IEEE ICMA 2019

Robotics and Automation Society

2019 IEEE International Conference on Mechatronics and Automation

AUGUST 4-7, 2019

TIANJIN, CHINA

Conference Proceedings

Conference Digest

Co-sponsored by

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Foreword

On behalf of the IEEE ICMA 2019 Conference Organizing Committee, it is our great pleasure, an honor, and a privilege to welcome you to Tianjin for the 2019 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 2019 marks the 16th edition of the IEEE ICMA annual conference series. We are proud to announce that a high number of **682** papers were submitted from **28** countries and regions, including **658** contributed papers, **24** papers for organized sessions, and **449** 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 **66%**. Presentations at ICMA 2019 are organized in 7 parallel tracks, for a total of **61** 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 2019 in Tianjin to live this unique experience. The main objective of IEEE ICMA 2019 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 2019 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 Tianjin, China.

Baofeng Zhang
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Welcome Remarks

It is my honor to welcome you to attend the 2019 IEEE International Conference on Mechatronics and Automation (IEEE ICMA 2019) on behalf of Tianjin University of Technology. We are delighted to host the Conference which marked as the 16th 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 Tianjin University of Technology (TJUT). TJUT was founded in 1979 focusing on engineering, mechanics, instrumentation, materials and so on. TJUT's well-developed education system—consisting of programs for undergraduates, masters, and doctors. At present in TJUT, there are 65 undergraduate majors, 19 primary discipline master programs, 3 primary discipline doctoral programs, 2 postdoctoral programs and 12 key disciplines of Tianjin. There are currently 1,419 professionals working at TJUT. There are 26,522 full-time students, including undergraduates and graduates. TJUT has 1 national engineering laboratory, 2 key laboratories of the Ministry of Education, 1 joint research laboratory of the Ministry of Education for international cooperation, 1 engineering research center of the Ministry of Education, 1 joint innovation and enlightenment base of the Ministry of Education of the Ministry of Foreign Affairs, and 7 Tianjin Key Laboratories, 9 engineering centers in Tianjin.

It is sincerely hoped that IEEE ICMA 2019 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 Tianjin University of Technology, I would like to express my sincere gratitude to all of the sponsoring societies and organizations as well as all the individuals contributed to the organization of the Conference. Also, special thanks are owed to all the authors, session organizers, plenary and keynote speakers, exhibitors for contributing their research works and making IEEE ICMA 2019 a successful and fruitful event. To all participants, I extend my heartfelt welcome and thanks for attending this event, wish your stay here in Tianjin, China, is very pleasant and enjoyable.

Qingxin Yang, *Professor*
President, Tianjin University of Technology.
Advisory Council Chair of IEEE ICMA 2019

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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
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Zhu, Xiaorui
Zhu, Xilin
Zhu, Yu
Zu, Jean
Zyada, Zakarya

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Changchun Institute of Optics, Fine Mechanics and Physics

Optics and Precision Engineering

General Information

Tianjin

Tianjin is one of China's four municipalities under the direct administration of central government. It is an international port city and the largest seaside city in the North of China, 137 km away from Beijing, the capital of China. Tianjin is a birthplace of modern industry of China: the first wrist watch, bicycle and television in New China were all made here. Since 1980s, Tianjin has turned itself into an important industrial base in North China. Tianjin is also a transportation hub with railway, waterway, highway and airway connecting other major cities in China and outside the country.

The name of Tianjin, which means “Emperor's port”, was adopted in the first year of Yongle Reign in Ming Dynasty. In the second year of Yongle Reign(1404), Tianjin became a walled garrison and began to be known as “Tianjin Wei”. In 1860 Tianjin was opened as a trading port. In the 1930s, it became the largest industrial and commercial city and financial center in the north of China. After the founding of the People's Republic of China in 1949, Tianjin became a municipality directly under the central government. After China adopted the policy of reform and opening up in 1978, Tianjin became one of the first coastal cities that are open to the outside world. Today, the city function according to the central government has been designated as becoming an international harbor city, economic center in north China, and an ecological city.

As one of the first cities open to the outside world, Tianjin has an excellent environment for business and investment. Up till now, among the top 500 world leading enterprises, more than 120 have invested in Tianjin. With the involvement of Binhai New Area in the national development strategy, Tianjin has become an area with the greatest attraction for investors and the highest investment profit rates in China.

Tianjin is a well known city with a long history and abundant resources. Panshan Mountain, the No. 1 Mountain in Capital's East; Dule Temple, one of the oldest wooden structures in China; Ancient Culture Street, full of ancient Chinese culture and Tianjin custom. More surprises are waiting for your exploration.

Attractions

➢ Dule Temple

Dule Temple is a Buddhist temple located in the town of Jixian, in Ji County, under the administration of the city of Tianjin, China. The temple is of historical as well as architectural significance. Its oldest surviving buildings are two timber-frame structures, the front gate and the central hall that houses a colossal clay statue of the goddess Guanyin. Both structures date back to the Liao Dynasty and are among the oldest surviving wooden buildings in China.

➢ Shi Family Grand Courtyard

Shi Family Grand Courtyardis situated in Yangliuqing Town of Xiqing District, which is the former residence of wealthy merchant Shi Yuanshi – the 4th son of Shi Wancheng, one of the eight great masters in Tianjin. First built in 1875, it covers over 6,000 square meters, including large and small yards and over 200 folk houses, a theater and over 275 rooms that served as apartments and places of business and worship for this powerful family. Shifu Garden, which finished its expansion in October 2003, covers 1,200 square meters, incorporates the elegance of imperial garden and delicacy of south garden. Now the courtyard of Shi family covers about 10,000 square meters, which is called the first mansion in North China. Now it serves as the folk custom museum in Yangliuqing, which has a large collection of folk custom museum in Yanliuqing, which has a large collection of folk art pieces like Yanliuqing New Year pictures, brick sculpture.

Shi's ancestor came from Dong'e County in Shandong Province, engaged in water transport of grain. As the wealth gradually accumulated, the Shi Family moved to Yangliuqing and bought large tracts of land and set up their residence. Shi Yuanshi came from the fourth generation of the family, who was a successful businessman and a good household manager, and the residence was thus enlarged for several times until it acquired the present scale. It is believed to be the first mansion in the west of Tianjin.

Today, the Shi mansion, located in the township of Yangliuqing to the west of central Tianjin, stands as a surprisingly well-preserved monument to China's pre-revolution mercantile spirit. It also serves as an on-location shoot for many of China's popular historical dramas. Many of the rooms feature period furniture, paintings and calligraphy, and the extensive Shifu Garden.

➢ Ancient Cultural Street

Tianjin Ancient Culture Street with 600 years history, standing in the area of key section in upstream of the Haihe River, is located in Nankai district of Tianjin. Covering an area of 224,200 sq meters, it used to be one of earliest water transport docklands in Tianjin where is one of the busiest cities of commerce and trade in history. As a cultural precinct, Tianjin Ancient Culture Street is well known by the local and overseas tourists. The two attractions, Yuan Huang Ge and Tian Hou Temple are two historic cultural relics in the list of city level ones reversed.

Tianjin Ancient Cultural Street rebuilt in 1980's is one of the great successes in the renovation and redevelopment. The whole block is still conserved the existing urban pattern and tissue of traditional Chinese layout. The lanes and houses in the Street are almost preserved in a good condition with Tianjin local feathers. In past time, whenever the day of 23th of March in lunar calendar was coming, a great ceremony would be held here, which it is said that it is the birthday of heaven Mother.

➢ Goubuli

Goubuli, also sometimes translated as Go Believe, is a brand of stuffed baozi from Tianjin, China. Founded in 1858, it is one of China's longest established brands. Each Goubuli bun has eighteen wrinkles. There are many explanations for the name Goubuli. The oft-quoted one relates to a poor village boy nicknamed Gouzhai. At 14, he became an apprentice at a food store. Thereafter, he set up his own shop specialising in selling steamed, stuffed baozi. His supposedly very delicious baozi soon gained immense popularity in a short period of time. As a result, Gouzhai got too occupied with his business to converse with his customers. So, they started to complain, “Gouzhai does not talk to people”.

Weather

Tianjin features a four season, monsoon-influenced climate, typical of East Asia, with cold, windy, very dry winters reflecting the influence of the vast Siberian anticyclone, and hot, humid summers, due to the monsoon.

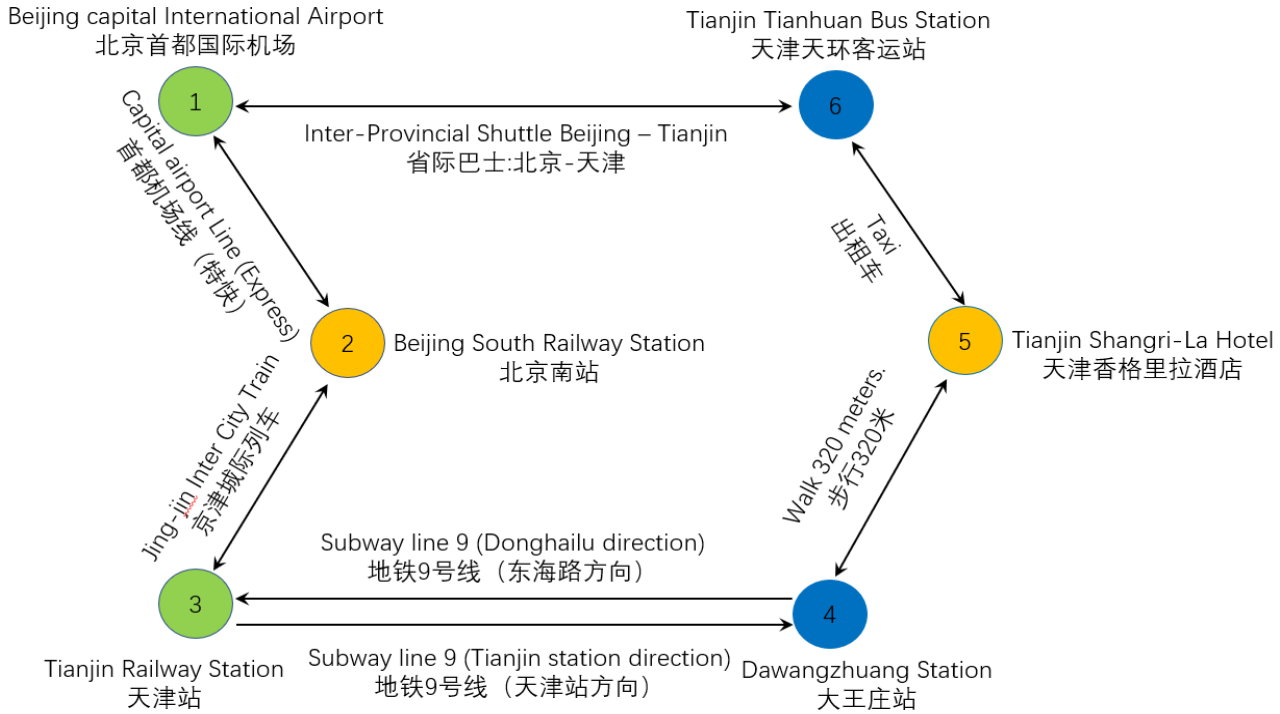
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
° F	26.8	23.2	43.7	68.9	79.0	86.2	87.8	86.4	79.3	67.5	51.1	39.0
° C	-2.8	-4.9	6.5	20.5	26.1	30.1	31.0	30.2	26.3	19.7	10.6	3.9

Transportation

All the registrants should make their own local transportation in the city. Travel by taxi is the most convenient and faster option for the journey. Tianjin is not only famous for charming natural scenery but also for large numbers of taxis and cheapest taxis cost: RMB 2.00 per km with base price RMB 8.00 ! Please prepare some changes in advance for taxi fee or subway in the staying in Tianjin. We suggest you wait for taxi at the airport designated taxi station. Please ask for a receipt with the taxi.

<u>Transportations from/to Airport</u>

- Transportations from/to Beijing Capital International Airport



Route 1: Traffic information about the Beijing Capital International Airport (北京首都国际机场) – Tianjin Shangri-La Hotel (天津香格里拉酒店) (1->2->3->4->5)

1st Step: Between Beijing Capital International Airport (北京首都国际机场) and Beijing South Railway Station (北京南站), you can take Capital Airport Line (Express) (机场线) or Taxi.

PS 1: If you take Capital Airport Line (Express) (机场线) for Beijing South Railway Station (北京南站), You will need to change Line2 (2 号线) at Dongzhi Men (东直门) and then change Line 4 (4 号线) at Xizhi Men (西直门). From Beijing South Railway Station(北京南站) to Beijing Capital International Airport (北京首都国际机场), you can take Line 4 (4 号线) and then change Line 2 (2 号线) at Xizhi Men (西直门), next change Capital Airport Line (机场线) at Dongzhi Men (东直门). The one-way fee is about 30 RMB.

PS 2: If you take taxi, the distance is about 37.2 km and you need to pay about 120 RMB.

2nd Step: Between Beijing South Railway Station (北京南站) and Tianjin Railway Station (天津站), please take Jing-jin Inter city Train (京津城际列车).

PS: The train runs from AM 6:13 to PM 10:56 with interval of 20 minutes every day and the one-way time is about 33 minutes. The fee is about 66 RMB.

3rd Step: Between Tianjin Railway Station (天津站) and Tianjin Shangri-La Hotel (天津香格里拉酒店), you can take Subway line 9 or Taxi.

PS 1: If you take taxi, the distance is about 2.4 km and you need to pay about 9 RMB.

PS 2: If you take Subway line 9, from/to Tianjin Railway Station (天津站) to/from Dawangzhuang Ave station (大王庄站), you need to pay about 2 RMB and you can take the Exit C. You can walk to Tianjin Shangri-La Hotel (天津香格里拉酒店) with 320m.

Route 2: Traffic information about the Beijing Capital International Airport (北京首都国际机场) – Tianjin Shangri-La Hotel (天津香格里拉酒店) (1->6->5)

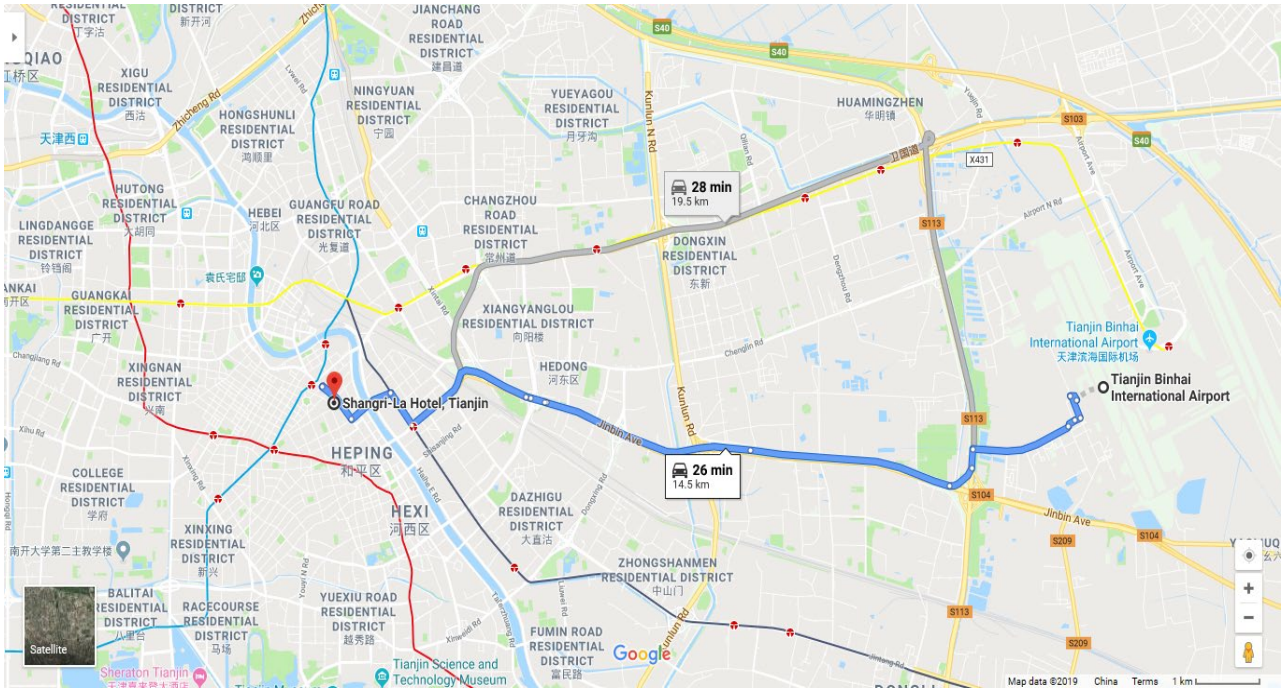
1st Step: From/to Beijing Capital International Airport (北京首都国际机场), you can take Inter-Provincial Shuttle Beijing – Tianjin (省际巴士:北京-天津) to/from Tianjin Tianhuan Bus Station (天津天环客运站) which will take 2 hours and a half and 82 RMB.

