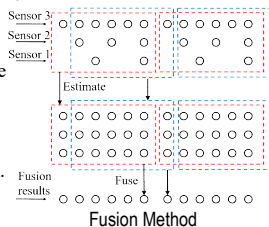


MP3-1(3) 17:30-17:45

**A Fusion Measurement Method Based on Kalman Filter with Improved State Block and Neural Network for Nanometer Displacement**

Zhuoliang Zhang, Zhangming Du, Lu Deng, Chao Zhou,  
 Zhiqiang Cao, Shuo Wang and Long Cheng  
 State Key Laboratory of Management and Control for Complex Systems, Institute of  
 Automation, Chinese Academy of Sciences  
 Beijing, China

- Kalman filter with improved state block was used to convert the multirate problem into a single rate problem.
- The neural network method was used to make full use of the calibration instrument information.

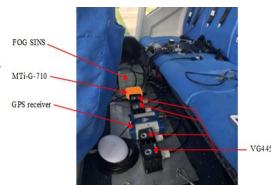


MP3-1(4) 17:45-18:00

**UAV attitude measurement based on enhanced Mahony complementary filter**

Meng Wang<sup>1</sup>, Lianwu Guan<sup>1\*</sup>, Daojun Xiong<sup>2</sup>, Yanbin Gao<sup>1</sup>, Xu Xu<sup>1</sup>, Xingbang Chen<sup>1</sup>  
 1. College of Automation, Harbin Engineering University, Harbin, China  
 2. Changping Machinery Co., Ltd, China Shipbuilding Industry Corporation, Chongqing, China

- We proposed an enhanced Mahony complementary filter applied to UAV attitude measurement.
- The algorithm based on gravity field adaptation to adjust the parameters of filter algorithm automatically.
- designed the UAV attitude measurement system VG445.
- The helicopter flight experiments results shown that the errors of horizontal attitude angles are less than 3 degrees.



The experimental equipment and their installation positions

**MP3-2: Medical Robots for Minimal Invasive Surgery III**

Session Chairs: Yuxia Li, Changchun Institute of Optics, Fine Mechanics and Physics

Yan Zhao, Beijing Institute of Technology

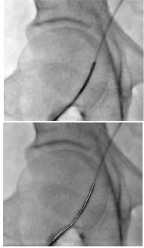
**Conference Room 2, 17:00-18:00, Monday, 6 August 2018**

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

**Catheter Tracking Based on Multi-scale Filter and Direction-oriented Method**

Yuwen Zeng, Nan Xiao, Shuxiang Guo, Yan Zhao, Yuxin Wang  
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology

- We present a catheter tracking method based on multiscale filter and direction-oriented algorithm, which can enhance and detect the catheter in real-time.
- This method does not need a large amount of data, nor a complex process of curve fitting.
- The method detects the guide wire correctly in 89.36% of the frames and takes 0.064s per frame.



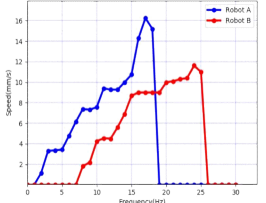
Catheter tracking

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

**Magnetic Driven Wireless Multiple Capsule Robots with Different Structures**

Shuxiang Guo, Qiuxia Yang, Luchang Bai, and Yan Zhao  
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, Beijing Institute of Technology, Beijing, China

- A driven approach for multiple capsule robots with screw structure and propeller structure is explored.
- Based on the non-overlapping driven frequencies, these robots are able to set off at different start frequencies and stop at different step-out frequencies.
- Different movements such as docking and release are verified.




Moving speeds of two robots under different driven frequencies

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

**Embedded System-based a Portable Upper Limb Rehabilitation Robot**

Baofeng Gao<sup>1</sup>, Chao Wei<sup>1</sup>, Shuxiang Guo<sup>1,2</sup>, Nan Xiao<sup>1</sup>, Dongdong Bu<sup>1</sup>, Hao Xu<sup>1</sup>, Hongdao Ma<sup>1</sup>  
<sup>1</sup> Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, Beijing Institute of Technology, Beijing, China  
<sup>2</sup> Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Japan

- The upper limb rehabilitation robot adopts exoskeleton structure. Motors and machinery are connected by line pipe and wire rope.
- Gyroscopes are used for sensor system, microcontroller as a control system realizes bilateral rehabilitation.
- PID controller realizes angle closed loop control.




Upper Limb Rehabilitation Robot

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

**Workspace Analysis for a 9-DOF Hyper-redundant Manipulator Based on An Improved Monte Carlo Method and Voxel Algorithm**

Zhiyuan Zhao, Shuai He, Yaping Zhao, Ce Xu, Qingwen Wu and Zhenbang Xu  
Innovation Lab of Space Robot System, Space Robotics Engineering Center, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science, Changchun, Jilin Province, China  
University of Chinese Academy of Sciences, Beijing, China

- This paper presents an improved Monte Carlo method and Voxel Algorithm
- To analyse the workspace of a 9-DOF hyper-redundant manipulator.



9-DOF hyper-redundant manipulator

Session Chairs: Tohid Alizadeh, Nazarbayev University

Hongmei Zhu , Shenzhen Institutes of Advanced Technology, Chinese Academy of Science

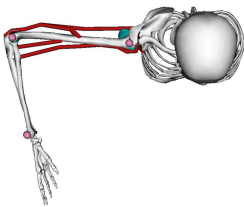
Conference Room 3, 17:00-18:00, Monday, 6 August 2018

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

**Optimal Impedance Modulation and Intention Angle of Elbow Assistive Robots: Based on Human Musculoskeletal Model**

Mohamad Mosadeghzad, Behnam Miripour Fard, Tohid Alizadeh  
Department of Robotics and Mechatronics, Nazarbayev University, Astana, Kazakhstan  
Robotics Engineering Department, Hamedan University of Technology, Iran

- Calculating the approximate optimal linear impedance regulation and intention angle of the Assistive As Needed (AAN) wearable devices
- OpenSim Simulation of the Upper body along with Computed Muscle Control (CMC) tool.
- Modelling human forearm as a single degree-of-freedom (DOF) system with an intrinsic passive stiffness and damping.



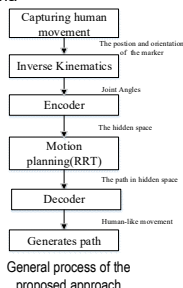
Full arm and forearm model from top view in OpenSim simulator.

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

**Dimensionality reduction for motion planning of dual-arm robots**

Pengfei Chen, Huan Zhao, Xin Zhao, Dongsheng Ge, and Han Ding  
State Key Laboratory of Digital Manufacturing Equipment and Technology  
Huazhong University of Science and Technology  
Wuhan, Hubei Province, China

- AE is proposed to reduce the dimensionality of the search space in the encoding process
- RRT-connect in the low-dimensional space is employed to get the planning path
- The low-dimensional space has non-linear representation of the original space
- The computational load and memory are reduced significantly
- Dual-arm robots can perform the human-like movement



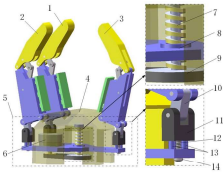
General process of the proposed approach

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

**Design of a Super Underactuated Dexterous Robotic Hand**

Xiaoshuai Ma<sup>1</sup>, Weimin Zhang<sup>1</sup>, Xuechao Chen<sup>1</sup>, Zhangguo Yu<sup>1</sup>, Wengpeng Ding<sup>1</sup>, Mingyue Qin<sup>1</sup>, Aiguo Ming<sup>1,2</sup>, Qiang Huang<sup>1</sup>  
<sup>1</sup>Beijing Advanced Innovation Center for Intelligent Robotics and Systems, Beijing Institute of Technology, Beijing, China  
<sup>2</sup>International Joint Research Laboratory of Biomimetic Robots and Systems  
Ministry of Education, Beijing, China

- This article presents a novel super underactuated robotic hand.
- This hand uses only one motor and has three cooperative fingers with two phalanxes per finger.
- Force analysis shows that the super underactuated robot hand is valid.
- The experiment results verify the stability of the novel mechanism.



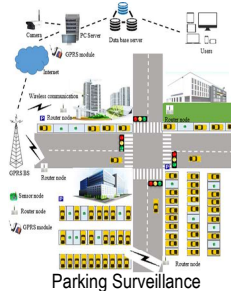
The Super Underactuated Dexterous Robotic Hand

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

**Parking Surveillance Based on Collaborative Decision Making**

Zhu, Songde Qiu, Jun Shen and Fengqi Yu  
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences  
Shenzhen, China

- Magnetic sensor: low-cost, small-size, excellent-privacy, whether-immunity, and easy to large-scale deployment.
- A multi-interim finite-state machine for interferences from moving vehicles.
- A D-S based collaborative decision making for interferences form adjacent parking vehicles.
- Experiments shows a significant accuracy improvement, about 99.8% for arrival and 99.9% for departure.



Parking Surveillance

Session Chairs: Jinjun Shan, Dept of Earth and Space Science and Eng. York University

Nobuto Matsuhira, Shibaura Institute of Technology

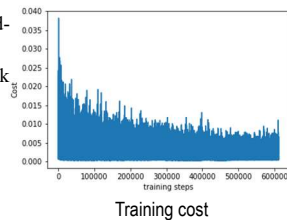
Conference Room 4, 17:00-18:00, Monday, 6 August 2018

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

### Decision-making of One-on-one Beyond-Visual-Range Air Combat Based on Improved Q-Network

Yuan Weilin, Duan Wei, Peng Shuangchun, Xie Yu, and Pan Liang  
College of Intelligence Science and Engineering, University of Defense and Technology

- Explore reinforcement learning methods for one-on-one beyond-visual-range air combat.
- Propose an improved Q-network (IQN) method, and design a rectified linear unit multi-layer perceptron.
- Design a new reward function.
- Simulations for three different situations are carried out.

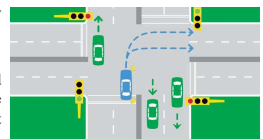


MP3-4(2) 17:15-17:30

### Fuzzy Inference Rule based Neural Traffic Light Controller

Aqeela Mir  
National University of Sciences and Technology, Islamabad, Pakistan

- An idea of developing a simple neural network based traffic controller using fuzzy inference rules
- The system uses fuzzy inference rule based strategy to train the neural network from the input data of Arrival and Queue and output data of Time for green light of signal
- The proposed system is simulated using MATLAB tool to present the validation of the test data results



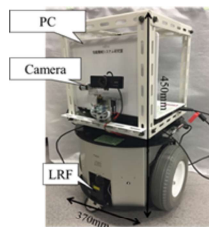
Neural Traffic Light Controller

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

### Experimental Evaluation of a Tele-operated Robot System in Traversing a Narrow Path

Zhefu Du, Zheng Zhang, Hubei University of Technology, Hubei, China  
Yuta Naito, Satoru Miki, Nobuto Matsuhira, Shibaura Institute of Technology, Tokyo, Japan

- We developed a tele-operated mobile robot system using Robot Service Network Protocol (RSNP).
- A control algorithm for traversing a narrow path was implemented and verified its validity experimentally.
- 40 mm clearance on both sides of the robot with 370 mm in diameter was confirmed without collisions.
- The narrow path function will be helpful to support an operator remotely controlling the robot.



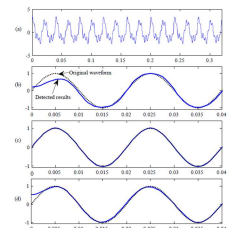
Mobile Robot in Experiment

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

### Research on Harmonic Detection Algorithm Based on Atomic Sparse Decomposition

Dan Zhao, Shiyong Hou, Nianrong Zhou, Lijun Tang, Tao Sun, Yuan Gong  
State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing 400044, China

- The atomic sparse decomposition method is studied for power system harmonic detection problems.
- Based on the overcomplete sine quantity atomic library to analyze the signal.
- compares it with the  $ip-iq$  detection method in the instantaneous reactive power theory to verify that the algorithm is effective and superior in harmonic detection.



Detection results

*IEEE ICMA 2018 Conference Digest*  
**MP3-5: Vision System & Application**

Session Chairs: Baoqi Wu, Jianguo Automation Dep.

Yifei Zhang, Dalian Navel Academy

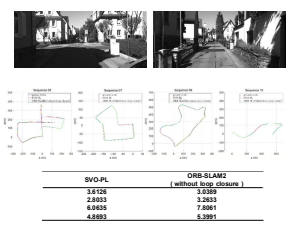
**Conference Room 5, 17:00-18:00, Monday, 6 August 2018**

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

**SVO-PL: Stereo Visual Odometry with Fusion of Points and Line Segments**

Yijun Zhou<sup>1</sup>, Kang Han<sup>1</sup>, Chen Luo<sup>1</sup> and Jian Wang<sup>2</sup>  
<sup>1</sup>School of Mechanical Engineering, Southeast University, Nanjing, China  
<sup>2</sup>Dept. of Research and Development, NanTong Memtech Technology CO., LTD, Nantong, China

- Merge adjacent lines with similar direction and perform stereo matching based on geometric constraints and descriptor.
- Combine optical flow algorithm together with descriptor to perform feature tracking.
- Camera motion is recovered through a nonlinear optimization method.



SVO-PL	ORB-SLAM2 (without loop closure)
2.6726	3.2389
2.6025	3.2637
4.6825	7.8951
4.9593	5.3921

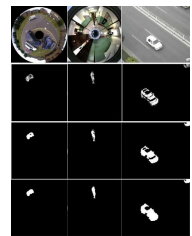
Results on KITTI dataset

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

**Research on Motion Detection Algorithm Based on Omnidirectional Vision**

Xiangyu Weng<sup>1</sup>, Chengtao Cai<sup>1</sup>, Zedong Qian<sup>2</sup>, and Xin Ding<sup>1</sup>  
<sup>1</sup>College of Automation, Harbin Engineering University, China  
<sup>2</sup>East china sea centre of standar&metrology, s.o.a. Shanghai, China

- Current motion detection algorithms are susceptible to interference from panoramic imaging illumination and resolution, sampling noise, shading and occlusion.
- The threshold method of subtraction image detection in motion detection, and put forward a partition adaptive double-threshold subtraction image threshold algorithm to suppress the above mentioned influences.



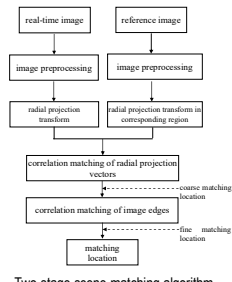
Partition double threshold detection

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

**Study on Guidance Algorithm of Scene Matching based on Different Source Images for Cruise Missile**

ZHANG Yi-fei, and YANG Hui  
 Dept. of Missile and Naval Gun, Dalian Naval Academy  
 DaLian, China

- A multi-level matching strategy is presented for matching visible images with infrared images.
- First the technologies of edge enhancement and histogram equalization are adopted to process the visible and infrared images.
- Second the radial projection transform is adopted to reduce the impact of angle rotation.
- Finally images' edge features are extracted to eliminate matching errors.



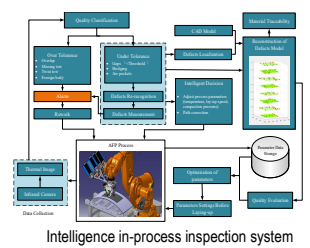
Two-stage scene matching algorithm

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

**Intelligent Inspection System Based on Infrared Vision for Automated Fiber Placement**

Mengjuan Chen<sup>1,2,3</sup>, Min Jiang<sup>1,2,3</sup>, Xilong Liu<sup>1</sup> and Baolin Wu<sup>\*1,3</sup>  
<sup>1</sup>Institute of Automation, Chinese Academy of Sciences, Beijing 100190, China  
<sup>2</sup>University of Chinese Academy of Sciences, Beijing 100049, China  
<sup>3</sup>TianJin Intelligent Tech. Institute of Casia, Tianjin 300300, China

- An intelligent inspection system based on infrared vision for Automated Fiber Placement is proposed in this paper.
- Experiments are conducted to verify the feasibility and effectiveness of the presented system in this paper.



Intelligence in-process inspection system diagram

**MP3-6: Actuator Design**

Session Chairs: Heba Amin, Egypt-Japan Univ. of Sci. and Tech.

Xin Deng, University of Science and Technology Liaoning

**Conference Room 6, 17:00-18:00, Monday, 6 August 2018**

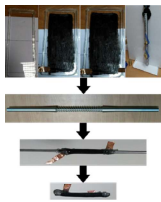
MP3-6(1) 17:00-17:15

**Design Methodology of a Spring Roll Dielectric Elastomer-Based Actuator for a Hand Rehabilitation System**

Heba Amin and Samy F. M. Assal

Mechatronics and Robotics Engineering Dep., Egypt-Japan University of Science and Technology, Alexandria, Egypt

- A Spring Roll Dielectric Elastomer-Based Actuator is proposed for a Hand Rehabilitation System.
- The proposed approach enables complex hand motions and avoids the bulky size, complicated structure and the difficulty in controlling the pneumatic actuation.
- A design methodology is established to calculate the design parameters: namely, the proper spring stiffness, the number of layers and the pre-strain for the DE material.
- Theoretical analysis and ANSYS MULTIPHYSICS simulations are carried out throughout the methodology
- Fabrication procedures are presented to obtain a prototype



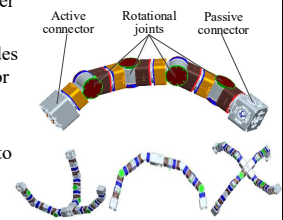
Fabrication Procedure of the actuator

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

**Connectors Based on 2-way SMA Actuator for Self-reconfigurable Chain Robots**

Fenglei Ni, Yongqiang Li, Yunhu Zhou, Yingyuan Zhu, Yuan Tang  
State Key Laboratory of Robotics and System, Science and Technology on Reactor System Design Technology Laboratory

- 2-way SMA actuator has high power density.
- The infrared sensing system provides position and posture information for the docking process.
- A cam-claw connection and separation mechanism contributes to the small size.
- The passive connector can be securely docked in five different facets for 3D reconstructions.



Self-reconfigurable chain model

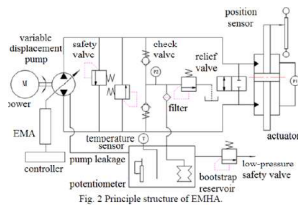
MP3-6(3) 17:30-17:45

**Redundancy Design of a New Electrically Powered Actuator for Aerospace Application**

Jiankang Zhi<sup>1</sup>, Binghui Qiu<sup>2</sup>, Xiaoye Qi<sup>1</sup>, Yongling Fu<sup>1</sup> and Jian Fu<sup>1</sup>

1. Department of Mechanical Engineering and Automatio, Beihang University  
2. Equipment Department of China PLA Air Force  
Beijing, China

- The fault tree method was used to analyze the fault of the EMHA system.
- The task reliability was calculated.
- The redundancy design of the EMHA system was carried out from the point of the overall redundancy and component redundancy.
- The switch valve block was analyzed in detail.



Principle structure of EMHA

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

**A Kind of Electric Actuator Controller Solving The Problem of Motor Concussion**

Yufeng Wang, Xin Deng, Peng Sun, and Dawei Qiao  
School of Electronics and Information, University of Science and Technology Liaoning  
Anshan, China

- A kind of adaptive learning control algorithm was proposed to solve the problem of motor concussion.
- A kind of electric actuator controller was designed with 32-bit ARM.
- Anti-interference of extreme value mean filtering and median filtering were programmed.
- The designed electric actuator controllers have been used in mass production now.



The Designed Controller

*IEEE ICMA 2018 Conference Digest*  
**MP3-7: Medical & Rehabilitation Systems**

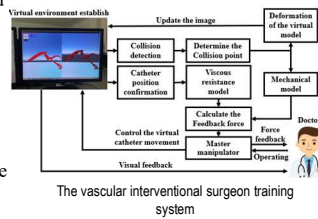
Session Chairs: Ritsu Go, Beijing Institute of Technology  
 Yili Fu, Harbin Institute of Technology  
**Conference Room 7, 17:00-18:00, Monday, 6 August 2018**

MP3-7(1) 17:00-17:15

**Vascular Environment Modeling and Verification for The Virtual Vessel Interventional Surgery Training System**

Shuxiang Guo<sup>1,2</sup>, Qi Zhan<sup>1</sup>, Jian Guo<sup>1</sup>, Cheng Meng<sup>1</sup> and Xiaoliang Jin<sup>1</sup>  
 1 Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology, Binshui Xidao 391, Tianjin, China  
 2 Intelligent Mechanical Systems Engineering Department, Kagawa University, Takamatsu, Kagawa, Japan

- In the virtual interventional surgery training system, blood flow resistance and viscous resistance are added to improve system authenticity.
- Experiment and verify that adding blood flow resistance and viscous resistance can improve the authenticity of the system
- Give trainees a more realistic training environment.

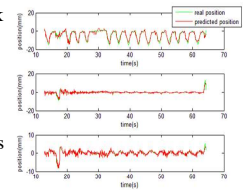


MP3-7(2) 17:15-17:30

**Prediction of lung tumor motion based on recurrent neural network**

Jiang Kai, Fumitake Fujii, Takehiro Shiinoki  
 Department of Mechanical Engineering and Department of Radiation Oncology., Yamaguchi University  
 Ube, Japan

- Construct a recurrent neural network model to predict a 1s future position of lung tumor.
- Predicting tumor position in three-dimensional space.
- The RMSE of the prediction result is generally less than 1mm shows it is satisfied prediction accuracy necessary for use in real-time dynamic tumor tracking radiotherapy



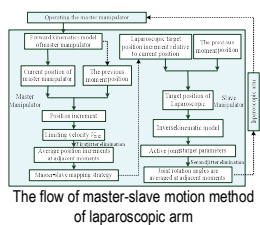
The predicted position and the measured lung tumor motion of a patient

MP3-7(3) 17:30-17:45

**Elimination method of Master-Slave Jitter for laparoscope arm**

Lan Wang, Jing Yang, Linglao Yu, Yanhui Li, Jiawei Wang  
 College of Mechanical and Electrical Engineering, Harbin Engineering University  
 Harbin, Heilongjiang Province, China

- This paper presents the jitter elimination method of master-slave control of laparoscope arm, and the driving torque of active joints before and after jitter elimination was compared.
- Two different jitters were defined, namely normal jitter and abnormal jitter. Two sets of separate jitter trajectories were captured by using the master manipulator.
- Simulation analysis of jitter elimination method was performed with two trajectories.
- virtual surgical system for the master-slave control of laparoscope arm was established. Simulation verification of jitter elimination method through virtual system was performed.

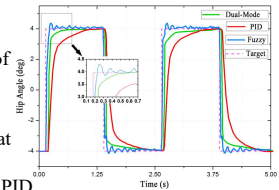


MP3-7(4) 17:45-18:00

**Dual-Mode Control of Rehabilitation Mechanical Leg Based on Kinematic Modeling**

Chao Li, Xianzhi Jiang and Xinchao Tian  
 Faculty of Mechanical Engineering & Automation, Zhejiang Sci-Tech University  
 Hangzhou, China

- Accurate mathematical models of lower limb rehabilitation robots are difficult to obtain.
- Kinematics modeling and analysis of the exoskeleton mechanical leg.
- Design of dual-mode controller.
- The experimental results showed that the dual-mode control can reach the steady state faster than the classical PID control by about 3.2%, and the steady-state error of about 4.8% was reduced compared to the fuzzy control.



Knee joint position response curve





Tuesday  
August 7, 2018

## Morning Sessions

- TA1-1 Signal and Image Processing I
- TA1-2 Intelligent Mechatronics
- TA1-3 Mechatronic Systems I
- TA1-4 Intelligent Control II
- TA1-5 Modeling, Simulation Techniques and Methodology IV
- TA1-6 Mobile Robots
- TA1-7 Control Theory and Application III
- TA2-1 Signal and Image Processing II
- TA2-2 Intelligent Mechatronics and Application I
- TA2-3 Mechatronic Systems II
- TA2-4 Multiple Robot Control
- TA2-5 Opto-electronic Element and Materials
- TA2-6 Biomimetic Measurement and Control in Robotics
- TA2-7 Control Theory and Application IV

# Tuesday

# August 7, 2018

## Afternoon Sessions

- TP1-1 Signal and Image Processing III
- TP1-2 Intelligent Mechatronics and Application II
- TP1-3 Mechanism & Design
- TP1-4 Biomimetic Systems
- TP1-5 Element, Structures and Mechanisms I
- TP1-6 Space and Telerobotics
- TP1-7 Control Theory and Application V
- TP2-1 Signal and Image Processing IV
- TP2-2 Intelligent Mechatronics and Application III
- TP2-3 Manufacturing Systems & Automation
- TP2-4 Intelligent Biomedical Technology
- TP2-5 Element, Structures and Mechanisms II
- TP2-6 AUV & Space Robots
- TP2-7 Control Theory and Application VI

*IEEE ICMA 2018 Conference Digest*  
**TA1-1: Signal and Image Processing I**

Session Chairs: Hongbin Ma, Beijing Institute of Technology  
 Yan Zhao, Beijing Institute of Technology

**Conference Room 1, 8:30-10:00, Tuesday, 7 August 2018**

TA1-1(1) 8:30-8:45

**Automatic Detection of Moving Baw Baw Frogs in Camera Trap Videos**

Gelayol Golkamarenji, Abbas Z. Kouzani, Nathan I. Semianiw, Damian Goodall, Deon Gilbert, Don Driscoll  
 Deakin University, Melbourne Zoo, Zoos Victoria, Australia

- Design and implementation of a motion detection algorithm for processing of video sequences captured by a purpose-built camera trap is presented.
- A motion detection method based on the optical flow Farneback algorithm is developed to reduce the size of the video sequences by detecting and keeping the frames that contain moving frogs, and discarding the frames that do not contain moving frogs.



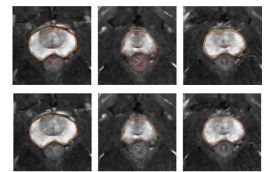
Detection of a moving frog.

TA1-1(2) 8:45-9:00

**For Prostate MRI Segmentation: A Prior-shape-based Level Set Model Combined with Gradient and Regional Information**

Bo Pan, Weirong Wang, Jiawen Yan, Yili Fu  
 State Key Laboratory of Robotics and System, Harbin Institute of Technology  
 Harbin, Heilongjiang Province, China

- Propose a level set model, which incorporates shape priors and the gradient information of the image into C-V model.
- The experimental results show that the method we proposed can adapt to different forms of the prostate better, also process the images with intensity inhomogeneity better.



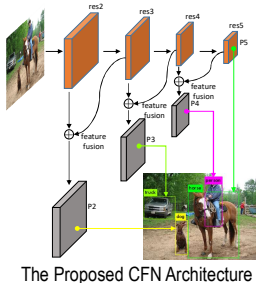
Contrast of prostate MRI segmentation results

TA1-1(3) 9:00-9:15

**Consecutive Feature Network for Object Detection**

Jiaming Huang, Xiaosong Lan, Shuxiao Li, Chengfei Zhu and Hongxing Chang  
 Institute of Automation, Chinese Academy of Sciences  
 Beijing, China

- Backbone CNN: in order to make full use of the benefit of deep expression and avoid gradient vanishing/ exploding, our model is built on the ResNet50.
- Feature fusion module: features from consecutive layers are merged instead of compartmental layers.
- Multi-Level supervised learning: we combine the deep and shallow layers for object detection.



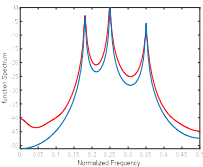
The Proposed CFN Architecture

TA1-1(4) 9:15-9:30

**Normalized Correlation-Based Levinson Method for spectrum estimation in alpha Noise**

Xiao-di Tian, Xiao-dong Sun, Xin-yu Chen, Yi-ran Shi  
 College of Communication Engineering, Jilin University  
 Changchun, China

- Research on spectrum estimation problem in alpha noise for Cognitive radio.
- Proposed normalized correlation based Levinson spectrum estimation method.
- The algorithm overcome the weakness of fractional lower order moment methods in alpha stable noise with  $\alpha < 1$ .
- Sinusoidal signals submerged in alpha noise and pure narrowband alpha noise are employed to test the Algorithm.



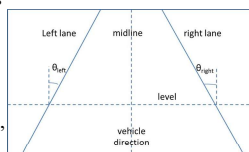
narrowband alpha noise Spectrum Estimation with  $\alpha=0.8$

TA1-1(5) 9:30-9:45

**Detection of Lane Lines on Both Sides of Road Based on Monocular Camera**

Jiannan Wang, Hongbin Ma, and Xinghong Zhang  
 School of Automation, Beijing Institute of Technology  
 Beijing, China

- This paper proposes and investigates a method which can get and display the lane lines on both sides of road in real time from videos.
- Two Hough transforms are the proposed method to detect lane lines, which has the property of rapidity and accuracy.
- A lane departure early warning model is also proposed, of which simulation and experimental results have verified the efficacy.



Road model when vehicle running along the middle line

TA1-1(6) 9:45-10:00

**Detail Maintained Low-light Video Image Enhancement Algorithm**

Ming Fang, Yichen Wang, Hongna Li and Jing X  
 Changchun University of Science and Technology  
 Changchun, Jilin Province, China

- Combine temporal neighboring information and spatial neighboring information.
- Takes two adjacent frames before and after the current frame to form a new reference pixel set.
- Cluster the pixel in the reference set and determine weight according to proportion of pixel gray values.
- The weight is integrated into the bilateral filter algorithm to denoise the image.



Experiment result

IEEE ICMA 2018 Conference Digest  
**TA1-2: Intelligent Mechatronics**

Session Chairs: Fangli Mou, Tsinghua University

Qiang Fu, Tianjin University of Technology

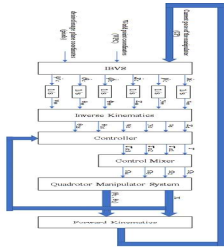
**Conference Room 2, 8:30-10:00, Tuesday, 7 August 2018**

TA1-2(1) 8:30-8:45

### Vision-Based Control of a Quad-rotor Manipulation System

Amr Hamed, Mohamed Fanni, Sabah Ahmed and Maha Salman  
 Mechatronics and Robotics Eng. Dept., Egypt-Japan University of Science and Technology, Egypt

- QMS is guided to pick and place object based on image feedback.
- The IBVS is used to control the pose of the manipulator to pick and place the desired object.
- A quadrotor manipulation system based on a vision system for object pick and place tasks was designed and tested using MATLAB/Simulink.



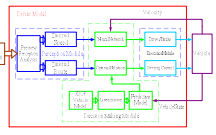
System Model

TA1-2(2) 8:45-9:00

### Intelligent Vehicle's Driver Model Considering Longitudinal and Lateral Integrated Control

Zhen Sui, Shuo Liang, Yantao Tian  
 College of Communication Engineering, Jilin University  
 Key Laboratory of Bionic Engineering of Ministry of Education  
 Changchun, Jilin, China

- A driver model has been designed.
- It includes a longitudinal controller based on BP neural network and a lateral controller based on MPC combined with the constraints such as side slip angle, yaw rate and lateral acceleration.
- The results are tested by CarSim.




The Structure of the Driver Model

TA1-2(3) 9:00-9:15

### Path tracking control for a robot-trailer system with parameter tuning using particle swarm optimization

Tong Wu  
 Dalian Neusoft University of Information  
 Dalian, China

- A path tracking controller is proposed for a robot-trailer system to track a given path.
- A fourth-order kinematic model is derived for the system.
- Linear quadratic controller is designed to remove the trailer position error using PSO for parameter tuning.



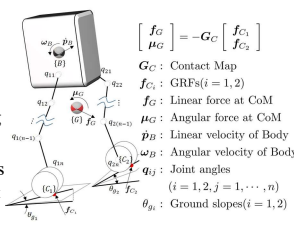
A Robot-trailer System

TA1-2(4) 9:15-9:30

### Control for balance of Legged-Wheel Hybrid Robot(LWHR) by regulating ground reaction force with kinematic coupling

SeungJae Yoo, YongHwan Oh  
 Department of HCI & Robotics, KIST School  
 Korea University of Science and Technology(UST)

- Design 2n+6 dimensional model of Legged-Wheel Hybrid Robot.
- Regulating ground reaction forces(GRFs) for balance control.
- Specify a unique GRFs by solving a rank deficient contact map.
- Indirect control of remained forces which decided to satisfy an output constraint.



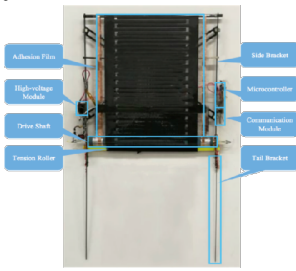
Legged-Wheel Hybrid Robot(LWHR)

TA1-2(5) 9:30-9:45

### Modeling and Analysis of a Climbing Platform Based on Inter-digital Electrode Adhesion Film

Chenyang Liu, Shaoping Wang, Shaochen Xu, Haitao Wang and Xuesong Luo  
 School of Automation Science and Electrical Engineering, Beihang University  
 Beijing, China

- Inter-digital Electrode Film
- Electrostatic Adhesion
- Wall-Climbing Platform
- High Velocity
- Low Power-Consumption



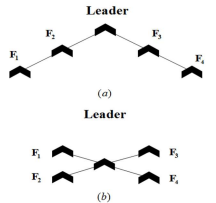
Prototype of the Climbing Platform

TA1-2(6) 9:45-10:00

### Nonlinear Formation Control of Small Fixed-Wing UAVs with Velocity and Heading Rate Constraints

Yang Xu, Jinhua Wang, Jun Wang, Yijie Ke  
 College of Electrical Engineering and Automation, Fuzhou University,  
 Fujian AeroTiger UAV Co., Ltd.  
 Fuzhou, China

- This paper proposes a geometric leader-follower formation control method with velocity and heading rate constraints.
- The path following and formation keeping problems can be solved together in this method.
- Simulation results have verified the effectiveness of the proposed method.



V-type and rectangle formation

IEEE ICMA 2018 Conference Digest  
**TA1-3: Mechatronic Systems I**

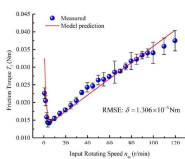
Session Chairs: Toshio Fukuda, Beijing Institute of Technology  
 Yonggeng Wei, Heilongjiang University  
**Conference Room 3, 8:30-10:00, Tuesday, 7 August 2018**

TA1-3(1) 8:30-8:45

**Investigation of the friction behavior of harmonic drive gears at low speed operation**

Donghui Ma<sup>1</sup>, Shaoze Yan<sup>1</sup>, Zhixiang Yin<sup>2</sup>, and Yunqiang Yang<sup>2</sup>  
 1. Department of Mechanical Engineering, Tsinghua University, Beijing, China  
 2. School of Engineering and Technology, China University of Geosciences, Beijing, China

- An experimental method is proposed to investigate the friction behavior of HDs.
- The friction torque of the HD has the Stribeck effect at low speed.
- The Coulomb-viscous-Stribeck friction model can be used to replicate the friction characteristics of the HD.
- Dependences of the friction behavior of the HD on different model parameters are discussed.



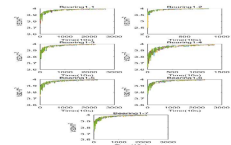
comparison of the experimental and simulation results

TA1-3(2) 8:45-9:00

**Bearings Degradation Monitoring Indicator Based on Segmented Hotelling T Square and Piecewise Linear Representation**

Fei Huang<sup>1,2</sup>, Alexandre Sava<sup>1</sup>, Kondo H. Adjallah<sup>1</sup>, and Zhouhang Wang<sup>1</sup>  
<sup>1</sup>LCOMS EA7306, ENIM, Université de Lorraine  
<sup>1</sup>Metz, France  
<sup>2</sup>Huaiyin Institute of Technology  
<sup>2</sup>Jiangsu, P.R. China

- The new indicator VSDHT<sup>2</sup> data series is monotonic and sensitive all along the bearings lifetime.
- Furthermore, the VSDHT<sup>2</sup> carries both current and historical information of bearings degradation evolution.