PS 1: Beijing departure point: T1/T2: In front of Gate 15 on the 1st Floor of T2; T3: In front of Gate 1 on the 1st Floor, departure time is from 8:00 to 23:00 with about 1 hour interval.

PS 2: Tianjin departure point : Starting from the northeast corner of the crossing of Hongqi Rd (红旗路) and Anshan West Avenue (鞍山西道), Tianjin departure time is from 4:00 to 18:00 with about 1 hour interval.

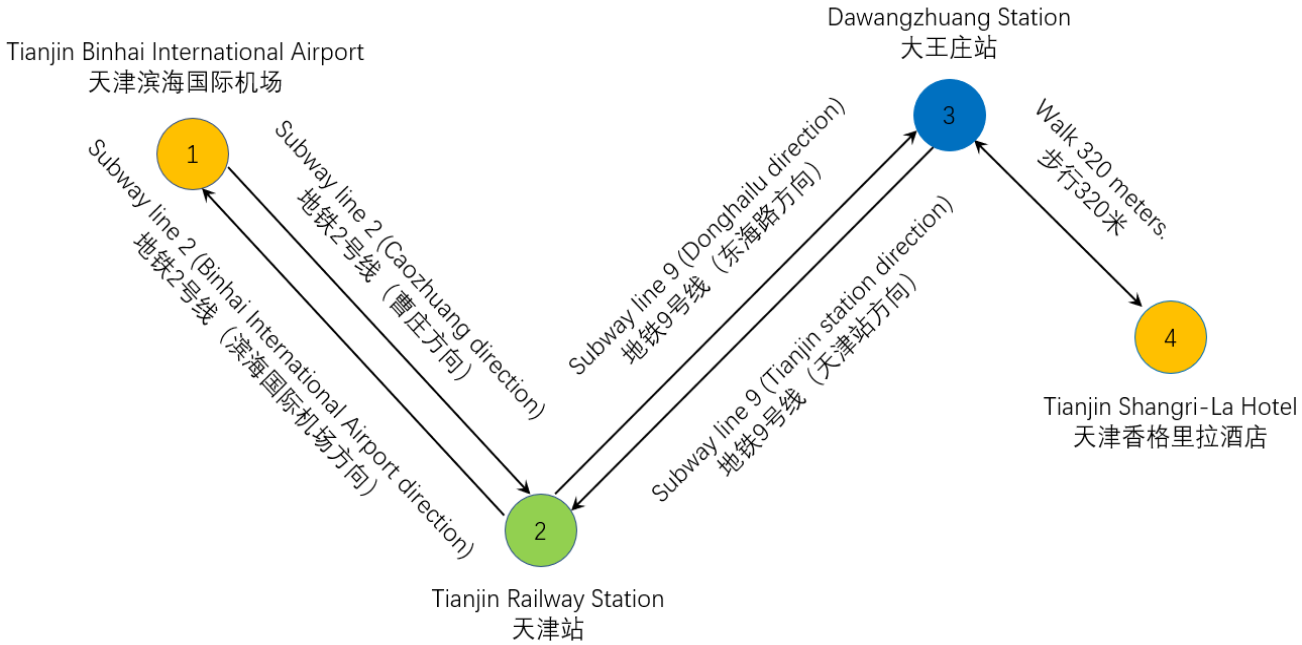
2nd Step: Between Tianjin Tianhuan Bus Station (天津天环客运站) with Tianjin Shangri-La Hotel (天津香格里拉酒店), you can take taxi with about 19 RMB and 30 minutes.

➢ Transportations from/to Tianjin Binhai International Airport by taxi



PS: It will take about 26 minutes. The distance is about 14.5 km and you need to pay about RMB 42 Yuan.

➢ Transportations from/to Tianjin Binhai International Airport by Bus

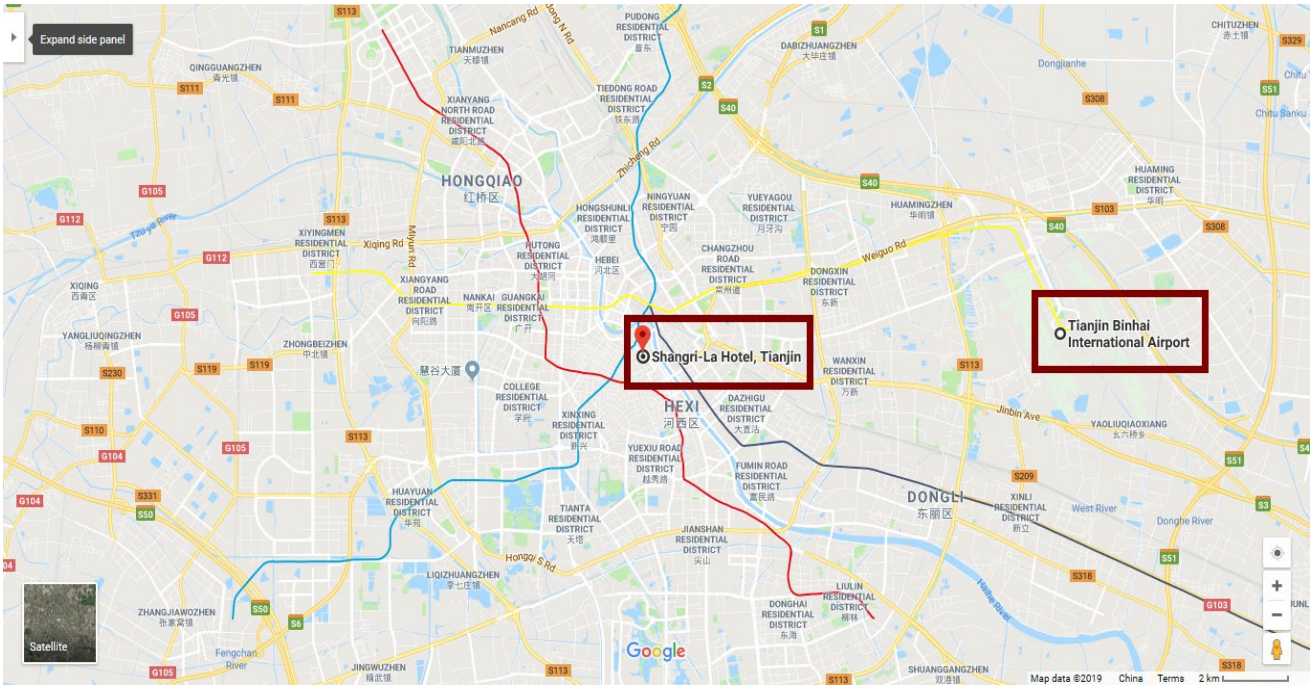


Route: Tianjin Binhai International Airport (天津滨海国际机场) – Tianjin Shangri-La Hotel (天津香格里拉酒店) (1->4)

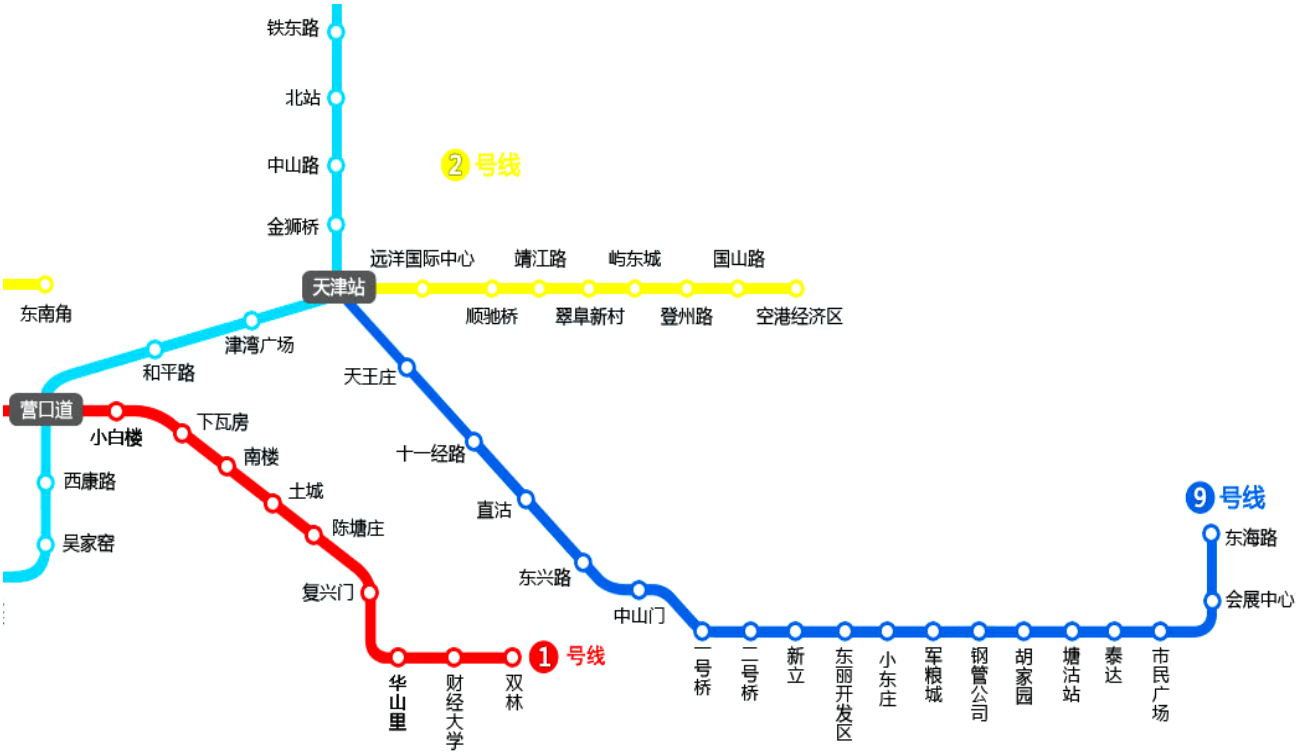
PS : It will take about 43 minutes. The distance is about 17.2 km and you need to pay about RMB 6 Yuan.

Appendix:

- The position of Tianjin Shangri-La Hotel



- Part of Tianjin Metro



Useful Information

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

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

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

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

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

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

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

- **Measurement:** In Metric system

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

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

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

Conference Information

Conference Venue

IEEE ICMA 2019 will be held in the city of Tianjin, at Shangri-La Hotel. Tianjin Shangri-La Hotel located within the fully-integrated Tianjin Kerry Centre, connected to the Riverview Place shopping mall, luxurious residences, and an array of dining and entertainment options. Take the subway to Dawangzhuang Station on line 9 and exit from entrance C or D, which are located in the Riverview Place shopping mall. The hotel is 25-minute drive from Tianjin Binhai International Airport, 5 minutes to Tianjin Railway Station by car and 2 hours' drive from Beijing.




Chinese Address Cards

Tianjin Shangri-La Hotel

天津香格里拉酒店

地址：中国天津市河东区海河东路 328 号

Tel： 86-22-8418-8888

Conference Registration

A conference registration desk will be set up and opened at the FUNCTION ROOM of 1st Floor of Tianjin Shangri-La Hotel from August 4 (13:30) to August 7 (11:00) as followings.

August 4, 2019 13:30~18:30 (near the escalator of 1st Floor)
August 5, 2019 07:30~12:00 (near the escalator of 1st Floor)
August 5, 2019 12:00~18:30 (near Room 6 of 1st Floor)
August 6, 2019 08:00~18:00 (near Room 6 of 1st Floor)
August 7, 2019 08:00~11:00 (near Room 6 of 1st Floor)

Internet Access

Free internet access will be provided during the conference period, to the IEEE ICMA 2019 participants at the Conference Room on 1st floor and 2nd floor of Tianjin Shangri-La Hotel **(天津香格里拉酒店)**. Broadband internet access services are also provided at the conference hotel for a fee. For the fee information, please contact the hotel you are staying directly.

Social Events

The social events organized by the IEEE ICMA 2019 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 4, 2019 in Conference Room 4 (DIAMOND 2), 1F of Tianjin Shangri-La Hotel **(天津香格里拉酒店).** All the conference participants are welcome to join this event.

Awards Banquet

The Awards Banquet will be held from 18:30 to 21:00 on August 6, 2019 in Conference GRAND BALLROM (BALLROM 2), 2F of Tianjin Shangri-La Hotel **(天津香格里拉酒店).** All the conference participants are welcome to join this event.

Farewell Party

The Farewell Party will be held from 12:00 to 13:00 on August 7, 2019 in Conference Room 4 (DIAMOND 2), 1F of Tianjin Shangri-La Hotel **(天津香格里拉酒店).** All the conference participants are welcome to join this event.

IEEE ICMA 2019 Conference

Plenary Talk 1

CPS Driven Control System

Tianyou Chai, Ph.D.

Director of National Research Center for Metallurgical Automation Technology, Professor

Department of Automatic Control

Northeastern University, P.R. China

Abstract:

China has abundance of mineral resources such as magnesite, hematite and bauxite, which constitute a key component of its economy. The relatively low grade, and the widely varying and complex compositions of the raw extracts, however, pose difficult processing challenges including specialized equipment with excessive energy demands. The energy intensive furnaces together with widely uncertain features of the extracts form hybrid complexities of the system, where the existing modeling, optimization and control methods have met only limited success. Currently, the mineral processing plants generally employ manual control and are known to impose greater demands on the energy, while yielding unreasonable waste and poor operational efficiency. The recently developed Cyber-Physical

System (CPS) provides a new key for us to address these challenges. The idea is to make the control system of energy intensive equipment into a CPS, which will lead to a CPS driven control system.This talk presents the syntheses and implementation of a CPS driven control system for energy-intensive equipment under the framework of CPS. The proposed CPS driven control system consists of four main functions: (I) setpoint control; (II) tracking control; (III) self-optimized tuning; and (IV) remote and mobile monitoring for operating condition. The key in realizing the above functions is the integrated optimal operational control methods to implement setpoint control, tracking control and self-optimized tuning together seamlessly. This talk introduces the integrated optimal operational control methods we proposed.

Hardware and software platform of CPS driven control system for energy-intensive equipment is then briefly introduced, which adopts embedded control system, wireless network and industrial cloud. It not only realizes the functions of computer control system using DCS (PLS), optimization computer and computer for abnormal condition identification and self-optimized tuning, but also achieves the functions of mobile and remote monitoring for industrial process.

Then, using fused magnesium furnace as an example, a hybrid simulation system for CPS driven control system for energy-intensive equipment developed by our team is introduced. The results of simulation experiments show the effectiveness of the proposed method that integrates the setpoint control, tracking control, self-optimized tuning and remote and mobile monitoring for operating condition in the framework of CPS.