The new indicator of bearings degradation monitoring

TA1-3(3) 9:00-9:15

**Design and Research of Point Absorber Wave Power Converter**

Chunjie Wang, Lin Qi, Peng Chen  
 Tianjin University of Technology  
 Tianjin, China  
 Lin Cui, Yunqi Duan  
 National Ocean Technology Center  
 Tianjin, China

- A problem of poor quality of wave power converter is presented.
- A wave power controller based on a point absorber Wave Power Converter is designed to solve the problem.
- The core function of the controller is to change the unstable three-phase AC into a stable DC.
- A large number of experimental data show that the control method can solve the power quality problem.



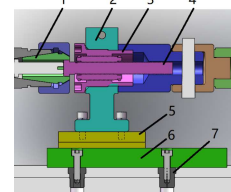
Wave Power Converter

TA1-3(4) 9:15-9:30

**Research on Detect Method for Transmission Accuracy and Efficiency of Planetary Roller Screw Pair**

Shicheng Zheng, Yongling Fu, Zhixiang Zhang, Peng Zhang and Wensen Zhang  
 Department of Mechanical Engineering and Automation, Beihang University  
 Beijing, China

- A research method for detecting the transmission accuracy and efficiency of the small planetary roller screw pair was proposed.
- The error of efficiency measurement under load condition is analyzed, and the torque loss of the system under different loads is directly measured by the method of equal quantity substitution, and the torque error is compensated accordingly in the final analysis.



3D image of clamping assembly

TA1-3(5) 9:30-9:45

**Research on Algorithm of Pointer Instrument Recognition and Reading Based on the Location of the Rotation Center of the Pointer**

Jianlong Gao,<sup>1,2</sup> Liang Guo,<sup>1,\*</sup> Yaoyu Lv,<sup>1,2</sup> Qingwen Wu,<sup>1</sup> Deqiang Mu<sup>3</sup>  
 1. Chinese Academy of Sciences, Changchun Institute of Optics, Fine Mechanics and Physics, No.3888 Dong Nanhu Road, Changchun, China, 130033  
 2. University of Chinese Academy of Sciences, 19 Yuquan Road, Beijing, China, 100049  
 3. Changchun University of Technology, School of Mechanical Engineering, 2055 Yanan Street, Changchun, China, 130012

- A pointer instrument recognition and reading algorithm based on the pointer rotation center position was designed.
- A similar feature triangle method is proposed to determine the rotation center of the pointer by matching feature points.



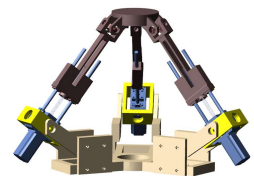
The Recognition and Reading of Pointer Instrument

TA1-3(6) 9:45-10:00

**Research on Bidirectional Macro-micro Assembly Technology Accuracy Based on 3-UPU Parallel Mechanism**

Xin Shi and Yonggeng Wei\*  
 Mechanical & Electrical Engineering, Heilongjiang University  
 Heilongjiang, China  
 \*Correspondence author: Yonggeng Wei

- The bidirectional macro and micro assembly technology is applied to 3-UPU parallel mechanism.
- Kinematics analysis and precision simulation analysis of 3-UPU parallel mechanism.
- By giving the error of each hinge point, the trajectory error of the moving platform is obtained.



3-UPU Parallel Mechanism

IEEE ICMA 2018 Conference Digest  
TA1-4: Intelligent Control II

Session Chairs: Zixu Wang, Kagawa University  
Min Li, Shanghai University

Conference Room 4, 8:30-10:00, Tuesday, 7 August 2018

TA1-4(1) 8:30-8:45

### Direct yaw moment control of electric vehicle for improving the vehicle lateral stability

Cao Xuanhao, Huang Kai, Lian Yufeng, and Tian Yantao  
The College of Communication Engineering  
Jilin University

- An advanced control method using the direct yaw moment control (DYC) is proposed.
- The purpose is to increase the stability and comfort of the Electric Vehicles.
- The effectiveness of this control approach has been demonstrated in simulations.

Structure of the control system

TA1-4(2) 8:45-9:00

### A new Neural Network Model based on the Recent Discovery of Brain Microenvironment

Xiaohong Wang, Hongbin Han  
liaoning university of petroleum and chemical engineering, Beijing university third hospital, magnetic resonance imaging equipment and technology, Beijing key laboratory fu-shun, liaoning Province, Beijing, China

- Based on the recent discovery of brain microenvironment, we propose a new neural network model (AINN).
- We apply this model in BP network, and the results show that AINN achieves better parameters than traditional BP model.

Processing Unit of Interstitium-neuron

TA1-4(3) 9:00-9:15

### Power System Fault Diagnosis Based on Extended Bayesian Network

Yanjuan Wu, Yannan Guo  
Tianjin Key Laboratory for Control Theory and Applications in Complicated System  
Tianjin University Of Technology

- Introduce the concepts of abnormal information.
- Establish a set of fuzzy rules about abnormal information.
- Establish fault diagnosis Extended Bayesian Network.
- Compare with original Bayesian Network and other methods.

Progress of proposed method

TA1-4(4) 9:15-9:30

### The Prediction of Greenhouse Temperature and Humidity Based on LM-RBF Network

Youjun Yue, Jun Quan, Hui Zhao, and Hongjun Wang  
Tianjin Key laboratory for Control Theory and Applications in Complicated System,  
Tianjin University of Technology Tianjin, China

- Firstly, investigate previous scholars' research and find out problems to be solved in the research topics.
- Secondly, selecting the inside and outside meteorological data of the greenhouse as input for data processing.
- Thirdly, using the Levenberg-Marquardt (LM) algorithm optimizes the width and the weights and the thresholds of the RBF neural network.
- Finally, using the LM-RBF prediction model to predict the temperature inside greenhouse and humidity for the intelligent greenhouse.
- The experimental results show that LM-RBF prediction model has more accurately than RBF and PSO-RBF model.

Modeling method	temperature Humidity RMS error	temperature/ Humidity absolute error sum	temperature/ Humidity relative error sum
RBF neural Network	0.0019/ 0.0019	19.1767/ 69.3851	1.0792/ 0.8273
PSO-RBF neural network	0.0014/ 0.0011	10.9411/ 55.2101	1.6194/ 0.4138
LM-RBF neural network	9.99e-006/ 9.91e-006	5.9571/ 23.5929	0.3125/ 0.2763

The table of error value

TA1-4(5) 9:30-9:45

### Application of QGA-BP Network in Objective Evaluation of Speech Jamming Effect

Jiaqing Mo1, Xiaoyi Lv1, Songbo Zhao2, Ningning Li2, Liang Xu2, Dahua Li2, Qiang Gao2  
1Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems Tianjin University of Technology Tianjin, China  
2School of Information Science and Engineering, Xinjiang University, Urumqi 803046, China

- The improved PSO-BP algorithm is used for fault detection, which complements the shortcomings of traditional fault detection methods.
- The MSE curve of the improved PSO-BP network quickly reached the expected set value.
- The improved PSO-BP model is a fault detection model of liquid-propellant rocket engine, which has good fault accuracy.

curve of the IPSO-BP neural network training

TA1-4(6) 9:45-10:00

### Pedestrian Detection Based on YOLO Network Model

Wenbo Lan, Jianwu Dang, Yangping Wang and Song Wang  
Gansu Provincial Engineering Research Center for Artificial Intelligence and Graphics & Image Processing., LANZHOU JIAOTONG UNIVERSITY  
Lanzhou, China

- This paper improves the network structure of YOLO algorithm and proposes a new network structure YOLO-R.
- Three Passthrough layers were added to the original YOLO network, and the number of Passthrough layer connections in the original YOLO algorithm was changed from Layer 16 to Layer 12.

Pedestrian detection

TA1-5: Modeling, Simulation Techniques and Methodology IV

Session Chairs: Chao Jia, Tianjin University of Technology

Xiufen Ye, Harbin Engineering University

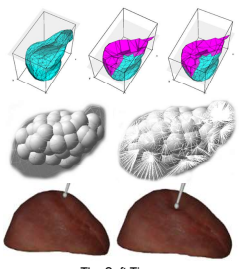
Conference Room 5, 8:30-10:00, Tuesday, 7 August 2018

TA1-5(1) 8:30-8:45

### Filling Model based Soft Tissue Deformation Model

Xiufen Ye, Xinkui Mei and Shuguo Xiao  
College of Automation, Harbin Engineering University  
No.145, Nangang District, Harbin, Heilongjiang Province, 150001, China

- This is a new soft tissue deformation model building method based on the combination of mass spring and filling model.
- This method not only solved the defect of the traditional mass spring, but also greatly reduces the amount of calculation and the time complexity of the algorithm.
- This method integrated into the filling model to make the soft tissue model be closer to the real human body tissue.



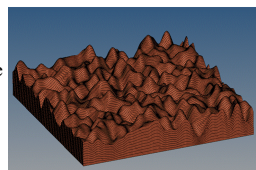
The Soft Tissue Deformation Model

TA1-5(2) 8:45-9:00

### Comprehensive Friction Model During High-speed Process

Lei Ji, Linfang Qian, Jin Huang, Guangsong Chen, Yicheng Zhu  
School of Mechanical Engineering, Nanjing University of Science and Technology  
Nanjing, China

- High-speed friction model including dry friction and melt lubrication.
- Rough surface generation.
- Contact of rough surface using finite element method.
- The melt lubrication friction coefficient varies with velocity.
- The comprehensive friction coefficient combining the dry friction coefficient and the melt lubrication friction coefficient by the ratio of contact area.



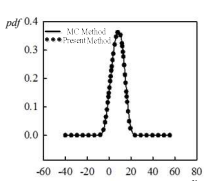
The Rough Surface

TA1-5(3) 9:00-9:15

### A Research Method of Uncertain Propagation Problems Based on Maximum Entropy Principle

Wenyu Zhai, Linfang Qian, Guangsong Chen and Mingming Wang  
School of Mechanical Engineering, Nanjing University of Science and Technology  
Nanjing, China

- Use an approximate numerical method combined with the Bootstrap method to calculate the statistical moments of each order of the response variable.
- Use a method based on the maximum entropy principle to solve the probability density function.
- A numerical example and an example of the calculation of the probability density function of natural frequency of a barrel are given and compared with the Monte Carlo simulation method.



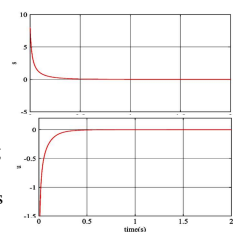
The probability density function of the numerical example.

TA1-5(4) 9:15-9:30

### Research on Simulation of Improved Sliding Mode Variable Structure Control

Chao Jia, Junqiang Zhou  
Mechatronics Research Lab., Tianjin University of Technology  
Tianjin, China

- Compare with traditional equal velocity trending law and exponential velocity trending law, the method proposed in this paper would decrease the response time, and weaken the chattering.
- Has achieved good results in solving the chattering problem of variable structure control systems. It provides a feasible solution for simply and quickly solving system stability problems and improving system performance.



Simulation of Improved Exponential Velocity Trending Law

TA1-5(5) 9:30-9:45

### Design and Accomplishment of Traceability System of Agricultural Products

Shun Lv, Yan Zhao, Lele Shen, Zhengyuan Xing, Man Zhang and Baofeng Zhang  
the school of Electrical and Electronic Engineering., Tianjin University of Technology  
Tianjin, China

- Analyzing the requirements of the traceability system
- Designing the structure of the traceability system
- Accomplishing a traceability system of agricultural products
- Pointing out some issues



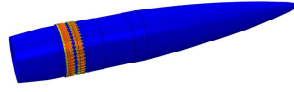
Traceability information display page

TA1-5(6) 9:45-10:00

### A modified Johnson-Cook model for rotating band considering a wide range of temperature

Yicheng Zhu, Linfang Qian, Guangsong Chen and Lei Ji  
School of Mechanical Engineering, Nanjing University of Science and Technology  
Nanjing, China

- Test the mechanical behaviors of rotating band through SHPB experiments.
- Fit the experimental curve with constitutive models.
- Modify the constitutive model.
- Evaluate the error of different models



The deformed rotating band



TA1-6: Mobile Robots

Session Chairs: Wei Zhang, Harbin Engineering University

Hongbin Chang, Kochi University of Technology

Conference Room 6, 8:30-10:00, Tuesday, 7 August 2018

TA1-6(1) 8:30-8:45

**Task-Based Design of Modular Robots: Evolutionary Approach**

Reem J. Alattas, Sarosh Patel, and Tarek M. Sobh  
Department of Computer Science & Engineering  
University of Bridgeport  
Bridgeport, CT, USA

- Autonomous task-based modular robotic design system based on an evolutionary approach to find the optimal results.
- The autonomous evolutionary design system takes as input the task to be performed by the resulting robot, and the modular repertoire.
- The final output of the system is a simulated robotic structure that can perform the input task.
- This robot can be implemented in reality using Dttto modular robotic kit.



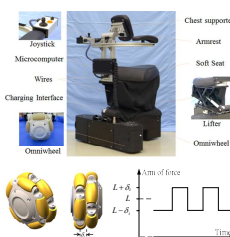
Dttto Modular Robot

TA1-6(2) 8:45-9:00

**Model Reference Adaptive Control for a Human Support Robot with Omniwheel Touchdown Characteristic**

Hongbin Chang, Shuoyu Wang, and Ping Sun  
Department of Intelligent Mechanical Systems Engineering, Kochi University of Technology  
Kochi, Japan

- Trajectory tracking control for a Human Support Robot considering omniwheel touchdown characteristic.
- Design of model reference adaptive law to account for the omniwheel touchdown characteristic.
- Prove that the tracking error system is asymptotically stable.
- Demonstrate the effectiveness of the proposed method by simulation results.



Human Support Robot

TA1-6(3) 9:00-9:15

**Design and Control of Multiple Wing-sail Land Yacht Robot**

Jiqing Chen, Zhou Ye, Rong Yang, Ganwei Cai, Jing Li, and Hengyu Li  
College of Mechatronic Engineering, Guangxi University  
Guangxi Manufacturing System and Advanced Manufacturing Technology Key Laboratory  
School of Mechatronics Engineering and Automation, Shanghai University

- A multiple wing-sail land-yacht robot is designed and manufactured.
- Design of land-yacht robot include frame body, wing-sails, distribution of wing-sail, turning system, control system.
- Start wind speed and running speed confirm the robot



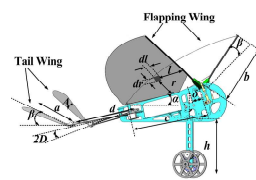
Multiple wing-sail Land yacht robot

TA1-6(4) 9:15-9:30

**Modeling and Simulation of a Flapping-Wing Robot with Active Tails for Balancing Control during Wheeled Running**

Shuyan Yang, Yueling Shen, Boyang Li, Yuhui Li, and Jun Zhang  
The State Key Laboratory of Bioelectronics, Jiangsu Key Lab of Remote Measurement and Control, School of Instrument Science and Engineering, Southeast University, China

- Self-takeoff for flapping-wing robots is still a challenging problem.
- Established the calculation model of the lift force and thrust considering the deformation of the wings.
- Active tails are studied to reduce the pitch torque and keep balance during wheeled running.
- Proper values of model parameters are found by simulation to provide guidance for the design of such FWRs.



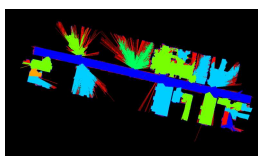
The flapping-wing robot model

TA1-6(5) 9:30-9:45

**An Approach to Graph-Based Grid Map Segmentation for Robot Global Localization**

Bingrui Liu, Lin Zuo, Chang-Hua Zhang, Yu Liu\*  
Intelligent Learning Institute for Science and Application,  
University of Electronic Science and Technology of China  
Chengdu, Sichuan, China

- Use ISODATA combined with the ray casting algorithm clustering the free space of the grid map.
- Merge the clusters of the map into different regions according to the connectivity of the graph.
- Present the results of the proposed method for grid map segmentation.
- Explain how the map segmentation method contributes to the global localization.



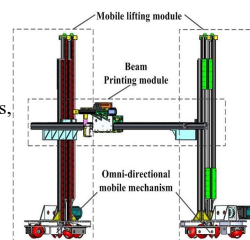
Grid map segmentation

TA1-6(6) 9:45-10:00

**A Variable-scale Modular 3D Printing Robot of Building Interior Wall**

Changlong Ye, Nan Chen, Lei Chen, and Chunying Jiang  
Shenyang Aerospace University, Shenyang, China

- The overall structure adopts a mobile + variable scale + modular design method, which allows the robot move and change it stations, print complex curved interior walls, facilitate upgrade.
- The kinematic analysis of robot.
- The control system of robot.
- Robot prototype is developed, and the experimental results are also given.



The Structure of Robot

*IEEE ICMA 2018 Conference Digest*  
**TA1-7: Control Theory and Application III**

Session Chairs: Dapeng Tian, Changchun Institute of Optics, Fine Mechanics and Physics  
 Jinchun Hu, Tsinghua University

**Conference Room 7, 8:30-10:00, Tuesday, 7 August 2018**

TA1-7(1) 8:30-8:45

**Research on Oscillating Buoy Wave Energy Generation Based on VSG Control Strategy**

Shuang Cao, Lijun Fu, Shuangming Yang, and Hongda Liu  
 National Key Lab. Of Science And Technology on Vessel IPS, Wuhan, China  
 College of automation, Harbin Engineering University, Harbin, China

- Research on oscillating float wave energy generation.
- Using the mathematical model to simulate the prime mover part of the device.
- VSG control mode on the inverter side.
- Modeling of VSG adaptive model and discussion on wave energy generation



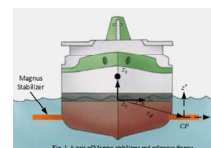
Wave energy generation

TA1-7(2) 8:45-9:00

**Backstepping Sliding Mode Control Design for Magnus Rotating Roll Stabilizer at Low Speed**

Lihua Liang, Yinling Jiang and Peng Zhao  
 College of Automation, Harbin Engineering University  
 Harbin, China

- Magnus rotating roll stabilizers are devices to provide roll damping at low speed through the rotating rotor wing at the bilge of ship hull based on Magnus effect
- Combine the backstepping method with sliding mode control method to guarantee fast convergence rapidity of rolling angle



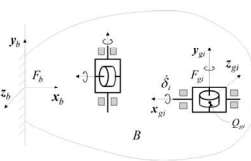
A pair of Magnus stabilizers and reference frames

TA1-7(3) 9:00-9:15

**Neural Network-based Adaptive Sliding Mode Control for Gyroelastic Body**

Shiyuan Jia and Jinjun Shan  
 Department of Earth and Space Science and Engineering, York University  
 Toronto, Canada

- This paper addresses the vibration suppression of gyroelastic body in the presence of uncertainties and external disturbances.
- A neural network-based adaptive sliding mode controller (NNASMC), combining neural network (NN) approximation, adaptive technique and sliding mode technique, is designed to ensure the vibration suppression of the gyroelastic body.



A Cantilevered Gyroelastic Body with n CMGs.

TA1-7(4) 9:15-9:30

**Modeling and Simulation of Wire-wound Friction of Compact Inertially Stabilized Platforms**

Yutang Wang<sup>1,2</sup>, Dapeng Tian<sup>1</sup>, Ming Dai<sup>1</sup>, Honghai Shen<sup>1</sup> and Ping Jia<sup>1</sup>  
 1 Key Laboratory of Airborne Optical Imaging and Measurement, Changchun Institute of Optics, Fine Mechanics and Physics Chinese Academy of Sciences, Changchun, Jilin China  
 2 University of Chinese Academy of Sciences, Beijing China

- for compact inertially stabilized platforms, due to the strict limits of structure space, transmission of signals through wires between shafts is unavoidable.
- A quantitative wire-wound friction model is established according to classical mechanics theory and a quantitative analysis of the influence of wire-wound friction on inertially stabilized platforms is established by simulation.



Compact Inertially Stabilized Platforms

TA1-7(5) 9:30-9:45

**Research on On-line Testing System of Flow Characteristics for Vehicle Electronic Fuel Injector**

Yanhao Li<sup>1</sup>, Bin Liu<sup>1</sup>, Jianwen Li<sup>1</sup>, Yan Zhao<sup>1</sup> and Wei Lei<sup>2</sup>  
 1. Tianjin Key Laboratory for Control Theory & Applications in Complicated System  
 School of Electrical and Electronic Engineering, Tianjin University of Technology, Tianjin, China  
 2. Military Transportation University, Tianjin, China

- Complied with relevant standards, a novel on-line testing system for flow characteristics of electronic fuel injector was proposed in this paper.
- The testing process on the dynamic flow and the static flow of the port fuel injectors driven by voltage was implemented.
- The error of the on-line system is less than 4%, which can meet the requirements on flow characteristics test of fuel injectors.



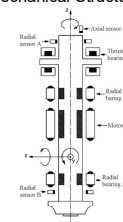
The On-line Testing System

TA1-7(6) 9:45-10:00

**Dynamic Analysis on Rotor System Supported by Active Magnetic Bearings based on Sliding Mode Control**

Tingchen Du, Yanhua Sun, Haipeng Geng, Yibin Li, Hao Lv and Lie Yu  
 State Key Laboratory for Strength and Vibration of Mechanical Structures  
 Xi'an Jiaotong University  
 Xi'an, China

- Establish the five-degree of freedom AMB-rotor control system which includes the effects of magnetic thrust bearings.
- Configure the sliding mode controller and design the switching function by the quadratic regulator and select the exponential reaching law as the input of the system.
- Simulate and verify the robustness of system.



The AMB rotor system

*IEEE ICMA 2018 Conference Digest*  
**TA2-1: Signal and Image Processing II**

Session Chairs: T. J. Tarn, Washington University  
 Shuxiang Guo, Kagawa University

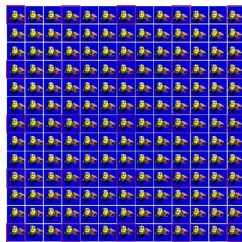
**Conference Room 1, 10:30-12:00, Tuesday, 7 August 2018**

TA2-1(1) 10:30-10:45

**Algorithm for Automatic Generation of Sparse Image Array Based on View Morphing**

Lijin Deng, Yan Piao and Qi Wang  
 Department of Electronics and Information Engineering,  
 Changchun University of Science and Technology Changchun, China

- Feature Point Specification: Use two cameras with the same parameters to get two input viewpoint images.
- Viewpoint Image Parallelization: Apply parallel processing to I0 and I1 based on the View Morphing projection transformation method.
- Divide: Split the image so we can get triangular meshes that are tightly connected to each other.
- Calculate the Coordinates of the Corresponding Point: Using the cross ratio invariance of the projective transformation, the coordinates of all corresponding points in the corresponding triangular meshes on I0 and I1 can be obtained.



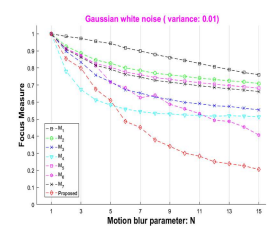
Sparse Image Array  
 Images in red frames are taken by camera

TA2-1(2) 10:45-11:00

**Focus measure based on the image moments**

LiQiang Guo, Lian Liu, and Haijiang Sun  
 School of Computer Science and Technology, Huaiyin Normal University, HuaifAn, China  
 Changchun Institute of Optics, Fine Mechanics and Physics,  
 Chinese Academic Sciences, Changchun, China

- we proposed a novel focus measure by using the blocked image moment functions and variance statistics.
- We first divide the image into 8\*8 non-overlapping blocks, and compute the Chebyshev moment  $T_{11}$  for each image blocks, then use the statistical method to construct the focus measure.



Focus measure under the Gaussian White noise conditions

TA2-1(3) 11:00-11:15

**Saliency Detection Algorithm Based on Local Linear Constraint**

Dongping Xu, Feng Chen  
 School of electrical engineering, Nantong University  
 Nantong, Jiangshu Province, China

- Using a simple linear iterative clustering (SLIC) method to segment the input image into superpixels
- Using the truth map of the image and detect the region segmentation.
- Locally-constrained liner coding(LLC) was used to calculate the sparse reconstruction error based on the foreground and background dictionary.



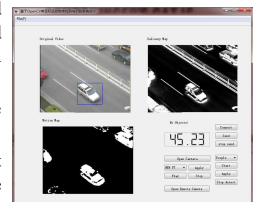
The input image

TA2-1(4) 11:15-11:30

**The Design of Single Moving Object Detection and Recognition System Based on OpenCV**

Lijun Yu, Weijie Sun, Wang Hui, Qiang Wang and Chaoda Liu  
 College of Automation, Harbin Engineering University, Harbin 150001, China

- Application of metrics improved frequency-tuned algorithm and Gaussian Mixture Model algorithm to detect moving targets.
- Application of Haar Cascade Classifier for Object Recognition.
- Application of OpenCV and Qt Platform for Multi-module Simulation System Modeling.
- Multi-algorithm comparison tests show that system can meet expected requirements.



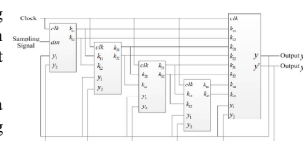
improved frequency-tuned algorithm with GMM

TA2-1(5) 11:30-11:45

**FPGA Implementation for a DPSK Digital Receiver Using Duffing Oscillators Array**

Yanan Li, Yongqing Fu, Lei Yu, Yanwei Wang and Chunxia Liu  
 College of Information and Communication Engineering, Harbin Engineering University  
 Harbin, Heilongjiang, China

- The DPSK digital receiver using Duffing oscillators array can realize DPSK signal non-coherent demodulation.
- The fourth-order Runge-Kutta algorithm used to solve Duffing equation is improved using the parameter features of the receiver.
- The simulation results indicate the correction of the FPGA design of the DPSK digital receiver.



The RTL structure for the RK4 method

TA2-1(6) 11:45-12:00

**Image Stitching Algorithm Based on Embedded System**

Zhengde Shi<sup>1</sup>, Hong Yu<sup>2</sup>  
 1.Yuxi Power Supply Bureau of Yunnan Power Grid Co., Ltd.  
 2.Electrical Research Institute of Yunnan Electric Power Research Institute (Group) Co.,Ltd.

- Consider the actual needs, Study image stitching algorithm in embedded Linux system and realize fast and accurate stitching;
- Complete image stitching in the embedded system;
- Using the FPGA-based embedded hardware and software system development process, with the DE0-NanoSoC to build embedded Linux system platform.



Image stitching result

TA2-2: Intelligent Mechatronics and Application I

Session Chairs: Guoyu Zuo, Beijing University of Technology

Ying Feng, South China University of Technology

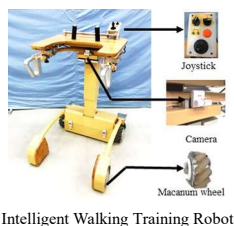
Conference Room 2, 10:30-12:00, Tuesday, 7 August 2018

TA2-2(1) 10:30-10:45

**A User's Steps Considered Motion Control Approach of an Intelligent Walking Training Robot**

Bo Shen, Shuoyu Wang  
Intelligent Robotics Lab., Kochi University of Technology, Kochi, Japan

- Omnidirectional Mobility
- A Vision-Based User's Steps Detection
- Walking Rehabilitation Trajectory Tracking Control
- Safe Walking Space Guarantee

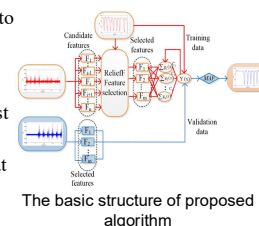


TA2-2(2) 10:45-11:00

**Angle Estimation in Wavelet Neural Network using ReliefF Selected Features of sEMG and Post Filter**

Yang Luo, Yongsheng Gao, Qiang Li, Jie Zhao  
State Key Laboratory of Robotics and System, Harbin Institute of Technology

- A wavelet neural network (WNN) to estimate the continuous wrist joint angle using the reliefF selected features of surface electromyography (sEMG) and post filter (WNN using RSF&PF).
- The comparison results suggest that WNN using RSF&PF achieves the best estimation in accuracy and speed in this work.



TA2-2(3) 11:00-11:15

**Feature Subset Discernibility Evaluation Method for Upper Limb Rehabilitation Training Based on the Discernibility of Relative Distance**

Guoyu Zuo, Zhaokun Xu, Jiahao Lu  
Beijing Key Laboratory of Computing Intelligence and Intelligent Systems, Faculty of Information Technology, Beijing University of Technology, Beijing, China

- With the increasing number of aging population in the world, the demand for rehabilitation training is increasing.
- We propose a feature subset discernibility hybrid evaluation method based on the discernibility of relative distance and support vector machine (DRD-SVM) for the feature selection problem of the rehabilitation training motion.

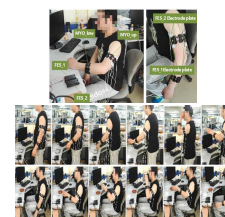


TA2-2(4) 11:15-11:30

**CPG-BMLC for Tremor Estimation in Functional Electrical Stimulation System**

Yang Luo, Yongsheng Gao, Qiang Li, Jie Zhao  
State Key Laboratory of Robotics and System, Harbin Institute of Technology

- A new algorithm named central pattern generator based band limited multiple Fourier linear combiner (CPG-BMLC) for tremor suppression is proposed.
- CPG-BMLC is programmed in functional simulation system (FES) for tremor suppression.
- Application of CPG-BMFLC in FES can indeed suppress tremor with good performance.

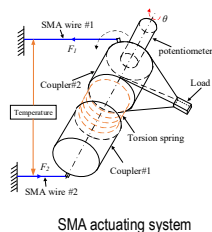


TA2-2(5) 11:30-11:45

**Dynamic Surface Control of Shape Memory Alloy Actuating Systems with Inverse Duhem Hysteresis Compensation**

Rui Li, Ying Feng, Zedong Hu  
School of Automation Science and Engineering  
Key Laboratory of Autonomous Systems and Networked Control  
South China University of Technology, Guangzhou, China

- A Duhem model with a Gaussian probability density functions is adopted to describe the hysteresis nonlinearity and an inverse of Duhem hysteresis is constructed as the feedforward compensator for the SMA actuating system
- A dynamic surface controller (DSC) is designed to ensure the output actuating performance.

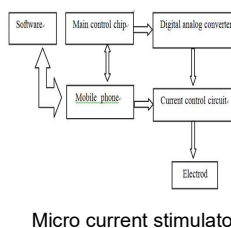


TA2-2(6) 11:45-12:00

**Design of Portable Transcranial Micro Current Depression Therapeutic Instrument**

Minghui Liang, Qiuyang Wang, Datong Chen, Dongbin Xu, Yueming Lin, Ke Zhang, Xiaodong Wang, Weibin Mu  
Qiqihar Medical University, Qiqihar, Heilongjiang Province, China

- A stimulator using transcranial micro current stimulation therapy is designed, and a main control chip is used to control the constant current generator circuit. Include one picture/graph of your work with >300 dpi resolution.
- It effectively induced the alpha brain wave which made the mood stable.
- It is used in the treatment of mental diseases such as depression, anxiety, insomnia and so on.



IEEE ICMA 2018 Conference Digest  
**TA2-3: Mechatronic Systems II**

Session Chairs: Wei Wu, Beijing Institute of Technology  
 Guo-Hua Feng, National Chung Cheng University


**Conference Room 3, 10:30-12:00, Tuesday, 7 August 2018**

TA2-3(1) 10:30-10:45

**Development of a Robot System for Applying Putty on Plastered Walls**

Xiang Li and Xin Jiang  
 Department of Electronic and Mechanical Engineering, Harbin Institute of Technology  
 Shenzhen, China

- An end effector is specially designed for the robot to flatten the wall surface.
- The method based on end-to-end artificial neural network to recognize the unevenness of the wall surface with an ordinary camera is proposed.
- Based on the unevenness status recognized by the defects detection system, the arm controller is implemented to achieve the work.
- The system is integrated and experiments conducted demonstrate the effectiveness.



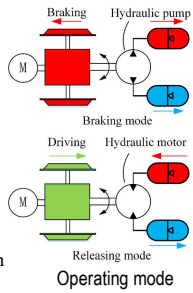
The Robot Platform : a)Actuator  
 b)UR5 c)Camera d)Moving Platform

TA2-3(2) 10:45-11:00

**An Electric-hydraulic Propulsion System for the Urban Rail Train Energy Saving**

Hui Liu, Wei Wu  
 National Key Laboratory of Vehicular, Beijing Institute of Technology  
 Beijing, China

- An electric-hydraulic propulsion system for the urban rail transit system is proposed.
- A control method of the hydraulic accumulator is proposed.
- The simulated results indicate that the energy recovery efficiency at the braking stage is more than 50%.
- The energy saving efficiency of the system at the driving stage is more than 30%.




Operating mode

TA2-3(3) 11:00-11:15

**Research on Motion Control of Mechanical Arm Based on Laser guidance**

Yajun Shi, Rongchuan Wang, Jianghai Zhao, and Xiaojian Zhang  
 Department of Automation, University of Science and Technology of China  
 Hefei, China

- Use CAN-open communication system, information is processed by upper computer.
- Laser range sensor and angles of motors are used here to obtain coordinates, as well as complex mathematical theory.
- Kinematics is used to calculate final angle of each shaft. And effective control methods are used to drive each shaft to target angle.



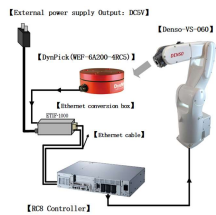
The Demolition Robot

TA2-3(4) 11:15-11:30

**An Approach of Direct Teaching Method Based on Multi-axis Force Sensor**

Lei Zhang, Kai Han and Xinzhi Liu  
 Department of Automation and Control, Ocean University of China  
 Qingdao, China

- A simple direct teaching method is proposed.
- The kinematic models of the robot is established and analyzed.
- The relationship between force and position are established.
- The experiential results validate that the control method is feasible and reliable.




System configuration

TA2-3(5) 11:30-11:45

**High Efficiency Off-line Programming for Robotic Blisk Grinding with Constant Contact Force**

Lin Chen, Huan Zhao\*, Fan Chen and Han Ding  
 State Key Laboratory of Digital Manufacturing Equipment and Technology  
 Huazhong University of Science and Technology  
 Wuhan, China

- A novel path planning method for robotic grinding with a smart force-controlled end effector is present.
- A reasonable and sparse optimizing is carried to the grinding path.
- The experimental results show that the surface roughness of the blisk blade is within Ra0.4.
- The grinding efficiency is increased nearly six times compared to traditional path planning method.




The Blisk Surface Appearance

TA2-3(6) 11:45-12:00

**Indoor Environment Intelligent Monitoring System**

Jiaqiang Li, Xiaoming Xu, Jian Cao, Wei Dai and Jinyu Zhang  
 Research Institute of Physical and Chemical Engineering of Nuclear Industry  
 Tianjin, China

- Introduction
- System Design
- System Software Design
- System Verification and Result Analysis
- Conclusion



Internal Structure of Test Nodes

**IEEE ICMA 2018 Conference Digest**  
**TA2-4: Multiple Robot Control**

Session Chairs: Dongdong Bu, Beijing Institute of Technology  
 Juan Li, Harbin Engineering University  
**Conference Room 4, 10:30-12:00, Tuesday, 7 August 2018**

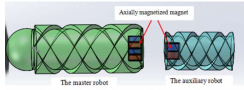
TA2-4(1) 10:30-10:45

**Design and Performance Evaluation of the Novel Multi-modular Capsule Robot**

Shuxiang Guo<sup>1</sup>, Peng Zhang<sup>1</sup>, Jian Guo<sup>1,2\*</sup>, Qiang Fu<sup>1\*</sup>, Lili Wang<sup>3</sup> and Gang Sun<sup>4</sup>

<sup>1</sup> Tianjin Key Laboratory for Control Theory & Application in Complicated Systems and Biomedical Robot Laboratory Tianjin University of Technology, Binshui Xidao 391, Tianjin, China  
<sup>2</sup> Intelligent Mechanical Systems Engineering Department, Kagawa University, Takamatsu, Kagawa, Japan  
<sup>3</sup> Internal Medicine-Oncology, Tianjin Hospital of ITCWM Naikai Hospital, Three latitude Road 122, Tianjin, China  
<sup>4</sup> Gastrointestinal Surgery, Tianjin Hospital of ITCWM Naikai Hospital, Three latitude Road 122, Tianjin, China  
 \*Corresponding Author: jianguo@tjut.edu.cn, fuqiang6369@hotmail.com

- This paper proposed the novel multi-modular robot driven by the external magnetic field. This robot system has two robots, namely the master robot and the auxiliary robot.
- The system of the robot including the driven system, video acquisition and modular docking and separation of the robots.
- The developed capsule robot can be used to improve the capsule robot system and help people do experiments in vivo in the future.



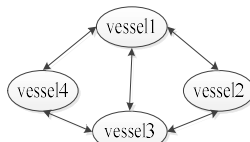
The 3D Model of multi-modular capsule robot

TA2-4(2) 10:45-11:00

**Robust Coordinated Formation Control of Multiple Vessels with Disturbance and Time Delay**

Jianxu Liu, Mingyu Fu  
 Harbin Engineering University  
 Harbin, China

- A disturbance estimator is used to estimating the disturbance.
- The undirected communication topology is constructed to represent the relation vessel of vessels.
- The stability of the disturbance estimator and the coordinated formation controller are proved by the Lyapunov theory



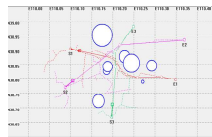
The Communication Topology

TA2-4(3) 11:00-11:15

**Multi-UAVs Cooperative Path Planning Method based on Improved RRT Algorithm**

Wei Zu, Guoliang fan, Haitao Zeng, Yang Gao, Yao Ma, Haiying Zhang  
 Institute of Automation, Chinese Academy of Sciences  
 Beijing, China

- This paper presents a cooperative path planning algorithm using improved Rapidly-exploring Random Trees (RRTs) for multiple UAVs.
- We propose an improved RRT and a cooperative path planning method by taking the maneuvering constraints and a simple and efficient path pruning method to delete redundant nodes on the path. affiliations, city and country.



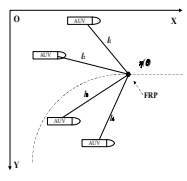
Multi-UAVs cooperative path planning with pop-up obstacles

TA2-4(4) 11:15-11:30

**Underactuated Multi-AUV Robust Formation Control Based On Virtual Leader**

LI Juan, DU XiaoZhou  
 College of Automation, Harbin Engineering University  
 Harbin, China

- Path tracking is a necessary part of the multi-AUV system.
- A multi-AUV robust formation control strategy based on virtual leader
- The virtual leader avoid the problem of formation collapse and improve the overall efficiency.




Multi-AUV formation

TA2-4(5) 11:30-11:45

**Multi-UUV Formation Coordination Control Based on Combination of Virtual Structure and Leader**

LI Juan, XUE Duorui and ZHANH Jianxin  
 College of Automation, Harbin Engineering University  
 Harbin, China

- Address the problem of formation path tracking control of multi-UUV
- It is divided into a single UUV path following control and coordinated control based on a combination of a virtual structure and a leader.
- The formation coordination control algorithm combining the virtual structure and the leader is adopted



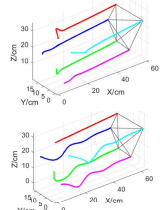
UUV Formation

TA2-4(6) 11:45-12:00

**Distance-based Formation Stabilization and Flocking Control for Distributed Multi-agent Systems**

Li Wang and Qiao Guo  
 School of Automation, Beijing Institute of Technology  
 Beijing, China

- Two novel distributed control rules for each agent only using the relative position and velocity of its neighbors are designed separately for the leaderless case and the leader-follower case.
- The algorithms ensure that multi-agent formation will convergence in target shape and consensus velocity without the collision between the agents connected.



The trajectories of the five agents in time in 3D space for the leaderless case

*IEEE ICMA 2018 Conference Digest*  
**TA2-5: Opto-electronic Element and Materials**

Session Chairs: Hongda Liu, Harbin Engineering University  
 Donghui Ma, Tsinghua University

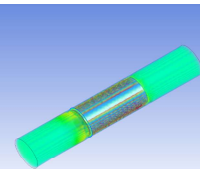
**Conference Room 5, 10:30-12:00, Tuesday, 7 August 2018**

TA2-5(1) 10:30-10:45

**Characteristic Evaluation of Shell Outlet Mechanism for a Magnetic Actuated Screw Jet Microrobot**

Zixu Wang, Shuxiang Guo and Wei Wei  
 Graduate School of Engineering, Kagawa University, Japan  
 Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science and Technology, Beijing Institute of Technology, Haidian District, Beijing 100081, China  
 Department of Intelligent Mechanical Systems Engineering, Kagawa University, Takamatsu, Kagawa 761-0396, Japan

- Series of simulations and experiments for the characteristic evaluation of a Magnetic Actuated Screw Jet Microrobot (SJM)
- The conclusion and contribution of the best characteristic of shell outlet by this paper, and make a great progress of microrobot design by analyzing the results



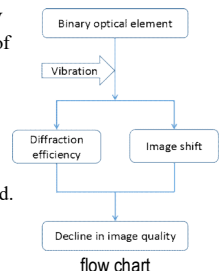
Simulation result of shell outlet mechanism

TA2-5(2) 10:45-11:00

**Effect of UAV Vibration on Imaging Quality of Binary Optical Elements**

Chao Li, Fanjiao Tan  
 Research Center for Space Optical Engineering, Harbin Institute of Technology  
 Harbin 150001, China

- This paper studies the effect of UAV vibration on the imaging capability of binary optical elements.
- First the influence of the incident angle on the diffraction efficiency was analyzed.
- Then the effect of vibration on the point spread function is also analyzed.
- Finally vibration images were simulated and factors that affect image quality were analyzed.



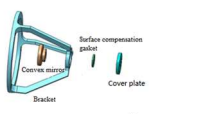
flow chart

TA2-5(3) 11:00-11:15

**Profile Detection and Surface Fitting Based on The Key Optical Components of The Seeker**

Si Wu, Xianming Li, Jun Zhou, Xue Tian, Zhun Deng, Zhong Sheng and Weibin Rong  
 State Key Laboratory of Robotics and System, Harbin Institute of Technology  
 Harbin, China

- The laser ranging sensor is used to scan the surface to obtain the data types of different specifications.
- The least square method is used to fit the data and analyze algorithm error.
- A new multi-ellipse fitting algorithm is proposed for determining the position of the fastening hole.



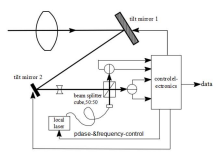
Optical component assembly diagram

TA2-5(4) 11:15-11:30

**Structure Design and Simulation Study of Dual Two-quadrant Coherent Tracking System in Free Space Optical Communication**

Rui Wang, Wenrui Zhang, Xiaodong Zeng, Changqing Cao\*, Zhejun Feng, Xu Yan, Xian Wang, Ting Wang  
 School of Physics and Optoelectronic Engineering, Xidian University  
 Xi'an, China

- Optical Heterodyne Detection Method
- Dual Perpendicular Mounted Two-quadrant Coherent Tracking Detector System
- Experimental structure design and simulation analysis




Structure diagram of dual two-quadrant detection

TA2-5(5) 11:30-11:45

**Brittle Fracture Effect on Dislocation Density of Single Crystal Germanium During Turning**

Guang Feng Shi<sup>1</sup>, Dong Dong Han<sup>2</sup>, Chao Chao Shi<sup>3</sup>, Wang Fu<sup>4</sup>  
 School of Mechanical and Electrical Engineering Changchun University of Science and Technology ChangChun, China

- Brittle fracture leads to dislocation movement resulting in residual stress in the surface layer of single crystal germanium by dislocation.
- Some movements of dislocations can be detected on the (111) crystal face of a single crystal germanium after brittle turning. By changing the grain integrity, there is no obvious regular change in surface roughness. The dislocation density increases first and then decreases with the increase of grain size.



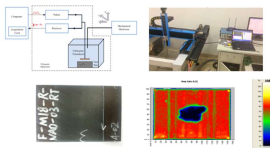
Machined Surface of single Crystal Germanium

TA2-5(6) 11:45-12:00

**Development of Phased array Ultrasonic Detection System Using a Post-processing Technique**

Xiaohui Wang<sup>[1]</sup>, Zhenggan Zhou<sup>[2]</sup>, Wentao Li<sup>[2]</sup> and Haiyan Shao<sup>[1]</sup>  
<sup>[1]</sup>Department of Mechanical Engineering, University of Jinan  
<sup>[2]</sup>School of Mechanical Engineering and Automation, Beihang University

- An ultrasonic testing system has been established using phased array probes and post-processing technique.
- Full Matrix Capture (FMC) and practical implementation of post-processing algorithm TFM were presented.
- The experimental detecting process and system have been designed and the testing results of composite material part are presented.



Experimental setup of ultrasonic inspection system and detecting results

**TA2-6: Biomimetic Measurement and Control in Robotics**

Session Chairs: Keigo Watanabe, Okayama University

Nagata Fusaomi, Sanyo-onoda City University (Tokyo University of Science, Yamaguchi)

**Conference Room 6, 10:30-12:00, Tuesday, 7 August 2018**

**TA2-6(1) 10:30-10:45**

**Outline Font Handler for Industrial Robots**

Fusaomi Nagata<sup>1</sup>, Yuta Seda<sup>1</sup>, Kosuke Hamada<sup>1</sup>, Shintaro Suzuki<sup>1</sup>, Akimasa Otsuka<sup>1</sup>, Takeshi Ikeda<sup>1</sup>, Hiroaki Ochi<sup>1</sup>, Keigo Watanabe<sup>2</sup>, Maki K. Habib<sup>3</sup>, Takamasa Kusano<sup>4</sup>

<sup>1</sup>Sanyo-onoda City University, <sup>2</sup>Okayama University, <sup>3</sup>American Univ. in Cairo, <sup>4</sup>SOLIC Co. Ltd.

- Outline font handler is proposed for three types of industrial robots.
- Without conventional teaching process, the handler can produce desired trajectories from outline fonts based on a spline interpolation approach.
- A promising CAD/CAM interface between commercially-provided industrial robots and widely-used design tools such as Illustrator and Photoshop is established.



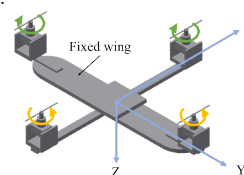
Engraving scene of an outline font

**TA2-6(2) 10:45-11:00**

**Transitional Flight Simulations for a Tilted Quadrotor with a Fixed-wing**

Yoshikazu Nakamura, Atsushi Arakawa, Keigo Watanabe, and Isaku Nagai  
Mechatronics Systems Lab., Okayama University  
Okayama, Japan

- Development a Quadrotor equipped with four tilt-rotors and a fixed-wing.
- Hovering when each rotor are upward direction.
- Level flight by tilt-rotors and a fixed-wing.
- Transition flight to move from a hovering to a level flight.
- It is verified by simulation that the airframe can perform a transition flight.



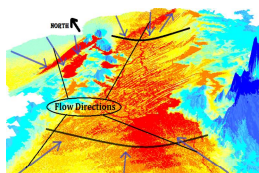
A Tilted Quadrotor with a Fixed-wing

**TA2-6(3) 11:00-11:15**

**The Detection of Flow Directions of Surface Waters using ArcGIS software**

Dembélé Abdramane, Ye Xiufen and Touré Amadou  
Biomimetic micro robot and system Lab., Harbin Engineering University, China  
College of Forestry, Northeast Forestry University, China

- The use GIS approaches (Geometrical interval and profile interpolation) to determine the flow directions of surface water.
- Areas classification by altitudes through "geometrical interval".
- Create the longitudinal profiles through "profile interpolation".
- Determination of flow directions of surface waters and flood areas.



The Inner Delta of Niger

**TA2-6(4) 11:15-11:30**

**Control of Attitude Angle for a Tilted Quadrotor**

Atsushi Arakawa, Tomohiko Hasegawa, Keigo Watanabe and Isaku Nagai  
Graduate School of Natural Science and Technology, Okayama University  
Okayama, Japan

- The tilted quadrotor is an aircraft with tilt mechanisms mounted on four rotor parts.
- Vertical and level flight mode are realized by changing the angle of the tilt mechanism.
- Attitude control using PD control method in each flight mode is verified by the real machine experiments.



The Tilted Quadrotor

**TA2-6(5) 11:30-11:45**

**Production of a Wall-climbing-type Quadrotor and Its Experiment for Verifying Basic Operations**

Keigo Watanabe, Takanori Nakatsuka, and Isaku Nagai  
Okayama University, Okayama, Japan

- A wall-climbing-type Quadrotor, which can make a hammering test as well as a visual inspection, is proposed.
- The design and production of a wall-climbing-type Quadrotor is described.
- Some operational experiments are conducted to demonstrate the usefulness of the proposed UAV.



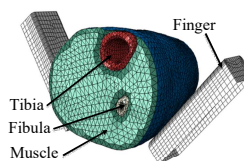
Manufactured Quadrotor

**TA2-6(6) 11:45-12:00**

**Biomechanical Study of Human Limbs under a Robot Hand Manipulation Using Finite Element Analysis**

Haihong Gan<sup>1</sup>, Xueyong Li<sup>1</sup>, Changhou Lu<sup>1</sup>, Wanming Zhang<sup>2</sup>, Yonghui Wang<sup>3</sup>  
1 Key Laboratory of High Efficiency and Clean Mechanical Manufacture of MOE, School of Mechanical Engineering, Shandong University, Jinan, China  
2 Medical Imaging Center, Second Hospital of Shandong University, Jinan, China  
3 Department of Physical Medicine and Rehabilitation  
Qilu Hospital, Shandong University, Jinan, China

- It should not be adopted that the angle between two fingers is 0°.
- In the research, it is best option that the angle between two fingers is 20°.
- The grasping force should be controlled in the vicinity of "the minimum value".



The FE Model



IEEE ICMA 2018 Conference Digest  
**TA2-7: Control Theory and Application IV**

Session Chairs: Ruijie Sun, Northwestern Polytechnical University  
 Xiaoping Zhu, UAV Research Institute Northwestern Poly Technical University  
 Conference Room 7, 10:30-12:00, Tuesday, 7 August 2018

TA2-7(1) 10:30-10:45

**Research on UUV Fixed-point Hovering Control Based on Model Predictive Control**

Jian Xu, Shuang Wang, Xingyu Zhou  
 Harbin Engineering University  
 Harbin, Heilongjiang Province, China

- The unmanned underwater vehicle (UUV) fixed-point hovering control provides the important technical foundation for various military and civilian applications of UUV.
- The model predictive control algorithm is based on continuous system design to avoid the discretization of nonlinear system.
- Given performance index, the Taylor series expansion and Lie derivative are used to solve the optimal control law under the continuous time state.

sway response

TA2-7(2) 10:45-11:00

**Research on UAV Simulation Training System Based on Visual Simulation**

Wang Ting Ting, Bai Bing, Yuan Yi Fang, and Zhu Yong Wei  
 Beijing Key Laboratory of UAV Autonomous Control, Beijing Institute Of Technology  
 Beijing, China

- Strong visibility. Visual simulation can construct a real environment close to reality, to enhance the sense of environmental immersion and achieve near-realistic training effects.
- Safe and controllable. Realize the training function for routine operations and handling of various accidents.
- The UAV model can be simulating verified.

System Schematic Diagram

TA2-7(3) 11:00-11:15

**Longitudinal Flight Quality Analysis of Small Diamond Wing Configuration UAV**

Ruijie Sun<sup>1</sup>, Zhou Zhou<sup>1</sup>, Zhu Xiaoping<sup>2</sup>, Wang Rui<sup>1</sup> and Guo An<sup>1</sup>  
 1.School of Aeronautics, 2.UAV Research Institute, Northwestern Polytechnical University  
 Xi'an City, Shaanxi Province, China

- The calculation of aerodynamic and modal characteristics is the basis of flight quality research.
- The rationality of flight quality evaluation is researched by adding the stabilization control system, and the flight quality characteristics of the small diamond wing configuration UAV at different altitudes are analyzed.
- A gust load alleviation (GLA) control system is designed according to the method of second-order system, and the flight quality of the small diamond wing configuration UAV in the '1-cos' longitudinal discrete wind gust model is analyzed.

Diamond wing configuration sensor aircraft

TA2-7(4) 11:15-11:30

**Modelling and Control of a Novel Hydraulic Hybrid Vehicle with Wheel Motors**

Haicheng Zhou, Zhaoping Xu, Liang Liu, Dong Liu and Lingling Zhang  
 School of Mechanical Engineering, Nanjing University of Science and Technology  
 Nanjing, China

- A novel hydraulic hybrid vehicle with wheel motors is designed to improve fuel economy.
- Control scheme of the proposed vehicle is designed and a forward simulation model is built.
- Vehicle performance is analyzed under the JC08 cycle.
- The simulation results show that vehicle fuel economy is improved about 29.27%.

A Novel Hydraulic Hybrid Vehicle with Wheel Motors

TA2-7(5) 11:30-11:45

**Study on Vibration and Crack Propagation Control of Cracked Asymmetric Rotor Based on Three-Dimensional Finite Element Model**

Rong Hu, Jun Liu, Jianen Chen, Xiaofeng Wang and Weimin Ge  
 Tianjin Key Laboratory of the Design and Intelligent Control of the Advanced Mechanical System, Tianjin University of Technology  
 Tianjin, China

- Finite element modeling of rotor with an asymmetric shaft and a transverse crack.
- The vibration characteristics of the asymmetric rotor and the cracked asymmetric rotor in different crack locations by numerical simulation.
- The effects of unbalance mass and rotational speed on the breathing behaviour of the cracked rotor.

The Aero-engine Rotor

TA2-7(6) 11:45-12:00

**Finite-time stability analysis of linear time-varying systems: A numerical algorithm**

Zhihua Chen, Yongchun Xie  
 Beijing Institute of Control Engineering  
 Beijing, China

- This paper investigates the finite-time stability (FTS) of continuous LTV systems under the perspective of numerical computation.
- The paper proposes a sufficient condition to guarantee the FTS of continuous LTV systems.
- A novel numerical algorithm for analyzing the FTS of continuous LTV systems is designed by using quadratic programming.

FTS discussed in this paper

*IEEE ICMA 2018 Conference Digest*  
**TP1-1: Signal and Image Processing III**

Session Chairs: Chengtao Cai, Harbin Engineering University

Enzeng Dong, Tianjin University of Technology

**Conference Room 1, 13:30-15:00, Tuesday, 7 August 2018**

TP1-1(1) 13:30-13:45

**Moving targets detection based on improved single Gaussian background model**

Enzeng Dong, Bo Han, Xiao Yu, Shengzhi Du  
 Complex System Control Theory and Application Key Laboratory  
 Tianjin University of Technology, Tianjin, China

- Firstly, the improved model adopts adaptive background learning rate.
- Secondly, the improved model uses a new update strategy of Gaussian background model,
- Finally, the moving targets are detected according to the principle of Gaussian distribution and the image morphology filtering.



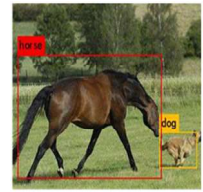
The traffic video image

TP1-1(2) 13:45-14:00

**An Improved Convolution Neural Network for Object Detection Using YOLOv2**

Enzeng Dong, Yanfang Zhu, Yuehui Ji, Shengzhi Du  
 Complex System Control Theory and Application Key Laboratory, Tianjin University of  
 Technology, Tianjin, China

- A  $1 \times 1$  convolutional layer is added to improve the detection accuracy.
- The output sizes of several layers are changed from  $13 \times 13$  to  $26 \times 26$  to extract more features from multi-pixels image.
- Improved model has higher accuracy on detecting small objects.



YOLO Detection System

TP1-1(3) 14:00-14:15

**The Optimal Scrambling Algorithm Based on Zigzag and Affine Transformation**

Hui Wang, Yukun Hu, Lijun Yu and Qiang Wang  
 College of Automation, Harbin Engineering University, Harbin, 150001, China

- This paper proposed a scrambling algorithm combined Zigzag with Affine transformation.
- Four new algorithms are proposed during the process according to the different order and the different way it circulates.
- Finally get the optimal scrambling algorithm and it has the advantages of low time complexity and easy to realize. It has a good scrambling effect and is hard to crack.



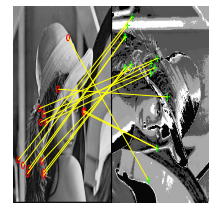
The original image and the best effect

TP1-1(4) 14:15-14:30

**Feature Points Extraction and Matching Based on Improved Surf Algorithm**

Wei Chen, Qian Cao  
 Qingdao University of Science and Technology  
 Qingdao, China

- In order to reduce the mismatch, SURF algorithm is improved in this paper.
- Based on the original algorithm, the RANSAC algorithm which reduces mismatch is added.
- The experimental results show that the improved SURF algorithm can reduce mismatch significantly, and the matching accuracy of the algorithm is improved effectively.



The Sony Aibo Dog

TP1-1(5) 14:30-14:45

**Research on Mean Shift Tracking Algorithm Base on Significant Features and Template Updates**

Hui Wang, Xue Zhang, Lijun Yu, Xueying Wang  
 College of Automation, Harbin Engineering University, Harbin 150001, China

- The proposed algorithm uses the improved Significant Features to replace the traditional color feature
- In the tracking process, a decision method based on the variance size is used to dynamically determine the target model update strategy.
- Compared original algorithm, the improved Mean Shift algorithm has smaller tracking error and stronger robustness.



The Original Algorithm



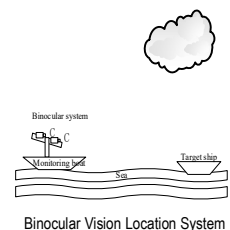
The Improved Algorithm

TP1-1(6) 14:45-15:00

**Binocular Vision Location with Swing Compensation Based on Fisheye Lens**

Chengtao Cai, Boyu Wang and Yueyuan Zhou  
 College of Automation, Harbin Engineering University  
 Harbin, China

- A binocular fisheye visual positioning method with added swing compensation.
- Under Matlab and OpenCV, the camera is calibrated using an improved algorithm.
- The system's image processing module correct and process the image
- Calculate the target's physical coordinates through tilt compensation.



TP1-2: Intelligent Mechatronics and Application II

Session Chairs: Dapeng Tian, Changchun Institute of Optics, Fine Mechanics and Physics  
Shijun Wang, Shanxi University

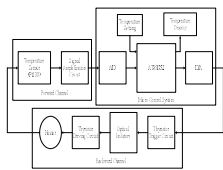
Conference Room 2, 13:30-15:00, Tuesday, 7 August 2018

TP1-2(1) 13:30-13:45

**Design of Temperature Intelligent Control System based on Transcranial Micro Current Depression Therapeutic Instrument**

Datong Chen<sup>1</sup>, Minghui Liang<sup>1\*</sup>, Yueming Lin<sup>1</sup>, Dongbin Xu<sup>1</sup>, Ke Zhang<sup>3</sup>, Xiaodong Wang<sup>1</sup>, Weibin Mu<sup>1</sup>, Qiuyang Wang<sup>2</sup>  
Qiqihar Medical University, Qiqihar, Heilongjiang Province, China

- The temperature control system designed is mainly based on microcontroller-AT89S52, using sub-PID control algorithm, to achieve accurate temperature measurement and control.
- This system is mainly composed of temperature sensor, signal conversion and conditioning circuits, A / D module, micro-controller, D / A module, temperature buttons circuit, data display module, thyristor trigger circuit, optical isolators, crystal Gateway tube drive circuit and implementation agencies.
- The test results show the temperature control system designed can achieve a more accurate measurement of temperature and runs stably.



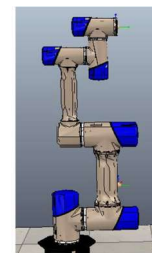
System Overall Design

TP1-2(2) 13:45-14:00

**Development of Hardware-in-Loop Simulation Platform for Collaborative Robots Based on LinuxCNC and V-rep**

Li Tongtong, Yang Tao, Yang Zelin, Liu Shuxuan, Li Jianming  
Beijing Institute of Precision Mechanical and Electrical Control Equipment  
Beijing, China

- Use real robot control system:
  - Control frequency: 1KHZ.
  - Supports EtherCAT standard servo and I/O devices.
  - Real-time, modular, intelligent, general-purpose, and low-cost.
- Use a simulated robot model as a controlled object in V-rep.
- Realized the kinematics algorithm and validated dynamic algorithm through hardware-in-loop simulation.



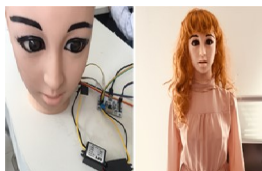
Simulation model in V-rep

TP1-2(3) 14:00-14:15

**Design of Integrated Vision and Speech Technology For a Robot Receptionist**

Linjian Sun, Ye Zhang, Xuling Chang, and Jijia Xu  
Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences  
Changchun, China

- The robot receptionist system consists of several independent functions modules.
- Driven by deep learning, visual recognition tasks have made remarkable progress.
- The robot receptionist integrates face recognition, human-computer interaction and facial expression display.
- We construct a experimental system to realize our design.



The robot receptionist

TP1-2(4) 14:15-14:30

**A new improved combined model algorithm for the application of photovoltaic power prediction**

Shijun Wang<sup>1</sup>, Chang Ping<sup>1</sup>, Guobin Xue<sup>1</sup>, Dinggang Wang<sup>2</sup> and Tao Jiang<sup>2</sup>  
1. Technology Research Institute of Gansu Electric Power Company,  
2. Electric Transmission & Transformer co. LTD of Gansu Electric Power Company  
Lanzhou, Gansu Province, China

- According to the simulation results of BP algorithm and ARMA algorithm, we know that the BP algorithm results are more accurate.
- Combining BP algorithm and ARMA algorithm to get combined algorithm model, he has better accuracy

Comparison of error indices between three models			
	ARMA algorithm	BP neural network	combination algorithm
MAE	2.0678	1.9979	0.8961
MAPE	0.2424	0.0700	0.1279
RMSE	2.4943	2.5990	1.2293
PCC	0.9454	0.9763	0.9957

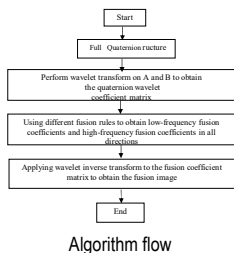
Comparison of error indices between three models

TP1-2(5) 14:30-14:45

**Full Quaternion based Color Image Fusion**

Yong Wang, Hongqi Liu  
College of Communication Engineering, Jilin University,  
No.5372, Nanhu Road, Changchun City, Jilin Prov, China,  
130012

- Step 1: Quaternion description.
- Step 2: Set parameters.
- Step 3: Deal with the high-frequency and low-frequency wavelet coefficients which obtained from each layer in the decomposed layers.
- Step 4: Select the coefficients.
- Step 5: Inverse transform, evaluate the fusion results.



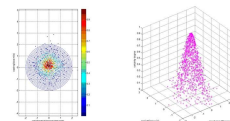
Algorithm flow

TP1-2(6) 14:45-15:00

**Reliability Assessment on Landmark Fixing Operation Based on Cloud Model**

Bing Wu and Wei-xing Xia  
Naval Submarine Academy  
Qingdao, Shandong Province, China

- The three digital features are obtained through reverse cloud algorithm, which reflects the personnel operation level and the dispersion degree and stability of the operation.
- The personnel operation can be imitated through forward cloud algorithm so as to obtain the simulated cloud chart of actual operation point.



Cloud Model

IEEE ICMA 2018 Conference Digest  
**TP1-3: Mechanism & Design**

Session Chairs: Yi Liu, Kagawa University  
 Qinxue Pan, Beijing Institute of Technology

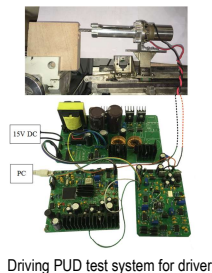
**Conference Room 3, 13:30-15:00, Tuesday, 7 August 2018**

TP1-3(1) 13:30-13:45

**Development of a Percussive Ultrasonic Drill Driver**

Qiquan Guan, Aimaity Bulading, Zhijun Zhao, Deen Bai, Dewei Tang, Zongquan Deng  
 State Key Laboratory of Robotics and System., Harbin Institute of Technology  
 Harbin, China

- Converts 15 V DC to 200 V<sub>P-P</sub> sinusoidal signal.
- Combine maximum current method and phase-locked loop method to realize frequency tracking.
- Change the locked phase and the speed of frequency adjustment during driving.
- Driving characteristics were tested and analyzed under different conditions.

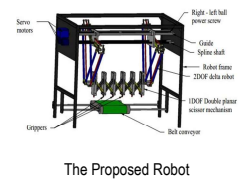


TP1-3(2) 13:45-14:00

**Conceptual Design and Kinematic Analysis of a Novel Open Field 3DOF Multi-Gripper Pot Seedlings Transplanting Robot**

Isaac Ndawula and Samy F. M. Assal  
 Mechatronics and Robotics Department, Egypt-Japan University of Science and Technology  
 New Borg El Arab, Alexandria, Egypt

- Pot seedlings transplanting is labour intensive, time consuming and needs high precision.
- A novel open field 3DOF multi-gripper pot seedlings transplanting robot is proposed.
- Conceptual design, kinematics analysis and optimal dimensional synthesis, workspace analysis and trajectory planning of the proposed robot were carried out.
- Simulation results indicates 6 seedlings per single transplanting cycle can be archived in 1.8 seconds.

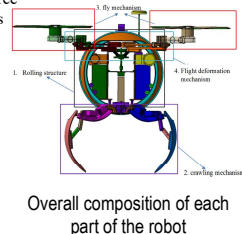


TP1-3(3) 14:00-14:15

**Design and Implementation of a Multi-Movement Spherical Robot**

Mengjie Zhang, Bo Chai, Lijuan Cheng, Zhaowu Sun, Guang Yao and Lei Zhou\*  
 Harbin Institute of Technology (Shenzhen)  
 Shenzhen, Guangdong, P.R. China

- By combining the four-legged crawling, the wheel-rolling, and the four-rotor-flying those three kinds of movement methods, a spherical robot is designed that can climb, roll, and fly.
- The deformation mechanism is designed to deform the structure according to the posture requirements
- In the environment of ROS and Gazebo, the motion state of spherical robot is analyzed comprehensively.



TP1-3(4) 14:15-14:30

**Robotic Compliant Grinding for Complex Blisk with an Intelligent End-Effector**

Dingwei Li, Fan Chen\*, Huan Zhao, and Han Ding  
 State Key Laboratory of Digital Manufacturing Equipment and Technology,  
 Huazhong University of Science and Technology  
 Wuhan, China

- A home-designed intelligent end-effector
- The combine of active compliance and passive compliance
- A PID controller is implemented for contact force control
- The surface roughness is less than 0.4 μm, the steady state error of the controlled force is about 0.3 N, and the force fluctuation is within 1 N



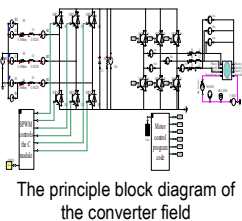
Robotic Compliant Grinding for Complex Blisk

TP1-3(5) 14:30-14:45

**A Coupling Simulation of Converter Field Circuit for Permanent Magnet Synchronous Motor Based on Simplorer and Maxwell**

Yibin Li, Jian Zhou, Haipeng Geng, Tingchen Du, Jigang Zhang and Hao Lv  
 State Key Laboratory for Strength and Vibration of Mechanical Structures  
 Xi'an Jiaotong University  
 Xi'an, China

- Establish the mathematical model of PMSM and then create a PMSM finite element model in Maxwell
- Establish rectifier and inverter main circuit, rectifier and inverter side C module control program in Simplorer
- give the results based on Simplorer and Ansoft Maxwell, PMSM inverter field-circuit coupling for the joint simulation

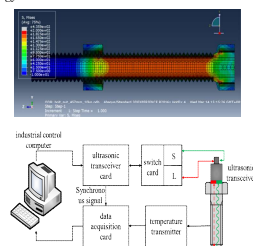


TP1-3(6) 14:45-15:00

**Reliability Evaluation of Stress in the Direction of Thickness Based on Ultrasonic Measurement Method**

Kun Zhou<sup>1,2</sup>, Qinxue Pan<sup>3</sup>, Chang Shao<sup>3</sup>, Ruipeng Pan<sup>3</sup>  
<sup>1</sup>School of Reliability and System Engineering, Beihang University  
<sup>2</sup>Southwest Technology and Engineering Research Institute, Chongqing Engineering Research Center for Environmental Corrosion and Protection  
<sup>3</sup>Key Laboratory of Fundamental Science for National Defense for Advanced Machining Technology, Beijing Institute of Technology

- On the basis of ultrasonic measurement, it proposed a reliability evaluation method for stress in the direction of thickness .
- The detection system is constructed to carry out the tensile tests with bolts of three kinds of material including stainless steel (SUS304), low-carbon steel (0.12%C) and medium-carbon steel(0.45%C).
- The experiment results show that When the stress increases to over 100MPa, the relative error is less than 5%, which proves the validity of this evaluation method.



Session Chairs: Guohong Li, Tianjin University of Technology

Huiming Xing, Beijing Institute of Technology

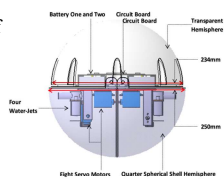
Conference Room 4, 13:30-15:00, Tuesday, 7 August 2018

TP1-4(1) 13:30-13:45

### The Structure Improvement and Stability for an Amphibious Spherical Robot

Zheng Liang<sup>1</sup>, Shuxiang Guo<sup>2,3</sup>, Shuoxin Gu<sup>1</sup>  
<sup>1</sup>Graduate School of Engineering, Kagawa University,  
 Takamatsu, Kagawa 761-0396, Japan

- The new design adopts the vertical installation method. The direction of the water spraying device can be arbitrarily controlled by using the servo motor drive shaft.
- According to the obtained pressure data, we will simulate the pressure of the robot under ten meters of under water, and carry out ANSYS software stress test.



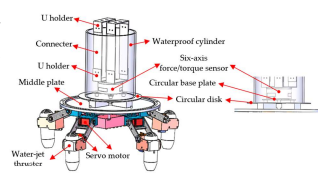
Spherical Amphibious Robot

TP1-4(2) 13:45-14:00

### Performance Evaluation of a Multi-Vectored Water-Jet Propellers Device for an Amphibious Spherical Robot

Huiming Xing<sup>1,2</sup>, Shuxiang Guo<sup>1,2,3\*</sup>, Liwei Shi<sup>2,3\*</sup>, Xihuan Hou<sup>1,2</sup>, Yu Liu<sup>2</sup>, Huikang Liu<sup>2</sup>  
<sup>1</sup>School of Automation, Beijing Institute of Technology, No.5, Zhongguancun South Street, Haidian District, Beijing 100081, China  
<sup>2</sup>Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, Beijing Institute of Technology, Beijing, China  
<sup>3</sup>Faculty of Engineering, Kagawa University, Kagawa, Japan

- To improve the performance of an amphibious spherical robot(ASR), a multi-vectored water-jet propellers system (MVWPS) was designed for ASR-IV.
- In order to get the propulsive effect of MVWPS in advance, a experimental testing mechanism using a six-axis force/torque sensor was proposed to measure all six components of force and torque.