The industrial application of the proposed CPS driven control system is also discussed. It has been successfully applied to the largest magnesia production enterprise in China, resulting in great returns. Finally, future research on the CPS driven control system is outlined.

Tianyou Chai received the Ph.D. degree in control theory and engineering in 1985 from Northeastern University, Shenyang, China, where he became a Professor in 1988. He is the founder and Director of the Center of Automation, which became a National Engineering and Technology Research Center and a State Key Laboratory. He is a member of Chinese Academy of Engineering, IFAC Fellow and IEEE Fellow.His current research interests include modeling, control, optimization and integrated automation of complex industrial processes.

He has published 200 peer reviewed international journal papers. His paper titled Hybrid intelligent control for optimal operation of shaft furnace roasting process was selected as one of three best papers for the Control Engineering Practice Paper Prize for 2011-2013. He has developed control technologies with applications to various industrial processes. For his contributions, he has won 4 prestigious awards of National Science and Technology Progress and National Technological Innovation, the 2007 Industry Award for Excellence in Transitional Control Research from IEEE Multiple-conference on Systems and Control, and the 2017 Wook Hyun Kwon Education Award from Asian Control Association.

IEEE ICMA 2019 Conference

Plenary Talk 2

Does the progress of robotics pass through soft materials?

Cecilia Laschi, Ph.D.

Professor, Deputy Director

The BioRobotics Institute

Scuola Superiore Sant'Anna, Rector's delegate to research

e-mail: cecilia.laschi@santannapisa.it

https://www.santannapisa.it/en/node/3934

Abstract:

Though a young discipline, robotics progressed rapidly and pervaded our lives more than we perceive, becoming a tool we cannot do without in manufacturing. Futuristic scenarios have been proposing robots in daily life of citizens and professionals for decades, creating expectations that have not yet been matched. What are the realistic scenarios that robotics technologies enable today? What are the abilities

that robots still miss to match expectations for extensive application and healthier and safer human life? Largely inspired by the observation of the role of soft tissues in living organisms, the use of soft materials for building robots is recognized as one of the current challenges for pushing the boundaries of robotics technologies and building robotic systems for service tasks in natural environments. The study of living organisms sheds light on principles that can be fruitfully adopted to develop additional robot abilities or to facilitate more efficient accomplishment of tasks, because living organisms exploit soft tissues and compliant structures to move effectively in complex natural environments.

Robots have a great potential for becoming part of our lives, for responding to current societal challenges, for contributing to economic growth. New materials and new forms of machine intelligence are key directions for the future robotics progress.

Cecilia Laschi is Full Professor at the BioRobotics Institute of Scuola Superiore Sant'Anna in Pisa, Italy, where she serves as Rector's delegate to Research. She graduated in Computer Science at the University of Pisa in 1993 and received the Ph.D. in Robotics from the University of Genoa in 1998. In 2001-2002 she was JSPS visiting researcher at Waseda University in Tokyo.

Her research interests are in the field of soft robotics, a young research area that she pioneered and contributed to develop at international level, including its applications in marine robotics and in the biomedical field. She has been working in humanoid robotics and neurorobotics, at the merge of neuroscience and robotics.

She is in the Editorial Boards of several international journals. She serves as reviewer for many journals, including Nature and Science, for the European Commission, including the ERC programme, and for many national research agencies.

She is senior member of the IEEE, of the Engineering in Medicine and Biology Society (EMBS), and of the Robotics & Automation Society (RAS), where she served as elected AdCom member and currently is Co-Chair of the TC on Soft Robotics. She founded and served as General Chair for the IEEE-RAS First International Conference on Soft Robotics in Livorno, in April 24-28, 2018.

She is founding member of RoboTech srl, spin-off company of the Scuola Superiore Sant'Anna, in the sector of edutainment robotics.

IEEE ICMA 2019 Conference

Plenary Talk 3

The New Wave in Robot Grasping

Ken Goldberg, Ph.D.

Professor and Director

William S. Floyd Jr. Distinguished Chair in Engineering

Department Chair, Industrial Engineering/Operations Research (IEOR)

Director, AUTOLAB and CITRIS "People and Robots" Initiative Founding Member, Berkeley AI Research (BAIR) Lab Joint Appointments: EECS, Art Practice, School of Information (UC Berkeley) and Radiation Oncology (UC San Francisco Medical School).

University of California, Berkeley

E-mail: goldberg@berkeley.edu http://goldberg.berkeley.edu

Abstract:

Robots are about to become far more dextrous based on a new wave in research that combines classical mechanics, stochastic, and deep learning.

Despite 50 years of research, robots remain remarkably clumsy, limiting their reliability for warehouse order fulfillment, robot-assisted surgery, and home decluttering. The First Wave of grasping research is purely analytical, applying variations of screw theory to exact knowledge of pose, shape, and contact mechanics. The Second Wave is purely empirical: end-to-end hyperparametric function approximation (aka Deep Learning) based on human demonstrations or time-consuming self-exploration. A "New Wave" of research considers hybrid methods that combine analytic models with stochastic sampling and Deep Learning models. I'll present this history with new results from our lab on grasping diverse and previously-unknown objects and discuss exciting future research including cloud and fog robotics.

Ken Goldberg is an artist, inventor, and UC Berkeley Professor focusing on robotics. He was appointed the William S. Floyd Jr Distinguished Chair in Engineering and serves as Chair of the Industrial Engineering and Operations Research Department. He has secondary appointments in EECS, Art Practice, the School of Information, and Radiation Oncology at the UCSF Medical School. Ken is Director of the CITRIS "People and Robots" Initiative and the UC Berkeley AUTOLAB where he and his students pursue research in machine learning for robotics and automation in warehouses, homes, and operating rooms. Ken developed the first provably complete algorithms for part feeding and part fixturing and the first robot on the Internet. Despite agonizingly slow progress, he persists in trying to make robots less clumsy. He has over 250 peer-reviewed publications and 8 U.S. Patents. He co-founded and served as Editor-in-Chief of the IEEE Transactions on Automation Science and Engineering. Ken's artwork has appeared in 70 exhibits including the Whitney Biennial and films he has co-written have been selected for Sundance and nominated for an Emmy Award. Ken was awarded the NSF PECASE (Presidential Faculty Fellowship) from President Bill Clinton in 1995, elected IEEE Fellow in 2005 and selected by the IEEE Robotics and Automation Society for the George Saridis Leadership Award in 2016.

More information can be obtained in http://goldberg.berkeley.edu

IEEE ICMA 2019 Conference

Keynote Speech

Cell Processing Task Automation

James K. Mills, Ph. D.

Professor

Department of Mechanical and Industrial Engineering

University of Toronto

5 King's College Rd. Toronto, Ontario Canada

Email: mills@mie.utoronto.ca

http://www.mie.utoronto.ca/labs/nonlin/mills2.html

Abstract:

Interest has grown rapidly over the last decade in biological research and clinical applications involving manipulation and processing of single cells. In research labs a variety of single cell processes are routinely conducted including removal of cell organelles, transfer of RNA, DNA and proteins into the cell and removal of human embryonic cells formed during cell cleavage, amongst others. Currently, much of this cell processing work is carried out manually by highly skilled technicians. This presentation summarizes some of our recent work directed towards the automation of biological micro-scale tasks using robotic technology. The work presented will address control and automation methods utilized to achieve automation of single cell surgery as well as other cell processing automation methods.

James K. Mills is with Department of Mechanical and Industrial Engineering, University of Toronto. He received the PhD in Mechanical Engineering, specializing in robotic control. His recent research interests include: 3D MEMS robotic assembly, meso-scale machine design, control and automation of micro-scale biological tasks. He has published over 450 papers. He has been an Invited Visiting Professor at the Centre for Artificial Intelligence and Robotics in Bangalore, India, a Visiting Professor at the Hong Kong University of Science and Technology, Chinese University of Hong Kong and the City University, Hong Kong.

IEEE ICMA 2019 Conference Workshop

World Premium Workshops on Robotics

Sunday, August 4, 2019

14:00 - 15:40

Conference Room 1, 1F

Tianjin Shangri-La Hotel, Tianjin, China

Regional Analysis of Distributed Parameter Systems and Their Applications for the Control of Cyber–Physical Systems

Venue: Conference Room 1, 1F
Tianjin Shangri-La Hotel, Tianjin

Date and Time: 14:00 - 15:40, August 4, 2019

Organizers:

Dr. YangQuan Chen, University of California, Merced, USA

Dr. Fudong Ge, China University of Geosciences, Wuhan, PR China

About the workshop:

It is well known that Cyber-physical systems (CPSs) with integrated computational and physical processes can be regarded as a new generation of control systems and can interact with humans through many new modalities. The objective of CPS is to develop new science and engineering methods in which sensor and actuator configurations, and physical designs are compatible, synergistic, and integrated at all scales. Many CPSs are characterized by parameters and variables that depend both on time and location so that distributed parameter systems (DPSs) governed by partial differential equations (PDEs) can be used to adequately represent the cyber-physical process dynamics. Moreover, due to the strong interactions between components in these DPS dynamics, there are cases when the

system is not controllable or observable in the whole domain of interest but can be controllable and observable in a subdomain. Thus, regional analysis makes more practical sense. Regional sensing and actuation is getting more and more important in this CPS age with cloud computing and big data movements.

This workshop will prepare the IEEE ICMA 2019 audience with 1) compelling reasons why this research theme is important, 2) what are basic concepts and existing results, and 3) what are rich future research opportunities.

List of Speakers and Schedule

Time	Topics	Speaker List
13:55-14:00	Welcome speech	
14:00-14:30	Regional analysis of DPSs and Their Applications for the control of CPSs – 25 years in review	Dr. YangQuan Chen, University of California, Merced, USA
14:30-15:00	Why we should use regional analysis: From MAS-net project to CPS to CHS	Dr. YangQuan Chen, University of California, Merced, USA
15:00-15:30	Regional analysis of fractional order DPSs and Their Applications for the control of CPSs –(Ge)	Dr. Fudong Ge, China University of Geosciences, Wuhan, PR China
15:30-15:40	Panel Discussion	Moderators: All speakers

IEEE ICMA 2019 Conference Workshop

Regional Analysis of Distributed Parameter Systems and Their Applications for the Control of Cyber–Physical Systems

The Workshop speakers

Dr. YangQuan Chen, Professor

Mechatronics, Embedded Systems and Automation (MESA) LAB,
Dept. of Mechanical Engineering, School of Engineering
University of California, Merced
5200 NorthLakeRoad, Merced, CA95343, USA
Emails:yqchen@ieee.org; ychen53@ucmerced.edu; Phone:(209)228-4672
https://scholar.google.com/citations?user=RDEIRbcAAAAJ&hl=en

YangQuan Chen joined University of California, Merced in summer 2012 with a vision to promote the wide-spread use of low cost scientific data-drones in precision agriculture and environmental monitoring. His unmanned aerial systems (UAS) team at UC Merced has been pursuing research excellence in innovative use of data-drones for crop, water, soil, dust, air, and fire etc. Dr. Chen received Ph.D. from Nanyang Technological University Singapore in 1998. His current areas of research interest include: applied fractional calculus in controls, signal processing and energy informatics; distributed measurement and distributed control of distributed parameter systems using mobile actuator and sensor networks; mechatronics; multi-UAV based cooperative multi-spectral "personal remote sensing" for precision agriculture and environmental monitoring. He is an Associate Editor for IFAC journals of Mechatronics and Control Engineering Practice, Fractional Calculus and Applied Analysis, IET Control Theory and Applications, IEEE Transactions of Control Systems Technology, ISA Transactions and Cogent Engineering (Systems and Control). He also serves as the Topic-Editor-in-Chief in "Field Robotics" for International Journal of Advanced Robotic Systems (IJARS), a Senior Editor for International Journal of Intelligent and Robotic Systems, and an associate editor for Journal of Intelligent Service Robotics. He was an associate editor for ASME Journal of Dynamical Systems, Measurement and Control (2009-2015) and a Founding Associate Editor for

Unmanned Systems (2013-2015). Dr. Chen is a member of ASPRS, AUVSI, AMA, IEEE, ASME, AIAA, and ASEE. He serves as the co-chair for IEEE RAS TC on Aerial Robotics and UAV, IEEE-USA CTAP, and Program Co-chair for ICUAS 2016, Washington, DC, and General Co-Chair for ICUAS 2017, Miami, FL. He can be reached by email: yqchen@ieee.org

Dr. Fudong Ge, Associate Professor

School of Computer Science, China University of Geosciences,
Wuhan 430074, PR China
Email: gefd@cug.edu.cn Phone : +86 18186449217
https://scholar.google.com/citations?hl=zh-CN&user=4rEo3fYAAAAJ

Fudong Ge earned his Ph.D. in the College of Information Science and Technology of Donghua University, Shanghai, China in 2016. He joined the MESA Lab of the University of California, Merced in October, 2014 as an Exchange Ph.D. student. He is now an associate professor at the School of Computer Science, China University of Geosciences, Wuhan, Hubei Province, China. His research interests include existence, stability/stabilization of solutions for fractional differential equations; continuous time random walks and anomalous diffusion systems; distributed measurement and distributed optimal control problems in general distributed parameter systems or cyber-physical systems in general form. He can be reached by email: gefd@cug.edu.cn

IEEE ICMA 2019
Program at a Glance

August 4-7, 2019

Tianjin Shangri-La Hotel, Tianjin, China

http://www.shangri-la.com/tianjin/shangrila/about/

Sunday, August 4, 2019	
13:30 - 18:30	Registration Desk Open
14:00 - 15:40	**World Premium Workshops on Robotics (GARNET ROOM on 1F)**
16:00 - 17:00	Keynote Speech (Dr. James K. Mills) **(GARNET ROOM on 1F)**
17:30 - 18:30	Reception **(DIAMOND ROOM on 1F)**
Monday, August 5, 2019	
8:30 - 9:00	Opening Ceremony **(BALLROOM 2&3 on 2F)**
9:00 - 9:50	Plenary Talk I (Dr. Tianyou Chai) **(BALLROOM 2&3 on 2F)**
9:50 - 10:40	Plenary Talk II (Dr. Cecilia Laschi) **(BALLROOM 2&3 on 2F)**
10:40 - 11:00	Morning Break
11:00 - 12:00	Technical Sessions MA1 (Poster Session) **(BALLROOM 2&3 on 2F)**
12:00 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions MP1
15:00 - 15:15	Afternoon Break
15:15 - 16:45	Technical Sessions MP2
17:00 - 18:30	Technical Sessions MP3
Tuesday, August 6, 2019	
8:30 - 9:20	Plenary Talk III (Dr. Ken Goldberg) **(GARNET ROOM on 1F)**
9:30 - 11:00	Technical Sessions TA1
11:00 - 11:15	Morning Break
11:15 - 12:15	Technical Sessions TA2
12:15 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions TP1
15:00 - 15:30	Afternoon Break
15:30 - 17:00	Technical Sessions TP2
18:30 - 21:00	Award Banquet in Tianjin Shangri-La Hotel **(BALLROOM 2&3 on 2F)**
Wednesday, August 7, 2019	
8:30 - 10:00	Technical Sessions WA1
10:00 - 10:30	Morning Break
10:30 - 12:00	Technical Sessions WA2
12:00 - 13:00	Farewell Party

* 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 2019 Technical Program, Sunday, August 4, 2019

Time \ Room	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
13:30-18:30	**Registration Desk Open** (Registration Area on 1F)						
14:00-15:40	**World Premium Workshops on Robotics** (GARNET ROOM on 1F)						
16:00-17:00	**Keynote Speech** (Prof. James K. Mills) (GARNET ROOM on 1F)						
17:30-18:30	**Reception** (DIAMOND ROOM on 1F)						