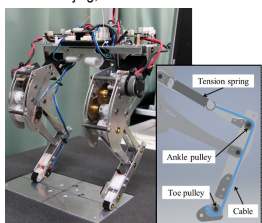
The experimental testing mechanism of MVWPS.

TP1-4(3) 14:00-14:15

### Introduction of Toe Mechanism with Bi-articular Tendon into Legged Robot

Kanako Kurokawa<sup>1</sup>, Ryuki Sato<sup>1</sup>, Shuma Hiasa<sup>1</sup>, Aiguo Ming<sup>1,2</sup>, Fei Meng<sup>2</sup>, Huaxin Liu<sup>2</sup>, Xuxiao Fan<sup>2</sup>, Xuechao Chen<sup>2</sup>, Zhangguo Yu<sup>2</sup> and Qiang Huang<sup>2</sup>  
<sup>1</sup>The University of Electro-Communications, Tokyo, Japan  
<sup>2</sup>Beijing Institute of Technology Beijing, China

- The bio-inspired toe mechanism with the bi-articular tendon system has been developed.
- The proposed mechanism consists of a tension spring and a cable between the ankle and toe joints.
- Design parameters have been determined through the jumping simulation.
- A prototype of the biped robot has been developed and the effectiveness of the toe mechanism is shown through vertical jumping experiments.



The Legged Robot with a Toe Mechanism

TP1-4(4) 14:15-14:30

### Hydrodynamic Analysis of a Novel Thruster for Amphibious Sphere Robots

Xihuan Hou, Shuxiang Guo, Liwei Shi, Huiming Xing, Shuxiang Su, Zhan Chen  
 Yu Liu, Huikang Liu  
 Key Laboratory of Convergence Medical Engineering System and Healthcare Technology,  
 Beijing Institute of Technology, Beijing, China

- Utilize Computational Fluid Dynamics (CFD) to simulate hydrodynamic behavior of the new thruster.
- Analyze the thrust force of the new thruster with different rotating velocity and inlet velocity.
- Provide foundation for the mathematical model building



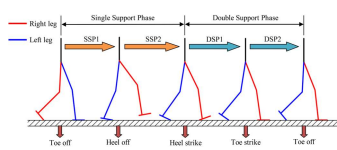
Mesh of new thruster

TP1-4(5) 14:30-14:45

### Development of a Complete Multi-phase Dynamics Model for a Biped Robot

Yixiang Liu, Xizhe Zang, Xinyu Zhou, and Yubin Liu  
 State Key Laboratory of Robotics and System, Harbin Institute of Technology  
 Harbin, China

- A complete multi-phase dynamics model for a biped robot is developed.
- Both the single support phase and double support phase are divided into two sub-phases by taking into consideration the rotation of stance foot around its toe and the rotation of swing foot around its heel.



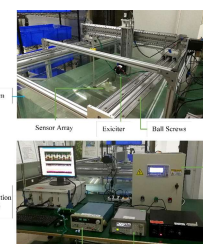
One gait cycle of the biped robot model

TP1-4(6) 14:45-15:00

### Design and Development of an Experimental Device for Underwater Target Recognition Based on Bionic Lateral Line

Xiande Zheng, Yong Zhang, Mingjiang Ji, Ying Liu, Xin Lin, Jing Qiu and Guanjun Liu  
 Science and Technology on Integrated Logistics Support Laboratory, National University of Defense Technology, Changsha, Hunan 410073, China

- The experimental device consists of five parts: cross-shaped sensor array, motion control system, vibration system, signal acquisition system and the aquarium.
- To validate the performance of the experimental device, we did an experiment to recognize underwater target in three-dimensional space, coalescent with the Generalized Regression Neural Network.



TP1-5: Element, Structures and Mechanisms I

Session Chairs: Dongdong Bu, Beijing Institute of Technology

Lihua Wang, Inner Mongolia University for the Nationalities

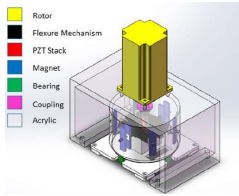
Conference Room 5, 13:30-15:00, Tuesday, 7 August 2018

TP1-5(1) 13:30-13:45

### Design and Testing of a New Rotary Piezoelectric Energy Harvester for Wind Energy Harvesting

Zehao Wu and Qingsong Xu  
Department of Electromechanical Engineering, University of Macau  
Macao, China

- A new compact rotary energy harvester is designed for harvesting renewable energy from wind flow
- It is composed of a rotor, permanent magnets, flexure mechanism, and piezoelectric stack
- Experiment results show that the proposed harvester provides a more compact design with larger power output than existing work



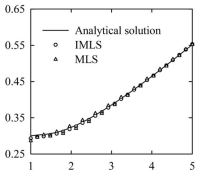
CAD model of the energy harvester

TP1-5(2) 13:45-14:00

### Meshless Interpolating Moving Least Square Mixed Collocation Method for Elasticity Problem

Hongjun Zhang, Linfang Qian, Jin Huang and Guangsong Chen  
School of Mechanical Engineering, Nanjing University of Science and Technology  
Nanjing, China

- A new interpolating moving least square (IMLS) method is proposed which has the properties of moving least square (MLS) and the radial basis function (RBF).
- The polynomial and the RBF are combined.
- The diffuse derivatives instead of full derivative are applied for the derivatives of shape functions.
- Show examples on elasticity problems.



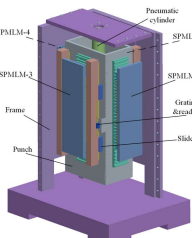
A horizontal displacement in an example for the two methods

TP1-5(3) 14:00-14:15

### Design and Analysis of A Novel Stator Permanent Magnet Linear Motor Drive Mechanical Press

Jintao Liang, Xiaopin Ji, Weijing Gong and Wenbo Wang  
School of Mechano-electronic Engineering, Xidian University  
Xi'an, Shaanxi Province, China

- A four-sides stator permanent magnet linear motor (SPMLM) direct drive mechanical press is designed.
- Electromagnetic FEA is conducted to optimize force performance and obtain design specification.
- Thermal characteristics is researched through electromagnetic thermal coupling FEA.
- Field-circuit coupling is conducted to simulate the dynamic performance.



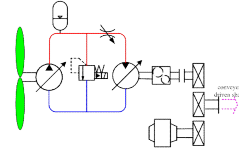
The SPMLM drive press

TP1-5(4) 14:15-14:30

### Analysis on Energy-saving Technology of Oil Field Pumping Unit

Chunyou Zhang, Liang Wang\*  
School of Automation Science and Electrical Engineering, Beihang University, Beijing, China

- Structure improvement
- Non-beam pumping unit
- Energy-saving motor
- Adopt advanced control technology
- Use new energy to realize energy saving



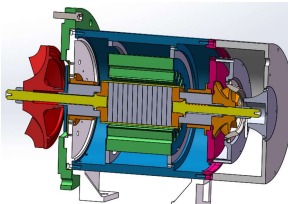
Torque Coupling Transmission

TP1-5(5) 14:30-14:45

### Analytical Solution of Armature Magnetic Field in Permanent Magnet Motors

Jigang Zhang, Jian Zhou, Yibin Li, Baisong Yang, Yanyan Zhang and Lie Yu  
Key Laboratory for Strength and Vibration of Mechanical Structures, Xi'an Jiaotong University  
Xi'an, Shaanxi Province, China

- A method for making the armature magnetic field analysis more accurate --- Analytical solution of armature magnetic field.
- It can also be derived further analytical solution of the load magnetic field, and then the entire motor magnetic field analysis.



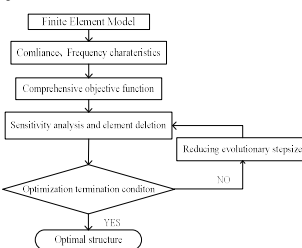
Permanent Magnet Motors

TP1-5(6) 14:45-15:00

### A novel multiobjective topology optimization method for suppressing vibration

Lihua Wang, Chunyou Zhang, and Weijin Gao  
College of Mechanical Engineering, Inner Mongolia University for the Nationalities,  
Tongliao, China

- Evolutionary Structural Optimization and Sensitivity Error Analysis
- ESO-SIMP Method
- Sensitivity Filtering Approach
- Numerical Experiment



The flow diagram for ESO-SIMP topology optimization

IEEE ICMA 2018 Conference Digest  
**TP1-6: Space and Telerobotics**

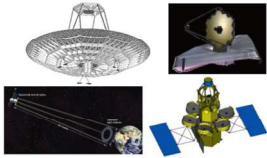
Session Chairs: Baosen Du, Beijing Institute of Precise Mechanics and Controls  
 Liang Zheng, Kagawa University  
**Conference Room 6, 13:30-15:00, Tuesday, 7 August 2018**

TP1-6(1) 13:30-13:45

**Status and Trends of the Large Aperture Space Optical Remote Sensor**

Jiang Guo<sup>1,2\*</sup>, Ji Zhao<sup>1,3</sup>, Lei Zhu<sup>2</sup> and Dapeng Gong<sup>2</sup>  
<sup>1</sup>College of Mechanical Science and Engineering, Jilin University, Changchun, China  
<sup>2</sup>Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China  
<sup>3</sup>Northeastern University, Shenyang, China

- Introduce the current situation of large aperture remote sensors.
- Discuss the key technologies of large aperture remote sensors.
- Give the right development direction of large aperture optical remote sensor in China



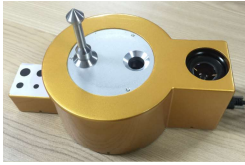
Large Aperture Space Optical Remote Sensors

TP1-6(2) 13:45-14:00

**Design and Analysis of Space Docking Mechanism for On-orbit Assembly with application to Space Telescope**

Yang Yu, Zhenbang Xu, Yaoyu Lv, Chunyang Han, Junpei He, Kai Wang, Ce Xu, Huo Qi  
 Innovation Lab. of Space Robot System, Changchun Institute of Optical, Fine Mechanics and Physics, Chinese Academy of Science, Changchun, China

- The small space docking mechanism is presented.
- The structural design is introduced in detail and the main components are analyzed by FEM
- The visual capturing method based on object identification is studied.
- The docking experiment is performed and the docking errors are tested.




The Docking Mechanism

TP1-6(3) 14:00-14:15

**A Teleoperation Framework of Hot Line Work Robot**

Xiaoming Mai<sup>1</sup>, Jiangcheng Chen<sup>2</sup>, Yang Wang<sup>1</sup>, Sheng Bi<sup>2</sup>, Yu Cheng<sup>2</sup>, Ning Xi<sup>2</sup>  
<sup>1</sup>Department of Artificial Intelligence and Robotics, The Guangdong Electric Power Research Institute of Guangdong Power Grid Corporation, Guangzhou, China  
<sup>2</sup>Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR

- The design concept of the hot line work robot system and the teleoperation framework are presented.
- The methods of robotic arm control, manually operation, visual based automatic operation are detailed introduced.
- A preliminary teleoperation testbed in lab is setup and the manually operation test is conducted.




Screenshots of the manually operation task

TP1-6(4) 14:15-14:30

**A Dimension Reduced Ground Test Method of Dual-arm Space Robot for On-orbit Assembly**

Baosen Du, Jiayu Liu, Zelin Yang, Yanbo Wang\*, Tao Deng  
 Beijing Institute of Precise Mechatronics and Controls(The 18th Institute) Beijing, China

- Ground test method for dual-arm space robot.
- Dynamic gravity compensation mechanism based on air bearing.
- A novel dimension reduced model is built for dynamics equivalence.



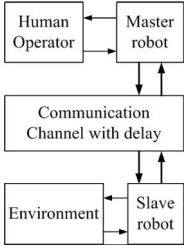
The Dual-arm Robot

TP1-6(5) 14:30-14:45

**Adaptive Terminal Sliding Mode Control for Time-delay Teleoperation with Uncertainties**

Shan Liu, Wenfeng Zheng, and Bo Yang  
 School of Automation Engineering, University of Electronic Science and Technology of China Chengdu, Sichuan, China

- An adaptive terminal sliding mode bilateral controller is proposed to solve uncertainty and finite convergence problem in a class of teleoperation systems with constant time-delay.
- The control laws are designed based on the terminal sliding mode control.
- The radial basis function neural network is used to model the uncertain items, weights of which are estimated using a designed adaptive law.



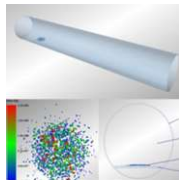
The teleoperation system

TP1-6(6) 14:45-15:00

**Study on Adhesion Effect of Martian Dust to Spacecraft Based on DEM-CFD Technology**

Pingping Xue, Xuyan Hou, Zhaoji Yu\*, Yuetian Shi, Xiaoshan Rao  
 School of Mechatronics Engineering, Harbin Institute of Technology Harbin City, Heilongjiang Province, China

- Analyze the mechanical properties of Martian dust, simulated Martian dust and established the discrete element model of Martian dust.
- Analyze the effect of Martian dust on spacecraft under different turbulence models in DEM-CFD model.
- Study the influence of various parameters on the critical start-up speed of Mars dust.



Adhesion model of Martian dust

IEEE ICMA 2018 Conference Digest  
**TP1-7: Control Theory and Application V**

Session Chairs: Tianyi Ma, Beijing Institute of Graphic Communication  
 Hui Wang, Beijing Information Science&Technology University  
**Conference Room 7, 13:30-15:00, Tuesday, 7 August 2018**

TP1-7(1) 13:30-13:45

### Research Review on the Smart Distribution Grid

Zhiqiang Gao, Junfei Xu, Xuesong Zhou and Youjie Ma  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems., Tianjin University of Technology  
 Tianjin, China

- Smart distribution grid plays an important part of strong smart grid having Chinese characteristics.
- The construction of the intelligent distribution network is enable to take advantage of clean energy.
- Along with the progress of the construction of the SDG, it will produce more and more obvious economic and social benefits.

Smart distribution grid structure.

TP1-7(2) 13:45-14:00

### The Primary Exploration of Application about Functional Reconstruction and Structure Reconstruction in Microgrid

Hongda Liu, Qi Wang, Shuang Cao  
 College of Automation Harbin Engineering University, Harbin, China  
 National Key Lab. Of Science And Technology on Vessel IPS, Wuhan, China

- An way to achieve micro-grid optimal dispatching.
- Proposes a framework based on the idea of structural reconfiguration and functional reconfiguration.
- The multi-functional grid connected inverter with the function of functional reconfiguration and its control strategy are presented .

The micro-grid

TP1-7(3) 14:00-14:15

### The Control Method of Reactive Power Sharing for Islanding Microgrid with Multiple Converters

Tianyi Ma, Guishan Zhang and Haichao Li  
 Beijing Institute of Graphic Communication  
 Beijing, China

- Based on equivalent circuit, analysis the cause of reactive power sharing error.
- Propose a reactive power sharing error compensate method.
- The reactive power of microgrid can be shared reasonably, and the stability of microgrid system can be improved.

Microgrid hierarchical control structure

TP1-7(4) 14:15-14:30

### A Review of Reactive Power Compensation Devices

Xuesong Zhou, Ke Wei, Youjie Ma and Zhiqiang Gao  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems, Tianjin University of Technology  
 Tianjin, China

- Synchronous condensers can provide continuous reactive power control when used with the proper automatic exciter circuit.
- SVC is a thyristor-controlled generator of reactive power.
- STATCOM primary aim is to provide a fast acting, precise, and adjustable quantity of reactive power

	merits	shortcomings
SC	Supply the continuous reactive power	large loss and noise speed of respond is slow
SVC	use the thyristor to control the circuit response quickly	generate harmonic
STATCOM	higher accurate of regulation higher operational flexibility	high investment price control complex

Comparing of Reactive Compensation Devices

TP1-7(5) 14:30-14:45

### Application of Improved PSO-BP Neural Network in Fault Detection of Liquid-Propellant Rocket Engine

Ningning Li<sup>1</sup>, Wei Xue<sup>2</sup>, Songbo Zhao<sup>1</sup>, Qiang Gao<sup>1</sup>, Dahua Li<sup>1</sup>, Liang Xu<sup>1</sup>  
<sup>1</sup>Tianjin Key Laboratory for Control Theory & Applications in Complicated SystemsTianjin University of TechnologyTianjin, China  
<sup>2</sup>Beijing Aerospace Propulsion Institute, Beijing, China

- The improved PSO-BP algorithm is used for fault detection, which complements the shortcomings of traditional fault detection methods.
- The MSE curve of the improved PSO-BP network quickly reached the expected set value.
- The improved PSO-BP model is a fault detection model of liquid-propellant rocket engine, which has good fault accuracy.

Curve of the IPSO-BP neural network training

TP1-7(6) 14:45-15:00

### Research Review on Big Data of the Smart Grid

Xuesong Zhou, Kang Li, Youjie Ma and Zhiqiang Gao  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems  
 Tianjin University of Technology  
 Tianjin, China

- Potential issues for smart grids and big data analytics
- The recent solutions and challenges in smart grids and big data analytics
- The technologies used for smart big data analytics

Relationships of Smart Grid, Big Data and Cloud Computing Technologies.



*IEEE ICMA 2018 Conference Digest*  
**TP2-1: Signal and Image Processing IV**

Session Chairs: Lianwu Guan, Harbin Engineering University

Abbas Kouzani, Deakin University

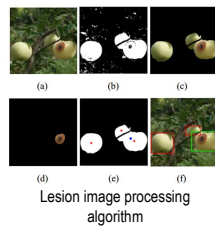
**Conference Room 1, 15:30-17:00, Tuesday, 7 August 2018**

TP2-1(1) 15:30-13:45

**An image processing method for green apple lesion detection in natural environment based on GA-BPNN and SVM**

Yunong Tian, En Li, Lei Yang, and Zize Liang  
 The Institute of Automation Chinese Academy of Sciences  
 Beijing, China

- An image processing method for the lesion image of green apple is proposed.
- A GA-BPNN algorithm is proposed to realize adaptive multi-threshold image binarization.
- Image ROI extraction, soft margin SVM algorithm and other algorithms are used in this paper to better finish the task of green apple lesion images processing.

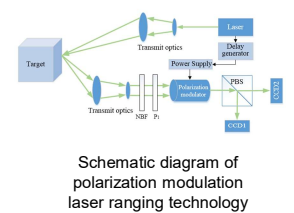


TP2-1(2) 15:45-16:00

**Analysis of polarization modulation laser ranging principle**

Heng Hu, Xiaoping Du, Changming Zhu and Yishuo Song  
 Academy of Space Command, University of Space Engineering Beijing, China

- The principle of polarization modulation laser ranging system
- Polarization Modulation Principle Analysis and Model Construction of Electro-optic Modulator
- Electro-optic modulator polarization modulation verification experiment

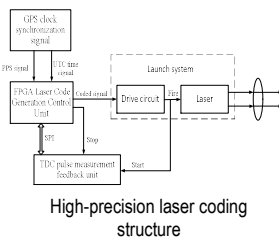


TP2-1(3) 16:00-16:15

**High Precision Laser Coding Method Based on Time Feedback**

Cong Liu, Yuning Liu, Huaxin Zhang  
 Institute of Space Optical Electronic Technology,  
 Changchun University of Science and Technology,  
 Changchun, China

- Use GPS timing as reference clock source, extract accurate UTC time and calibrate the local clock.
- Use the PPS interval as the timer's time.
- Use TDC technology to measure the pulse interval of the coded signal in real time and feedback the measured value to the FPGA laser coding unit



TP2-1(4) 16:15-16:30

**Pipeline Junction Detection based on Complex Continuous Wavelet Transform and MEMS Accelerometer Measurement**

Lianwu Guan<sup>1\*</sup>, Yanbin Gao<sup>1</sup>, Aboelmagd Noureldin<sup>2</sup>, Xiaodan Cong<sup>3</sup>  
 1. College of Automation, Harbin Engineering University, Harbin, China  
 2. Department of Electrical and Computer Engineering, Royal Military College of Canada  
 3. Institute of Automation, Heilongjiang Academy of Sciences, Harbin, China

- We propose a PJ detection method by using Complex Continuous Wavelet Transform (CCWT).
- Both raw and de-noised accelerometer measurement data are extracted and analyzed by CCWT.
- The experiments results shown that the PJ detection result can provide azimuth and pitch angles updates for MEMS IMU.



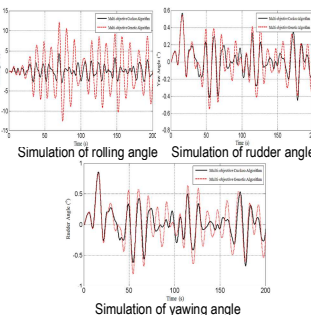
Experimental equipment

TP2-1(5) 16:30-16:45

**Optimization of Shock Absorption Energy of Ship Based on Multi-objective Cuckoo Algorithm**

Hui Wang, Xueying Wang, Lijun Yu and Weijie Sun  
 College of Automation, Harbin Engineering University, Harbin, 150001, China

- This paper proposes an improvement of the fitness function based on multi-objective cuckoo algorithm.
- Through a series of simulation comparisons, the self-tuning PID controller based on the multi-objective cuckoo algorithm is better than the classical PID controller.
- This system has better anti-roll effect and ship heading accuracy.

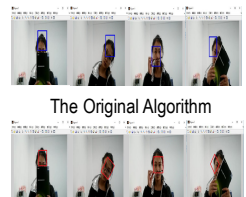


TP2-1(6) 16:45-17:00

**Research on Target Tracking Algorithm Based on Variance Sampling for Fast Sparse Representation**

Hui Wang, Xue Zhang, Lijun Yu, Qiang Wang  
 College of Automation, Harbin Engineering University, Harbin 150001, China

- The proposed algorithm uses the improved Sparse Representation and Particle Filter algorithm to track the moving target.
- Compared original algorithm, the improved algorithm can overcome the interference of self deformation and external environment.
- The improved algorithm improved the tracking rate with good robustness.



TP2-2: Intelligent Mechatronics and Application III

Session Chairs: Xiaotao Cao, Changchun Institute of Optics, Fine Mechanics and Physics

Xiaohai Wang, Navy Submarine Academy

Conference Room 2, 15:30-17:00, Tuesday, 7 August 2018

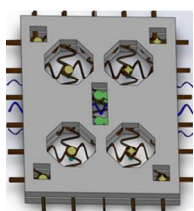
TP2-2(1) 15:30-13:45

**Smart Material Constructed Flexible and Stretchable Electronics for Knee Joint Health Monitoring and Improved Drug Delivery**

Guo-Hua Feng and Wei-Ming Tseng

Department of Mechanical Engineering, National Chung Cheng University, Chiayi, Taiwan

- A flexible and stretchable electronic device with multi-functionality.
- Two kinds of smart materials are utilized: PZT film for sensing acoustic emission wave and PNIPAM film for delivering drug.
- We demonstrate the smart patch assembled with a knee band strap for monitoring the knee joint motion.



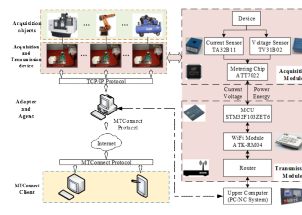
The proposed electronics

TP2-2(2) 15:45-16:00

**Design and Application of Energy Consumption Acquisition System Based on MTConnect**

Yao Xiao, Qiang Liu, Jian Wang, Pengpeng Sun, and Qitong Liu  
School of Mechanical Engineering and Automation, Beihang University  
Beijing, China

- Energy consumption signal sensing, acquisition and processing system
- Machine tool general data interconnection communication interface
- Field device networking technology



System overall architecture

TP2-2(3) 16:00-16:15

**Fault Diagnosis of Measurement System for Dynamic Positioning Ship based on NN-SVM Method**

Wang Yuanhui, BaoChengcheng, Ding Fuguang  
College of Automation., Harbin Engineering University  
Harbin, China

- Firstly, three neural network methods, including BP, RBP, and adaptive linear neuron, which are used to predict output time series.
- Then, the three types of neural networks are compared for the first time through output time series prediction with performance index of MAE and MSPE.
- Finally, RBF neural network combined with SVM is for the fault diagnosis of gyro in ship dynamic positioning system.

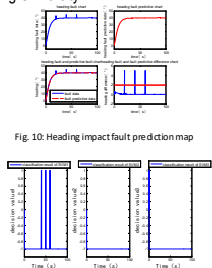


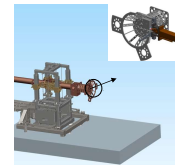
Fig. 11: Heading sensor shock fault classification chart

TP2-2(4) 16:15-16:30

**Research on in-Situ Calibration Technology of Six-dimension Force Sensor for the LIDM Docking Performance Test-bed**

Bo Ni<sup>1</sup>, Jiliang Zhao<sup>2</sup>, Hongbo Li<sup>2</sup>, Yu Su<sup>2</sup>, Xiaoping Luo<sup>1</sup> and Haiyan Wu<sup>3</sup>  
1 Shanghai Precision Measuring and Testing Institute, 2 Aerospace System Engineering  
Shanghai, 3 Jiujiang Precision Measuring Technology Research Institute  
1 Shanghai, China 2 Shanghai, China 3 Jiujiang, Jiangxi Province,

- Analysis of the calibration principle
- Design and static analysis of in-situ calibration loading device
- Static analysis of Y direction in-situ calibration loading device
- Calibration experiment of six-dimension force sensor of the performance test-bed



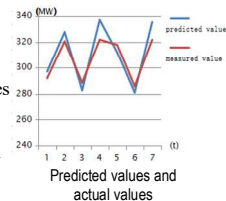
In-Situ Calibration of Six-dimension Force Sensor

TP2-2(5) 16:30-16:45

**The Application and Study of Time Series Forecasting and Machine Learning Algorithms Forecasting on Electric Vehicle Power Load Forecasting**

Shijun Wang<sup>1</sup>, Guobin Xue<sup>1</sup>, Chang Ping<sup>1</sup>, Dinggang Wang<sup>2</sup>, Feng You<sup>2</sup> and Tao Jiang<sup>2</sup>  
1.State Grid Gansu Electric Power Economy & Technology Research Institute;  
2.State Grid Gansu Electric Transmission & Transformer Company  
Lanzhou, Gansu, China

- Time series autoregressive model algorithm and BP neural network algorithm in the field of short-term load forecasting of new energy electric vehicles
- In the short-term load forecasting, the Time Series Autoregressive Modeling Algorithm has higher prediction accuracy



TP2-2(6) 16:45-17:00

**Two-point Calibration Accuracy Analysis Model of Inertial Navigation System**

Xiao-dong YANG and Wen-ming SHI  
Naval Submarine Academy  
Qingdao, Shandong Province, China

- Firstly, the basic principle of two-point calibration of inertial navigation system is described.
- Secondly, the influence model of measurement error and dynamic misalignment angle on the accuracy of two-point correction is deduced, and the explicit analytical solution is given.
- Finally, the simulation test is performed for the algorithm.

*IEEE ICMA 2018 Conference Digest*  
**TP2-3: Manufacturing Systems & Automation**

Session Chairs: Shuai Wang, Changchun Institute of Optics, Fine Mechanics and Physics  
 Qingsong Xu, University of Macau  
**Conference Room 3, 15:30-17:00, Tuesday, 7 August 2018**

TP2-3(1) 15:30-13:45

**Optimal Wrist Design of Wrist-hollow type 6-axis Articulated Robot using Genetic Algorithm**

Hyeon Min Jo, Dong Jae Lim, Won Jee Chung, Jong Kap Choi, Dae Young Kim,  
 Yeon Joo Ahn and Hee Sung Ahn  
 Robotics&Systems Lab., Changwon National University  
 Changwon, South Korea

- Improving the wrist-hollow design
- Optimizing the wrist shape at a detail design stage when the driving torque of each joint for the wrist-hollow type 6-axis robot (to being developed) is not matched with the servomotor specifications.



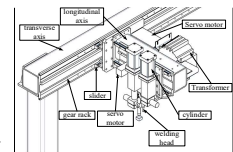
6-axis Articulated Robot

TP2-3(2) 15:45-16:00

**Implementation of Automatic Control System of Resistance Spot Welding for Square-Rectangular Steel Tube Packing Belt**

Qiang Gao, Zemin Mao, Dong Li, Jie Cui and Yu Han  
 National Demonstration Center for Experimental mechanical and electrical engineering Education, Tianjin University of Technology  
 Tianjin, China

- A square-rectangular steel tube packing belt resistance spot welding automatic control system is designed.
- Tensile experiments are used to measure the tensile strength of solder to obtain optimal welding parameters.
- The practical application shows that the whole system is uncomplicated, stable, efficient and environmentally friendly compared with arc welding.



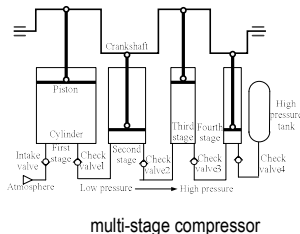
Overall Structure of Resistance Spot Welding for Square-Rectangular Steel Tube Packing Belt

TP2-3(3) 16:00-16:15

**Research on key structural parameters for multi-stage reciprocating compressor**

Xiaohui Gao, Yongguang Liu and Hong Guo  
 School of Automation Science and Electrical Engineering, Beihang University, Beijing China

- Mathematical model of multi-stage variable cross-section reciprocating is established.
- The influence rules are studied between compression performance and structural parameters.
- intake check valve and seal of high-pressure cylinder play an important role in the multi-stage reciprocating compressor



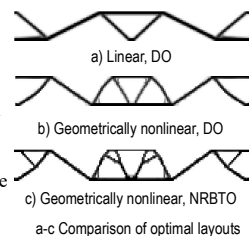
multi-stage compressor

TP2-3(4) 16:15-16:30

**An equivalent loads method for non-probabilistic reliability-based topology optimization of geometrically nonlinear structures**

Ming Li, Lin Yang, Yang Cao and Zaibin Yang  
 Nanjing Research Institute of Electronics Technology, Nanjing, 210039, China

- This paper proposes an approach for reliability optimization of geometrically nonlinear structures.
- Compared with deterministic optimization, reliability optimization suggests a more reliable layout.
- Compared with the conventional method, the proposed method is more efficient and more suitable for the complicated optimization problem.



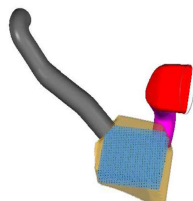
a-c Comparison of optimal layouts

TP2-3(5) 16:30-16:45

**Noise Control and Experimental Study of Engine Oil Pump**

Wangyong Hua, Fengyu Xu, Zheming Liu, Haiquan Wu, Huadong Yu  
 College of Mechanical and Electric Engineering, Changchun University of Science and Technology, Changchun 130021, China.

- At the design beginning of a certain type of passenger car, the noise spectrum of the air intake system is analyzed.
- First, the structural model and acoustic model are established by GEM3D.
- Then GT-POWER was used to analyze the noise of the system and simulate the full load condition of engine.



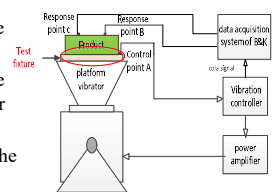
The acoustic model of the intake system.

TP2-3(6) 16:45-17:00

**Structure design and dynamic characteristic analysis of vibration fixture**

Haitao Luo, Changshuai Yu, Tingke Wu and Haonan Wang  
 Shenyang Institute of Automation Chinese Academy of Sciences, Shenyang Ligong University and Northeastern University  
 Shenyang, Liaoning Province, China

- Proposes the basic requirements for the function and design of the vibration test fixture
- Take a detailed description of the fixture design, specific parameter design, and structural design
- Propose a method for detecting the dynamic characteristics of the fixture



Schematic diagram of vibration test

*IEEE ICMA 2018 Conference Digest*  
**TP2-4: Intelligent Biomedical Technology**

Session Chairs: Xiangkai Meng, Changchun University of Science and Technology  
 Jian Guo, Tianjin University of Technology  
**Conference Room 4, 15:30-17:00, Tuesday, 7 August 2018**

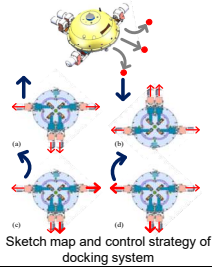
TP2-4(1) 15:30-13:45

**Binocular Camera-based a Docking System for an Amphibious Spherical Robot**

Shuxiang Guo, Yu Liu, Liwei Shi, Ping Guo, Huiming Xing, Xihuan Hou, Zhan Chen, Shuxiang Su, Huikang Liu  
 Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology

Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa, Japan

- Aiming at vision-based amphibious spherical robot, a binocular camera-based docking system was designed and implemented.
- To achieve this system, the principle of binocular vision was applied and the yaw control strategy was designed for the proposed robot.
- The experimental results proved the feasibility and robustness of this system.

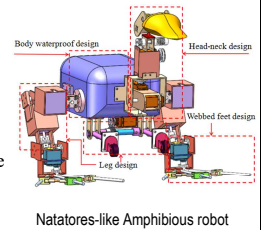


TP2-4(2) 15:45-16:00

**Platform Design for a Natatores-like Amphibious robot**

Huikang Liu, Liwei Shi, Shuxiang Guo, Huiming Xing, Xihuan Hou, Yu Liu  
 Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Beijing Institute of Technology, Beijing, China

- Use the principles of natatores to develop a novel amphibious robot.
- The robot utilize coordinated movement of body to realize multi-mode motion.
- The mechanical design is divided into four aspects, and telescopic rod play a important role in power stroke stage and recovery stroke stage.
- Use ADAMS to simulate the kinematics and dynamics of the robot and analyze the stability.

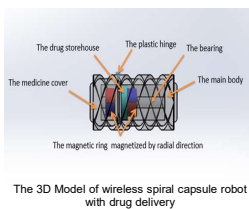


TP2-4(3) 16:00-16:15

**Design of A Novel Drug-delivery Module for Active Locomotive Intestinal Capsule Endoscopy**

Jian Guo<sup>1</sup>, Zihong Bao<sup>1</sup>, Shuxiang Guo<sup>1,2</sup>, Qiang Fu<sup>1</sup>  
 1 Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology, Binshui Xidao 391, Tianjin, China  
 2 Intelligent Mechanical Systems Engineering Department, Kagawa University, Takamatsu, Kagawa, Japan

- This paper proposed novel drug-delivery module for active locomotive intestinal capsule endoscopy. This module has three parts: plastic hinge connection, drug warehouse of movable magnet and fixed medicine warehouse cover
- The module robot can move autonomously and give medicine at different positions and angles.
- The developed capsule robot can be used to improve the capsule robot system and help people do experiments in vivo in the future.

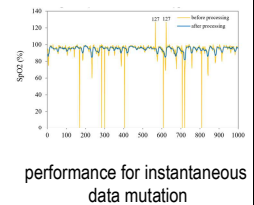


TP2-4(4) 16:15-16:30

**Optimizing Blood Oxygen Saturation Measurement Accuracy and Consistency Using Fingertip Acceleration and Blood Perfusion Index**

Longping Huang and Min Li, Yihan Zhao, Dong He  
 School of Mechatronic Engineering and Automation, Shanghai University, China

- Pulse oximeter performance is often degraded by motion artifacts and low perfusion
- This paper divided the obtained data into sleep data and sober data
- This paper divided the abnormal blood oxygen saturation data into 3 types, and deal with them in different ways.

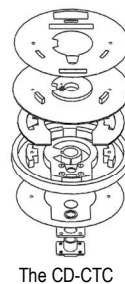


TP2-4(5) 16:30-16:45

**Research on Accurate Screening Technology for Circulating Tumor Cells**

Xiangkai Meng, Yuanhua Yu, Guangyong Jin, Jiamei Liu, Xingjia Feng, Chunlei Li  
 Changchun University of Science and Technology  
 Changchun, Jilin Province, China

- Circulating tumor cells(CTCs).
- For early clinical screening, detection and treatment of tumor cells and provide research foundation for precision medical.
- Microfluidic technology, chromatography, and centrifugation methods and combined the physical and biological characteristics of tumor cells.
- Stain and enrichment of CTCs.