IEEE ICMA 2019 Technical Program, Monday, August 5, 2019

Time \ Room	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
8:30-9:00	**Opening Ceremony** (BALLROOM 2&3 on 2F)						
9:00-9:50	**Plenary Talk I** (Dr. Tianyou Chai) (BALLROOM 2&3 on 2F)						
9:50-10:40	**Plenary Talk II** (Dr. Cecilia Laschi) (BALLROOM 2&3 on 2F)						
10:40-11:00	Morning Break						
11:00-12:00	Technical Sessions MA1 Poster Session (BALLROOM 2&3 on 2F)						
12:00-13:30	Lunch Break						
13:30-15:00	**MP1-1**	**MP1-2**	**MP1-3**	**MP1-4**	**MP1-5**	**MP1-6**	**MP1-7**
	Micro and Nano Systems	Manipulator Control and Manipulation (I)	Biomimetic Measurement and Control in Robotics	Neuro, Fuzzy, and Intelligent Control (I)	Vision System and Robotic Vision (I)	Control Theory and Application (I)	Rotor Dynamics, Vibration Analysis and Vibration Control
15:00-15:15	Afternoon Break						
15:15-16:45	**MP2-1**	**MP2-2**	**MP2-3**	**MP2-4**	**MP2-5**	**MP2-6**	**MP2-7**
	Sensor Networks, Distributed Sensor Systems	Manipulator Control and Manipulation (II)	Human-System Interaction and Interface (I)	Neuro, Fuzzy, and Intelligent Control (II)	Vision System and Robotic Vision (II)	Control Theory and Application (II)	Biomimetic Systems
17:00-18:30	**MP3-1**	**MP3-2**	**MP3-3**	**MP3-4**	**MP3-5**	**MP3-6**	
	Laser Technology and Laser Processing	Manipulator Control and Manipulation (III)	Human-System Interaction and Interface (II)	Neuro, Fuzzy, and Intelligent Control (III)	Vision System and Robotic Vision (III)	Control Theory and Application (III)	

IEEE ICMA 2019 Technical Program, Tuesday, August 6, 2019

Time \ Room	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
8:30-9:30	**Plenary Talk III** (Dr. Ken Goldberg) (GARNET ROOM on 1F)						
9:30-11:00	**TA1-1**	**TA1-2**	**TA1-3**	**TA1-4**	**TA1-5**	**TA1-6**	**TA1-7**
	Medical, Biomedical and Rehabilitation Systems (I)	Mobile Robot System (I)	Signal and Image Processing (I)	Industrial, Manufacturing Process and Automation (I)	Intelligent Mechatronics and Application (I)	Control Theory and Application (IV)	Modeling, Simulation Techniques and Methodology (I)
11:00-11:15	Morning Break						
11:15-12:15	**TA2-1**	**TA2-2**	**TA2-3**	**TA2-4**	**TA2-5**	**TA2-6**	**TA2-7**
	Medical, Biomedical and Rehabilitation Systems (II)	Mobile Robot System (II)	Signal and Image Processing (II)	Industrial, Manufacturing Process and Automation (II)	Intelligent Mechatronics and Application (II)	Control Theory and Application (V)	Modeling, Simulation Techniques and Methodologies (II)
12:15-13:30	Lunch Break						
13:30-15:00	**TP1-1**	**TP1-2**	**TP1-3**	**TP1-4**	**TP1-5**	**TP1-6**	**TP1-7**
	Medical, Biomedical and Rehabilitation Systems (III)	Mobile Robot System (III)	Signal and Image Processing (III)	Industrial, Manufacturing Process and Automation (III)	Intelligent Mechatronics and Application (III)	Control Theory and Application (VI)	Modeling, Simulation Techniques and Methodologies (III)
15:00-15:30	Afternoon Break						
15:30-17:00	**TP2-1**	**TP2-2**	**TP2-3**	**TP2-4**	**TP2-5**	**TP2-6**	**TP2-7**
	Medical, Biomedical and Rehabilitation Systems (IV)	Mobile Robot System (IV)	Signal and Image Processing (IV)	Industrial, Manufacturing Process and Automation (IV)	Intelligent Mechatronics and Application (IV)	Control Theory and Application (VII)	Modeling, Simulation Techniques and Methodologies (IV)
18:30-21:00	Award Banquet in **Tianjin Shangri-La Hotel (BALLROOM 2&3 on 2F)**						

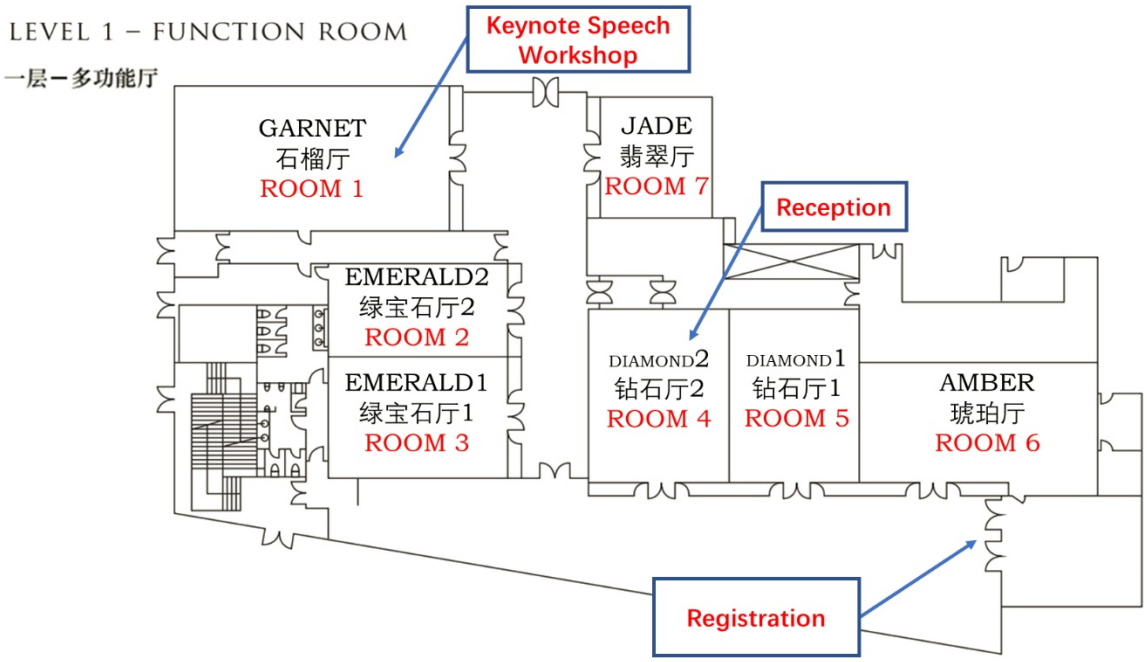
IEEE ICMA 2019 Technical Program, Wednesday, August 7, 2019

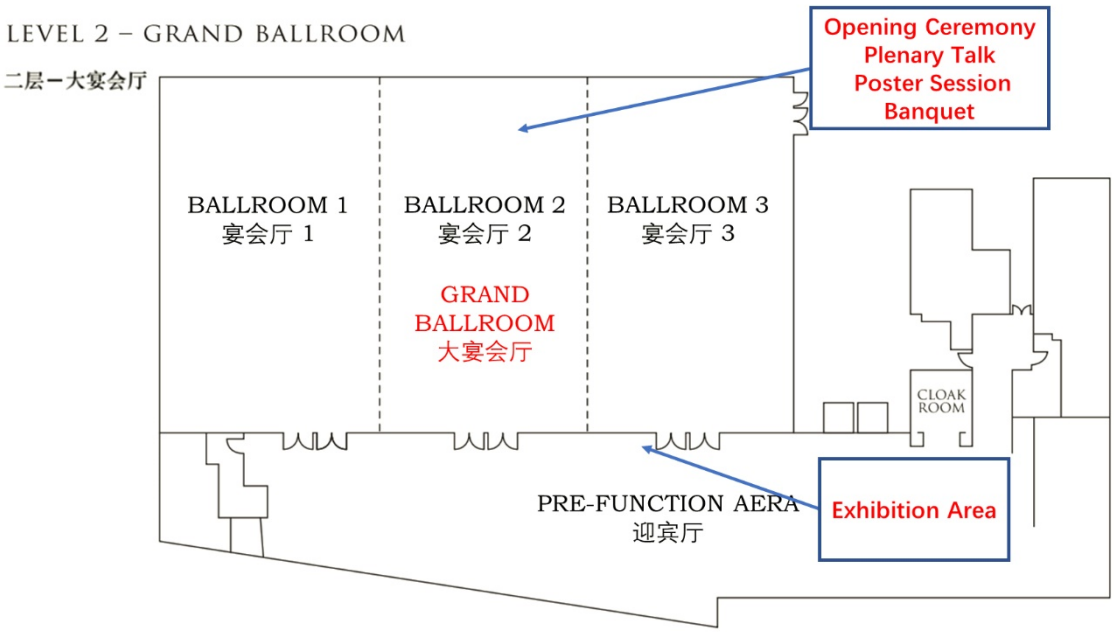
Time \ Room	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7
8:30-10:00	**WA1-1** Medical, Biomedical and Rehabilitation Systems (V)	**WA1-2** Medical Robots for Minimal Invasive Surgery (I)	**WA1-3** Signal and Image Processing (V)	**WA1-4** Elements, Structures, and Mechanisms (I)	**WA1-5** Robot Navigation and Control Algorithm (I)	**WA1-6** Biomimetic Underwater Robots	
10:00-10:30	Morning Break						
10:30-12:00	**WA2-1** Intelligent Control Strategies and Algorithms	**WA2-2** Medical Robots for Minimal Invasive Surgery (II)	**WA2-3** Signal and Image Processing (VI)	**WA2-4** Elements, Structures, and Mechanisms (II)	**WA2-5** Robot Navigation and Control Algorithm (II)	**WA2-6** Rescue Robots and Field Robot Systems	
12:00-13:00	Farewell Party						

IEEE ICMA 2019

Floor Map of Conference Rooms

1F & 2F, Shangri-La Hotel, Tianjin
Conference Room 1-7 and Grand Ballroom





Monday
August 5, 2019

Morning Sessions

MA1-P Poster Session (Intelligent Mechatronics and Automation)

Monday
August 5, 2019

Afternoon Sessions

MP1-1	Micro and Nano Systems
MP1-2	Manipulator Control and Manipulation (I)
MP1-3	Biomimetic Measurement and Control in Robotics
MP1-4	Neuro, Fuzzy, and Intelligent Control (I)
MP1-5	Vision System and Robotic Vision (I)
MP1-6	Control Theory and Application (I)
MP1-7	Rotor Dynamics, Vibration Analysis and Vibration Control
MP2-1	Sensor Networks, Distributed Sensor Systems
MP2-2	Manipulator Control and Manipulation (II)
MP2-3	Human-System Interaction and Interface (I)
MP2-4	Neuro, Fuzzy, and Intelligent Control (II)
MP2-5	Vision System and Robotic Vision (II)
MP2-6	Control Theory and Application (II)
MP2-7	Biomimetic Systems
MP3-1	Laser Technology and Laser processing
MP3-2	Manipulator Control and Manipulation (III)
MP3-3	Human-System Interaction and Interface (II)
MP3-4	Neuro, Fuzzy, and Intelligent Control (III)
MP3-5	Vision System and Robotic Vision (III)
MP3-6	Control Theory and Application (III)

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

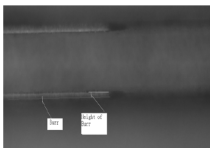
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

An Experimental Study on Burrs in Micro Milling Antenna Micro Narrow Slots

Yu Cao, Chaoyang Wang, Yuan Ping,Peng Hou, Weishe
Luoyang Optoelectro Technology Development Center
Luoyang, China

Micromilling is a key machining process in the fabrication of radar antenna. However, burr formation in mechanical machining process is the most important problem which becomes more critical for a micro-scale feature.. In order to control the size of burrs on antenna micro narrow slots, the effects of rotational speed; feed speed and cutting depth on burrs formation in micro milling have been studied experimentally.



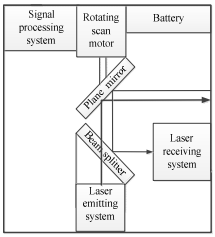
The Micro Burrs

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

Optimization of Spectroscope Parameters for Single-beam Pulsed Laser Scanning Circumferential Detection System

Yangliang Gao, Bingting Zha*, Jinbo Huang and Hailu Yuan
ZNDY of Ministerial Key Laboratory., Nanjing University of Science and Technology
Nanjing, China

- Provides a single-beam pulsed laser scanning circumferential detection system.
- Establishes the echo power equation of the optical system and get the optimal split ratio of the beam splitter .
- Analyzes the lateral and longitudinal optical path dimensions of the system.
- Calculates the relationship between the volume and F-number, effective aperture and beam splitter radius.



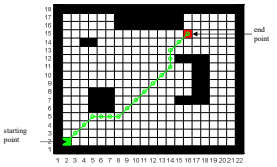
Single-beam pulsed scanning circumferential detection system

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

A Path Planning Strategy for Intelligent Sweeping Robots

Zhang Hongmei1, Hong Wei2, Chen Mingjie1
1. College of Automation, Harbin Engineering University
2. School of Control Science and Engineering, Dalian University of Technology, Dalian

- A path planning algorithm and its optimization for intelligent sweeping robot was designed.
- To realize ergodic cleaning, a inward spiral path planning strategy is designed .
- To solve the dead zone problem, a escape algorithm is proposed based on A* algorithm .



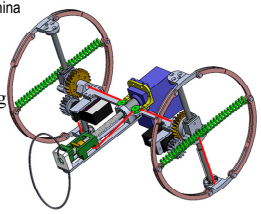
The shortest path searching by A* algorithm

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

Dynamic Analysis and Simulation of a Deformable Wheeled Jumping Robot

Hequan Wang, Han Li, Changlong Ye and Guanglin Ding
School of Mechatronics Engineering, Shenyang Aerospace University
Shenyang, China

- The research object of this paper is an intermittent jumping robot with deformable wheel mechanism, which effectively combines jumping and wheeled movement.
- The Lagrange dynamic equation of the robot system is deduced based on the multi-rigid-body dynamics theory.
- The theoretical failure angle of the robot jump is given.



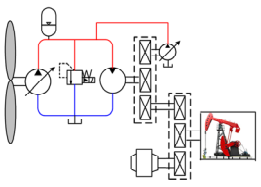
The Deformable Wheeled Jumping Robot

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

Research on energy saving principle of pumping unit driven by wind turbine

Lihua Wang and Chunyou Zhang
College of Mechanical Engineering, Inner Mongolia University for the Nationalities , tongliao, Inner Mongolia ,China

- Use wind to save energy
- New energy saving technology
- Saving energy scheme for pumping unit
- System mathematical model
- Simulation and result analysis



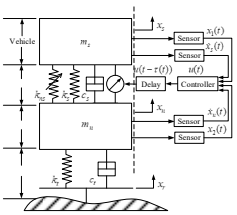
Wind power hydraulic transmission system

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

Exponential stability criterion for vehicle nonlinear uncertain suspension systems with time-varying delay

Binqiang Li, Yanliang Cui, Guangtian Shi, Rui Shi, Xiaoan Zhang and Lanlan Xu
School of Mechanical Engineering, and School of Civil Engineering
Lanzhou Jiaotong University, Lanzhou, China

- Car suspension is a vibration system with mass, spring and damping.
- The vibration affects the comfort and stability of the vehicle, making the passenger feel uncomfortable or generating a bad driving experience .
- By constructing a reasonable Lyapunov-Krasovskii function and using an weighted integral inequality to gain a controller with low conservation.