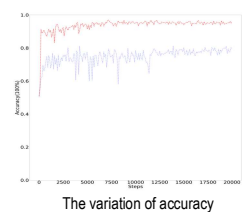


TP2-4(6) 16:45-17:00

**Transfer learning of pre-trained Inception-v3 model for Colorectal cancer lymph node metastasis classification**

Jin Li<sup>1</sup>, Peng Wang<sup>1</sup>, Yanzhao Li<sup>1</sup>, Yang Zhou<sup>1,2</sup>, Xiaolong Liu<sup>1</sup> and Kuan Luan<sup>1\*</sup>  
 1.Automation College, Harbin Engineering University, Harbin, Heilongjiang Province, China  
 2.Department of Radiology, Harbin Medical University Cancer Hospital, Harbin, Heilongjiang Province, China

- Colorectal cancer (CRC) lymph node (LN) metastasis is a critical index for CRC pathological staging.
- Current methods need to manually extract features
- use pre-train Inception-v3 model to classify CRC LN



*IEEE ICMA 2018 Conference Digest*  
**TP2-5: Element, Structures and Mechanisms II**

Session Chairs: Xihuan Hou, Beijing Institute of Technology  
 Chunyou Zhang, Beihang University

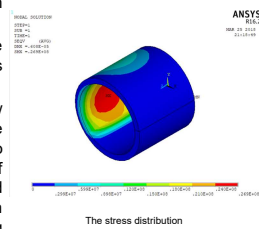
**Conference Room 5, 15:30-17:00, Tuesday, 7 August 2018**

**TP2-5(1) 15:30-13:45**

**The application of dimensional analysis in the design of sliding bearing**

Hao Li, Haipeng Geng, Yanhua Sun, Sixun Tang, Lei Qi and Lie Yu  
 State Key Laboratory for Strength and Vibration of Mechanical Structures  
 Xi'an Jiaotong University

- A rapid analysis model for bearing stress is established based on dimensional analysis.
- the orthogonal test shows that the clearance has the most obvious influence on bearing stress.
- The numerical simulation results show that it is reasonable to use the dimensional analysis method to establish the rapid analysis model of bearing stress. Therefore, this method can also be extended to the calculation of the other parameters of the sliding bearing in the follow-up study

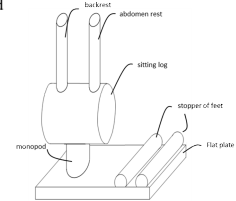


**TP2-5(2) 15:45-16:00**

**Development of a Chair Preventing Low Back Pain with Sitting Person Doing Hand Working at the Same Time**

Keiji Ikegami\*1, Hideyuki Hirata\*2, Hidenori Ishihara\*2 and Shuxiang Guo\*2  
 \*1 Graduate School of Engineering, Kagawa University, Takamatsu, JAPAN  
 \*2 Faculty of Engineering and Design, Kagawa University

- Sitting on a present chair long time with hand working causes low back pain.
- Hypothesis of the conditions in which sitting person can do hand working.
- Monopod rocking chair of logs meets the conditions and prevented low back pain for 2 hours.
- New swing model which is caused by one's breath and controlled by one's toes.



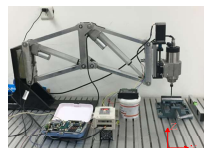
monopod rocking chair of logs

**TP2-5(3) 16:00-16:15**

**Comparative Study of Stiffness Modeling Methods for A Novel Industrial Robotic Arm with Hybrid Open- and Closed-Loop Kinematic Chains**

Longfei Sun and Fengyong Liang  
 School of Mechanical Engineering and Automation, Northeastern University, Shenyang, China  
 Lijin Fang  
 Faculty of Robot Science and Engineering, Northeastern University, Shenyang, China

- A novel industrial robotic arm with hybrid open- and closed-loop kinematic chains is proposed.
- An analytical method and a semi-analytical method based on strain energy and Castigliano's theorem are proposed to establish the stiffness model of the robot.
- The stiffness modeling methods are verified by the FEA and experimental results, and a comparative study of the two stiffness modeling methods is presented.



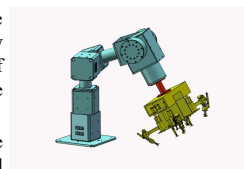
The Novel Industrial Robotic arm

**TP2-5(4) 16:15-16:30**

**Structure Design and Analysis of Reconfigurable Fixture Robot Based on the Auto-body Panels**

Jilong Li, Jun Liu, Xiaofeng Wang and Weimin Ge  
 Tianjin Key Laboratory of the Design and Intelligent Control of the Advanced Mechatronical System, Tianjin University of Technology, Tianjin, China

- Reconfigurable fixture robots are capable of gripping the auto-body panels with the different radii of curvature, which can also meet the work scopes on the production lines.
- The three-dimensional model and the kinematic equations of the proposed reconfigurable fixture robot are established.
- The working space and the modal analysis of the reconfigurable fixture robot are performed.



Reconfigurable Fixture Robot

**TP2-5(5) 16:30-16:45**

**Design and Research of a Centrifugal Compressor for Automotive Fuel Cell Systems**

Lei Qi, Haipeng Geng, Jigang Zhang, Tingchen Du, Hao Lv and Lie Yu  
 State Key Laboratory for Strength and Vibration of Mechanical Structures  
 Xi'an, Shaanxi Province, China

- a centrifugal compressor for automotive fuel cell systems has been designed.
- A CFD software CFX is used to simulate three dimensional flow field of the designed centrifugal compressor.
- the load of the blade is analyzed and some adjustments are made so that it meets the mechanical properties.



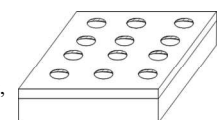
The Centrifugal Compressor

**TP2-5(6) 16:45-17:00**

**Study on Sound Absorption of Perforated Plate**

Wu Haiquan, Chen Wen, Liu Zheming, Wang Yonghua  
 College of Mechanical and Electric Engineering, Changchun University of Science and Technology  
 ChangChun, China

- Noise pollution is one of the four modern pollution, so noise control is becoming more and more important.
- Microperforated plate sound absorbers have the advantages of simple structure, friendly environment, light weight and low price, and corrosion resistance.
- The sound absorption ability of the multilayer microperforated plate is improved.



Multilayer Microperforated Plate

TP2-6: AUV & Space Robots

Session Chairs: Hongbo Wang, Parallel Robot and Mechatronic System Laboratory of Hebei Province

Sheng Bi, University of Hong Kong

Conference Room 6, 15:30-17:00, Tuesday, 7 August 2018

TP2-6(1) 15:30-13:45

**Experimental Validation of Planar Free-Floating Emulator via Model-free Force-Feedback Control**

Narendran Muraleedharan, Iacopo Gentilini, and Douglas R. Isenberg  
Space Robotics Laboratory, Embry-Riddle Aeronautical University  
Prescott, USA

- A 3-DOF Robotic Platform (RP) mounts a six-axis Force-Torque (FT) transducer on its end-effector and a 4-DOF planar Space Robot (SR) is installed on the transducer flange.
- Planar free-floating is emulated by nullifying forces/torque at the interface between the SR and the FT transducer.
- Differently from HIL, this approach does not require any knowledge of the SR inertial properties.



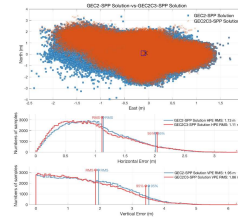
Planar Free-Floating Emulator

TP2-6(2) 15:45-16:00

**Initial Assessment and Impact on GNSS Positioning Performance Analysis of Including BeiDou-3 Satellites**

Ping Nie, Xin Meng, Junren Sun and Zun Niu  
School of Electronics Engineering and Computer Science, Peking University  
Beijing, China

- The signal strength of BDS-3 is comparable to that of the most excellent GPS, BDS-2 and Galileo satellites' signals.
- Including BDS-3 satellites improves the DOP, HPE and VPE by an average of about 4.5, 4.0, 4.0 percent and 3.0, 2.0, 0.5 percent over the GPS+Galileo+BDS-2 and GPS+Galileo+BDS-2 positioning.



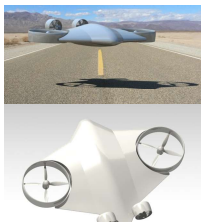
SPP performance

TP2-6(3) 16:00-16:15

**Design of a Lift-propulsion VTOL UAV system**

Xin Zhao, Zhou Zhou, Xiaoping Zhu  
School of Astronautics, Northwestern Polytechnical University  
Xi'an, China

- A general design method for lift-propulsion VTOL UAV is proposed.
- The power matching based conceptual parameter estimation and aerodynamic shape design are carried out.
- The attitude control law is designed. The hovering and level flight test of the prototype are carried out.
- Confirming the validity of the overall design method and the attitude control law design.



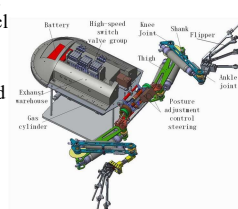
Lift-propulsion VTOL UAV

TP2-6(4) 16:15-16:30

**Joint Design and Position Servo Control of Frog Inspired Robot Based on Pneumatic Muscle and Reset Spring**

Fan Jizhuang, Yuan Bowen, Du Qilong and Zhang He  
State Key Laboratory of Robotics and System, Harbin Institute of Technology  
Harbin, China

- A single degree of freedom joint of frog inspired robot based on pneumatic muscle and reset spring.
- A three-order affine nonlinear mathematical model is established based on a model of pneumatic muscle and related parameters and other factors.
- The static and dynamic response, the influence of the some main factors is studied through simulation.
- The equivalent sliding mode control law, verifying the stability, the static and dynamic control effect.



The Frog Inspired Robot

TP2-6(5) 16:30-16:45

**Review of modeling and control in UAV autonomous maneuvering flight**

Renshan Zhang, Jiyang Zhang and Huangchao Yu  
Department of Unmanned Systems, Nantional University of Defense Technology

- Provides a comprehensive survey of the state-of-the-art of modeling and control of UAV maneuvering flight and exhibits the current status.
- The topics include maneuver actions definition and classification, modeling and control technology of maneuver UAV.
- Some new trends for the realization of UAV maneuver flight were summarized.



The maneuvering flight

TP2-6(6) 16:45-17:00

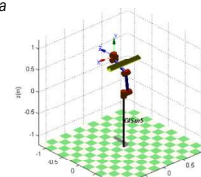
**Research on Obstacle Avoidance of Space Manipulators Based on Cylindrical Bounding Box Model**

Jing Liu<sup>1</sup>, Ruimin Liu<sup>1</sup>, Xin Shen<sup>2</sup> and Linmin Meng<sup>2</sup>

1. Faculty of Information Engineering and Automation, Kunming University of Science and Technology, Kunming, China

2. Yunnan power grid limited liability company Power Science Research Institute Kunming, China

- Bullet points : Manipulator arm
- Obstacle avoidance
- Cylindrical bounding box
- Modeling and simulation



Motion simulation of space manipulators with obstacles

*IEEE ICMA 2018 Conference Digest*  
**TP2-7: Control Theory and Application VI**

Session Chairs: Mingsheng Tang, Technical Institute of Physics and Chemistry, CAS  
 Junjie Zhou, Beijing Institute of Technology  
**Conference Room 7, 15:30-17:00, Tuesday, 7 August 2018**

TP2-7(1) 15:30-13:45

### Hierarchical Control Strategy Design for A 6WD Unmanned Skid-steering Vehicle

Yansong Zhang, Xueyuan Li\*, Junjie Zhou, Xufeng Yin, Men Du  
 Science and Technology on Vehicular Transmission Laboratory, Beijing Institute of Technology  
 Beijing, China

- Develop a dynamic model for skid-Steering Vehicle "spark".
- Design a hierarchical control strategy for a 6 × 6 skid-steering vehicle.
- Simulate by Trucksim/Simulink.
- Prove that Hierarchical control strategy improve the vehicle maneuverability.



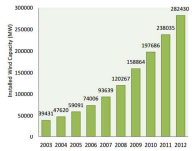
"SPARK" Unmanned Platform

TP2-7(2) 15:45-16:00

### An Overview on Development of Wind Power Generation

Xuesong Zhou, Ziruo Wang, Youjie Ma and Zhiqiang Gao  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems  
 Tianjin University of Technology

- As a clean, renewable and small footprint's new green energy, development and utilization technology of wind power energy is mature, so it has been developed and utilized in the world.
- The development of wind power generation is fast. In the future, we should set out to solve technical problems, and improve the efficiency of wind power.




DogGlobal Total Installed Wind Capacity (2003-2012)

TP2-7(3) 16:00-16:15

### Reactive Power Control of Compound Reactive Power Compensation Device

Hongjun Wang<sup>1</sup>, BoHui Wu<sup>1</sup>, Hui Zhao<sup>1</sup>, YoujunYue<sup>1</sup>  
 Tianjin University of Technology391, Binshui Xidao, Xiqing District, Tianjin, 300384, China

- INTRODUCTION.
- SYSTEM STRUCTURE AND COMPARATIVE ANALYSISI
- OVERALL CONTROL STRATEGY
- CONCLUSION



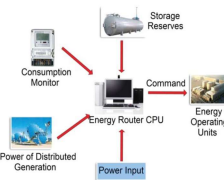
Power Compensation Device

TP2-7(4) 16:15-16:30

### Design And Application Of Energy Router To Realise The Smart Power Microgrid

Zhiqiang Gao, Bin Niu, Xuesong Zhou and Youjie Ma  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems  
 Tianjin University of Technology

- Based on conventional concept of energy hub ,the renewable energy as input power have been added in designing energy router, which is to realize the final target of Energy Internet.
- Within an Energy Internet, energy router is the key element to receive, control, transmit, transfer, store and distribute energies.
- The design of energy router.



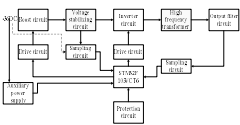
The energy routers

TP2-7(5) 16:30-16:45

### Design and Implementation of Digital Sine Wave Inverter Power Supply

Wei Fu, Guohong Li  
 Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems., Tianjin University of Technology  
 Tianjin, China

- A scheme of digital inverter power supply system is given in this paper.
- The system input 36VDC and the sine wave alternating current of 220VAC 50Hz is obtained.
- Use STM32F103VCT6 as the system controller.



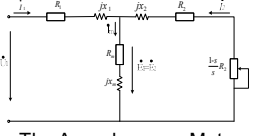
Digital Power Supply

TP2-7(6) 16:45-17:00

### Energy Saving Technology Based on Variable Frequency Speed Regulation

Youjie Ma, Qiang Li, Xuesong Zhou and Zhiqiang Gao  
 Key Research Laboratory for Control Theory & Applications in Complicated Systems  
 Tianjin University of Technology  
 Tianjin, China

- Introducing the status of energy consumption and the main motor energy saving technology.
- Analyzing the loss of three-phase asynchronous motor.
- Discussing three different frequency conversion control strategies.



The Asynchronous Motor Equivalent Circuit

# Wednesday

# August 8, 2018

## Morning Sessions

- WA1-1 Signal and Image Processing V
- WA1-2 Manipulator Control I
- WA1-3 Sensor Design and Sensing System
- WA1-5 Modeling, Simulation Techniques and Methodology III
- WA1-6 Control Theory and Application VII
- WA1-7 Human-System Interaction
- WA2-1 Signal and Image Processing VI
- WA2-2 Manipulator Control II
- WA2-3 Signal Measurement and Process in Automatic Control
- WA2-5 Rotor Dynamics, Vibration Analysis and Vibration Control
- WA2-6 Manipulation Sensing & System
- WA2-7 Robot Navigation and Control Algorithm





*IEEE ICMA 2018 Conference Digest*  
**WA1-1: Signal and Image Processing V**


Session Chairs: Xianqiang Bao, Beijing Institute of Technology  
 Chengtao Cai, Harbin Engineering University  
**Conference Room 1, 9:30-11:00, Wednesday, 8 August 2018**

WA1-1(1) 9:30-9:45

**Development of the HALCON Software-based  
 Harness Number Identification**

Ying Zhang, Guohua Cao, Hongchang Ding, Changfu Zhao  
 School of Mechanical Engineering,  
 Changchun University of Science and Technology,  
 Changchun, Jilin, China

- The paper proposes that after determining the wire diameter of the cable, the global and local thresholds are segmented according to the characteristics of different wire diameters.
- The researcher has targeted the method of numbering area positioning, line number deflection correction, and character breakage repair, and then targeted the processing optimization to obtain the online cable number information.
- Through experiments, the recognition of the line number character was successfully achieved, and a higher level of recognition accuracy was achieved, and the production efficiency was improved.




The identify the line number

WA1-1(2) 9:45-10:00

**The research of Liveness detection  
 method based on sparse support vector  
 machines**

Yu Lijun, Ding Ying, Wang Hui, Sun Weijie  
 College of Automation, Harbin Engineering University, Harbin 150001, China

- Based on the existing technology, using the sparse support vector machine for training classification, a constraint on the loss vector is added in the traditional support vector machine model.
- The purpose of this is to reduce the number of support vectors, then the solution of support vector has better sparsity, it is also improved in the rate of operation and accuracy.



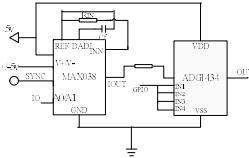
The obtained LBP feature is the input characteristics which is needed to sparse support vector machine classification.

WA1-1(3) 10:00-10:15

**The Design and simulation of transcranial  
 electric stimulation system**

Yueming Lin, Minghui Liang, Datong Chen, Dongbin Xu, Qiuyang Wang, Ke Zhang, Xiaodong Wang, Weibin Mu  
 Qiqihar Medical University,  
 Qiqihar, China

- Transcranial electrical stimulation, as a widely used non-traumatic brain stimulation technology, has been widely used in medicine.
- MAX038 is selected as the chip of signal generation module.
- ADG1434, it can achieve a variety of stimulus model output.
- Results show that the signal generation system can output waveform independently and control coupling output, so as to meet different therapeutic targets.



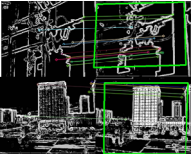
The signal generator circuit

WA1-1(4) 10:15-10:30

**Registration of Infrared and Visible Image  
 Based on OpenCV**

Chengtao Cai, Xin Ding, HongZhu  
 Harbin Engineering University & East china sea centre of standar&metrology, s.o.a.  
 Harbin & Shanghai, China

- A novel registration algorithm of infrared and visible image based on morphological edge detection is proposed.
- The algorithm firstly performs a series of morphological operations based on the multi-directional structure elements on infrared and visible images to obtain the edge images of them.




Accurately match images

WA1-1(5) 10:30-10:45

**FPGA Based Design and Implementation of  
 Improved Edge Detection Algorithm using  
 LOG Operator**

Enzeng Dong, Kaifeng Li, Jigang Tong  
 Complex System Control Theory and Application Key Laboratory School of Electrical and  
 Electronic Engineering, Tianjin University of Technology  
 Tianjin, China

- Basic theory of LOG operator
- The improved algorithm of LOG operator
- FPGA implementation of the improved algorithm
- Result analysis



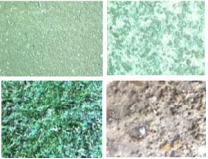
Lena diagram

WA1-1(6) 10:45-11:00

**Image Feature Based Machine Learning  
 Approach for Road Terrain Classification**

Yang Chen, Pengfei Zhang, Shifeng Wang, Dawei Gong  
 School of Opto-Electronic Engineering, Changchun University of Science and Technology  
 Changchun, China

- Road terrain perception for smart vehicles with images.
- Extracted texture features for classification.
- Improve classification accuracy using principal component analysis.
- Abundant image information processed.



Four types of road terrain surfaces processed.

Session Chairs: Yan Zhao, Beijing Institute of Technology

Jian Guo, Tianjin University of Technology

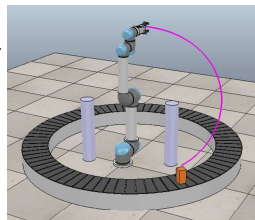
Conference Room 2, 9:30-11:00, Wednesday, 8 August 2018

WA1-2(1) 9:30-9:45

**A Path Optimization Algorithm for Motion Planning with the Moving Target**

Sicheng Liu, Houde Liu, Xiaojun Zhu, Kangkang Dong, Bin Liang  
Graduate School at Shenzhen, Tsinghua University  
Shenzhen, China

- Improved bidirectional RRT\* algorithm based on greedy heuristic.
- A path optimization algorithm tailored to moving target.
- Get the solution rapidly and has a rapid rate of convergence.
- Strong adaptability in different obstacle placements.



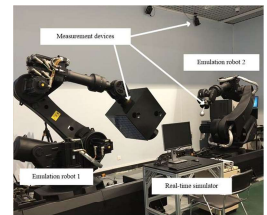
Motion planning in V-rep

WA1-2(2) 9:45-10:00

**Study on a Numerical Simulation of a Manipulator Task Verification Facility System**

Qian Liu1, Xuan Xiao2, Fangli Mou2, Shuang Wu2, Wei Ma1 and Chengwei Hu1  
1 China Academy of Space Technology, Beijing 100094, China  
2 School of Aerospace Engineering, Tsinghua University, Beijing 100084, China

- The MTVF simulation is established to ensure the security and to verify the control algorithm of the MTVF system.
- The MTVF simulation considering a space capturing operation is studied.
- Simulation results demonstrate the necessity of the MTVF simulation.



The MTVF system

WA1-2(3) 10:00-10:15

**A HIL Simulation Facility for Task Verification of the Chinese Space Station Manipulator**

Fangli Mou, Xuan Xiao, Tao Zhang, Qian Liu, Daming Li, Chengwei Hu and Wei Ma  
Tsinghua University and China Academy of Space Technology  
Beijing, China

- A HIL simulation facility designed to support the Chinese Space Station Manipulator.
- Outstanding advantages such as high bandwidth, low latency, and precise dynamic parameters.
- Special designs make the MTVF can ensure emulation authenticity.
- Experimental validation has been conducted by the MTVF.



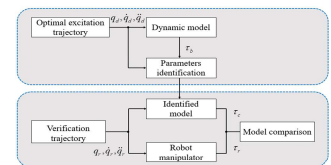
The MTVF hardware testing part

WA1-2(4) 10:15-10:30

**Dynamic parameter identification of robot manipulators based on the optimal excitation trajectory**

Xijie Guo, Lei Zhang and Kai Han  
Department of Automation and Control Ocean University of China  
Qingdao, China

- Build a dynamic model of robot manipulator;
- Design a optimal excitation trajectories;
- Sample and process data;
- Estimate of dynamic parameters;
- Verify the dynamic model



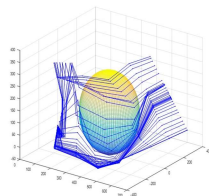
Dynamic Parameter Identification

WA1-2(5) 10:30-10:45

**An obstacle avoidance method for redundant manipulators based on artificial potential field**

Wenrui Wang, Jinlin Gu, and Mingchao Zhu  
Institute of Optics, Fine Mechanics and Physics Chinese Academy of Sciences, Changchun  
University of Chinese Academy of

- Definition of repulsive potential field.
- Collision avoidance with obstacles.
- Collision avoidance with other manipulators
- Collision avoidance system design.
- Simulations and conclusions.



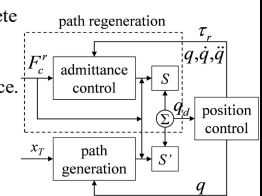
Configurations with obstacle avoidance

WA1-2(6) 10:45-11:00

**Admittance Control of Manipulators in Unknown Environment**

Cunqiu Liu, Junyao Gao, Yi Liu  
Mechatronics Research Lab., Beijing Institute of Technology  
Beijing, China

- In order to make manipulators complete tasks safely in unknown environment, admittance control is applied in the parallel and vertical to the contact force.
- Virtual force perpendicular to contact force is applied make manipulators away from obstacles.
- Simulation performed shows that the method proposed reduces joint torque and contact force and make the manipulator get to the goal.



The Control Scheme

*IEEE ICMA 2018 Conference Digest*  
**WA1-3: Sensor Design and Sensing System**

Session Chairs: Zixu Wang, Kagawa University  
 Aiguo Ming, University of Electro-Communications  
**Conference Room 3, 9:30-11:00, Wednesday, 8 August 2018**

WA1-3(1) 9:30-9:45

**A Miniature Device for In-Situ Measurement of Concrete Corrosion**

Dean M. Corva, Seyyed Sobhan Hosseini, Scott Adams,  
 Will Gates, Frank Collins, Abbas Z. Kouzani  
 Deakin University, Geelong, Victoria 3216, Australia

- A low-cost aggregate-sized sensing device suitable for embedding within concrete structures, designed with large scale deployments in mind is presented.
- It includes electrodes and degradation measurement electronic circuitry. The circuitry includes a low-power microcontroller, a current source chip, among others.



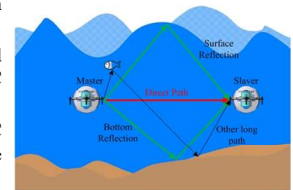
Device for In-Situ Measurement of Concrete Corrosion

WA1-3(2) 9:45-10:00

**Characteristic Evaluation of the Mobile Acoustic Communication for Spherical Underwater Robots (SUR III)**

Shuoxin Gu, Shuxiang Guo, Liang Zheng  
 Graduate School of Engineering, Kagawa University, Takamatsu, Kagawa 761-0396, Japan

- Propose the underwater acoustic communication (UWAC) system for the SUR III;
- Analyze the Doppler effect and propagation loss of the UWAC system in SUR III;
- Experiments of mobile UWAC system and multi-path effect are carried out;
- The experimental results show that the bit error rate is 0.



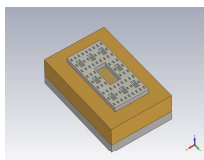
Acoustic Channel for SUR

WA1-3(3) 10:00-10:15

**The Optimization Design of Micro-Strip UHF Sensor and the Applied Research of GIS PD Detection**

Jie Li<sup>1</sup>, Jiabao Li<sup>1</sup>, Yingfen Wang<sup>1</sup>, Shizhen<sup>1</sup> and Yanhang Zhao<sup>2</sup>  
 1.Honghe Power Supply Bureau of Yunnan Power Grid Co., Ltd. Mengzi, China  
 2.State Key Laboratory of Power Transmission Equipment & System Security and New Technology (Chongqing University) Chongqing, China

- According to the characteristics of GIS PD, the UHF sensor is designed based on the micro-strip theory.
- Starting from the rectangular patch micro-strip sensor, the fractal theory is used to optimize it, and the fractal micro-strip sensor is obtained.
- The fractal micro-strip sensor is fabricated, and the PD test platform is set up to verify the performance of UHF sensor.



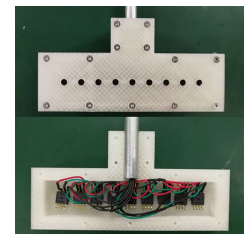
Fractal micro-strip sensor

WA1-3(4) 10:15-10:30

**Dipole Source Localization Based on Least Square Method and 3D Printing**

Xin Lin, Yong Zhang, Mingjiang Ji, Xiande Zheng, Kehong Lv, Jing Qiu, and Guanjun Liu  
 College of Artificial Intelligence, National University of Defense Technology  
 Changsha, China

- The sensor array was used for underwater dipole source localization.
- It consists of 9 pressure sensors, MPVZ5004GW6U.
- 3D printing was applied to fabricate the array shell.
- The center distance between adjacent sensors is 14.48mm ; the body length is 160mm.



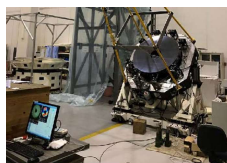
The Pressure Sensor Array

WA1-3(5) 10:30-10:45

**Design and Tests of Multi-motors Hydromantic Position Control System of Primary Mirror Based on Large Telescope**

Yuxia Li, Bin Zhang, Jianfeng Li, Xiaoxia Wu, Pengfei Guo  
 Changchun Institute of Optics, Fine Mechanics and Physics,  
 Chinese Academy of Sciences Changchun, Jilin Province, China

- Introduction of hydromantic position control system.
- Description and working principle of the hydromantic passive supporting control system.
- The hardware and software design of the position control system.
- The test results on platform of 4m telescope and 1.2m primary mirror.
- Conclusion



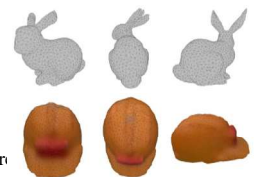
Active Optics correction Experiments With Position control

WA1-3(6) 10:45-11:00

**Research on Key Technologies of Lidar 3D Point Cloud Imaging**

Yanxin Yu, Yuxin Li, Chunyang Wang\* and Xuellian Liu  
 Department of Electronics and Information Engineering, Changchun University of Science and Technology, Changchun, China

- The three-dimensional laser scanning technology can directly obtain the spatial sample points or point cloud data on the surface of real objects.
- Firstly, the classifications of point cloud data measurement methods are introduced, then the denoising methods of point cloud data are summarized, and the methods of point cloud data surface reconstruction are summarized.



Reconstructed models using the extended GNG method for face reconstruction

WA1-5: Modeling, Simulation Techniques and Methodology III

Session Chairs: Yi Liu, Kagawa University

Baofeng Gao, Beijing Institute of Technology

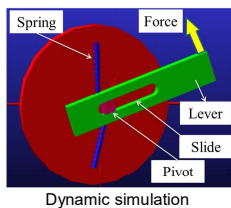
Conference Room 5, 9:30-11:00, Wednesday, 8 August 2018

WA1-5(1) 9:30-9:45

**Modeling and Analysis of a Variable Stiffness Actuator for a Safe Home-based Exoskeleton**

Yi Liu, Shuxiang Guo, Songyuan Zhang and Luc BOULARDOT  
Guo Lab., Kagawa University  
Kagawa, Japan

- A variable stiffness actuator is integrated to the exoskeleton for adjusting the actuated joint stiffness independently.
- The characteristic of the elastic elements affects the performance of the variable stiffness actuator.
- The model of the variable stiffness actuator and simulated its stiffness characteristics with different spring coefficients, preloads and damping.

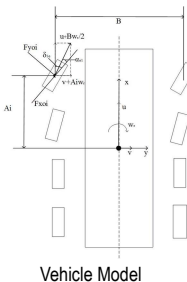


WA1-5(2) 9:45-10:00

**Study on Steering Mobility of Multi-axle Vehicles with Independent Braking System**

Yishan Sun, Zhicheng Wu  
School of Mechanical Engineering, Beijing Institute of Technology  
Beijing, China

- A new method of improve steering mobility through braking inner wheels is proposed.
- Through establishment and analysis of an 11-DOF vehicle model, the change regulation of steering radius under different steering angle and driving torque is obtained.
- This method can sufficiently decrease steering radius and increase steering mobility.

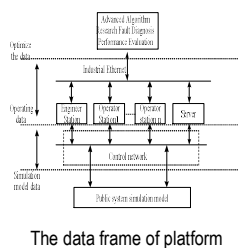


WA1-5(3) 10:00-10:15

**Hardware-in-the-loop Simulation System for Process Control**

Lili Zhao, He Tian  
Tianjin Key Lab. for Control Theory & Applications in Complicated Systems2, Tianjin University of Technology, Tianjin, China

- This paper provides a hardware-in-the-loop simulation system for offshore oil platform public system.
- The simulation of the system through the analog control box to simulate the analog signal to the production process conditions.
- It can realize the real-time monitoring of the parameters of the simulation system platform equipment, but also simulate the operation and signal of industrial field devices.

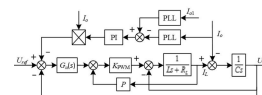


WA1-5(4) 10:15-10:30

**Research on the Circulating-Current Suppression of Parallel Inverters Based on Droop Control**

Jingnan Zhang and Tianhao Zhang  
Department of Electrical Engineering, Harbin Engineering University  
Harbin, China

- Calculating the circulating-current with the equivalent impedance of the inverters
- Analyzing the influence of the difference between equivalent impedance on the circulating-current
- A method of circulating-current suppression is proposed
- Verifying the control strategy through simulation and experiment



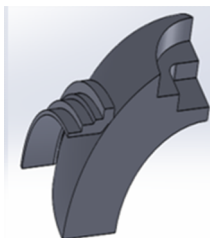
Control block of virtual resistance ring

WA1-5(5) 10:30-10:45

**Seal Performance Analysis of Hard Seal Ceramic Ball**

Xiaofang Zhou, Haiyan Shao, Yanjun Wang  
School of Mechanical Engineering, University of Jinan  
Jinan, China

- Set up a ball valve model.
- Analyze the seal performance of ball valve.
- The material of ball valve is Zirconia Ceramics.

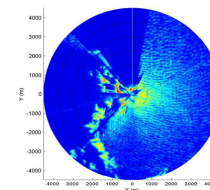


WA1-5(6) 10:45-11:00

**Retrieving Wave Height Based on Shadow Statistics Method from X-band Marine Radar Images**

Yan Zheng, Zhen Shi and Zhizhong Lu  
College of Automation, Harbin Engineering University, Harbin, China

- The importance of the research on wave height.
- Introduce the basic principle and implementation process.
- Present the image adjustment method.
- Show the validity of the novel method with the acquired radar images.



The Shore-based Radar Image

*IEEE ICMA 2018 Conference Digest*  
**WA1-6: Control Theory and Application VII**

Session Chairs: Huiming Xing, Beijing Institute of Technology  
 Nan Xiao, Beijing Institute of Technology  
**Conference Room 6, 9:30-11:00, Wednesday, 8 August 2018**

WA1-6(1) 9:30-9:45

**Design of Speech Control System for a Upper Limb Rehabilitation Robot Based on Wavelet De-noising**

Shuxiang Guo<sup>1,2</sup> and Zhi Wang<sup>1</sup>, Jian Guo<sup>1\*</sup>, Qiang Fu<sup>1</sup> and Nan Li<sup>1</sup>  
 1. Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology  
 Tianjin, China  
 2. Intelligent Mechanical Systems Engineering Department, Kagawa University  
 Kagawa, Japan

- This paper proposed a new type of exoskeleton upper limb rehabilitation robot based on biomechanics and a speech control system has been designed.
- For the speech recognition better, the speech signal was de-noised.
- Through the rehabilitation training experiment, the effectiveness of the speech system is verified.



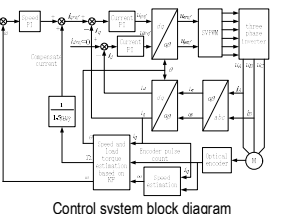
Speech Rehabilitation System

WA1-6(2) 9:45-10:00

**Anti-disturbance Control of SPMSM with Load Torque Feedforward Compensation**

Hui Wang, Lihua Liu and Xingjian Fu  
 Beijing Information Science & Technology University  
 Beijing, China

- Kalman Filter based on kinematics equation of SPMSM model.
- Precise Load torque and speed estimation without delay.
- Load torque feedforward compensation in the current  $i_q$ .
- Inhibit both the load disturbance and motor parameters fluctuation.



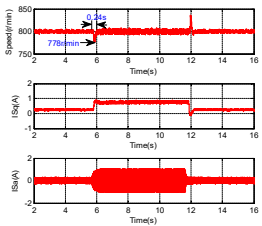
Control system block diagram

WA1-6(3) 10:00-10:15

**Speed Control of PMSM with Sliding Mode Disturbance Observer**

Yongting Deng, Jianli Wang, Hongwen Li, Jing Liu and Dapeng Tian  
 Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science

- To promote the performance of PMSM speed loop, such as fast response, tracking accuracy and robustness.
- A sliding mode disturbance observer (SMDO) is proposed. The SMDO is used as a compensator, which is designed to estimate the lumped external disturbances and add a corresponding feedback compensation item to the output of the speed controller.



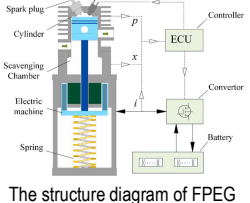
Experimental results of SMDO method at the speed of 800r/min

WA1-6(4) 10:15-10:30

**Modeling and Control of a Portable Two-Stroke Free-Piston Engine Generator**

Dong Liu, Zhaoping Xu, Liang Liu, Lingling Zhang, Haicheng Zhou  
 Nanjing University of Science and Technology,  
 Nanjing, China

- A multidisciplinary model of the prototype is presented.
- A PID algorithm is designed to control the current of the FPEG.
- The TTC and BTC of free-piston are considered as control objectives.
- Controller performance is analyzed on piston trajectory, TTC and BTC.



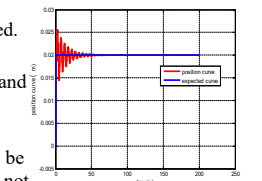
The structure diagram of FPEG

WA1-6(5) 10:30-10:45

**Supertwisting Sliding Mode Repetitive Control under Periodic Disturbance**

Chao Jia, Junqiang Zhou  
 Tianjin Key Laboratory for Control Theory & Application in Complicated Systems, School of Electrical and Electronic Engineering, Tianjin University of Technology, Tianjin300384, China

- A supertwisting sliding mode repetitive control method is proposed.
- By utilizing the advantages of both supertwisting sliding mode control and repetitive control, a method that combines them is presented.
- The gains in controller only need to be some small constants, which would not increase continuously.
- Simulation results in a hydraulic system show the effectiveness.



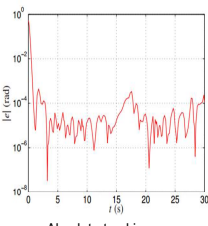
Position Curve by Proposed Method

WA1-6(6) 10:45-11:00

**Different Reformulation, ZD Tracking Control and Analysis of One-Link Rigid Robot System with Motor Dynamics**

Jinjin Guo, Binbin Qiu, Deyang Zhang, Mingzhi Mao, and Yunong Zhang  
 School of Information Science and Technology, Sun Yat-sen University  
 Guangzhou, China

- This paper investigates the tracking control of one-link rigid robot system with motor dynamics.
- Based on Zhang dynamics (ZD), a new kind of ZD controller is developed and for achieving the tracking control purpose.
- Theoretical analysis and result are also presented to guarantee the global and exponential convergence performance of the ZD controller.



Absolute tracking error

IEEE ICMA 2018 Conference Digest  
**WA1-7: Human-System Interaction**

Session Chairs: Linshuai Zhang, Kagawa University

Jinglong Wu, Okayama University

**Conference Room 7, 9:30-11:00, Wednesday, 8 August 2018**

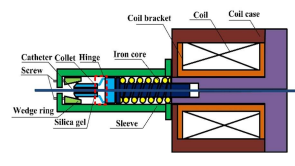
WA1-7(1) 9:30-9:45

**Adaptive Clamping Mechanism-based a Novel Slave Manipulator for Endovascular Catheterization**

Linshuai Zhang<sup>1, 4</sup>, Shuxiang Guo<sup>2, 3</sup>, Huadong Yu<sup>4</sup>, Yu Song<sup>1</sup>, Dapeng Song<sup>1</sup>

<sup>1</sup> Faculty of Engineering, Kagawa University, Takamatsu, Kagawa, Japan  
<sup>2</sup> Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, School of Life Science, Beijing Institute of Technology, Haidian District, Beijing 100081, China  
<sup>3</sup> Department of Intelligent Mechanical Systems Engineering, Kagawa University, Takamatsu, Kagawa 761-0398, Japan  
<sup>4</sup> School of Mechatronical Engineering, Changchun University of Science and Technology, Changchun, Jilin, China

- Design a novel catheter manipulator with adaptive clamping mechanism.
- Use the electromagnetic device to control the clamping force by adjusting the input current.
- Performance evaluation of force measurement by *in vitro* experiments was carried out.



Schematic of the adaptive clamping mechanism

WA1-7(2) 9:45-10:00

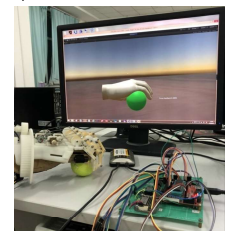
**A VR-based Upper Limb Rehabilitation Hand Robotic Training System**

Jian Guo<sup>1</sup>, Nan Li<sup>1\*</sup> and Shuxiang Guo<sup>1,2\*</sup>

<sup>1</sup> Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology, Tianjin, Binshui Xidao 391, China

<sup>2</sup> Intelligent Mechanical Systems Engineering Department, Faculty of Engineering, Kagawa University, Takamatsu, Kagawa, Japan

- The VR-based upper limb rehabilitation hand robotic training system is proposed to help patients with hand grab function training.
- The virtual feedback and force feedback realized in the system could avoid dull rehabilitation training and make users feel more realistic when interacting with objects in the virtual environment.
- The system could improve the initiative of patients' rehabilitation and improve the overall effect of rehabilitation training.



Upper Limb Rehabilitation Hand Robotic Training System

WA1-7(3) 10:00-10:15

**An improved KFCM algorithm for unsupervised image segmentation based on neighborhood constraints**

Huiying Jiao<sup>1</sup>, Xianglian Meng<sup>2</sup>, Jianhua Song<sup>3</sup>

<sup>1</sup>China Academy of Information and Communication Technology, Beijing, China, <sup>2</sup>Automation College, Harbin Engineering University, Harbin, China, <sup>3</sup>Electronic Engineering College, Heilongjiang University, Harbin, China

- Fuzzy C-means clustering (FCM) and its merits and demerits
- Neighborhood constraints in digital image processing
- Kernel fuzzy C-means clustering (KFCM) and its improved algorithm
- Robustness and validity of the proposed algorithm

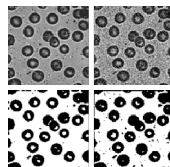


Image segmentation

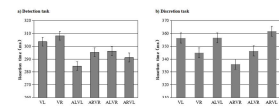
WA1-7(4) 10:15-10:30

**The Effect of Spatial Consistence on Visual Detection and Discretion**

Jingjing Yang<sup>1</sup>, Jinglong Chu<sup>1</sup>, Xijun Li<sup>1</sup>, Qi Li<sup>1</sup> and Jinglong Wu<sup>2</sup>

<sup>1</sup> School of Computer Science and Technology, Changchun University of Science and Technology, China  
<sup>2</sup> Graduate School of Natural Science and Technology, Okayama University, Japan

- This study designed behavioral experiments to control the selective attention of the visual modal, and studied the reaction time and accuracy of the human brain to unimodal visual/auditory stimuli and multimodal audio-visual stimuli.
- Through analysis of experimental results, it was found that auditory stimuli that were not attended affect visual information processing, which was associated with experimental tasks.



Average response time of each stimulus type

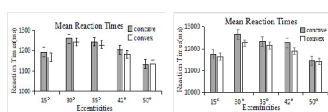
WA1-7(5) 10:30-10:45

**The Effect of Visual Attention on Peripheral Stereopsis**

Yan Wu, Qi Li, Xiangbo Han

Changchun University of Science and Technology  
 Changchun, Jilin Province, China

- The perception of stereopsis declined with the increasing eccentricities.
- Within the central 30 arc deg of the visual field, the stereopsis was clear.
- Beyond 30 arc deg of the visual field, specially beyond 42 arc deg, it was very hard to distinguish crossed disparity and uncrossed disparity.
- When the cue was invalid, the reaction times were about 10 times that of valid cue condition.



Mean reaction times were plotted against the different eccentricities  
 (a) Valid condition (b) invalid condition

WA1-7(6) 10:45-11:00

**Constructing Virtual Image for Navigational Fix Training Based on Digital Watermarking**

Xiaohai WANG, Yang ZHANG, Ningchuan ZHANG

Navy Submarine Academy  
 Qingdao, China

- Analysis of virtual fix training
- Virtual image based on digital watermarking
- Bypassing observation error caused by the projection distortion
- Increasing accuracy of training feedback from multiple observation devices
- Reducing system's accuracy requirements and construction difficulty .

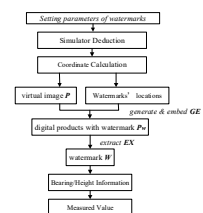


Image processing framework

*IEEE ICMA 2018 Conference Digest*  
**WA2-1: Signal and Image Processing VI**

Session Chairs: Xianqiang Bao, Beijing Institute of Technology  
 Shuxiang Guo, Kagawa University

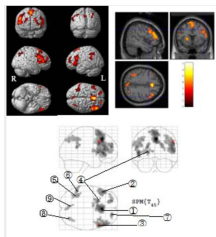
**Conference Room 1, 11:15-12:15, Wednesday, 8 August 2018**

WA2-1(1) 11:15-11:30

**Brain activation neuronal substrates of nonword priming effect: An fMRI study**

Jingjing Yang, Xiujun Li, Qi Li, Dan Tong and Jinglong Wu  
 The School of Computer Science and Technology, Changchun University of Science and Technology, Jilin, China

- We investigated changes in the behavioral performance and brain activities associated with nonword priming in a Non Word Stem Completion (NWS) task.
- In the behavioral results, we found obvious facilitatory effects in subject's performance.
- In the fMRI results, we found the activations in the bilateral middle and inferior frontal gyrus with right hemispheric prevalence, the superior and inferior parietal gyrus, and the supplementary motor area.



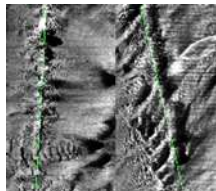
Activated Area in Brain

WA2-1(2) 11:30-11:45

**Submarine Pipeline Identification in Side Sonar Scan Image**

Yiping Chen<sup>1\*</sup>, Hui Li<sup>2\*</sup>, Yao Yao<sup>1\*</sup>, Peng Yang<sup>2\*</sup>, Xiufen Ye<sup>2\*</sup> and Shuguo Xiao<sup>2\*</sup>  
<sup>1\*</sup> Jiangsu Automation Research Institute College of Automation, Jiangsu, China  
<sup>2\*</sup> College of Automation, Harbin Engineering University, Heilongjiang, China

- Amplify data set to improve detection accuracy and prevent overfitting.
- Use all pixels of the image as input to extract features automatically.
- Initial detection algorithm with improved BP neural network.
- Pipeline detection with genetic algorithm.



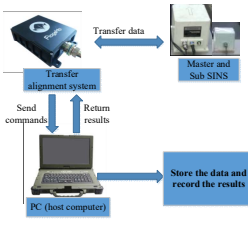
Identify pipelines covered by sand

WA2-1(3) 11:45-12:00

**Application of a Novel Fast Transfer Alignment Algorithm on SINS for Vehicular Launching System**

Meng Wang, Kunpeng He, Lianwu Guan\*, Yanbin Gao, Liqiang Yu, Xulong Luo  
 College of Automation, Harbin Engineering University, Harbin, China

- We proposed a novel fast and high-precision transfer alignment algorithm on SINS applied to vehicular launching.
- The algorithm based on "speed + attitude" matching model and lever arm error direct compensated method.
- Hardware experiment platform of transfer alignment system is designed.



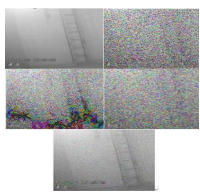
The verification process of vehicular Experiment

WA2-1(4) 12:00-12:15

**A Fast Hybrid Noise Filtering Algorithm Based on Median-Mean**

Xun Zhang, Hongzhou Liao, Xue Du, and Bo Xu  
 Department of Automation, Harbin Engineering University  
 Harbin, China

- The optical images often contain impulse noise and gaussian noise at the same time.
- When the mixed noise pollution is serious, the interaction between the noises can lead to a single filtering method that can not effectively eliminate the noise.
- In order to suppress these two kinds of noises simultaneously, a fast algorithm of median and mean joint filtering is proposed.



Median-Mean Joint Filtering



IEEE ICMA 2018 Conference Digest  
**WA2-2: Manipulator Control II**

Session Chairs: Liang Zheng, Kagawa University

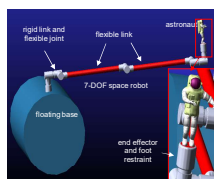
Dapeng Tian, Changchun Institute of Optics, Fine Mechanics and Physics  
**Conference Room 2, 11:15-12:15, Wednesday, 8 August 2018**

WA2-2(1) 11:15-11:30

**Dynamics and Control of Manipulator-Supported EVA Operations**

Weiyang Ren, Haiquan Li, Jianxun Liang and Ou Ma  
 School of Aerospace Engineering, Tsinghua University  
 Beijing, China

- A joint control method for the manipulator was proposed.
- A control method is designed and applied to reduce the disturbance of the EVA supporting system.
- A human-robot coupled EVA supporting system is modeled using the MSC ADAMS software.
- The model is used to simulate the dynamic interaction between the astronaut and the manipulator.



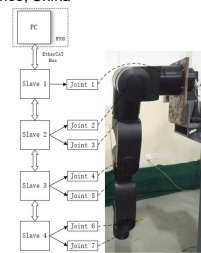
Extravehicular Activity

WA2-2(2) 11:30-11:45

**A Control System Design for 7-DoF Light-weight Robot based on EtherCAT Bus**

Guojun Zhang, Fenglei Ni\*, Zhiqi Li, Hong Liu  
 State Key Laboratory of Robotics and System  
 Harbin Institute of Technology  
 Harbin, Heilongjiang Province, China

- A 7-degree-of-freedom(DoF) light-weight robot control system is designed based on EtherCAT.
- A novel joint controller is designed based on FPGA.
- A robot arm controller operated under the Xenomai real-time kernel based on Linux.



The system of 7-DoF light-weight robot

WA2-2(3) 11:45-12:00

**A Vision-Based Robotic Grasping Approach under the Disturbance of Obstacles**

Xionglei Zhao, Zhiqiang Cao, Qun Jia, Lei Pang, Yingying Yu, Min Tan  
 Institute of Automation, Chinese Academy of Sciences  
 Beijing, China

- Object detection based on deep learning.
- Obstacle extraction based on 3D point cloud
- Planning under the disturbance of obstacles



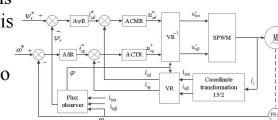
Snapshots of the grasping experiment

WA2-2(4) 12:00-12:15

**Modeling and Simulation for Fifteen-phase Asynchronous Motor of Ship Electric Propulsion**

Jingnan Zhang, Jing Han and Nanqiu Li  
 Department of Electrical Engineering, Harbin Engineering University  
 Harbin, Heilongjiang, China

- The mathematical model of the fifteen-phase asynchronous motor is deduced and the simulation model is established.
- Vector control strategy according to the rotor flux oriented is designed.
- A fuzzy PID controller combining fuzzy control theory with traditional PID controller is applied to the fifteen-phase asynchronous motor speed control system.



The block diagram of fifteen-phase asynchronous motor vector control.

WA2-3: Signal Measurement and Process in Automatic Control

Session Chairs: Dongdong Bu, Beijing Institute of Technology

James K Mills, University of Toronto

Conference Room 3, 11:15-12:15, Wednesday, 8 August 2018

WA2-3(1) 11:15-11:30

### A Starting Value Computation Method for Displacement Measurement Based on Magnetic Field

Shengwu Du, Jinchun Hu, Yu Zhu and Ming Zhang  
Department of Mechanical Engineering, Tsinghua University  
Beijing, China

- The solution value  $X(t_0)$  at initial measurement moment  $t_0$  is termed as starting value for displacement measurement solution (Fig.1).
- This paper proposes a multi-parameter numerical continuous method with wide convergence range to compute starting value.
- Simulation results have verified that it has better convergence performance than traditional homotopy continuous method.
- Experiment results have illustrated the effectiveness of this method.

WA2-3(2) 11:30-11:45

### Improving Vehicle Detection in Point Cloud Data with Novel Features

Pengfei Zhang<sup>1</sup>, Shifeng Wang<sup>2</sup>, Ze Wang<sup>3</sup>, Wei Liu<sup>4</sup> and Yijun Tu<sup>5</sup>  
School of Opto-Engineering, Changchun University of Science and Technology  
Changchun, Jilin, China

- Lidar point cloud data's clustering and classifying
- Grid-occupy segmentation and Support Vector Machine for vehicle detection
- Vehicle's plate intensity characteristic is introduced as new feature
- Reduce the redundant features using Principle Component Analysis

Vehicle Detection Visualization

WA2-3(3) 11:45-12:00

### Real-time Electrical Simulation Inertia Detection Based on Savitzky-Golay Filtering Algorithm

Zhongquan Shuai, Fei Gao, Rong Fu and Wei Qi  
Engineering Research Center of Continuous Extrusion, Dalian Jiaotong University  
Dalian, China

- This paper proposes a method of brake dynamometer electrical simulation inertia detection.
- The effects of brake torque and speed signal on mass are analyzed respectively.
- Brake test results have verified the efficacy of the real-time electrical simulation inertial detection method.

Brake dynamometer Inertia

WA2-3(4) 12:00-12:15

### Influence of Subdivision Error of Encoder on Speed Stability of Telescopes

Wang Shuai, Zhu Juan  
Changchun Institute of Optics, Fine Mechanics and Physics,  
Chinese Academy of Sciences Changchun, Jilin Province, China

- Position encoder is a very important factor on driving control performance.
- In order to achieve the required high resolution, the position encoder must subdivide the sinusoidal signal scanned by the encoder.
- This paper analyses the effect of periodic subdivision error on the velocity measurement and the speed stability of servo system from the dynamic application of encoder.

Subdivision Error of Encoder

WA2-5: Rotor Dynamics, Vibration Analysis and Vibration Control

Session Chairs: Xihuan Hou, Beijing Institute of Technology

Aiguo Ming, University of Electro-Communications

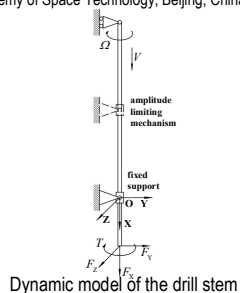
Conference Room 5, 11:15-12:15, Wednesday, 8 August 2018

WA2-5(1) 11:15-11:30

**Dynamic modeling and analysis of the drill stem in the lunar soil drilling sampler**

Shuai Yang<sup>1,2</sup>, Jianchao Han<sup>1</sup>, Huajun Hu<sup>1</sup>, Xiaoming Lai<sup>1</sup>, Jiabo Zhang<sup>1</sup>, Jing Sun<sup>1,3</sup>, Bo Pan<sup>3</sup>  
<sup>1</sup>Beijing Spacecrafts, China Academy of Space Technology, Beijing, China  
<sup>2</sup>State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin, China  
<sup>3</sup>Institute of Spacecraft System Engineering, China Academy of Space Technology, Beijing, China

- Lunar soil drilling sampler
- Frill stem
- Smplitude limiting mechanism
- Variable-length
- Beam-shaft element

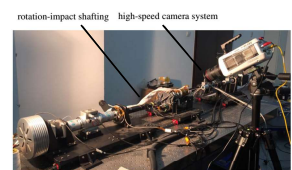


WA2-5(2) 11:30-11:45

**Design and Experimental Research of the Rotation-Impact Shafting in the Lunar Soil Drilling Sampler**

Xiaoqing Liu<sup>1</sup>, Shuai Yang<sup>1,2</sup>, Jianchao Han<sup>1</sup>, Huajun Hu<sup>1</sup>, Qichen Sun<sup>1</sup>, Xiaoming Lai<sup>1</sup>, Jing Sun<sup>1,3</sup>  
<sup>1</sup>Beijing Spacecrafts, China Academy of Space Technology, Beijing, China  
<sup>2</sup>State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin, China  
<sup>3</sup>Institute of Spacecraft System Engineering, China Academy of Space Technology, Beijing, China

- Lunar soil
- Sampling
- Rotation-impact shafting
- Dynamic characteristics



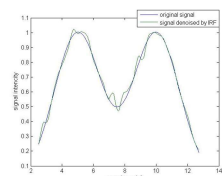
Experimental platform

WA2-5(3) 11:45-12:00

**Wavelet De-noising Algorithm and Application Based on Improved Threshold Function**

Xiaohui Jiang, Jie Sun, Quan YuWen, Bingsheng Liu and YangBo Bai  
 School of the Electrical and Electronic Engineering  
 Tianjin University of Technology  
 Tianjin, China

- Introduction of the signal denoising methods and the wavelet denoising theory.
- Analysis of Traditional Wavelet Threshold De-noising.
- Analysis of Improved Wavelet Threshold De-noising.
- Analysis
- Conclusion



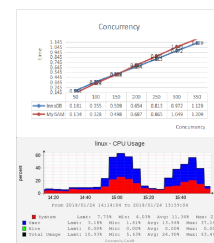
the original signal and the signal denoised by IRF

WA2-5(4) 12:00-12:15

**Optimization Design Method of Cache Extension in MySQL Database**

Jianyun Ni, Shuzhi Xie, Zihao Li, Chao Jia  
 Complex control theory Lab., Tianjin University of Technology  
 Tianjin, China

- This paper introduces the realization method of MySQL database optimization design on large data volume and high concurrency.
- Increase the data buffer between memory and disk, effectively share the storage pressure on the data cache, increase the number of bytes per data read, and save more data into the auxiliary buffer, thus increasing the efficiency of the data prereading.



Result analysis

*IEEE ICMA 2018 Conference Digest*  
**WA2-6: Manipulation Sensing & System**

Session Chairs: Linshuai Zhang, Kagawa University

Jian Guo, Tianjin University of Technology

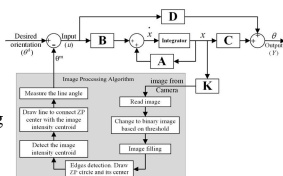
**Conference Room 6, 11:15-12:15, Wednesday, 8 August 2018**

WA2-6(1) 11:15-11:30

**Automated System for Cell Manipulation and Rotation**

Ihab Abu Ajamieh, Beno Benhabib, and James K. Mills  
 Nonlinear Systems Control Lab., University of Toronto  
 Toronto, Canada

- The proposed cell rotation approach uses the conventional tools that are in use in the Labs now.
- The simulation results show the rolling and sliding friction coefficients importance in controlling the cell rotational motion.
- A vision-based feedback control system including image processing algorithm used to track the cell rotation and obtain its desired orientation.



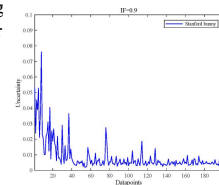
The control system algorithm

WA2-6(2) 11:30-11:45

**Object Grasping Under Shape Uncertainty Using Linear Combination of Two Kernel Functions**

Jian Ruan, Houde Liu, Kangkang Dong, Xiaojun Zhu, Bin Liang  
 Graduate School at Shenzhen, Tsinghua University  
 Shenzhen, China

- We presents a new grasping planning algorithm using Gaussian process for 2-finger gripper which could explicitly calculate the shape uncertainty of 3D objects.
- We used the linear combination of two different kernel functions.
- We are the first to analyze the relationship between the impact factor of kernel function and the shape uncertainty of target objects.



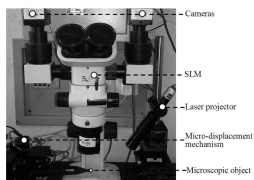
Stanford bunny uncertainty caused by each point cloud

WA2-6(3) 11:45-12:00

**Edge Detection Method Used for Red Laser Stripe Located on Microscope Images**

Yuezong Wang and Benliang Geng  
 The College of Mechanical Engineering and Applied Electronics Technology.,  
 Beijing University of Technology Beijing, China

- The system consists of a stereo light microscope, two cameras, and a laser projector.
- The method to reconstruct 3D shape of microscopic object is proposed based on laser stripe scanning.
- The method to detect microscopic edges is proposed based on Canny rule.



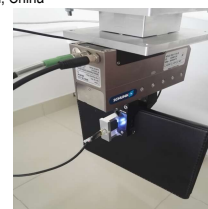
The System of Microscopic Vision System

WA2-6(4) 12:00-12:15

**Center of Mass and Friction Coefficient Exploration of Unknown Object for a Robotic Grasping Manipulation**

Zhongqiu Zhao<sup>1</sup>, Xueyong Li<sup>1</sup>, Changhou Lu<sup>1</sup> and Yonghui Wang<sup>2</sup>  
<sup>1</sup>Key Laboratory of High Efficiency and Clean Mechanical Manufacture of MOE, School of Mechanical Engineering, <sup>2</sup>Department of Physical Medicine and Rehabilitation Qilu Hospital, Shandong University, Jinan, China

- The position of Center of Mass and friction coefficient is detected simultaneously.
- The method can be used for unknown objects in irregular shapes.
- The method does not need priori knowledge such as shape, volume, texture and other properties.



The Grasping Manipulation

IEEE ICMA 2018 Conference Digest  
**WA2-7: Robot Navigation and Control Algorithm**

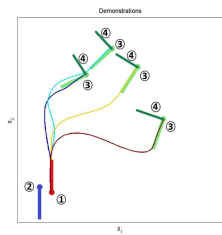
Session Chairs: Shuoxin Gu, Kagawa University  
 Liwei Shi, Beijing Institute of Technology  
**Conference Room 7, 11:15-12:15, Wednesday, 8 August 2018**

WA2-7(1) 11:15-11:30

**Exploiting the task space redundancy in robot programming by demonstration**

Tohid Alizadeh\*, and Navab Karimi  
 \* Department of Robotics and Mechatronics, Nazarbayev University  
 Astana, Kazakhstan

- A PbD approach based on TP-GMM is proposed.
- The redundant task parameters (TPs) are identified after model learning.
- Only one of the redundant TPs (main TP) is used in the normal situations for reproduction.
- While a main TP is not fully observable, a spare one is used to provide proper reproduction, to have a fault tolerant configuration.



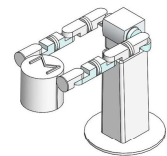
Demonstration with redundant task parameters

WA2-7(2) 11:30-11:45

**Real-Time Collision Avoidance of a Redundant Dual-Arm Robot Based on Distance Function Method**

Mahir Abdelwahid , Yan Dong , Li Tiejun and Guo Shijie.  
 School of Mechanical Engineering, Hebei University of Technology  
 Tianjin, China.

- A new method for collision avoidance of a redundant dual arm robot is introduced.
- An optimization anti collision distance index and a weight function are introduced.
- The work ability and the collision avoidance of the robot are enhanced.
- The feasibility of the method is verified by using simulation.



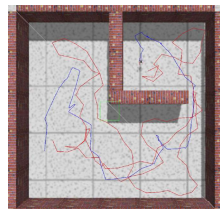
A redundant dual-arm robot handling an object.

WA2-7(3) 11:45-12:00

**A Target Point based MAV 3D Exploration Method**

Tong Baiming, Shan Jicheng, Dai Chaofan, and Liu Qingbao  
 Department of Systems Engineering., National University of Defense Technology  
 Changsha, China

- A target point based MAV 3D exploration method has been proposed.
- The proposed method outperform the RRT based next best view planner(nbvplanner)[1] in exploration time and path length.
- The proposed method decouple the planning of exploration trajectory into 4 steps



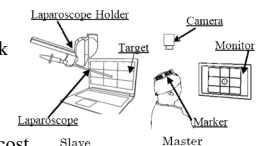
The exploration path of the proposed method(blue) and nbvplanner(red)

WA2-7(4) 12:00-12:15

**Tele-Operation of Robot by Image Processing of Markers Attached to Operator's Head**

Masahiko Minamoto<sup>1)</sup>, Masaki Sato<sup>2)</sup>, Takahiro Kanno<sup>3)</sup> and Kenji Kawashima<sup>3)</sup>  
<sup>1)</sup>Monozukuri Engineering Department, Tokyo Metropolitan College of Industrial Technology, Tokyo, Japan <sup>2)</sup> Mechanical Engineering, Faculty of Engineering, Chiba University, Chiba, Japan  
<sup>3)</sup> Institute of Biomaterial and Bioengineering, Tokyo Medical and Dental University, Tokyo, Japan

- We propose an interface for tele-operation of the camera by tracking image of markers.
- A laparoscopic holder robot and a pick and place robot are controlled by this interface.
- The proposed interface by image processing can be constructed at low cost.
- User only has to move their head for all degree-of-freedoms.



# Index of Session Chairs

## -A-

Alizadeh, Tohid	MP3-3
Alizadeh, Tohid	MP1-1
Amin, Heba	MP3-6

## -B-

Bao, Xianqiang	WA1-1
Bao, Xianqiang	WA2-1
Bao, Xianqiang	MP2-2
Bi, Sheng	TP2-6
Bu, Dongdong	WA2-3
Bu, Dongdong	TA2-4
Bu, Dongdong	TP1-5

## -C-

Cai, Chengtao	TP1-1
Cai, Chengtao	WA1-1
Cao, Liwen	MP2-4
Cao, Xiaotao	TP2-2
Chang, Hongbin	TA1-6
Chen, Fei	MP2-2

## -D-

Deng, Xin	MP3-6
Dong, Enzeng	TP1-1
Du, Baosen	TP1-6

## -F-

Feng, Guo-Hua	TA2-3
Feng, Ying	TA2-2
Fu, Qiang	TA1-2
Fu, Qiang	MP3-1

Fu, Yili	MP3-7
Fukuda, Toshio	MP1-1
Fukuda, Toshio	TA1-3
Fusaomi, Nagata	TA2-6

## -G-

Gao, Baofeng	WA1-5
Go, Ritsu	MP3-7
Gu, Shuoxin	WA2-7
Guan, Lianwu	TP2-1
Guo, Jian	MA1-P
Guo, Jian	MP2-1
Guo, Jian	TP2-4
Guo, Jian	WA1-2
Guo, Jian	WA2-6
Guo, Shuxiang	TA2-1
Guo, Shuxiang	WA2-1

## -H-

Hou, Xihuan	TP2-5
Hou, Xihuan	WA2-5
Hou, Xihuan	MP2-3
Hu, Jinchun	TA1-7

## -J-

Jia, Chao	TA1-5
-----------	-------

## -K-

Kazuhiro, Kosuge	MP1-2
Kong, Fankai	MP1-4
Kouzani, Abbas	TP2-1

## -L-

Li, Guohong	TP1-4	Tarn, T. J.	MP1-6
Li, Hao	MP1-4	Tarn, T. J.	TA2-1
Li, Juan	TA2-4	Tian, Dapeng	TA1-7
Li, Min	TA1-4	Tian, Dapeng	TP1-2
Li, Yuxia	MP3-2	Tian, Dapeng	WA2-2
Ling, Yong	MP2-6		
Liu, Hongda	TA2-5	<b>-W-</b>	
Liu, Yi	TP1-3	Wang, Hongbo	TP2-6
Liu, Yi	WA1-5	Wang, Hongbo	MP1-5
<b>-M-</b>		Wang, Hui	TP1-7
Ma, Donghui	TA2-5	Wang, Jianli	MP1-3
Ma, Hongbin	TA1-1	Wang, Lihua	TP1-5
Ma, Tianyi	TP1-7	Wang, Ming	MP2-6
Matsuhira, Nobuto	MP3-4	Wang, Shijun	TP1-2
Meng, Xiangkai	TP2-4	Wang, Shuai	TP2-3
Mills, James K	MP1-6	Wang, Shuoyu	MP1-5
Mills, James K	WA2-3	Wang, Xiaohai	TP2-2
Ming, Aiguo	MP2-1	Wang, Zixu	TA1-4
Ming, Aiguo	WA1-3	Wang, Zixu	WA1-3
Ming, Aiguo	WA2-5	Watanabe, Keigo	TA2-6
Mou, Fangli	TA1-2	Wei, Yonggeng	TA1-3
<b>-P-</b>		Wu, Baoqi	MP3-5
Pan, Qinxue	TP1-3	Wu, Jinglong	WA1-7
<b>-S-</b>		Wu, Wei	TA2-3
Shan, Jinjun	MP3-4	<b>-X-</b>	
Shi, Liwei	MA1-P	Xiao, Nan	WA1-6
Shi, Liwei	MP2-5	Xing, Huiming	WA1-6
Shi, Liwei	WA2-7	Xing, Huiming	MP2-5
Sun, Ruijie	TA2-7	Xing, Huiming	TP1-4
<b>-T-</b>		Xu, Qingsong	TP2-3
Tang, Mingsheng	TP2-7	<b>-Y-</b>	
		Yang, Li	MP2-7
		Ye, Xiufen	TA1-5

Yu, Lie	MP2-3
Yu, Xiuping	MP2-7
Yu, Yong	MP1-2

## -Z-

Zhang, Chunyou	TP2-5
Zhang, Defu	MP3-1
Zhang, Linshuai	WA1-7
Zhang, Linshuai	WA2-6
Zhang, Wei	TA1-6
Zhang, Xiaoshuang	MP1-7
Zhang, Ye	MP2-4
Zhang, Yifei	MP3-5
Zhao, Yan	WA1-2
Zhao, Yan	MP3-2
Zhao, Yan	TA1-1
Zheng, Guojun	MP1-3
Zheng, Liang	MP1-7
Zheng, Liang	WA2-2
Zheng, Liang	TP1-6
Zhou, Junjie	TP2-7
Zhu, Hongmei	MP3-3
Zhu, Xiaoping	TA2-7
Zuo, Guoyu	TA2-2



# Index of Authors

## -A-

Abdramane, Dembélé	TA2-6
Adams, Scott	WA1-3
Adjallah, Kondo H.	TA1-3
Ahmed, Sabah	TA1-2
Ahn, Hee Sung	TP2-3
Ahn, Yeon Joo	TP2-3
Ajamieh, Ihab Abu	WA2-6
Alattas, Reem J	TA1-6
Alizadeh, Tohid	MP3-3
Alizadeh, Tohid	WA2-7
Amadou, Touré	TA2-6
Amin, Heba	MP3-6
Arai, Tatsuo	MP2-1
Arai, Tatsuo	MP2-1
Arakawa, Atsushi	TA2-6
Arakawa, Atsushi	TA2-6
Assal, Samy F. M.	TP1-3
Assal, Samy F.M.	MP3-6
Azami, Osamu	MP1-1

## -B-

Bai, Bing	TA2-7
Bai, Deen	TP1-3
Bai, Lang	MP1-4
Bai, Luchang	MP3-2
Bai, Yangbo	WA2-5
Bao, Chengcheng	TP2-2
Bao, Xianqiang	MP2-2
Bao, Xianqiang	MP2-2
Bao, Xianqiang	MP2-2
Bao, Zihong	TP2-4

Benhabib, Beno	WA2-6
Beyramzad, Jalil	MA1-P
Bi, Sheng	TP1-6
Boulardot, Luc	WA1-5
Bu, Dongdong	MP1-2
Bu, Dongdong	MP3-2
Bulading, Aimaiti	TP1-3

## -C-

Cai, Chengtao	MA1-P
Cai, Chengtao	MA1-P
Cai, Chengtao	MP3-5
Cai, Chengtao	TP1-1
Cai, Chengtao	WA1-1
Cai, Ganwei	TA1-6
Cao, Changqing	MA1-P
Cao, Changqing	TA2-5
Cao, Guohua	WA1-1
Cao, Jian	TA2-3
Cao, Linlin	MA1-P
Cao, Liwen	MA1-P
Cao, Qian	TP1-1
Cao, Shuang	TP1-7
Cao, Shuang	TA1-7
Cao, Xiaotao	MP1-1
Cao, Xuanhao	MP1-7
Cao, Xuanhao	TA1-4
Cao, Yang	TP2-3
Cao, Zhiqiang	MP3-1
Cao, Zhiqiang	WA2-2
Chai, Bo	TP1-3
Chang, Hongbin	TA1-6
Chang, Hongxing	TA1-1