Quarter-vehicle model

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

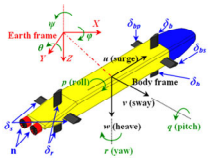
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Variable Structure Control for the Roll Stabilization of the AUV During the Diving Process with a Constant Speed

Zhigang Qi, Yuan Chen and Wei Zhao
Automation College, Harbin Engineering University
Harbin, China

- The horizontal rudders of AUV are used to generate enough stabilization moment to reduce the roll of the AUV during the diving process at low speed.
- Presents a variable structure controller for the autonomous underwater vehicle to reduce the roll.
- The simulation shows the effectiveness of the controller and gives the roll efficiency finally.



AUV:NPS II

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

DSC and LADRC Path Following Control for Dynamic Positioning Ships at High Speed

Guoqing Xia , Hongfei Chu ,Yunan Shao, Binyuan Xia
Department of Automation, Harbin Engineering University
Harbin, China

- First, ILOS guidance is used to calculate desired heading angles and compensate drift angles.
- Second, path following controllers are designed based on LADRC and DSC.
- Third, the linear extended state observer expands the unknown nonlinear part as a new state, and estimate and compensate the model errors and external uncertain nonlinear disturbance.

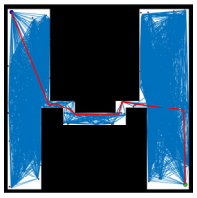
Ocean Oil 299

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

Improved PRM for Path Planning in Narrow Passages

Kai Cao[1,2], Qian Cheng[1], Song Gao[1*],Yangquan Chen[2], Chaobo Chen[1]
1.School of Electronic Information Engineering, Xi'an Technological University, Xi'an, China
2.School of Mechatronic Engineering, Xi'an Technological University, Xi'an, China

- In order to solve the problem of insufficient adaptability of PRM in the case of narrow passage, an improved method based on optimal sampling strategy is proposed.
- The simulation results show that the improved PRM has more sampling points in the narrow passages than the standard PRM. And the time of path planning, the success rate and the path length are also significantly improved



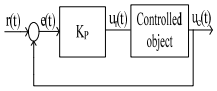
Improved PRM

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

Mechanism Analysis and Simulation Study of Static Difference Generated by Proportional Controller

Jiayao Wang, Xuesong Zhou, Youjie Ma
Key Research Laboratory for Control Theory & Applications in Complicated Systems ,Tianjin University of Technology
Tianjin, China

- Proportional control is one of the most simple control method.
- Proportional control is a kind of differential control.
- Proportional control always produces static errors that cannot be eliminated.



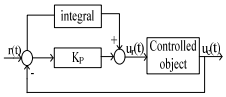
P control structure diagram

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

Static Error Mechanism Analysis and Simulation Research Based on PI Control

Xuesong Zhou, Yongliang Zhou, Youjie Ma
Key Research Laboratory for Control Theory & Applications in Complicated Systems ,Tianjin University of Technology
Tianjin, China

- the static error mechanism of PI control is analysed in the time domain and the frequency domain, respectively.
- In the frequency domain analysis, the time domain static error formula is transformed into the frequency domain static error formula



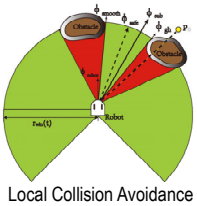
PI control structure diagram

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

Real-time Obstacle Avoidance and Person Following Based on Adaptive Window Approach

Minfeng Cen[1], Yonglong Huang[1], Chaosheng Zou[2], Xunyu Zhong[1], Xiafu Peng
1.School of Aerospace Engineering, Xiamen University, Xiamen, China
2. Wanjiu Technology Co., Ltd, Xiamen, China

- All scan points are clustered into several segments.
- Clusters are classified as leg or non-leg.
- All the detected clusters are tracked by using multi-Kalman filter.
- Designing person following strategy.
- Improving adaptive window approach for local collision avoidance.



Local Collision Avoidance

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

Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

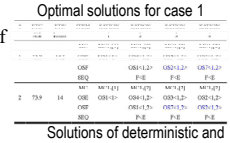
MA1-P(13) 11:00-12:00

Robust Optimization Models of Integrated Configuration Design and Scheduling for Reconfigurable Flowline

Jianping Dou, Xia Zhao, and Qi Sun
School of Mechanical Engineering, Southeast University, Nanjing, China

- A scenario based robust optimization model for integrated configuration design and scheduling is established.
- A mixed integer linear programming (MILP) model is derived to minimize the sum of total cost, the cost variation for prescribed scenarios, and penalty of earliness and tardiness.
- The validation and advantages of the robust MILP model are illustrated against two cases

Optimal solutions for case 1



Solutions of deterministic and robust models for case 2

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

Study on Cooperative Control Algorithm of Two Spherical Amphibious Robots

Liang Zheng, Shuxiang Guo, Yan Piao, Shuoxin Gu, Ruochen An, Wenbo Sui
Graduate School of Engineering, Kagawa University, Takamatsu, Kagawa 761-0396, Japan

- Control strategy for two amphibious robots Grayscale
- Underwater movement is also analyzed
- Analyze the thrust of the underwater robot
- Underwater motion analysis experiment

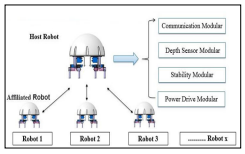


Diagram of the spherical amphibious robot

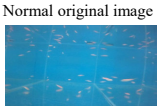
MA1-P(15) 11:00-12:00

Fish Population Status Detection Based on Deep Learning System

Baofeng zhang, Fuhua xie and Fangfang Han
Engineering Research Center of Optoelectronic Devices & Communication Technolog, Tianjin key Laboratory for Control Theory &Applications in Complicated Systems,Tianjin, China

- This study attempts to detect the different states of moving objects of the same group, using convolution neural network, to achieve the purpose of qualitative analysis of group behavior.
- In the same sample state detection, compared with the ordinary texture detection, the accuracy of the experiment is improved by 5% by using the deep learning model.

Normal original image



Abnormal original image

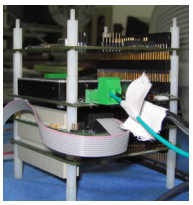
The Sample

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

Study on Visual Detection Device of Plant Leaf Disease

Ning fu
JiLin Agricultural Science and Technology University Jilin, Jilin, China

- Data processing using ARM processor
- Using image processing technology to realize the recognition of plant leaf disease color
- Grayscale recognition algorithm
- Using image fusion technology



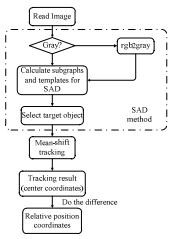
Plant pathology detection system

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

Automatic Extraction Tracking and Control of Robotic Based on Mean-shift

Yang Zhang,Xiukun Wang
Department of Mechanical Engineering University of ShenyangJianzhu Liaoning, China

- tracking method that automatically extracts targets and applies them to mobile robot tracking and controlling is proposed.
- The SAD method is first introduced and fused based on the traditional Mean-shift tracking method.
- The motor that needs to complete the tracking and conducted experiments is modeled and closed-loop controlled.



Target tracking method flow diagram

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

Research on Multiple Blind Watermarking Algorithm Based on Double Scrambling

Hui Wang, Qiang Wang, Lijun Yu and Fei Zhong
College of Automation, Harbin Engineering University, Harbin, 150001,China

- This paper proposes a multi-blind watermarking algorithm for color images, which combines spatial domain and DCT domain.
- The proposed algorithm is robust to white noise attacks, Gaussian low-pass filtering and JPEG attacks, and the watermarking information is not easily cracked.
- These watermarks are used to complete the copyright authentication and additional information detection.

Attacked carrier image and extracted watermarks

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

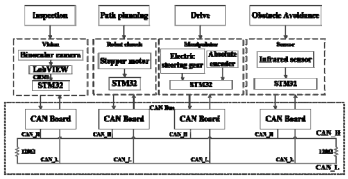
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Design of Distributed Control System for Pick-up Robot Based on CAN Bus

Rui Chen, Biao Liu, Man Pan, Haibo Zhou*
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- Modular distributed control system based on CAN bus.
- Visual inspection module, manipulator drive module, robot path planning module and infrared obstacle avoidance module.



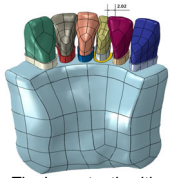
Distributed control system

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

Finite Element Analysis on the Orthodontic Treatment of Loose Tooth with Overlapping by Periodontal Splint

Chunqiu Zhang[1*], Zhongxin Li[1], Yang Song[1], Xue Shi[2], Xinyue Li[2]
1.*Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, National Demonstration Center for Experimental Mechanical and Electrical Engineering Education,Tianjin,University of Technology, Tianjin 300384,P.R.China*
2. *Tianjin Stomatological Hospital, Tianjin 300090,P.R.China*

- The periodontal ligament stress will increase sharply if the treatment is not taken when the tooth has II degree loose with 2 mm overlap.
- In the reduce stress of the periodontal ligament or limit the displacement of the loosed tooth after repaired by the two kinds of splints, which repair effects are exceedingly obvious, but Super-bond adhesive splint is better.



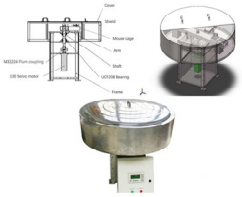
The loose tooth with Overlapping

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

Study on a High G Mechanical Device for Animal Experiments

Li Kangning, Cui Lu, Liu Haiying,Zhang Chunqiu*,Zhang Xizheng
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control,National Demonstration Center for Experimental Mechanical and Electrical Engineering Education,Tianjin University of Technology, Tianjin 300384,P.R.China

- A high G mechanical loading device, acceleration can reach 1G, 2G, 3G... 40G (accurate to 1G)
- It has the functions of setting acceleration time, deceleration time, duration and acceleration magnitude.
- Mechanical loading of rats in different high-G environments was carried out with a high-G loading device.



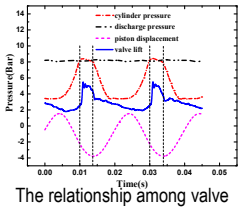
a High G Mechanical Device

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

Dynamic behavior of the discharge valve in a moving coil oil-free linear compressor for refrigeration cycle

Chengzhan Li ,Jinghui Cai
a. University of Chinese Academy of Sciences, Beijing 100049, China
b. Key Laboratory of Space Energy Conversion Technologies, Technical Institute of Physics and Chemistry, CAS, Beijing 100190,China

- The laser triangulation method is used to measure the lift of discharge valve.
- The discharge power loss and suction power loss can be clearly present in this paper.
- The valve lift additional displacement fluctuations is observed which offers a guide for design and optimization of discharge valve.



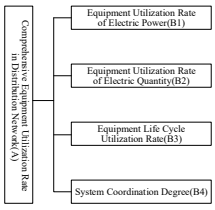
The relationship among valve displacement, cylinder pressure and movement of piston

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

Evaluation Index and Method of Equipment Utilization Rate in Distribution Network with the Integration of PV

Yang Yang[1], Qi Gong[2], Chao Lv[1], Shan Guo[1], He Li[1] and Wenchao Cai[1]
1.Reliability and Power Quality Technology Center, Inner Mongolia Electric Power Research Institute, Hohhot, China. 2.State Key Laboratory of New Energy and Power Systems,North China Electric Power University, Beijing, China

Digest: Firstly, three main definitions of equipment utilization rate has been studied. Secondly, evaluation Index of equipment utilization rate in distribution network is raised. Then, the evaluation steps of equipment utilization rate are summarizes of distribution network with the integration of PV. Finally, a typical distribution network is analyzed and evaluation index proposed before is applied to the actual power grid.



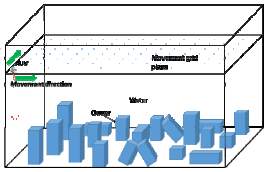
Evaluation Index and Number of Equipment Utilization Rate in Distribution Network

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

Mapping of an Enclosed Underwater Environment by Acoustic Side-Scan

Yibin Peng, Peter N Green
The University of Manchester,
Manchester, UK

- Acoustic side-scan mapping strategy that collects the bottom information of an unknown enclosed water pond.
- Ray tracing method is used to model and simulate the sound propagation.
- The consequence of the mapping is a point cloud data.
- Construct an occupancy grid map which will contribute to the navigation of the AUV.



Acoustic side-scan on equal-spaced grid

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

Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Industrial Robot Optimal Time Trajectory Planning Based on Genetic Algorithm

Guohong Li, Yuanliang Wang
Department of Intelligent Robotics, Tianjin University of Technology
Tianjin, China

- In this paper, an optimal trajectory planning method for industrial robots is proposed, which uses a cubic polynomial curve to connect the adjacent path points, so that the joint trajectory curve is more smooth.

6 Degree of freedom industrial robot

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

Construction of welding quality intelligent judgment system

Jinjin Guo1,2, Yang Liu1,2 Gang Wu1,2
1 Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control
2 National Demonstration Center for Experimental Mechanical and Electrical Engineering Education
Tianjin University of Technology
Tianjin, China

- Inputting various features into the fuzzy neural network .
- Using fuzzy control theory combined with BP neural network to identify welding defects .
- Optimize welding process parameters
- Provide parameters for the grinding and spraying process

Welding Robot

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

A Fast Calculation Method of Eccentricity Based on Least Squares

Sanying Zhu, Qiang Liu, Pengpeng Sun, Jian Wang
School of Mechanical Engineering and Automation, Beihang University
Beijing, China

- Use only the relative displacement of the contour points on rotary parts relative to the distance transducer.
- Use four points on the contour of the part as a set of data and N sets of data in total to calculate.
- Is suitable for the case where the ratio between radius and eccentricity is greater than 200.
- Is 40-50% faster than the calculation of Least Squares.

Eccentricity Measurement

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

Research on The Design of Terminal for EV DC Charging Coupler

Wenjia Sun, Jiaojiao Wang, Xiao Li and Yang Li
Department of New Energy Test and Research, China Automotive Technology and Research Center Co., Ltd.
Tianjin, China

- The torsional spring terminal configuration has good performance under long-term wear.
- the crown spring is easy to get good electrical properties in the condition of new product.
- The asymmetrical salient point crimping is not as good as that of symmetrical hexagonal crimping.

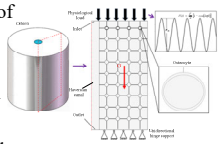
The temperature rise test device

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

Effects of Loading Frequency on the Mechanical Response Properties of Osteocytes in Microgravity Environment

Sen Zhao 1,2, Haiying Liu*1,2, Yang Song 1,2, Yonghe Li 1,2, and Chunqiu Zhang 1,2
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2. National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology), Tianjin 300384, China

- This study explored the underlying causes of weightless bone loss.
- The effect of loading with frequency 0-0.6 Hz on the stress extremum of osteocytes in microgravity environment.
- The significant liquid pressure gradient in the osteocytes within the earth gravity field.
- Provide theoretical guidance for subsequent research on confrontation.



The Finite element model

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

Practical Kicking Motion Generation Method for NAO

Chaojun Wang, Wenchuan Jia, Yi Sun, Shugen Ma
School of Mechatronic Engineering and Automation
Shanghai Key Laboratory of Intelligent Manufacturing and Robotics
Shanghai University
Shanghai, China

- A practical method of generating the omnidirectional kicking motion.
- Use the distance measurement system (DMS) to obtain the coordinate of ball and target point.
- Use the kicking motion generating system (KMGS) to plan the trajectory of swinging leg and generate kicking motion online.

omnidirectional kick

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

Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Virtual Simulation Test of on-board Electronic Equipment under Mechanical Environment

Yahong Dong & Yuejin SHANG
School of Mechanical Engineering, Lanzhou Jiaotong University,
Lanzhou, China

- The virtual simulation test platform of on-board electronic equipment for the high-speed EMU (Electric Multiple Unit) was constructed,
- The virtual simulation test under natural frequency, sinusoidal vibration, semi sinusoidal impact and random vibration was completed.
- The results show that the on-board electronic equipment is meeting to design requirements. The virtual simulation test platform is feasibility.

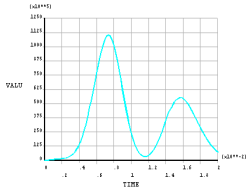


Fig.1 Stress response of underfoot in the direction of vertical plate surface

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

Basic Experiments for a Remote Control Robot-Mapping System in Complex Environments

Li Ke*1*2, TingXinSong*2, Nattawat Pinrath*1, Darren Phang Ren Yee*1*3, Nobuto Matsuhira*1
*1Shibaura Institute of Technology/*2Hubei University of Technology/*3Universiti Tunku Abdul Rahman

- Teleoperation robot System with Gmapping and IMU sensor
- Teleoperation robot move in narrow path
- Display actual robot pose in robot simulator
- Small obstacle find and marked in Gmapping System

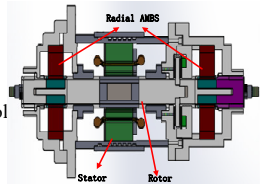
Teleoperation System

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

A Coupling Simulation of Converter Field Circuit for Active Radial Electromagnetic Bearing Based on Simplorer and Maxwell

Yibin Li, Jian Zhou, Haipeng Geng, Tingchen Du, Yonghong Qi and Xiliang Yin
School of Mechanical Engineering,Xi'an Jiaotong University
Xi'an, China

- Design the structure of eight-level active electromagnetic bearing for high speed motor.
- Establish the mathematical model of active electromagnetic bearing control and design the PID controller.
- The finite element model of electromagnetic bearing was established in Maxwell, and the joint simulation was carried out in Simplorer.



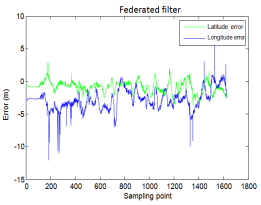
The Permanent Magnet Synchronous Motor Shaft System

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

Multi-Sensor Integrated Navigation System for Ships Based on Adaptive Kalman

Bo Fu, Junsheng Liu, Qishuang Wang
Xi'an Modern Control Technology Research Institute
Xi'an, China

- The non-reset federated Kalman filter algorithm is used to fuse the data of multiple.
- INS is used as the dominant navigation system; GPS, BeiDou and Doppler log are selected as auxiliary navigation systems.
- The MAKF algorithm and the improved Sage-Husa adaptive filtering algorithm are used as sub-filter.



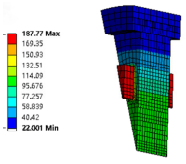
Federated Filter Error Curve

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

Analysis of thermal characteristics of 10Kw high speed permanent magnet synchronous motor

Xiliang Yin,Haipeng Geng,Hao Lv,Hao Xu,and Yonghong Qi
State Key Laboratory for strength and Vibration of Mechanical Structures., Xi'an Jiao Tong University
Xi'an, China

- Various losses of high-speed permanent magnet synchronous motor in high-speed operation lead to complex internal temperature changes.
- By studying the thermal characteristics of the motor, the rationality of the motor design is verified, and the help for later optimization is provided.



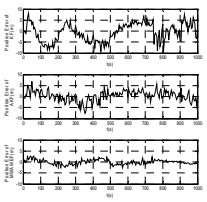
Temperature Distribution Map of Motor

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

A Study on Moving Window Adaptively Weighting Estimation Method

Yi Gao[1], Ya Gao[2], Yanhui Mao[1]
[1]School of Electronic Engineering, Xi'an Shiyou University
[2]School ofElectronic Information Engineering, Xi'an Technological University
Xi'an, China

- Introduction of the advantage and disadvantage about the Kalman filter and the Sage-Husa filtering .
- System model and error equation.
- The method of moving window weighted adaptive estimation.
- Simulation experiment and analysis.
- Conclusion.



Position error calculated using methods of the KF、AKF and MWAWEW

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

Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Application of a Combined Denoising Method in Ground Penetrating Radar Signal Pre-processing

Dingjie Xu, Yuxuan Wu and Feng Shen
School of Instrumentation of Science and Engineering, Harbin Institute of Technology
Harbin, China

- A new combined denoising method is proposed.
- The method realizes the extraction of useful signals with slowly changing speed by multi-resolution analysis of signals containing Gauss white noise.
- Compared with traditional processing methods, the proposed method has higher SNR and smaller mean square error (MSE).

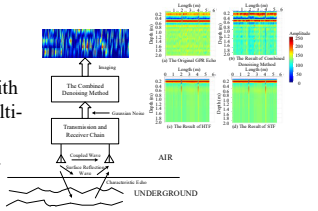


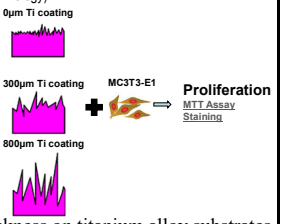
Fig. 1. The structure of system with its original echo and the experimental results.

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

Biocompatibility of Ti Coatings with Varied Thicknesses on Ti Alloy Substrates using Osteoblasts

Xin Wang[1,2*], Zheng He[1,2], Jinduo Ye[1,2], Chunqiu Zhang[1,2]
1 Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2 National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- The purpose of this study is to investigate cellular biocompatibility of Ti coatings with varied thickness on titanium alloy substrates using osteoblasts and to explore the surface characteristics of implants, which are in favour of the growth of osteoblasts.



varied thickness on titanium alloy substrates

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

Design and analysis of dual-arm cooperative robot system for hole-axis assembly

Bin Li, Yuhang Wang and Shoujun Wang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control., Tianjin University of Technology，Tianjin, China
National Demonstration Center for Experimental mechanical and Electrical Engineering Education, Tianjin University of Technology，Tianjin, China

- Construction of a two-arm cooperative robot system for hole shaft assembly
- Perform kinematic analysis to derive the forward kinematics and inverse kinematics equations of the robot.
- Visual processing with Halcon to identify target objects and obtain poses
- Perform a simple shaft hole assembly experiment and analyze the data with matlab

Dual-armed robot

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

An Adaptive Contrast Threshold SIFT Algorithm Based on Local Extreme Point and Image Texture

Yunwei Jia, Kun Wang and Chenxiang Hao
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control,Tianjin University of Technology
Tianjin, China

- SIFT algorithm cannot extract feature points well from blurred images and low-light images
- This paper proposes an adaptive contrast threshold SIFT algorithm based on the average value of local extreme points and the texture character of the whole image.

The processing results of low-light image

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

A New Saliency Object Extraction Algorithm Based on Itti's Model and Region Growing

Yunwei Jia,Chenxiang Hao and Kun Wang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control,Tianjin University of Technology
Tianjin, China

- A new method based on Itti's model is proposed in order to extract saliency objects as complete as possible.
- The new method combines the advantages of Itti's model and region growing.
- Compared with Itti's model, the precision, the recall rate and F-measure of the saliency object extraction by the new method are improved obviously.

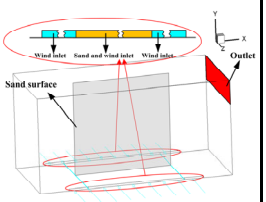
The saliency object extracted by the new method

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

Numerical Simulation of Sand Concentration and Pressure Distribution in Sand Experimental Box

Youshi Xuchen, Bingting Zha*, Zhen Zheng and Hailu Yuan
ZNDY of Ministerial Key Laboratory, Nanjing University of Science and Technology
Nanjing, China

- Provide a scheme for the construction of sand experimental box.
- The length of the sand surface simulates the thickness of the sand in reality.
- Control sand concentration (0~20g/m^3) by setting velocity and mass flow rate.
- Provide quantitative experimental conditions for laser experiments in sand environments



The Sand Experimental Box

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

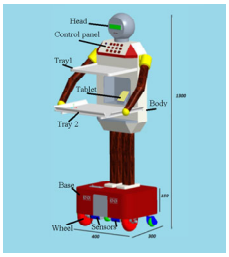
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Restaurant Serving Robot with Double Line Sensors Following Approach

Vo Nhu Thanh, Dang Phuoc Vinh, Ngo Thanh Nghi, Le Hoai Nam, Do Le Hung Toan
The University of Danang -University of Science and Technology
Da Nang, Viet Nam

- A restaurant serving robot is developed.
- Double line-sensors are used for better performance.
- PID controllers are used to drive the PWM signals that control the speed and direction of the robot.
- Many sensors are intergrated to improve the performance capability of the serving robot.



Restaurant serving robot

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

Research on Control Effect of Window Glass on Inner Sound Environment of High-speed Train

Zhengxiao Xu, Guangtian Shi, Xungang Diao, Xiaoan Zhang, Zhidan Huang and Huanhuan Zhang
School of Mechanical Engineering, Lanzhou Jiaotong University
Lanzhou,Gansu, China

- In this paper, the sound insulation of different single-layer glass, laminated glass and hollow glass are compared and analyzed basing on a statistical energy model of side window glass for high-speed train.
- The sound insulation performance of windows with different edge sealing materials is analyzed.
- The window with combined edge sealing materials have better sound insulation performance.

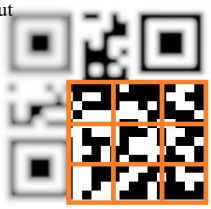
The CRH380A window

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

A New QR Code Multi-layer encryption system based on Image geometric processing

Mingyin Xu, Lianrong Lv*, Jiawei Zhang,Mengqi Xu,Chaosen Zhang,JianfengandZhangTianjin University of Technology
Tianjin, China

- The image processing method is used to cut the QR code image out , and the invalid information segment and the effective information segment in the two-dimensional code are simultaneously processed to amplify the encrypted data capacity and increase the cracking cost.
- It is expected to be applied to express company customer information insurance Secret, solving the shared bicycle QR code vulnerabilities and commodity anti-counterfeiting and other civilian areas.



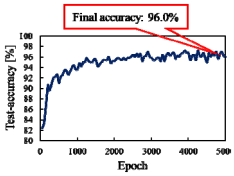
QR code image encryption

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

Target Approach for an Autonomous Mobile Robot Using Camera Images and Its Behavioral Acquisition for Avoiding an Obstacle

Yuta Takashima, Keigo Watanabe, and Isaku Nagai
Graduate School of Natural Science and Technology, Okayama University
Okayama, Japan

- Controlling the robot using a camera.
- Generating the potential field to approach the target.
- Constructing a collision prediction system using a convolutional neural network to avoiding a moving obstacle.
- The effectiveness of the proposed method is verified by experiments.



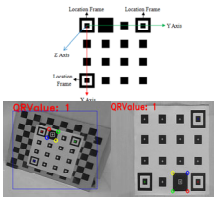
Test-accuracy of a collision prediction system

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

A Fast Pose Estimation Method Based on New QR Code for Location of Indoor Mobile Robot

Xuewei Cao, Yiping Yang, Tao Lu, Lixin Fang and Jixiang Zhang
Institution of Automation Chinese Academy of Sciences
Beijing, China

- A new QR Code is devised.
- A pose estimation method based on two stages is proposed. In the first stage, the decision whether or not QR Code exists is made efficiently based on the devised clustering method. In the second stage, a strategy in which every reckoned pixel block is reprocessed is employed.
- The proposed method can be used to the location of indoor mobile robot.



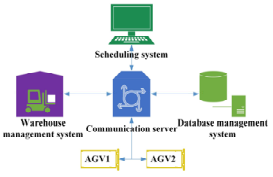
The devised QR Code and two examples of recognition

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

A Traffic Control Strategy of the Heavy-duty AGVS in a Square Topology

Qiyuan Sun,Fei Pan
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology
National Demonstration Center for Experimental mechanical and Electrical Engineering Education, Tianjin University of Technology
Tianjin, China

- The design of square topology.
- Establishment of dynamic task priority
- Authorization of collision avoidance strategy
- Combination of deadlock detection and recovery



System Frame Diagram

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

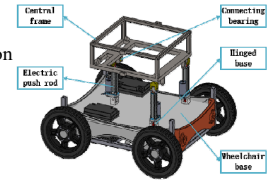
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Modal Analysis of Center Frame Structure of Electric Wheelchair

Lianyu Zhao, Yuping Wang, Jutao Wang
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- This paper uses finite element analysis software MSC.Patran / Nastran to perform modal analysis on the central frame of electric wheelchair.
- Effectively avoid the external excitation frequency to avoid resonance of the system structure.
- Verification of the safety and rationality of structural design.



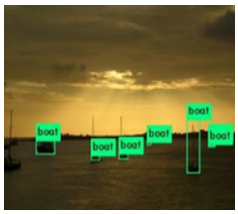
Wheelchair Drive Mechanism And Center Frame

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

Ship detection based on deep learning

Huixuan Fu, Xiangyun Ning, Binghan Leng and Yuchao Wang
College of Automation
Harbin Engineering University

- Using a deep learning approach to detection ships target.
- The accuracy and speed of the algorithm is determined by calculating the loss of the verification set and the corresponding label. Discuss the effects of changes in each hyperparameter on loss.



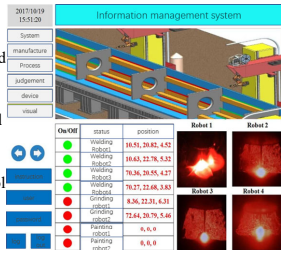
The result of detection

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

Data Transmission and Management System for Robotized Welding Station

Jinjin Guo,Song Jin, Enhong Xing
System Design and Intelligent Control, Tianjin University of Technology

- The data transmission management considering the needs of automatized production, transportation, storage and inspection.
- The production management with production adjustment and the control of production process.
- Coordinate local controllers (in our case PLCs) for application and control of image server/servers.
- Extracte the information from the real-time data

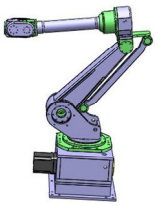


MA1-P(52) 11:00-12:00

Design Study of 6-DOF Grinding Robot

Liang Li, Weimin Ge, Enhong Xing
National Key Research and Development Program of China (2017YFB1303300),
Tianjin University of Technology
Tianjin, China

The mechanical structure of the 6-DOF grinding robot is derived considering the properties of grinded objects. The MDA350 grinding head produced by Mannesmann-Demag is considered as the tool. The direct and inverse kinematic problem is solved using Denavit-Hartenberg method. Next, the robot dynamics using the simulation method is investigated. Considering the actual working load, the strength of the relevant links is analyzed using ANSYS software.



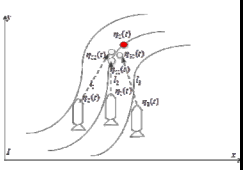
The 6-DOF Grinding Robot

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

Trajectory tracking Control of Multi-AUVs Formation based on Virtual Leader

Li Juan[1,2],Zhang Xu[2],Zhang Honghan[2], Du Xue[2]
1.Science and Technology on Underwater Vehicle Technology, Harbin Engineering University
2.College of Automation Harbin Engineering University

- The article proposes a control method for multi-AUVs formation trajectory tracking with guidance-control structure design based on the formation control strategy of virtual pilot and the passivity of Euler-Lagrangian error system under directed communication conditions.
- Based on the virtual pilot, the multi-AUVs formation control and multi-AUVs trajectory tracking control tasks are completed.