Chang, Jingyuan	MA1-P	Chen, Mingjie	MA1-P
Chang, Xuling	TP1-2	Chen, Nan	TA1-6
Chang, Yadong	MA1-P	Chen, Peng	TA1-3
Chang, Ying	MP1-3	Chen, Pengfei	MP3-3
Chang, Yukang	MP1-6	Chen, Qimeng	MP1-2
Chen, Chaozhan	MP2-1	Chen, Rui	MP1-4
Chen, Dachuan	MP1-4	Chen, Shengyong	MP2-4
Chen, Daidai	MA1-P	Chen, Sizhong	MA1-P
Chen, Datong	MP2-4	Chen, Wei	TP1-1
Chen, Datong	TA2-2	Chen, Xiaojuan	MA1-P
Chen, Datong	TP1-2	Chen, Xiaoqi	MA1-P
Chen, Datong	WA1-1	Chen, Xiaoqi	MA1-P
Chen, Ding	MP1-4	Chen, Xiaoqi	MA1-P
Chen, Fan	TA2-3	Chen, Xingbang	MP3-1
Chen, Fan	TP1-3	Chen, Xinyu	TA1-1
Chen, Feng	TA2-1	Chen, Xuanwen	MP1-6
Chen, Guangsong	MA1-P	Chen, Xuechao	MP3-3
Chen, Guangsong	TA1-5	Chen, Xuechao	TP1-4
Chen, Guangsong	TA1-5	Chen, Yang	MA1-P
Chen, Guangsong	TA1-5	Chen, Yang	WA1-1
Chen, Guangsong	TP1-5	Chen, Yangquan	MA1-P
Chen, Hongli	MA1-P	Chen, Yiping	WA2-1
Chen, Hua	MA1-P	Chen, Zhan	TP1-4
Chen, Huanan	MP2-1	Chen, Zhan	TP1-4
Chen, Jianen	TA2-7	Chen, Zhan	TP2-4
Chen, Jiangcheng	TP1-6	Chen, Zhanjun	MP2-7
Chen, Jiqing	TA1-6	Chen, Zhaoyi	MA1-P
Chen, Junli	MA1-P	Chen, Zhaoyi	MP3-1
Chen, Junnan	MP2-1	Chen, Zhihua	TA2-7
Chen, Kun	MA1-P	Cheng, Jianhua	MA1-P
Chen, Kun	MA1-P	Cheng, Lijuan	TP1-3
Chen, Lei	TA1-6	Cheng, Long	MP3-1
Chen, Lin	TA2-3	Cheng, Wen	TP2-5
Chen, Mengjuan	MP3-5	Cheng, Wenjie	MP2-3
Chen, Ming	MA1-P	Cheng, Xu	MP2-4

Cheng, Yang	MP2-2	Deng, Zhun	TA2-5
Cheng, Yu	TP1-6	Deng, Zongquan	TP1-3
Chiang, Cheng-Ta	MA1-P	Ding, Fuguang	MP2-5
Chiang, Cheng-Ta	MA1-P	Ding, Fuguang	TP2-2
Chien, Liang-Yu	MA1-P	Ding, Han	MP3-3
Chirstos, Papavassiliou	MP2-4	Ding, Han	TA2-3
Choi, Jong Kap	TP2-3	Ding, Han	TP1-3
Chu, Jinlong	WA1-7	Ding, Hongchang	WA1-1
Chung, Won Jee	MP2-3	Ding, Huaqiu	MP1-4
Chung, Won Jee	TP2-3	Ding, Wenpeng	MP3-3
Collins, Frank	WA1-3	Ding, Xilun	MP1-1
Cong, Wang	MA1-P	Ding, Xin	MP3-5
Cong, Wang	MA1-P	Ding, Xin	WA1-1
Cong, Xiaodan	TP2-1	Ding, Ying	WA1-1
Corva, Dean M.	WA1-3	Dong, Enzeng	TP1-1
Cui, Dehua	MA1-P	Dong, Enzeng	TP1-1
Cui, Jie	TP2-3	Dong, Enzeng	WA1-1
Cui, Jinxin	MP2-2	Dong, Han	MP1-3
Cui, Lin	TA1-3	Dong, Huifang	MP2-6
Cui, Xinlei	MA1-P	Dong, Junxian	MP1-5
Cui, Xun	MA1-P	Dong, Kangkang	WA1-2
		Dong, Kangkang	WA2-6
		Dong, Shengnan	MP2-1
		Dou, Jianping	MP2-3
		Driscoll, Don	TA1-1
		Du, Baosen	TP1-6
		Du, Meng	TP2-7
		Du, Qilong	TP2-6
		Du, Shengwu	WA2-3
		Du, Shengzhi	TP1-1
		Du, Shengzhi	TP1-1
		Du, Tingchen	MA1-P
		Du, Tingchen	TP2-5
		Du, Tingchen	TA1-7
		Du, Tingchen	TP1-3

## -D-



Gao, Qiang	MP2-5	Geng, Benliang	WA2-6
Gao, Qiang	TP2-3	Geng, Haipeng	MA1-P
Gao, Qiang	TA1-4	Geng, Haipeng	MA1-P
Gao, Qiang	TP1-7	Geng, Haipeng	MA1-P
Gao, Shuangshuang	MA1-P	Geng, Haipeng	MP2-3
Gao, Weijin	TP1-5	Geng, Haipeng	TP1-3
Gao, Xiaohui	TP2-3	Geng, Haipeng	TP2-5
Gao, Xuefeng	MA1-P	Geng, Haipeng	TP2-5
Gao, Ya	MA1-P	Geng, Haipeng	TA1-7
Gao, Yanbin	MP3-1	Gentilini, Iacopo	TP2-6
Gao, Yanbin	WA2-1	Ghanbari, Ahmad	MA1-P
Gao, Yanbin	TP2-1	Gilbert, Deon	TA1-1
Gao, Yang	TA2-4	Go, Ritsu	MA1-P
Gao, Yi	MA1-P	Go, Ritsu	MA1-P
Gao, Yibo	MP1-6	Golkarnarenji, Gelayol	TA1-1
Gao, Yongsheng	TA2-2	Gong, Dapeng	TP1-6
Gao, Yongsheng	TA2-2	Gong, Dawei	WA1-1
Gao, Zhiqiang	MA1-P	Gong, Qiuting	MP1-5
Gao, Zhiqiang	MA1-P	Gong, Weijing	TP1-5
Gao, Zhiqiang	MA1-P	Gong, Yuan	MP3-4
Gao, Zhiqiang	MA1-P	Goodall, Damian	TA1-1
Gao, Zhiqiang	TP1-7	Gu, Jinlin	MP2-5
Gao, Zhiqiang	TP1-7	Gu, Jinlin	WA1-2
Gao, Zhiqiang	TP1-7	Gu, Mingfei	MA1-P
Gao, Zhiqiang	TP2-7	Gu, Shuoxin	TP1-4
Gao, Zhiqiang	TP2-7	Gu, Shuoxin	WA1-3
Gao, Zhiqiang	TP2-7	Guan, Bo	MA1-P
Gates, Will	WA1-3	Guan, Lianwu	MP3-1
Ge, Dongsheng	MP3-3	Guan, Lianwu	TP2-1
Ge, Huijian	MP2-2	Guan, Lianwu	WA2-1
Ge, Qingcai	MP1-5	Gunasekara, P.S	MP1-2
Ge, Weimin	MA1-P	Guo, An	MP1-4
Ge, Weimin	MP2-4	Guo, An	TA2-7
Ge, Weimin	TP2-5	Guo, Hong	TP2-3
Ge, Weimin	TA2-7	Guo, Jian	MA1-P

Guo, Jian	MA1-P	Guo, Yangming	MP2-2
Guo, Jian	MP2-6	Guo, Yannan	TA1-4
Guo, Jian	MP3-7		
Guo, Jian	TA2-4	<b>-H-</b>	
Guo, Jian	TP2-4	Habib, Maki K.	TA2-6
Guo, Jian	WA1-6	Hamada, Kosuke	TA2-6
Guo, Jian	WA1-7	Hamed, Amr	TA1-2
Guo, Jiang	TP1-6	Han, Bo	TP1-1
Guo, Jinjin	MP2-4	Han, Chunyang	MA1-P
Guo, Jinjin	WA1-6	Han, Chunyang	TP1-6
Guo, Juncheng	MA1-P	Han, Dongdong	TA2-5
Guo, Kang	MP2-1	Han, Hasiaoqier	MA1-P
Guo, Liang	TA1-3	Han, Hongbin	MA1-P
Guo, Liqiang	TA2-1	Han, Hongbin	TA1-4
Guo, Pengfei	WA1-3	Han, Jianchao	WA2-5
Guo, Pin	MP1-1	Han, Jianchao	WA2-5
Guo, Ping	TP2-4	Han, Jing	WA2-2
Guo, Qiao	TA2-4	Han, Kai	TA2-3
Guo, Shijie	WA2-7	Han, Kai	WA1-2
Guo, Shuxiang	MA1-P	Han, Kang	MP3-5
Guo, Shuxiang	MA1-P	Han, Liangliang	MP2-5
Guo, Shuxiang	MA1-P	Han, Ruiqing	MA1-P
Guo, Shuxiang	MP1-2	Han, Xiangbo	WA1-7
Guo, Shuxiang	MP2-2	Han, Yixing	MA1-P
Guo, Shuxiang	MP2-2	Han, Yu	TP2-3
Guo, Shuxiang	MP2-2	Hasegawa, Tomohiko	TA2-6
Guo, Shuxiang	MP2-2	Hassan, Ali	MP3-4
Guo, Shuxiang	MP2-2	He, Dong	TP2-4
Guo, Shuxiang	MP3-2	He, Junpei	TP1-6
Guo, Shuxiang	MP3-2	He, Kunpeng	WA2-1
Guo, Shuxiang	MP3-2	He, Shuai	MP3-2
Guo, Shuxiang	MP3-7	He, Shuai	WA1-2
Guo, Shuxiang	TA2-4	He, Xiangkun	MP1-6
Guo, Ting	MA1-P	He, Yu	MP2-2
Guo, Xijie	WA1-2	He, Yuqing	MA1-P

Hiasa, Shuma	TP1-4	Huo, Qi	MP2-5
Hirata, Hideyuki	TP2-5	Huo, Qi	TP1-6
Hong, Seung Ho	MP1-3	Huo, Qi	WA1-2
Hosseini, Seyyed Sobhan	WA1-3		
Hou, Shiyong	MP3-4	<b>-I-</b>	
Hou, Xihuan	TP1-4	Ikeda, Takeshi	TA2-6
Hou, Xihuan	TP1-4	Ikegami, Keiji	TP2-5
Hou, Xihuan	TP2-4	Isenberg, Douglas R.	TP2-6
Hou, Xihuan	TP2-4	Ishihara, Hidenori	TP2-5
Hou, Xuyan	MP1-6		
Hou, Xuyan	TP1-6	<b>-J-</b>	
Hu, Chengwei	WA1-2	Ji, Lei	TA1-5
Hu, Chengwei	WA1-2	Ji, Lei	TA1-5
Hu, Heng	TP2-1	Ji, Ming	MP1-7
Hu, Hong	MP2-1	Ji, Mingjiang	TP1-4
Hu, Huajun	WA2-5	Ji, Mingjiang	WA1-3
Hu, Huajun	WA2-5	Ji, Xiaopin	TP1-5
Hu, Jinchun	WA2-3	Ji, Xuewu	MP1-6
Hu, Rong	TA2-7	Ji, Yuehui	MA1-P
Hu, Yukun	TP1-1	Ji, Yuehui	TP1-1
Hu, Zedong	TA2-2	Jia, Chao	TA1-5
Huang, Chin-Hu	MA1-P	Jia, Chao	WA2-5
Huang, Dagui	MA1-P	Jia, Chao	WA1-6
Huang, Fei	TA1-3	Jia, Ping	TA1-7
Huang, Hsuan-Hao	MA1-P	Jia, Qun	WA2-2
Huang, Jiaming	TA1-1	Jia, Renfeng	MP1-5
Huang, Jin	TA1-5	Jia, Shiyuan	TA1-7
Huang, Jin	TP1-5	Jia, Songmin	MA1-P
Huang, Kai	MP1-7	Jiang, Chunying	TA1-6
Huang, Kai	TA1-4	Jiang, Huai	MP1-7
Huang, Longping	TP2-4	Jiang, Jun	MP2-6
Huang, Mingguang	MA1-P	Jiang, Junhui	MP1-3
Huang, Peng	MA1-P	Jiang, Kai	MP3-7
Huang, Qiang	MP3-3	Jiang, Min	MP3-5
Huang, Qiang	TP1-4	Jiang, Shan	MA1-P

Jiang, Tao	TP1-2	Kim, Jeong Kweon	MP2-3
Jiang, Tao	TP2-2	Kojima, Masaru	MP2-1
Jiang, Xianzhi	MP3-7	Kojima, Masaru	MP2-1
Jiang, Xiaohui	WA2-5	Kong, Fankai	MP1-4
Jiang, Xin	TA2-3	Kong, Liuyang	MA1-P
Jiang, Xinggang	MA1-P	Kong, Liuyang	MA1-P
Jiang, Yinling	TA1-7	Kong, Liuyang	MA1-P
Jiang, Yu	MA1-P	Kong, Liuyang	MA1-P
Jiang, Yuhua	MP2-2	Kong, Liuyang	MA1-P
Jiang, Zainan	MP1-4	Kong, Liuyang	MP1-5
Jiao, Huiying	WA1-7	Kong, Liuyang	TA2-1
Jiao, Yuzhao	MP1-7	Kouzani, Abbas Z.	TA1-1
Jin, Guangyong	TP2-4	Kouzani, Abbas Z.	WA1-3
Jin, Haojun	WA1-5	Kulasekera, A.L.	MP1-2
Jin, Hongyan	MA1-P	Kuroda, Yusuke	MA1-P
Jin, Jing	MA1-P	Kurokawa, Kanako	TP1-4
Jin, Xiaoliang	MP3-7	Kusano, Takamasa	TA2-6
Jin, Yin	MA1-P		
Jing, Fengshui	MP2-5	<b>-L-</b>	
Jing, Wenbo	MA1-P	Lai, Xiaoming	WA2-5
Jinxin, Cui	MP2-2	Lai, Xiaoming	WA2-5
Jo, Hyeon Min	MP2-3	Lan, Wenbo	TA1-4
Jo, Hyeon Min	TP2-3	Lan, Xiaosong	TA1-1
		Lei, Wei	TA1-7
<b>-K-</b>		Li, Weidong	MA1-P
Kakogawa, Atsushi	MP1-6	Li, Chunying	MP2-6
Kang, Yi	MA1-P	Li, Ang	MA1-P
Kanno, Takahiro	MP1-1	Li, Bing	MA1-P
Kanno, Takahiro	WA2-7	Li, Bing	MP2-4
Karimi, Navab	WA2-7	Li, Boyang	TA1-6
Kawashima, Kenji	MP1-1	Li, Chao	MP3-7
Kawashima, Kenji	WA2-7	Li, Chao	TA2-5
Ke, Yijie	TA1-2	Li, Chongyang	MP1-1
Kim, Dae Young	MP2-3	Li, Chunlei	TP2-4
Kim, Dae Young	TP2-3	Li, Chunli	WA1-5



Li, Chunying	MA1-P	Li, Jin	MA1-P
Li, Dahua	MP1-5	Li, Jin	MA1-P
Li, Dahua	MP2-5	Li, Jin	TP2-4
Li, Dahua	TA1-4	Li, Jing	TA1-6
Li, Dahua	TP1-7	Li, Juan	TA2-4
Li, Daming	WA1-2	Li, Juan	TA2-4
Li, Dingwei	TP1-3	Li, Kaifeng	WA1-1
Li, Dong	TP2-3	Li, Kang	TP1-7
Li, En	TP2-1	Li, Long	MP1-6
Li, Fangming	MP2-7	Li, Min	TP2-4
Li, Guohong	MA1-P	Li, Ming	MP2-3
Li, Guohong	TP2-7	Li, Ming	TP2-3
Li, Guoping	MA1-P	Li, Mingai	MA1-P
Li, Guoyuan	MP2-4	Li, Minggao	MA1-P
Li, Haichao	TP1-7	Li, Mingji	MA1-P
Li, Haiquan	WA2-2	Li, Nan	WA1-6
Li, Hao	MA1-P	Li, Nan	WA1-7
Li, Hao	MA1-P	Li, Nanqiu	WA2-2
Li, Hao	TP2-5	Li, Ningning	TA1-4
Li, Hengyu	TA1-6	Li, Ningning	TP1-7
Li, Hongbo	TP2-2	Li, Pengyun	MP2-1
Li, Hongna	TA1-1	Li, Pengzhi	MP2-1
Li, Hongwen	WA1-6	Li, Qi	MA1-P
Li, Huaijian	MA1-P	Li, Qi	WA2-1
Li, Huaijian	MP3-1	Li, Qi	WA1-7
Li, Hui	WA2-1	Li, Qi	WA1-7
Li, Ji	MA1-P	Li, Qiang	MA1-P
Li, Ji	MA1-P	Li, Qiang	TA2-2
Li, Jiabao	WA1-3	Li, Qiang	TA2-2
Li, Jianfeng	WA1-3	Li, Qiang	TP2-7
Li, Jianming	TP1-2	Li, Qianqian	MA1-P
Li, Jianwen	TA1-7	Li, Qingqing	MA1-P
Li, Jiaqiang	TA2-3	Li, Rui	TA2-2
Li, Jie	WA1-3	Li, Shichao	TP2-7
Li, Jilong	TP2-5	Li, Shizhen	WA1-3

Li, Shuanzeng	MP1-3	Li, Yuan	MP2-5
Li, Shuxiao	TA1-1	Li, Yuanyuan	MA1-P
Li, Tiejun	WA2-7	Li, Yuhai	MA1-P
Li, Tongtong	TP1-2	Li, Yuhui	TA1-6
Li, Wanyou	MA1-P	Li, Yuting	MP1-3
Li, Wei	MP2-3	Li, Yuxia	WA1-3
Li, Wentao	TA2-5	Li, Yuxin	WA1-3
Li, Xiang	TA2-3	Li, Zengliang	MP2-4
Li, Xianling	MP2-1	Li, Zhiqi	MP1-1
Li, Xianming	TA2-5	Li, Zhiqi	MP2-2
Li, Xianxia	MA1-P	Li, Zhiqi	WA2-2
Li, Xiao	MP1-2	Li, Zihao	WA2-5
Li, Xiaodong	MP1-3	Lian, Yufeng	TA1-4
Li, Xiaoyu	MA1-P	Liang, Bin	WA1-2
Li, Xinle	MA1-P	Liang, Bin	WA2-6
Li, Xiujun	WA2-1	Liang, Bin	MP2-6
Li, Xiujun	WA1-7	Liang, Fengyong	TP2-5
Li, Xu	MP2-6	Liang, Hong	MA1-P
Li, XueAi	MP1-1	Liang, Hong	MA1-P
Li, Xueyong	TA2-6	Liang, Jianxun	WA2-2
Li, Xueyong	WA2-6	Liang, Jintao	TP1-5
Li, Xueyuan	TP2-7	Liang, Lihua	MP1-4
Li, Yanan	TA2-1	Liang, Lihua	MP1-7
Li, Yanhao	TA1-7	Liang, Lihua	MP1-7
Li, Yanhui	MP3-7	Liang, Lihua	TA1-7
Li, Yanzhao	TP2-4	Liang, Minghui	MP2-4
Li, Yi	MA1-P	Liang, Minghui	TA2-2
Li, Yi	MA1-P	Liang, Minghui	TP1-2
Li, Yi	MA1-P	Liang, Minghui	WA1-1
Li, Yibin	TP1-3	Liang, Shuo	TA1-2
Li, Yibin	TP1-5	Liang, Zize	TP2-1
Li, Yibin	TA1-7	Liao, Hongzhou	WA2-1
Li, Yongqiang	MP3-6	Liao, Hongzhou	MP1-5
Li, Youxiang	MP2-2	Liao, Yi	MP1-2
Li, Yuan	MA1-P	Lim, Dong Jae	MP2-3

Lim, Dong Jae	TP2-3	Liu, Hong	MP2-7
Lin, XiaoGong	MA1-P	Liu, Hong	WA2-2
Lin, Xiaogong	MP1-7	Liu, Hongda	TA1-7
Lin, Xin	TP1-4	Liu, Hongda	TP1-7
Lin, Xin	WA1-3	Liu, Hongli	MA1-P
Lin, Yueming	MP2-4	Liu, Hongli	MA1-P
Lin, Yueming	TA2-2	Liu, Hongli	MA1-P
Lin, Yueming	TP1-2	Liu, Hongli	MA1-P
Lin, Yueming	WA1-1	Liu, Hongqi	TP1-2
Lin, Yuqing	MP2-1	Liu, Hongqin	MA1-P
Lin, Yuqing	MP2-1	Liu, Houd	WA1-2
Ling, Yong	MP2-6	Liu, Houde	MP2-6
Liu, Bin	TA1-7	Liu, Houde	WA2-6
Liu, Bingrui	TA1-6	Liu, Huaxin	TP1-4
Liu, Bingsheng	WA2-5	Liu, Hui	TA2-3
Liu, Chaoda	MP2-6	Liu, Huikang	TP1-4
Liu, Chaoda	TA2-1	Liu, Huikang	TP1-4
Liu, Chenying	TA1-2	Liu, Huikang	TP2-4
Liu, Chuan	MA1-P	Liu, Huikang	TP2-4
Liu, Chunxia	TA2-1	Liu, Jiamei	TP2-4
Liu, Chuzhao	WA1-2	Liu, Jianxu	TA2-4
Liu, Cong	MA1-P	Liu, Jiayu	TP1-6
Liu, Cong	TP2-1	Liu, Jing	TP2-6
Liu, Cunqiu	WA1-2	Liu, Jing	WA1-6
Liu, Dong	MP2-7	Liu, Jinyue	MA1-P
Liu, Dong	TA2-7	Liu, Jun	TP2-5
Liu, Dong	WA1-6	Liu, Jun	TA2-7
Liu, Dongyu	MP2-2	Liu, Lian	TA2-1
Liu, Fanming	MP2-7	Liu, Liang	MP2-7
Liu, Guanjun	TP1-4	Liu, Liang	TA2-7
Liu, Guanjun	WA1-3	Liu, Liang	WA1-6
Liu, Hong	MP1-1	Liu, Lihua	WA1-6
Liu, Hong	MP1-1	Liu, Lixin	MA1-P
Liu, Hong	MP2-2	Liu, Peng	MP2-2
Liu, Hong	MP3-6	Liu, Qian	WA1-2

Liu, Qian	WA1-2	Liu, Yi	WA1-5
Liu, Qiang	MA1-P	Liu, Ying	TP1-4
Liu, Qiang	MA1-P	Liu, Yinghui	MA1-P
Liu, Qiang	MP1-3	Liu, Yiwei	MP1-1
Liu, Qiang	TP2-2	Liu, Yixiang	TP1-4
Liu, Qingbao	WA2-7	Liu, Yongguang	TP2-3
Liu, Qingping	MA1-P	Liu, Yu	TP1-4
Liu, Qitong	MA1-P	Liu, Yu	TP1-4
Liu, Qitong	TP2-2	Liu, Yu	TP2-4
Liu, Rang	MA1-P	Liu, Yu	TP2-4
Liu, Ruimin	TP2-6	Liu, Yu	TA1-6
Liu, Runqi	MP1-7	Liu, Yubin	TP1-4
Liu, Shan	MA1-P	Liu, Yulong	MP1-6
Liu, Shan	TP1-6	Liu, Yunqing	TP2-1
Liu, Shuxuan	TP1-2	Liu, Yutao	MA1-P
Liu, Sicheng	WA1-2	Liu, Yuzheng	MA1-P
Liu, Tao	MP2-7	Liu, Zheming	TP2-3
Liu, Wei	WA2-3	Liu, Zheming	TP2-5
Liu, Weiping	MA1-P	Lu, Changhou	TA2-6
Liu, Xiaolong	TP2-4	Lu, Changhou	WA2-6
Liu, Xiaomeng	TA1-1	Lu, Jiabin	MA1-P
Liu, Xiaoming	MP2-1	Lu, Jiahao	TA2-2
Liu, Xiaoming	MP2-1	Lu, Kaiyuan	MP2-1
Liu, Xiaoqing	WA2-5	Lu, Zhizhong	WA1-5
Liu, Xilong	MP3-5	Luan, Kuan	TP2-4
Liu, Xinke	MP2-2	Luo, Ani	MA1-P
Liu, Xinzhi	TA2-3	Luo, Chao	MP2-2
Liu, Xuelian	MA1-P	Luo, Chen	MP2-5
Liu, Xuelian	WA1-3	Luo, Chen	MP3-5
Liu, Yang	MA1-P	Luo, Haitao	MA1-P
Liu, Yang	MA1-P	Luo, Haitao	TP2-3
Liu, Yang	MA1-P	Luo, Xiaoping	TP2-2
Liu, Yanjie	MP1-6	Luo, Xuesong	TA1-2
Liu, Yechao	MP2-2	Luo, Xulong	WA2-1
Liu, Yi	WA1-2	Luo, Yang	TA2-2

Luo, Yang	TA2-2	Ma, Youjie	TP1-7
Luo, Yuluo	MA1-P	Ma, Youjie	TP1-7
Lv, Baolin	MA1-P	Ma, Youjie	TP2-7
Lv, Hao	MA1-P	Ma, Youjie	TP2-7
Lv, Hao	TP1-3	Ma, Youjie	TP2-7
Lv, Hao	TP2-5	Mahir, Abdelwahid	WA2-7
Lv, Hao	TA1-7	Mai, Xiaoming	TP1-6
Lv, Kehong	WA1-3	Mao, Mingzhi	WA1-6
Lv, Shaofeng	MA1-P	Mao, Yanhui	MA1-P
Lv, Shun	TA1-5	Mao, Zemin	TP2-3
Lv, Yaoyu	MP2-5	Matsuhira, Nobuto	MP3-4
Lv, Yaoyu	TA1-3	Mei, Xinkui	TA1-5
Lv, Yaoyu	TP1-6	Meng, Cheng	MP3-7
		Meng, Fei	TP1-4
		Meng, Linmin	TP2-6
		Meng, Xiangdong	MA1-P
		Meng, Xiangkai	MP1-2
		Meng, Xiangkai	TP2-4
		Meng, Xianglian	MA1-P
		Meng, Xianglian	MA1-P
		Meng, Xianglian	WA1-7
		Meng, Xin	MP1-1
		Meng, Xin	TP2-6
		Miao, Mengliang	MP1-4
		Miki, Satoru	MP3-4
		Mills, James K.	WA2-6
		Minamoto, Masahiko	WA2-7
		Ming, Aiguo	MP3-3
		Ming, Aiguo	TP1-4
		Mir, Aqeela	MP3-4
		Miyazaki, Tetsuro	MP1-1
		Mo, Jiaqing	TA1-4
		Mo, Zhijie	MP2-5
		Mohamed, Abdelfatah M.	MP1-1
		Mohamed, Elkeran	MP1-2

## -M-

Ma, Donghui	TA1-3	Meng, Xiangdong	MA1-P
Ma, Hongbin	TA1-1	Meng, Xiangkai	MP1-2
Ma, Hongdao	MP1-2	Meng, Xiangkai	TP2-4
Ma, Hongdao	MP3-2	Meng, Xianglian	MA1-P
Ma, Huidong	MP2-4	Meng, Xianglian	MA1-P
Ma, Liulong	MP1-6	Meng, Xianglian	WA1-7
Ma, Ou	WA2-2	Meng, Xin	MP1-1
Ma, Shugen	MP1-6	Meng, Xin	TP2-6
Ma, Tianyi	TP1-7	Miao, Mengliang	MP1-4
Ma, Wei	WA1-2	Miki, Satoru	MP3-4
Ma, Wei	WA1-2	Mills, James K.	WA2-6
Ma, Xiaoshuai	MP3-3	Minamoto, Masahiko	WA2-7
Ma, Xu	MA1-P	Ming, Aiguo	MP3-3
Ma, Yao	TA2-4	Ming, Aiguo	TP1-4
Ma, Youjie	MA1-P	Mir, Aqeela	MP3-4
Ma, Youjie	MA1-P	Miyazaki, Tetsuro	MP1-1
Ma, Youjie	MA1-P	Mo, Jiaqing	TA1-4
Ma, Youjie	MA1-P	Mo, Zhijie	MP2-5
Ma, Youjie	MA1-P	Mohamed, Abdelfatah M.	MP1-1
Ma, Youjie	TP1-7	Mohamed, Elkeran	MP1-2

Mohamed, Fanni	MP1-2	Oh, YongHwan	TA1-2
Mosadeghzad, Mohamad	MP3-3	Oka, Yoshimichi	MP1-6
Mou, Fangli	WA1-2	Otsuka, Akimasa	TA2-6
Mou, Fangli	WA1-2		
Mu, Deqiang	TA1-3	<b>-P-</b>	
Mu, Weibin	MP2-4	Pan, Bo	TA1-1
Mu, Weibin	TA2-2	Pan, Bo	WA2-5
Mu, Weibin	TP1-2	Pan, Hongli	MP1-4
Mu, Weibin	WA1-1	Pan, Liang	MP3-4
Muraleedharan, Narendran	TP2-6	Pan, Qinxue	TP1-3
		Pan, Ruipeng	TP1-3
<b>-N-</b>		Pang, Lei	WA2-2
Nagai, Isaku	TA2-6	Patel, Sarosh	TA1-6
Nagai, Isaku	TA2-6	Peña, Cesar	MP1-3
Nagai, Isaku	TA2-6	Peng, Shuangchun	MP3-4
Nagata, Fusaomi	TA2-6	Piao, Yan	TA2-1
Naito, Yuta	MP3-4	Ping, Chang	TP1-2
Nakamura, Yoshikazu	TA2-6	Ping, Chang	TP2-2
Nakatsuka, Takanori	TA2-6	Ping, Ping	MP1-2
Ndawula, Isaac	TP1-3		
Ni, Bo	TP2-2	<b>-Q-</b>	
Ni, Fenglei	MP3-6	Qi, Lei	MA1-P
Ni, Fenglei	WA2-2	Qi, Lei	TP2-5
Ni, Jianyun	WA2-5	Qi, Lei	TP2-5
Ni, Jinping	MP1-4	Qi, Lin	TA1-3
Ni, Mingyang	MP2-1	Qi, Wei	WA2-3
Nie, Jun	MP1-7	Qi, Xiaoye	MP3-6
Nie, Ping	TP2-6	Qian, Linfang	MA1-P
Niu, Bin	TP2-7	Qian, Linfang	TA1-5
Niu, Zun	TP2-6	Qian, Linfang	TA1-5
Noorani, Mohammad-Reza Sayyed	MA1-P	Qian, Linfang	TA1-5
Noureldin, Aboelmagd	TP2-1	Qian, Linfang	TP1-5
		Qian, Siyu	MA1-P
<b>-O-</b>		Qian, Zedong	MP3-5
Ochi, Hiroaki	TA2-6	Qiao, Dawei	MP3-6



Shi, Yanmei	MA1-P	Sui, Yongxin	MP2-1
Shi, Yiran	TA1-1	Sui, Zhen	TA1-2
Shi, Yuetian	MP1-6	Sun, Gang	TA2-4
Shi, Yuetian	TP1-6	Sun, Gang	MP1-6
Shi, Zhen	WA1-5	Sun, Haijiang	TA2-1
Shi, Zhengde	TA2-1	Sun, Jie	WA2-5
Shuxiang, Guo	TP1-4	Sun, Jing	WA2-5
Shuxiang, Guo	TP1-4	Sun, Jing	WA2-5
Shuxiang, Guo	TP1-4	Sun, Junren	TP2-6
Shuxiang, Guo	TP2-4	Sun, Kui	MP1-1
Shuxiang, Guo	TP2-4	Sun, Lei	MA1-P
Shuxiang, Guo	TP2-4	Sun, Linjian	TP1-2
Shuxiang, Guo	TA2-5	Sun, Longfei	TP2-5
Shuxiang, Guo	TP2-5	Sun, Peng	MP3-6
Shuxiang, Guo	WA1-3	Sun, Pengpeng	TP2-2
Shuxiang, Guo	WA1-5	Sun, Ping	TA1-6
Shuxiang, Guo	WA1-6	Sun, Qichen	WA2-5
Shuxiang, Guo	WA1-7	Sun, Ruijie	TA2-7
Shuxiang, Guo	WA1-7	Sun, Tao	MP3-4
Shuxiang, Guo	MP2-6	Sun, Weijie	TA2-1
Shuai, Zhongquan	WA2-3	Sun, Weijie	TP2-1
Sobh, Tarek M	TA1-6	Sun, Weijie	WA1-1
Song, Dapeng	WA1-7	Sun, Wenlei	MA1-P
Song, Jianhua	WA1-7	Sun, Xiaodong	TA1-1
Song, Lulu	MA1-P	Sun, Xiwei	MA1-P
Song, Yishuo	TP2-1	Sun, Yanhua	TP2-5
Song, Yu	MA1-P	Sun, Yanhua	TA1-7
Song, Yu	WA1-7	Sun, Yanjun	MA1-P
Song, Zithong	MA1-P	Sun, Yishan	WA1-5
Su, Chun	MP2-3	Sun, ZhaoWu	TP1-3
Su, Shuxiang	TP1-4	Suzuki, Shintaro	TA2-6
Su, Shuxiang	TP1-4	-T-	
Su, Shuxiang	TP2-4		
Su, Xin	MP3-1	Takahashi, Satoshi	MA1-P
Su, Yu	TP2-2	Takahashi, Satoshi	MA1-P



Takehiro, Shiinoki	MP3-7		
Tan, Fanjiao	TA2-5		
Tan, Jingjing	MP2-5		
Tan, Min	WA2-2		
Tan, Zhenhai	MA1-P		
Tan, Zhenhai	MA1-P		
Tang, Biao	MP2-6		
Tang, Dewei	TP1-3		
Tang, Lijun	MP3-4		
Tang, Mingsheng	MP2-7		
Tang, Sixun	MA1-P		
Tang, Sixun	TP2-5		
Tang, Xiaoqing	MP2-1		
Tang, Yuan	MP3-6		
Teng, Yanbin	MA1-P		
Tian, Changqing	MP2-7		
Tian, Dapeng	TA1-7		
Tian, Dapeng	WA1-6		
Tian, He	WA1-5		
Tian, Hesuo	MA1-P		
Tian, Tian	MA1-P		
Tian, Xiaodi	TA1-1		
Tian, Xinchao	MP3-7		
Tian, Xue	TA2-5		
Tian, Yantao	MP1-7		
Tian, Yantao	TA1-2		
Tian, Yantao	TA1-4		
Tian, Yunong	TP2-1		
Tong, Baiming	WA2-7		
Tong, Dan	WA2-1		
Tong, Jigang	WA1-1		
Tong, Shoufeng	MA1-P		
Tong, Xin	MP1-3		
Tseng, Wei-Ming	TP2-2		
Tu, Yijun	WA2-3		
		-V-	
		Vumiliya, Angelo	MA1-P
		-W-	
		Wang, Lili	TA2-4
		Wang, Aibo	MA1-P
		Wang, Bingham	MP1-4
		Wang, Bo	MP2-3
		Wang, Bohan	MP2-6
		Wang, Boyu	MA1-P
		Wang, Boyu	TP1-1
		Wang, Chunhong	MP2-7
		Wang, Chunjie	TA1-3
		Wang, Chunlei	MP1-6
		Wang, Chunlin	MP2-4
		Wang, Chunwei	MP1-2
		Wang, Chunyang	MA1-P
		Wang, Chunyang	WA1-3
		Wang, Cunyu	MP1-3
		Wang, Dejiang	MA1-P
		Wang, Dejiang	MA1-P
		Wang, Dinggang	TP1-2
		Wang, Dinggang	TP2-2
		Wang, Gang	MA1-P
		Wang, Haitao	TA1-2
		Wang, Han	MP1-1
		Wang, Haonan	TP2-3
		Wang, Hongbo	MA1-P
		Wang, Hongfei	MA1-P
		Wang, Hongjun	MA1-P
		Wang, Hongjun	TA1-4
		Wang, Hongjun	TP2-7
		Wang, Hui	MP2-6
		Wang, Hui	TA2-1