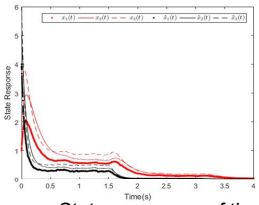
Trajectory tracking diagram of formation during multi-AUVs navigation

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

Stability Analysis and Observer-Based Controller Design for Uncertain T-S Fuzzy Systems with Disturbance and Time-Delay

Rui Shi , Guangtian Shi, Yanliang Cui, Binqiang Li, Xiaoyun Zhang and Lanlan Xu
School of Mechanical and Civil Engineering, Lanzhou Jiaotong University
Lanzhou, China

- The robustness of the observer is enhanced by the absence of uncertainties and disturbances
- The above methods and innovations make the system less conservative and more stable.
- Finally, a simulation example is given to verify the effectiveness and superiority of the proposed method.



State responses of the closed-loop system

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

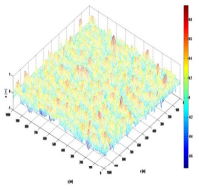
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

A Research Review on Wave Modeling and Simulation Methods in Marine Environment

Jian Fu and Fuxiang Huang and Wei Gao and Binggang Yin and Lihui Li
Offshore Oil Engineering Co. LTD.
Tianjin, China

- P-M spectrum and ITTC dual-parameter wave energy spectrum can simulate the wave more effectively under the wave state, which can represent the wave height and meet the simulation requirements.
- JONSWAP spectrum is more suitable for the region where the wind path is limited.
- Wave-front maps and wave heights by simulating three-dimensional random waves with the appropriate wave model based on the wave spectrum.



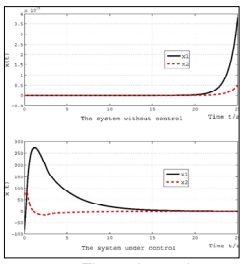
Waveform of P-M Spectrum

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

Observer-based Event-triggered Output Feedback Control for a Class of Uncertain Nonlinear Systems

Min Jin and Fudong Ge
School of Computer Science ,China University of Geosciences Wuhan, 430074, China

- An observer-based event-triggered controller has been designed for a class of uncertain nonlinear systems.
- Under the designed triggering condition, the Zeno behavior could be avoided.
- The numerical example has been given to show the effectiveness of the proposed method with a suitable initial value.



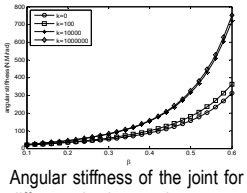
The main result

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

Angular Stiffness of a Trunnion Joint

Sheng Feng, Baisong Yang, Yonghong Qi, Haipeng Geng, and Lie Yu
State Key Laboratory for Strength and Vibration of Mechanical Structures, Xi'an Jiaotong Univeristy,Xi 'an, China

- A trunnion joint is modeled as a thin circular plate.
- Angular stiffness of the trunnion joint for elastic support is calculated.
- when the ratio of outer radius to the inner radius increased more than 0.6, the different elastic stiffness of the constraint can significantly affect the values of angular stiffness, the larger of the elastic constraint, the larger of the angular stiffness.



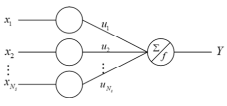
Angular stiffness of the joint for different elastic restraint

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

Dynamic Parameter Identification for Reconfigurable Robot Using Adaline Neural Network

Weimin Ge, Bingda Wang and Haozhi Mu
School of Mechanical Engineering, Tianjin University of Technology
Tianjin, China

- A dynamic parameter identification method for the reconfigurable robot based on Adaline neural network is proposed.
- The Adaline network model is a single-layer network with one output and one linear activation function.
- The dynamic parameter identified by the network is taken as the weights between the input and output layers of the network.



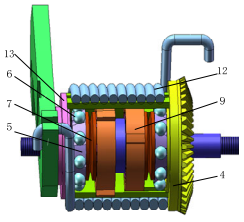
Adaline neural network model

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

Design and Research of Flexible Joint with Variable Stiffness Based on Torsion Spring

Xiangxu Qu,Dongxing Cao,Qiang Wang,and Yalin Li
Hebei University of Technology
Tianjin, China

- The mechanism rests on preventing the structural parameters of torsion spring from changing during the process of twisting.
- The stiffness between the rotating joints can be adjusted actively and passively.
- Compact structure, small size and convenient installation are the great strengths.



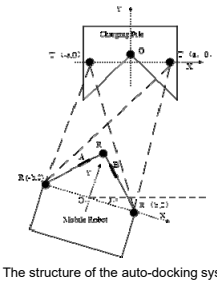
Flexible joints mechanism

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

A Sectional Auto-docking Charging Control Method for the Mobile Robot

Juzhong Zhang, Liming Cai and Yuyi Chu
Suzhou Institute of Biomedical Engineering and Technology, Chinese Academy of Sciences
Suzhou, China

- A wall following algorithm and the infrared sensors are used to help the mobile robot find rough direction of the charging pile.
- An adaptive unscented Kalman filter (AUKF) with several ultrasonic measurements are used innovatively to obtain precise relative pose .
- It is simpler and cheaper than the traditional visual guidance and laser guidance.



The structure of the auto-docking system

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

Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Influence of Variable Frequency Starting Parameters on Synchronous Motor Starting

Yonghong Qi, Haipeng Geng, Tingchen Du, Yibin Li, Xiliang Yin and Hao Xu
School of Mechanical Engineering Xi'an Jiao Tong University
Xi'an, Shaanxi Province, China

- The commonly used permanent magnet synchronous motor control methods mainly include vector control, direct torque control and the like. These control methods are based on flux linkage orientation.
- it is difficult to determine the position of the rotor when the motor is started. At present, the method of asynchronous startup is commonly used. When the motor starts, the starting voltage and starting speed directly affect the starting performance.

Permanent magnet synchronous motor

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

Feature Matching Algorithm Design and Verification in Rotates Camera Normal Region Based on ROS System

Mi, Shihua Yuan, Xueyuan Li*, Junjie Zhou, Xufeng Yin
Science and Technology on Vehicular Transmission Laboratory, Beijing Institute of Technology
Tianjin, China

- Design a feature matching algorithm for rotates camera normal region
- Simulating by robot operating system(ROS) and Gazebo
- Analyzed and compared the angles and matching rate as parameters to verify the accuracy and stability of the matching algorithm.

"GROUNDHOG" Unmanned Vehicle

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

Design of Mechanical Arm-motor Control System Based on DSP

Yanjuan Wu, Yanbin Cheng
Tianjin University of Technology
Tianjin, China

- The mechanical arm motor is controlled by a digital signal processor DSP (TMS320F28335), and software simulation platform Code Composer Studio (CCS). The pulse control signal output by the processor controls the motor through the driver output port. This design improves the stability, reliability and immunity of the arm control system.

Grabbing Mechanical Arm

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

Non-linear Observer Design for Ship Based on Covariance fitting for square-root cubature Kalman Filter

LIN XiaoGong LIU ZhiYu
College of Automation, Harbin Engineering University
Harbin, China

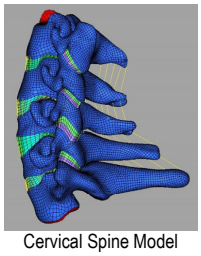
- Marine dynamic positioning technology is widely used in special operations.
- A square-roots Kalman filter non-linear observer in view of covariance fitting is proposed.
- This filter algorithm prove the validity of the covariance fitting for square-root cubature Kalman filter.

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

The Biomechanical Response of Cervical Spine under Different Follower Loads

Cheng-Fei Du, Xin-Yi Cai, Meng-Si Sun and Cheng-Fei Du
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control
School of Mechanical Engineering, Tianjin University of Technology, Tianjin, China

- Cervical spine(C3-C7)
- Three-dimensional nonlinear finite element model
- Biomechanical response
- Range of motion
- Intradiscal pressure
- Different follower load(0N, 50N, 100N, 150N)
- A moment of 1Nm

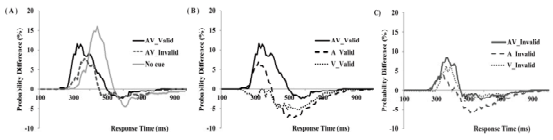


Cervical Spine Model

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

Suppression of Audiovisual Integration by Exogenous Unimodal Spatial Cue

Yanna Ren1, Zhenhua Zhou2, Yue Ding3, Nie Wei4, Weiping Yang5
Department of Psychology, Medical Humanities College, Guizhou University of Traditional Chinese Medicine, Guiyang, China.



Audiovisual integration in different conditions

- The exogenous cue speeds up the response to the following target.
- The exogenous cue decrease the audiovisual integration effect.
- This result suggested that the exogenous bimodal cue elicits a much larger audiovisual integration effect.

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

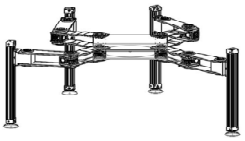
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Structural Design and Kinematics Analysis of a Multi-legged Wall-climbing Robot

Bin Li, Weiqi Lu, Chaowei Kang and Shoujun Wang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin, China
National Demonstration Center for Experimental mechanical and Electrical Engineering Education, Tianjin University of Technology Tianjin, China

- Design a four-legged wall-climbing robot for some special fields.
- The kinematics of the robot is analyzed and the simulation calculation is completed. To determine the feasibility of the leg structure design.



Overall Structure Model of the Robot

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

Biomechanical Comparison of Lateral Interbody Fusion with and without Fixation

Cheng-Fei Du;Meng-Si Sun;Xin-Yi Cai;Chen-Xi Yuchi
Tianjin Key Laboratory of Advanced Electromechanical System Design and Intelligent Control., Tianjin University of TechnologyTianjin, China

- Propose two different surgical methods for lumbar disc degeneration
- Establish three-dimensional finite element models with different surgical methods.
- Compare the biomechanical stability of different methods.
- Obtain the results of comparision

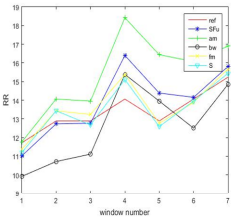
Finite Element Model

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

Respiratory Rate Estimation from the Photoplethysmogram Combining Multiple Respiratory-induced Variations Based on SQI

Haonan Yang, Min Li, Dong He, Xinze Che and Xiaogang Qin
Department of Mechatronic Engineering and Automation., Shanghai University
Shanghai, China

- identified low-quality PPG and extract four features.
- Autoregressive modelling (AR) used to obtain frequency.
- RR is estimated by a data fusior method combine the four respiratory-induced variations.



Test result

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

Design and application of fault prevention system for automobile shock absorber assembly process based on RFID

QIAN Shide1
(1. Beijing Benz automobile co., LTD., Beijing, 100176, E-mail:cau2005cau@163.com)

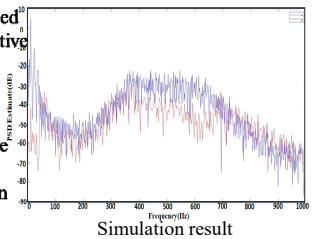
Metal spring and air suspension spring are equipped to two series models with Beijing Benz 205 (C), 213 (E), therefore, four KO angles with similar angles need to be determined necessarily when tightening the installation, KO angle of C-series car metal spring, KO angle of C-series car air suspension, KO angle of E-series car metal spring, KO angle of E-series car air suspension. Since these four KO angles are very similar, C and E metal spring tooling and C and E air spring tooling are easy to be confused. Abmoral noise was found in the rear suspenion when road tests on C-series. Therefore, real-time detection is added to fixture installation and assembly angle aiming at the shortcomings of the original process. The installation distance read by RFID chip after the operator locates the shock absorber position on the chassis assembly fixture, then PLC judges whether the system is going on next step according to FID test results, the assembly accuracy is improved effectively.

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

Vibration control for lathe system against deterministic and band-limited random disturbances

Fanfan Qian, Zhizheng Wu, Maotong Zhang, Tao Wang, Yuanyuan Wang, Tengfei Yue
Department of Precision Mechanical Engineering, Shanghai University
Shanghai, China

- A H_∞ controller with augmented Youla (Q) parameterized adaptive regulation approach.
- Reject both random and deterministic disturbances.
- The simulation results illustrate that the control approach can effectively reject both vibration disturbances.



Simulation result

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

Intelligent Bugs Mapping and Wiping (iBMW): An Affordable Robot-Driven Robot for Farmers

Haoyu Niu, Tiebiao Zhao, and YangQuan Chen
MESA Lab, University of California, Merced, USA

- iBMW is to perform pest population spatial and temporal distribution and "surgical precision spraying" for pest wipeout.
- iBMW's innovation is the cognitive of pest population mapping and wiping
- Measuring success: the pest population temporal and spatial distribution, the amount of pesticide being used, and the almond yield of targeted trees

Unmanned Ground Vehicle (UGV)

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

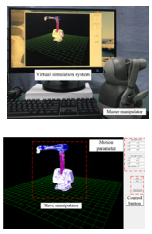
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

Research on a Virtual Simulation System for Master-slave Teaching of a Spraying Robot

Kai Feng, Zhengyu Wang, Bin Zi, Daoming Wang, Sen Qian
School of Mechanical Engineering, Hefei University of Technology,Hefei, Anhui Province, China

- According to the characteristics of spraying robot master-slave teaching, the structure of the system is established.
- Analysis the requirement and function of the virtual system, the framework of the virtual simulation system is established.
- Kinematics analysis and determining master-slave mapping algorithm.
- The position information collected by the master manipulator is smoothed.



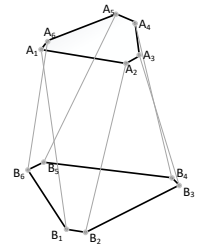
The master-slave system

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

An Improved Method for Forward Kinematics of Parallel Manipulator Based on Hybrid Strategy

Qidan Zhu and Zheng Zhang
Department of Automation., Harbin Engineering University
Harbin, China

- This paper solves the forward kinematics problem of the parallel manipulator with an improved hybrid strategy.
- The improved method requires fewer training sample while maintaining convergence.
- The improved method can be easily transferred to parallel manipulators of other configurations.



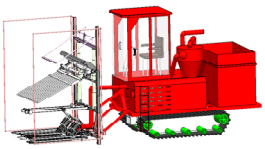
The Stewart Platform

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

Analysis on the research status and structure characteristics of Castor harvester

College of Mechanical Engineering, Inner Mongolia University for the Nationalities , tongliao,Inner Mongolia, China

- Current research status and development trends at home and abroad
- Agricultural and forestry crop harvesting methods and institutional principles
- Optimization and modal analysis of key structure surface analysis method



Castor harvester

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

Prediction of Body Temperature from Smart Pillow by Machine Learning

Songsheng Li
Department of Computer Engineering, Guangdong College of Business and Technology
Zhaoqing 526020, China

- A smart pillow consists of three temperature sensors provide qualified data for regression algorithms to learn body temperature (BT).
- BT extracted from a nonintrusive and unwired smart pillow accurately.
- Data are fed to adapted regression algorithms, such as KNN, DT, RF, and ANN to predict BT.
- Regression algorithms can improve the accuracy of BT prediction.

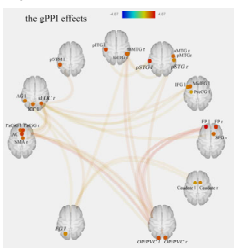
Smart pillow

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

Functional brain network analysis during informative auditory stimulus-modulated audiovisual integration

Siyuan He, Ning Gao, Yang Xi, and Qi Li
School of Computer Science and Technology,
Changchun University of Science and Technology
Changchun, China

- When a task-irrelevant informative auditory concurrent with a visual stimulus, the detection performance of visual stimulus was improved.
- We used the gPPI method for fMRI data to investigate the functional connectivity when informative auditory concurrent with a visual stimulus.
- We constructed a functional brain network model according the gPPI results. We suggested that some regions (such as left AG, right MTG, and bilateral PaCiG) were the key node for information flow transferring among the activated regions.