Wang, Hui	TP1-1	Wang, Ming	MP2-6
Wang, Hui	TP1-1	Wang, Mingming	MA1-P
Wang, Hui	TP2-1	Wang, Mingming	TA1-5
Wang, Hui	TP2-1	Wang, Peng	TP2-4
Wang, Hui	WA1-1	Wang, Ping	WA1-5
Wang, Hui	WA1-6	Wang, Qi	TA2-1
Wang, Jian	MP2-5	Wang, Qi	TP1-7
Wang, Jian	MP3-5	Wang, Qiang	MP2-6
Wang, Jian	TP2-2	Wang, Qiang	TA2-1
Wang, Jianli	WA1-6	Wang, Qiang	TP1-1
Wang, Jiannan	TA1-1	Wang, Qiang	TP2-1
Wang, Jianping	MA1-P	Wang, Qiuyang	MP2-4
Wang, Jiawei	MP3-7	Wang, Qiuyang	TA2-2
Wang, Jinghui	MA1-P	Wang, Qiuyang	TP1-2
Wang, Jinghui	MP2-4	Wang, Qiuyang	WA1-1
Wang, Jinhua	TA1-2	Wang, Rongchuan	TA2-3
Wang, Jinjin	MP2-1	Wang, Rui	MA1-P
Wang, Jun	TA1-2	Wang, Rui	MA1-P
Wang, Kai	MP1-3	Wang, Rui	TA2-5
Wang, Kai	TP1-6	Wang, Rui	TA2-7
Wang, Kaiying	MA1-P	Wang, Shaoping	TA1-2
Wang, Lan	MP3-7	Wang, Shaoyang	MP1-5
Wang, Lei	MP1-2	Wang, Sheng	MP1-2
Wang, Li	TA2-4	Wang, Shifeng	WA1-1
Wang, Liang	TP1-5	Wang, Shifeng	WA2-3
Wang, Lihua	TP1-5	Wang, Shijun	TP1-2
Wang, Lingling	MA1-P	Wang, Shijun	TP2-2
Wang, Lingling	MP2-4	Wang, Shuai	MP2-7
Wang, Longqi	MA1-P	Wang, Shuai	WA2-3
Wang, Luoxin	MA1-P	Wang, Shuang	TA2-7
Wang, Meiling	MP1-5	Wang, Shukun	TA2-5
Wang, Meng	MA1-P	Wang, Shuo	MP3-1
Wang, Meng	WA2-1	Wang, Shuoyu	MP1-5
Wang, Meng	MP3-1	Wang, Shuoyu	TA2-2
Wang, Min	MP2-7	Wang, Shuoyu	TA1-6

Wang, Song	TA1-4	Wang, Yang	TP1-6
Wang, Sun-an	MA1-P	Wang, Yangping	TA1-4
Wang, Tao	MA1-P	Wang, Yanjun	WA1-5
Wang, Tian	MP1-2	Wang, Yanwei	TA2-1
Wang, Tianqi	MP1-2	Wang, Yaozhong	MA1-P
Wang, Tianqi	MP2-6	Wang, Yi	MA1-P
Wang, Ting	MA1-P	Wang, Yichen	TA1-1
Wang, Ting	TA2-5	Wang, Yingfen	WA1-3
Wang, Tingting	TA2-7	Wang, Yong	TP1-2
Wang, Weirong	TA1-1	Wang, Yonghua	TP2-3
Wang, Wenbo	TP1-5	Wang, Yonghua	TP2-5
Wang, Wenrui	MP2-5	Wang, Yonghui	TA2-6
Wang, Wenrui	WA1-2	Wang, Yonghui	WA2-6
Wang, Wu	MA1-P	Wang, Yuanhui	TP2-2
Wang, Wugui	MP2-4	Wang, Yuchao	MA1-P
Wang, Xian	TA2-5	Wang, Yuchao	MP2-5
Wang, Xiaodong	MP2-4	Wang, Yuchao	MA1-P
Wang, Xiaodong	TA2-2	Wang, Yuezong	WA2-6
Wang, Xiaodong	TP1-2	Wang, Yufeng	MP3-6
Wang, Xiaodong	WA1-1	Wang, Yutang	TA1-7
Wang, Xiaofeng	MA1-P	Wang, Yuxin	MP2-2
Wang, Xiaofeng	MP2-4	Wang, Yuxin	MP2-2
Wang, Xiaofeng	TP2-5	Wang, Yuxin	MP3-2
Wang, Xiaofeng	TA2-7	Wang, Ze	WA2-3
Wang, Xiaohai	WA1-7	Wang, Zhaoze	MA1-P
Wang, Xiaohong	TA1-4	Wang, Zhe	MP1-2
Wang, Xiaohui	TA2-5	Wang, Zhe	MP2-5
Wang, Xiaoyu	MP1-7	Wang, Zhe	TP2-4
Wang, Xiaoyuan	MA1-P	Wang, Zhengan	MP2-6
Wang, Xuemeng	MA1-P	Wang, Zhenyang	MP1-4
Wang, Xueying	TP1-1	Wang, Zhi	WA1-6
Wang, Xueying	TP2-1	Wang, Zhigang	MA1-P
Wang, Xusheng	MA1-P	Wang, Zhigang	MP2-4
Wang, Yan	MP1-4	Wang, Zhouhang	TA1-3
Wang, Yanbo	TP1-6	Wang, Ziruo	TP2-7

Wang, Zixu	TA2-5	Wu, Qingwen	TA1-3
Watanabe, Keigo	TA2-6	Wu, Qiong	MA1-P
Watanabe, Keigo	TA2-6	Wu, Qiong	MA1-P
Watanabe, Keigo	TA2-6	Wu, Qiong	MA1-P
Watanabe, Keigo	TA2-6	Wu, Qiong	MA1-P
Wei, Bing	MP2-6	Wu, Shuang	WA1-2
Wei, Chao	MP1-2	Wu, Si	TA2-5
Wei, Chao	MP3-2	Wu, Tingke	TP2-3
Wei, Ke	TP1-7	Wu, Tong	TA1-2
Wei, Shilin	MA1-P	Wu, Wei	TA2-3
Wei, Wei	TA2-5	Wu, Wenshuai	MA1-P
Wei, Xiaoqian	MA1-P	Wu, Xiaoxia	WA1-3
Wei, Yonggeng	TA1-3	Wu, Yan	WA1-7
Wen, Hao	MA1-P	Wu, Yanjuan	TA1-4
Weng, Xiangyu	MP3-5	Wu, You	MA1-P
Wickramasinghe , H.D	MP1-2	Wu, Zehao	TP1-5
Wu, Baolin	MP3-5	Wu, Zehua	MA1-P
Wu, Baoqi	MP1-7	Wu, Zhicheng	WA1-5
Wu, Bing	TP1-2		
Wu, Bohui	TP2-7	<b>-X-</b>	
Wu, Fengxia	MA1-P	Xi, Ning	TP1-6
Wu, Haiquan	TP2-3	Xia, Li	MA1-P
Wu, Haiquan	TP2-5	Xia, Weixing	TP1-2
Wu, Haiyan	TP2-2	Xia, Yongming	MP2-1
Wu, Jian	MP1-6	Xiao, Ling	MP2-3
Wu, Jiaqi	MP1-3	Xiao, Nan	MP2-2
Wu, Jiaqing	MP2-2	Xiao, Nan	MP2-2
Wu, Jie	MA1-P	Xiao, Nan	MP2-2
Wu, Jinglong	MA1-P	Xiao, Nan	MP2-2
Wu, Jinglong	MA1-P	Xiao, Nan	MP2-2
Wu, Jinglong	MA1-P	Xiao, Nan	MP3-2
Wu, Jinglong	MA1-P	Xiao, Nan	MP3-2
Wu, Jinglong	WA2-1	Xiao, Shuguo	TA1-5
Wu, Jinglong	WA1-7	Xiao, Shuguo	WA2-1
Wu, Qingwen	MP3-2	Xiao, Xuan	WA1-2

Xiao, Xuan	WA1-2	Xu, Lixin	MP3-1
Xiao, Yao	TP2-2	Xu, Qingsong	TP1-5
Xie, Shuzhi	WA2-5	Xu, Shaochen	TA1-2
Xie, Yongchun	TA2-7	Xu, Wenxin	MA1-P
Xie, Yu	MP3-4	Xu, Xiangming	MA1-P
Xie, Zongwu	MP1-1	Xu, Xiaoming	TA2-3
Xing, Huiming	TP1-4	Xu, Xu	MP3-1
Xing, Huiming	TP1-4	Xu, Yang	TA1-2
Xing, Huiming	TP2-4	Xu, Zhang	MA1-P
Xing, Huiming	TP2-4	Xu, Zhaokun	TA2-2
Xing, Shihong	MA1-P	Xu, Zhaoping	MP2-7
Xing, Zhengyuan	TA1-5	Xu, Zhaoping	TA2-7
Xiong, Daojun	MP3-1	Xu, Zhaoping	WA1-6
Xu, Aidong	MP1-3	Xu, Zhenbang	MA1-P
Xu, Bo	WA2-1	Xu, Zhenbang	MP3-2
Xu, Ce	MP3-2	Xu, Zhenbang	MP2-5
Xu, Ce	TP1-6	Xu, Zhenbang	TP1-6
Xu, Chaozheng	MP2-4	Xu, Zhenbang	WA1-2
Xu, Dongbin	MP2-4	Xue, Duorui	TA2-4
Xu, Dongbin	TA2-2	Xue, Guobin	TP1-2
Xu, Dongbin	TP1-2	Xue, Guobing	TP2-2
Xu, Dongbin	WA1-1	Xue, Pingping	TP1-6
Xu, Dongping	TA2-1	Xue, Wei	TA1-4
Xu, Feng	MA1-P	Xue, Wei	TP1-7
Xu, Fengyu	TP2-3		
Xu, Hao	MP1-2	-Y-	
Xu, Hao	MP3-2	Yan, Dong	WA2-7
Xu, Jiajia	TP1-2	Yan, Jiawen	TA1-1
Xu, Jian	TA2-7	Yan, Junliang	MA1-P
Xu, Jianan	MP1-4	Yan, Junliang	MP3-1
Xu, Jing	MP1-5	Yan, Liu	MA1-P
Xu, Jing	TA1-1	Yan, Shaoze	TA1-3
Xu, Junfei	TP1-7	Yan, Weifan	MP1-1
Xu, Liang	TA1-4	Yan, Xu	TA2-5
Xu, Liang	TP1-7	Yang, Baisong	MA1-P

Yang, Baisong	TP1-5	Yang, Zelin	TP1-2
Yang, Bao	MA1-P	Yao, Guang	TP1-3
Yang, Bo	MA1-P	Yao, Yao	WA2-1
Yang, Bo	MA1-P	Ye, Changlong	MP2-6
Yang, Bo	TP1-6	Ye, Changlong	TA1-6
Yang, Guang	MP1-5	Ye, Peiqing	MP1-3
Yang, Hui	MP3-5	Ye, Xiufen	MP1-2
Yang, Jiajia	MA1-P	Ye, Xiufen	TA1-5
Yang, Jiajia	MA1-P	Ye, Xiufen	TA2-6
Yang, Jing	MP3-7	Ye, Xiufen	WA2-1
Yang, Jingjing	WA2-1	Ye, Zhou	TA1-6
Yang, Jingjing	WA1-7	Yin, Zhixiang	TA1-3
Yang, Junyou	MP1-5	Yoo, SeungJae	TA1-2
Yang, Kaiming	MP1-6	You, Feng	TP2-2
Yang, Lei	TP2-1	Yu, Changshuai	TP2-3
Yang, Li	MP2-7	Yu, Fengqi	MP3-3
Yang, Lin	MA1-P	Yu, Haoyang	MA1-P
Yang, Lin	TP2-3	Yu, Hong	MA1-P
Yang, Peng	WA2-1	Yu, Hong	MA1-P
Yang, Qiuxia	MP3-2	Yu, Hong	MA1-P
Yang, Rong	TA1-6	Yu, Hong	MA1-P
Yang, Shuai	MA1-P	Yu, Hong	MA1-P
Yang, Shuai	WA2-5	Yu, Hong	MP1-5
Yang, Shuai	WA2-5	Yu, Hong	TA2-1
Yang, Shuangming	TA1-7	Yu, Huadong	TP2-3
Yang, Shuyan	TA1-6	Yu, Huadong	WA1-7
Yang, Tao	TP1-2	Yu, Huangchao	TP2-6
Yang, Wenbo	MP2-5	Yu, Jianbo	MA1-P
Yang, Xiaodong	TP2-2	Yu, Junzhi	MP2-6
Yang, Xiaoxia	MP2-7	Yu, Lei	TA2-1
Yang, Xujie	MA1-P	Yu, Lie	MA1-P
Yang, Xujie	MP2-6	Yu, Lie	MP2-3
Yang, Yunqiang	TA1-3	Yu, Lie	TP1-5
Yang, Zaibin	TP2-3	Yu, Lie	TP2-5
Yang, Zelin	TP1-6	Yu, Lie	TP2-5

Yu, Lie	TA1-7		
Yu, Lijun	MP2-6		
Yu, Lijun	TA2-1	Zang, Xizhe	TP1-4
Yu, Lijun	TP1-1	Zeng, Haitao	TA2-4
Yu, Lijun	TP1-1	Zeng, Xiaodong	MA1-P
Yu, Lijun	TP2-1	Zeng, Xiaodong	TA2-5
Yu, Lijun	TP2-1	Zeng, Yong	MA1-P
Yu, Lijun	WA1-1	Zeng, Yuwen	MP2-2
Yu, Lingtao	MP3-7	Zeng, Yuwen	MP2-2
Yu, Liqiang	WA2-1	Zeng, Yuwen	MP3-2
Yu, Ran	MP2-4	Zhai, Wenyu	MA1-P
Yu, Xiao	MP1-5	Zhai, Wenyu	TA1-5
Yu, Xiao	TP1-1	Zhan, Qi	MP3-7
Yu, Xiuping	MP2-7	Zhang, Ke	MP2-4
Yu, Yang	MA1-P	Zhang, Bainan	MP2-2
Yu, Yang	TP1-6	Zhang, Baofeng	TA1-5
Yu, Yanxin	WA1-3	Zhang, Bin	MP1-1
Yu, Yingying	WA2-2	Zhang, Bin	MP2-7
Yu, Yiyang	MA1-P	Zhang, Bin	WA1-3
Yu, Yuanhua	MP1-2	Zhang, Chang-Hua	TA1-6
Yu, Yuanhua	TP2-4	Zhang, Chunting	MA1-P
Yu, Yue	MA1-P	Zhang, Chunyou	TP1-5
Yu, Yueqing	MP2-1	Zhang, Chunyou	TP1-5
Yu, Zhangguo	MP3-3	Zhang, Chunyou	TP1-5
Yu, Zhangguo	TP1-4	Zhang, Defu	MA1-P
Yu, Zhaoji	TP1-6	Zhang, Defu	MP2-1
Yuan, Bowen	TP2-6	Zhang, Deyang	WA1-6
Yuan, Weilin	MP3-4	Zhang, Deyuan	MA1-P
Yuan, Yifang	TA2-7	Zhang, Guishan	TP1-7
Yuan, YuQi	MA1-P	Zhang, Guojun	WA2-2
Yue, Youjun	MA1-P	Zhang, Hailong	MA1-P
Yue, Youjun	TA1-4	Zhang, Haiying	TA2-4
Yue, Youjun	TP2-7	Zhang, He	TP2-6
Yun, Zerong	MA1-P	Zhang, Hongjun	TP1-5
Yun, Zerong	MP2-4	Zhang, Hongmei	MA1-P

-Z-

Zhang, Houxiang	MP2-4	Zhang, Mengjie	TP1-3
Zhang, Huaxin	TP2-1	Zhang, Ming	WA2-3
Zhang, Hui	MP1-3	Zhang, Mingxi	MA1-P
Zhang, Huizhen	MA1-P	Zhang, Ningchuan	WA1-7
Zhang, Jiabo	WA2-5	Zhang, Peipei	MP2-3
Zhang, Jianguo	MP2-1	Zhang, Peng	TA1-3
Zhang, Jianku	MA1-P	Zhang, Peng	TA2-4
Zhang, Jianxin	TA2-4	Zhang, Pengfei	WA1-1
Zhang, Jigang	MA1-P	Zhang, Pengfei	WA2-3
Zhang, Jigang	TP1-3	Zhang, Qi	MP2-4
Zhang, Jigang	TP1-5	Zhang, Qiang	MP1-5
Zhang, Jigang	TP2-5	Zhang, Renshan	TP2-6
Zhang, Jingnan	WA2-2	Zhang, Renyu	MP1-6
Zhang, Jingnan	WA1-5	Zhang, Shaokang	MA1-P
Zhang, Jingnan	MP1-7	Zhang, Shizhong	MA1-P
Zhang, Jingping	MA1-P	Zhang, Songtao	MP1-4
Zhang, Jinyu	TA2-3	Zhang, Songtao	MP1-7
Zhang, Jiyang	TP2-6	Zhang, Songyuan	WA1-5
Zhang, Jun	TA1-6	Zhang, Tao	WA1-2
Zhang, Ke	TA2-2	Zhang, Tianhao	WA1-5
Zhang, Ke	TP1-2	Zhang, Wanming	TA2-6
Zhang, Ke	WA1-1	Zhang, Wei	MA1-P
Zhang, Kun	MP2-5	Zhang, Weimin	MP3-3
Zhang, Lanyong	MP2-4	Zhang, Wenrui	TA2-5
Zhang, Le	MP2-4	Zhang, Wensen	TA1-3
Zhang, Lei	MA1-P	Zhang, Xiaojian	TA2-3
Zhang, Lei	MP2-4	Zhang, Xiaoshuang	MP1-7
Zhang, Lei	TA2-3	Zhang, Xinchao	MA1-P
Zhang, Lei	WA1-2	Zhang, Xinghong	TA1-1
Zhang, Lingling	MP2-7	Zhang, Xudong	MA1-P
Zhang, Lingling	TA2-7	Zhang, Xue	TP1-1
Zhang, Lingling	WA1-6	Zhang, Xue	TP2-1
Zhang, Linshuai	MA1-P	Zhang, Xun	WA2-1
Zhang, Linshuai	WA1-7	Zhang, Xuping	MP2-1
Zhang, Man	TA1-5	Zhang, Yang	WA1-7



Zhang, Yanlu	MP2-6	Zhao, Hui	MA1-P
Zhang, Yansong	TP2-7	Zhao, Hui	TA1-4
Zhang, Yanyan	MP2-3	Zhao, Hui	TP2-7
Zhang, Yanyan	TP1-5	Zhao, Ji	TP1-6
Zhang, Ye	TP1-2	Zhao, Jianghai	MP1-5
Zhang, Yifei	MP3-5	Zhao, Jianghai	TA2-3
Zhang, Ying	WA1-1	Zhao, Jie	TA2-2
Zhang, Yong	MP1-3	Zhao, Jie	TA2-2
Zhang, Yong	TP1-4	Zhao, Jiliang	TP2-2
Zhang, Yong	WA1-3	Zhao, Jingchao	WA1-2
Zhang, Yonggang	MA1-P	Zhao, Jingdong	MP1-4
Zhang, Yuanfei	MP1-1	Zhao, Jinxin	MA1-P
Zhang, Yuanfei	MP1-1	Zhao, Lili	WA1-5
Zhang, Yunong	WA1-6	Zhao, Peng	MP1-4
Zhang, Zheng	MP3-4	Zhao, Peng	MP1-7
Zhang, Zhixiang	TA1-3	Zhao, Peng	MP1-7
Zhang, Zhiyong	MP1-6	Zhao, Peng	TA1-7
Zhang, Zhongliang	MA1-P	Zhao, Shunli	MA1-P
Zhang, Zhongliang	MA1-P	Zhao, Songbo	TA1-4
Zhang, Zhuo	MP2-1	Zhao, Songbo	TP1-7
Zhang, Zhuoliang	MP3-1	Zhao, Weiguo	MP1-1
Zhang, Zixuan	MP2-3	Zhao, Xia	MP2-3
Zhao, Changfu	WA1-1	Zhao, Xin	MP3-3
Zhao, Changhai	MP2-6	Zhao, Xin	TP2-6
Zhao, Dan	MP3-4	Zhao, Xionglei	WA2-2
Zhao, Dawei	MP2-5	Zhao, Yan	MP2-2
Zhao, Fangzhou	WA1-2	Zhao, Yan	MP2-2
Zhao, Faqing	MA1-P	Zhao, Yan	MP3-2
Zhao, Gang	MA1-P	Zhao, Yan	MP3-2
Zhao, Guomei	MA1-P	Zhao, Yan	TA1-5
Zhao, Haibo	MP1-1	Zhao, Yan	TA1-7
Zhao, Hongdong	MA1-P	Zhao, Yanhang	WA1-3
Zhao, Huan	MP3-3	Zhao, Yaping	MP3-2
Zhao, Huan	TA2-3	Zhao, Yihan	TP2-4
Zhao, Huan	TP1-3	Zhao, Zhijun	TP1-3

Zhao, Zhiyuan	MP3-2	Zhou, Xiaofang	WA1-5
Zhao, Zhongqiu	WA2-6	Zhou, Xingyu	TA2-7
Zheng, Guojun	MP1-3	Zhou, Xinyu	TP1-4
Zheng, Liang	TP1-4	Zhou, Xuesong	MA1-P
Zheng, Liang	WA1-3	Zhou, Xuesong	MA1-P
Zheng, Shanglong	MP1-4	Zhou, Xuesong	MA1-P
Zheng, Shicheng	TA1-3	Zhou, Xuesong	MA1-P
Zheng, Wenfeng	MA1-P	Zhou, Xuesong	MA1-P
Zheng, Wenfeng	TP1-6	Zhou, Xuesong	TP1-7
Zheng, Xiande	TP1-4	Zhou, Xuesong	TP1-7
Zheng, Xiande	WA1-3	Zhou, Xuesong	TP1-7
Zheng, Yan	WA1-5	Zhou, Xuesong	TP2-7
Zheng, Yuqi	MP1-5	Zhou, Xuesong	TP2-7
Zhi, Hui	MA1-P	Zhou, Xuesong	TP2-7
Zhi, Jiankang	MP3-6	Zhou, Yang	TP2-4
Zhong, Bin	MP2-3	Zhou, Yijun	MP2-5
Zhong, Jianming	MA1-P	Zhou, Yijun	MP3-5
Zhou, Lei	TP1-3	Zhou, Yueyuan	MA1-P
Zhou, Chao	MP3-1	Zhou, Yueyuan	TP1-1
Zhou, Haicheng	MP2-7	Zhou, Yunhu	MP3-6
Zhou, Haicheng	TA2-7	Zhou, Zhenggan	TA2-5
Zhou, Haicheng	WA1-6	Zhou, Zhou	MP1-4
Zhou, Jian	MA1-P	Zhou, Zhou	TP2-6
Zhou, Jian	MP2-3	Zhou, Zhou	TA2-7
Zhou, Jian	TP1-3	Zhu, Changming	TP2-1
Zhou, Jian	TP1-5	Zhu, Chengfei	TA1-1
Zhou, Jian	MA1-P	Zhu, Chuanming	MP1-6
Zhou, Jinpeng	MA1-P	Zhu, Hong	WA1-1
Zhou, Jun	TA2-5	Zhu, Hongmei	MP3-3
Zhou, Junjie	TP2-7	Zhu, Juan	WA2-3
Zhou, Junqiang	TA1-5	Zhu, Lei	TP1-6
Zhou, Junqiang	WA1-6	Zhu, Mingchao	MA1-P
Zhou, Kun	TP1-3	Zhu, Mingchao	MP2-5
Zhou, Nianrong	MP3-4	Zhu, Minghao	WA1-2
Zhou, Qi	MA1-P	Zhu, Xiaojun	MP2-6

Zhu, Xiaojun	WA1-2
Zhu, Xiaojun	WA2-6
Zhu, Xiaoping	MP1-4
Zhu, Xiaoping	TP2-6
Zhu, Xiaoping	TA2-7
Zhu, Yanfang	TP1-1
Zhu, Yicheng	TA1-5
Zhu, Yicheng	TA1-5
Zhu, Yongwei	TA2-7
Zhu, Yu	WA2-3
Zou, Huiming	MP2-7
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### August 4-7, 2019, Tianjin, China



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The 2019 IEEE International Conference on Mechatronics and Automation (ICMA 2019) will take place in Tianjin, China from August 4 to August 7, 2019. Tianjin is a municipality direct under the Central Government, as well as an opening city. It's situated in the eastern part of the North China Plain, covering an area of 11,917 square km and with a population of 12,930,000.

As the host city of ICMA 2019, Tianjin not only provides the attendees with a great venue for this event, but also an unparalleled experience in Chinese history through several historical architectures. You are cordially invited to join us at IEEE ICMA 2019 in Tianjin. The objective of ICMA 2019 is to provide a forum for researchers, educators, engineers, and government officials involved in the general areas of mechatronics, robotics, automation and sensors to disseminate their latest research results and exchange views on the future research directions of these fields.

### 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

**Contributed Papers:** All papers must be submitted in PDF format prepared strictly following the IEEE PDF Requirements for Creating PDF Documents for IEEE Xplore. The standard number of pages is 6 and the maximum page limit is 8 pages with extra payment for the two extra pages. See detailed instructions in the conference web site. All papers accepted by IEEE ICMA 2019 will be indexed by EI and included in IEEE Xplore®. Extensions of selected papers will be published in a regular or a special issue of the journals of **IJMA**.

**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 March 20, 2019.

**Tutorials & Workshops:** Proposals for tutorials and workshops that address related topics must be submitted to one of the Tutorial/Workshop Chairs by May 1, 2019.

### Important Dates:

**April 10, 2019** Full papers and organized session proposals  
**May 1, 2019** Proposals for tutorials and workshops  
**May 15, 2019** Notification of paper and session acceptance  
**June 1, 2019** Submission of final papers in IEEE PDF format

For detailed up-to-date information, please visit the IEEE ICMA conference website at:

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*IJMA* is a fully refereed international journal that presents the 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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*IJMA* provides a forum for information exchange between professionals, academicians and engineers who are working in the area of mechatronics, control engineering, and industrial automation, helping them to disseminate information and to learn from each other's work.

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*IJMA* publishes original papers, technical reports, case studies, review papers and tutorials. Special Issues devoted to important topics in advanced mechatronic systems, robotics, control engineering and industrial automation will be published from time to time.

### Subject Coverage

Suitable topics include, but are not limited to:

- Intelligent mechatronics, robotics and biomimetics
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- Biomedical and rehabilitation engineering, prosthetics and artificial organs
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- Industrial automation, process control and networked control systems
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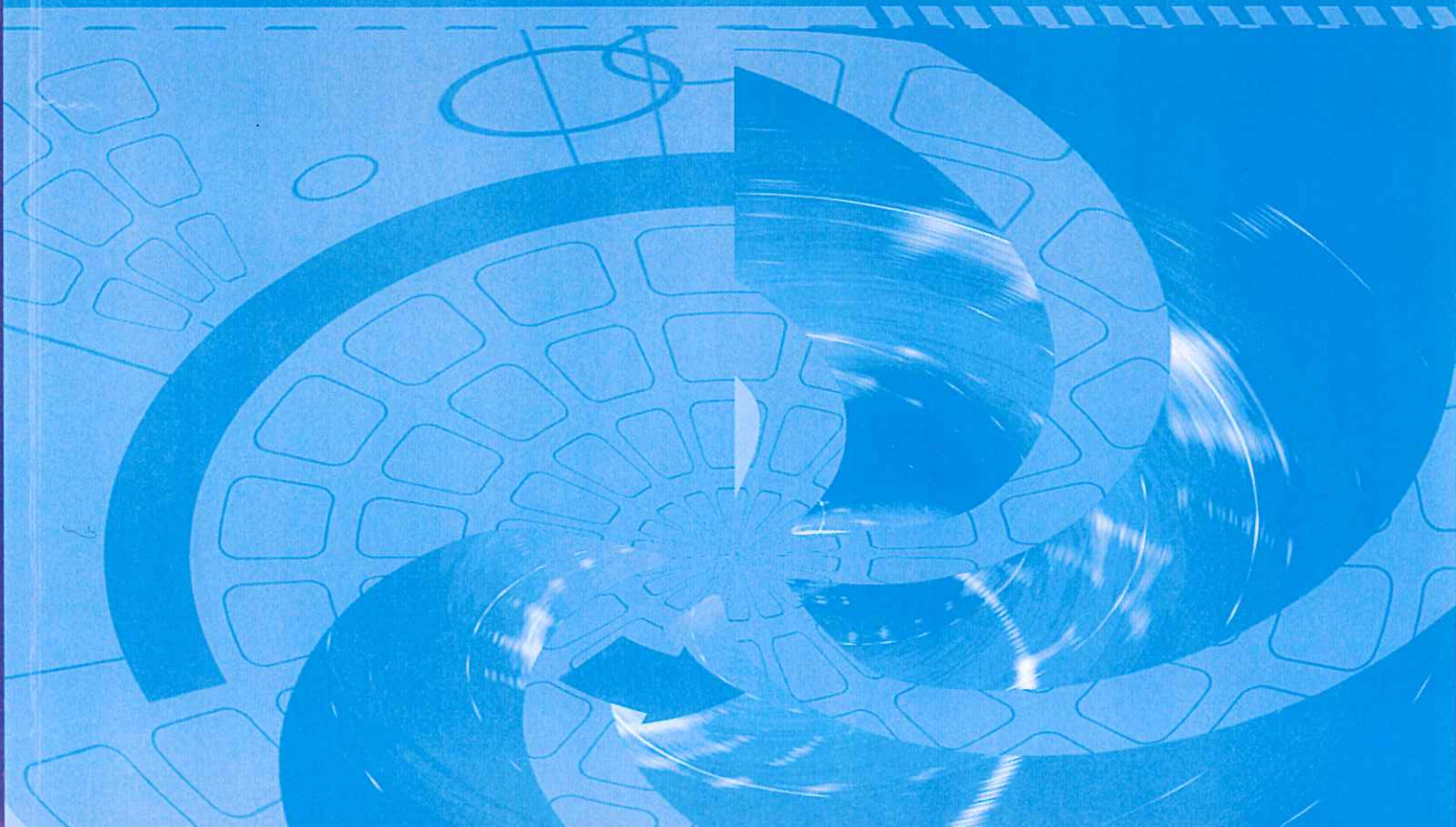
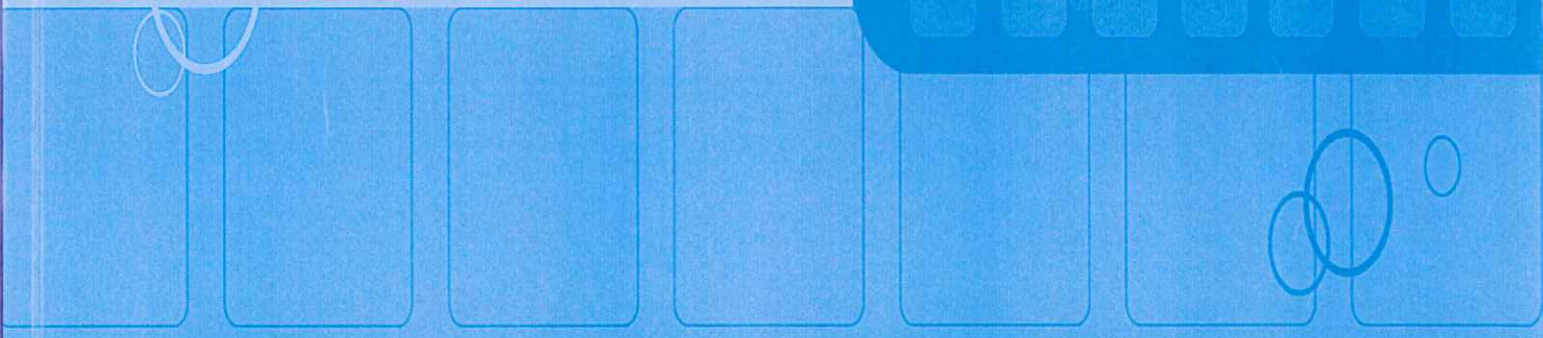
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# Mechatronics and Automation

Volume 5, No. 4, 2016

**Publisher's website: [www.inderscience.com](http://www.inderscience.com)**

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**ISSN (Online): 2045-1067**

**ISSN (Print): 2045-1059**

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**Toshio Fukuda,**  
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*I am honored to be a part of this exciting new journal which addresses an important and emerging area of research, and believe that it will be extraordinarily successful. I am confident that IJMA will have a significant impact in the area of mechatronics and automation.*

**T.J. Tarn,**  
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*It is certainly an honor for me to serve as an Editorial Board member for this important new journal. Mechatronics and automation technologies are central in a wide range of expanding industries across the world. IJMA promises to provide both basic and applied researchers a high quality avenue to report their work in this exciting aspect of modern engineering.*

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**James K. Mills,**  
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# IEEE ICMA 2018 Program at a Glance

August 5-8, 2018

[Sheraton Changchun Jingyuetan Hotel](#), Changchun, Jilin, China

## Sunday, August 5, 2018

- 13:30 - 18:30 Registration Desk Open on 1F
- 13:30 - 15:40 World Youth Development Workshops on Opto-Mechatronics at Conference Room 1
- 16:00 - 17:00 **Keynote Speech (Prof. Toshio Fukuda) (Conference Room 1)**
- 17:30 - 18:30 Reception at Conference Room 2

## Monday, August 6, 2018

- 8:30 - 9:00 Opening Ceremony(**Yitian Convention Center**)
- 9:00 - 9:50 **Plenary Talk #1 (Dr. Peter B. Luh) (Yitian Convention Center)**
- 9:50 - 10:40 **Plenary Talk #2 (Dr. Darwin G. Caldwell) (Yitian Convention Center)**
- 10:40 - 11:00 Morning Break
- 11:00 - 12:00 Technical Sessions MA1 (**Poster Session**) (**Yitian Convention Center**)
- 12:00 - 13:30 Lunch Break
- 13:30 - 15:00 Technical Sessions MP1 (**Conference Room on -1F and 1F**)
- 15:00 - 15:15 Afternoon Break
- 15:15 - 16:45 Technical Sessions MP2 (**Conference Room on -1F and 1F**)
- 17:00 - 18:00 Technical Sessions MP3 (**Conference Room on -1F and 1F**)

## Tuesday, August 7, 2018

- 8:30 - 10:00 Technical Sessions TA1 (**Conference Room on -1F and 1F**)
- 10:00 - 10:30 Morning Break
- 10:30 - 12:00 Technical Sessions TA2 (**Conference Room on -1F and 1F**)
- 12:00 - 13:30 Lunch Break
- 13:30 - 15:00 Technical Sessions TP1 (**Conference Room on -1F and 1F**)
- 15:00 - 15:30 Afternoon Break
- 15:30 - 17:00 Technical Sessions TP2 (**Conference Room on -1F and 1F**)
- 18:30 - 21:00 Award Banquet, [Yitian Convention Center, 1F in Sheraton Changchun Jingyuetan Hotel](#),

## Wednesday, August 8, 2018

- 8:30 - 9:20 **Plenary Talk #3 (Dr. Dong Sun) (Yitian Convention Center)**
- 9:30 - 11:00 Technical Sessions WA1 (**Conference Room on -1F and 1F**)
- 11:00 - 11:15 Morning Break
- 11:15 - 12:15 Technical Sessions WA2 (**Conference Room on -1F and 1F**)
- 12:30 - 13:30 Farewell Party at Conference Room 2

\* 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