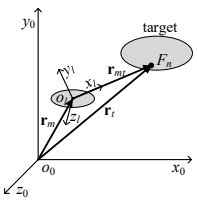
the functional connection network during informative auditory stimulus-modulated audiovisual integration

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

Model for Calculating the Target Characteristics of Synchronous Scanning Circumferential Pulsed Laser Detector

Bingting Zha, Yanliang Gao, Jinbo Huang and Xuchen Youshi
ZNDY of Ministerial Key Lab., Nanjing University of Science and Technology
Nanjing, China

- The circumferential laser detector with directional action device can realize highly effective aimed damage.
- The target velocity model based on multiple detection points is established, which can calculate the target velocity and distinguish the authenticity of the target.
- The optimal controlling model based on multiple detection points is established, the optimal controlling time and the optimal controlling position can be solved.



Laser detection system detecting target point

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

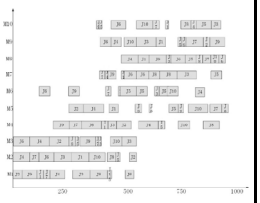
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

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

An Improved Bat Algorithm for Job Shop Scheduling Problem

Xiaohan Chen, Beike Zhang, Dong Gao
College of Information Science and Technology, Beijing University of Chemical Technology
Beijing, China

- In this paper, an Improved Bat Algorithm was proposed to avoid premature convergence and improves the ability to find global optimal solution.
- Compared with Bat Algorithm and Particles Swarm Algorithm, the simulation results show that the Improved Bat Algorithm is efficacious to minimize makespan and find the optimal solution



Gantt Chart of FT10

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

A Fuzzy Approach to Visual Servoing with A Bagging Method for Wheeled Mobile Robot

Meng Xu, Haobin Shi,Kai Jiang, Lihua Wang and Xuesi Li
School of computer science, Northwestern Polytechnical University
Xi'an, China

- A systematic method for determining a series of mixture parameter values using a fuzzy-based method to improve the performance of IBVS controller.
- A bagging method for predicting velocity is proposed for WMR, which decreases the deviation in the prediction by generating additional data using the original data and continuous iteration. .

Wheeled Mobile Robot

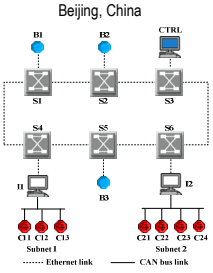
MA1-P(81) 11:00-12:00

Modeling of Hybrid Energy Management Information Network in Vessel Integrated Power System

You Wu, Lijun Fu, Fan Ma and Xueping Gao
National Key Laboratory of Science and Technology on Vessel Integrated Power System, NUE
Wuhan, Hubei, China

Yinan Xu
Naval Research Academy
Beijing, China

- In this paper, an IPS double-layer hybrid energy management network based on Ethernet and CAN bus is studied.
- Based on OPNET Modeler, the simulative models of different network nodes and the whole network are built.
- Simulations of control delay within the network are performed under different working conditions.



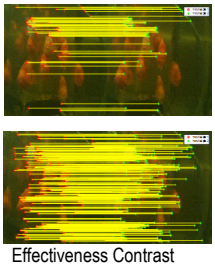
Network Topology

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

An improved SURF algorithm based on gradient and amplitude pre-computation

Yanhui Wei, Pengfei Yang and Lixue Xu and Zhi Zheng
Department of Automation, Harbin Engineering University, Harbin , China

- In this paper, an improved SURF algorithm based on gradient amplitude pre-operation is disclosed, which covers the field of underwater target image recognition.
- The method solves the problem that the number of feature points is small and the feature points are not uniform in the traditional SURF algorithm. It has high-precision feature point extraction.



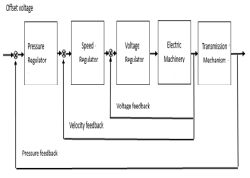
Effectiveness Contrast

MA1-P(83) 11:00-12:00

A Pressure Regulating System for Wheelchair Back Based on PID Algorithms

Tao Wang, Lianyu Zhao
College of Electrical and Electronic Engineering, Tianjin University of Technology
Tianjin, China

- This project is to make a multifunctional wheelchair bed which is easy to use at home, aiming at reducing the labor intensity of nurses and improving the quality of life of the elderly or bedridden patients. The back of wheelchair can lift 0-80 degrees under the action of electric push rod.



Flow chart of control system

MA1-P(84) 11:00-12:00

Learning Pushing Skills Using Object Detection and Deep Reinforcement Learning

Wei Guo, Guantao Dong, Shuaijun Wang, Mantian Li
School of Mechatronics Engineering, Harbin Institute of Technology
Harbin, Heilongjiang Province, China

- Combining object detection with reinforcement Learning by designing special actions of reinforcement learning
- Greatly improving the efficiency of reinforcement learning in learning pushing skill
- Enable the robot to learn the pushing skills in a small number of training steps

Pushing the cup to the target area

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

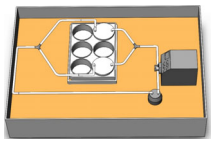
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

MA1-P(85) 11:00-12:00

Perfusion System for Cell-Scaffold Complex Culture in Vitro

Chunqiu Zhang, Pengfei Wu, Xin Wang and Lilan Gao
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, 300384, China

- A new type of in vitro perfusion system for cell tissue engineering has been developed.
- Basing on laboratory universal consumables and six-well plates, Sealing caps were prepared by 3D printing and pouring technology.
- The system has the characteristics of simple operation, flexible , collocation and strong practicability.



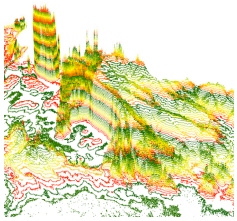
The Perfusion System

MA1-P(86) 11:00-12:00

Topography state analysis using structures

Dembélé Abdramane[1,2], Ye Xiufen[1], Mariko Adama[2], and Ibrahima Daou[3]
[1]Biomimetic micro robot and system Lab., [1]Harbin Engineering University, [1]China, [2]Geodesy and geology Lab, [2]National School of Engineers (Ecole Nationale d'Ingenieurs), [2]Mali, [3]GREF Lab, [3]Institut Polytechnique Rural de Formation et de recherche Appliquée, [3]Mali

- The use of different topographic structures to explore the environment elevation.
- Topography Analysis by: Linear regression , density of contours, Structural dynamic of contour lines, TIN structure.
- Characterization of 3D structures by assigning research domains.



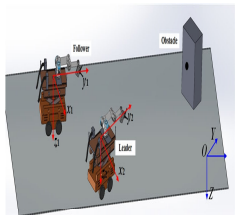
Contour lines structure 3D

MA1-P(87) 11:00-12:00

Mobile Blasting Robot Obstacle Avoidance Planning

Lianyu Zhao, Yanqiang Wang, Jutao Wang
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- This paper proposes a method based on the improved artificial potential field method to solve the problem of obstacle avoidance.
- Blasting robot, artificial potential field, multi-robot, safety distance.
- The problem of unreachable target point and safe distance is solved.
- The obstacle avoidance task of multi-robot formation is realized.



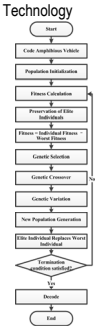
Multi-Robot Sandblasting System

MA1-P(88) 11:00-12:00

Vehicle Layout Optimization based on Adaptive Elite Genetic Algorithm

Sun Mingxiao, Luan Tiantian and Xu Jun
School of Automation, Harbin University of Science and Technology
Harbin, China

- The elite strategy of AE-GA preserves the best individual of each generation and replaces the worst individual in the population after genetic manipulation
- The adaptive selection strategy improves the adaptability of the population.
- Compared with T-GA and SAA, the deck utilization rate of AE-GA is the largest. And the distribution of vehicle number in four types is the most uniform.



Flow Chart of AE-GA

MA1-P(89) 11:00-12:00

Design, Fabrication and Experiments of a 3D-motion Soft Elastomer Actuator

Jian Zhang, Junjie Zhou, Shihua Yuan, Chongbo Jing
School of Mechanical Engineering, Beijing Institute of Technology
Beijing, China

- Introduces the design and manufacture method of a new type of soft fluidic elastomer actuators.
- Describe the design scheme of the soft actuator and the drive principle of omnidirectional bending and elongation.
- The actuators can complete the movement of three degrees of freedom of omnidirectional bending, elongation and contraction.

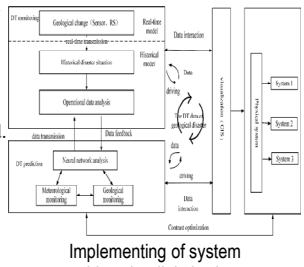
The Soft Elastomer Actuator

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

Monitoring and Warning for Digital Twin-driven Mountain Geological Disaster

Huan Zhang, Ruigang Wang and Chuang Wang
Institute of Internet of Things and IT-based Industrialization, Xi'an University of Posts & Telecommunications, Xi'an, China

- The operational mechanism, key technologies and implementation methods of geological disaster monitoring and early warning based on digital twin driving are proposed.
- The digital twin combine the two spaces of physical space and information space with BP neural network algorithm to dynamic warning the geological disasters.



Implementing of system driven by digital twin

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

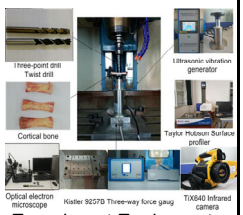
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

MA1-P(91) 11:00-12:00

Ultrasonic vibration assisted drilling in cortical bone experiment: a comparative study of twist drill and three-point drill

Yahui Hu,Zhiqiang Yan,Chunqiu Zhang,Qingchun Zheng,Weihua Fu
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control;
Tianjin University of Technology, Tianjin 300384, China;
Tianjin Medical University General Hospital, Tianjin 300384, China.

- Drilling is one of the most important surgical methods in surgical plastic surgery. However, when the medical twist drill is used, since the bone is mostly curved, the chisel edge of the twist drill is long, so there is a problem that the centering ability is poor.
- Through research, it is found that ultrasonic vibration assisted three-point drilling (UATD) drilling not only improves the problem of poor centering ability during bone drilling, but also compared with the twist drill (UAD), the three-point drilling is drilling in the thrust force, Drilling temperature and surface roughness are greatly reduced compared with medical twist drill drilling, and the diameter accuracy of drilling is greatly improved.
- UATD has greatly improved the surface quality of the hole and provided a reference for expanding medical drilling equipment.



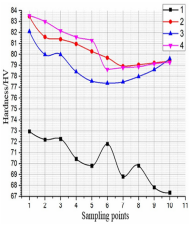
Experiment Equipment

MA1-P(92) 11:00-12:00

Simulation and Analysis on Work hardening of Mechanical repeated ruling process

Chaochao Shi,Guangfeng Shi and Guoquan Shi
Mechanical and Electrical Engineering., Changchun University of Science and Technology
Changchun, China

- The hardening uniformity on the non-blazed surface is low, the fluctuation is large and the hardness is small about the first combination.
- The microhardness distribution of the sampling points of the non-blazed surface obtained by repeated simulation experiment is linear, and the hardening uniformity is good.
- The second combination can obtain a high hardening degree.



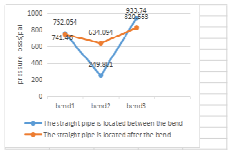
Surface microhardness

MA1-P(93) 11:00-12:00

Analysis of influencing factors of pipeline blockage in domestic garbage pneumatic conveying system

Rui Tian, Hongbo Liu,Yue Li
[1]Tianjin Eco-city environmental protection co., LTD.[2]Tianjin zhonghai project management consulting co., LTD.[3]CNOOC Safety & Technology Services Co., LTD.

- In this article 0.5 m diameter bend model is set up, the garbage density of 300 kg/m^3(charcoal), simulate the flow state of garbage in the pipeline, and analyzes different bend angle (30°, 60°, 90°) and different garbage bend inlet velocity (0 to 35 m/s) effects on garbage movement characteristics.



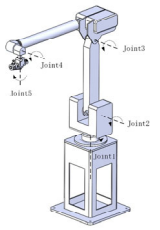
The pressure lost distribution of combined bend with garbage transported

MA1-P(94) 11:00-12:00

Kinematics Modeling and Analysis of a Novel Five-DoF Spraying Robot

Jiarui Wan, Zhengyu Wang, Bin Zi, Daoming Wang, Zixiang Cao
School of Mechanical Engineering, Hefei University of Technology, Hefei, Anhui Province, China

- The forward kinematics and analytic solution of robot inverse kinematics was obtained.
- The forward kinematics and inverse kinematics was verified by Matlab simulation.
- The workspace of spraying robot was analyzed based on the kinematics model.
- These work lays the foundation for the trajectory planning and motion control.



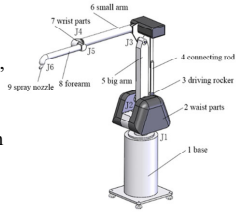
The Spraying Robot

MA1-P(95) 11:00-12:00

Simulation and Analysis of Mechanical Characteristics of a 6-DOF Spray-painting Robot

Daoming Wang, Zitong Huang, Bin Zi, Jiawei Pang, Huajian Zhang, Lei Zheng
School of Mechanical Engineering, Hefei University of Technology, Hefei, Anhui Province, China

- A 6-DOF spray-painting robot is designed. It mainly includes a base, waist parts, a driving rocker, a connecting rod, a big arm, a small arm, wrist parts, a forearm, a spray nozzle and so on.
- The finite element analysis of the main parts under the special position is carried out by Workbench.
- Dynamic analysis of spray-painting robot is carried out by ADAMS



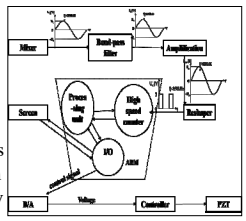
6-DOF Spray-painting Robot

MA1-P(96) 11:00-12:00

Stability Control of Intermediate Frequency for A Double Cavity HCN Laser

Junjie Shen, Bin Sun, Fuyong Hu, Haiqing Liu, Yingxian Jie, and Yuan Yao
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology
Tianjin, China

- This paper introduces the principle of intermediate frequency stabilization and the function of a double cavity HCN laser.
- The system is designed including hardware and software . The system is based on ARM embedded system with the principle of intermediate frequency acquisition.
- PID is the core algorithm of the system.



The composition of the frequency stabilization control system.

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

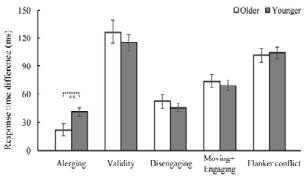
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

MA1-P(97) 11:00-12:00

The effect of aging on attentional networks

Yanna Ren1, Zhihan Xu2, Ying Zhang3, Jing Li4, Jianqiu Wu5, Weiping Yang6
Department of Psychology, Medical Humanities College, Guizhou University of Traditional Chinese Medicine, Guiyang, China.

- The response was significantly slower than younger adults.
- There was significant alerting deficit in older adults.
- no significant difference between older and younger adults for orienting and executive control were found.
- There was a compensatory network existed in older adults.



The calculation for efficiency of attentional networks

MA1-P(98) 11:00-12:00

Portable Wireless Food Safety Rapid Detection Device Based on MCU

Luyang Jin, Xiuling Yan, Jing Wang, Wenbin Zhao, Wei Wei and Jun Liu*
School of Electrical and Electronic Engineering, Advanced Materials and Printed Electronics Center, Tianjin Key Laboratory of Film Electronic & Communication Devices,Tianjin University of Technology,Tianjin, China

- A portable wireless food safety rapid detection device is designed.
- Using USB interface to realize the multiple sensor signals collection.
- Different samples can be detected by using different sensors.

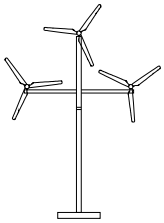
Portable Wireless Food Safety Rapid Detection Device

MA1-P(99) 11:00-12:00

Seismic Response Study of the Tower of a 3 Rotors-Horizontal Axis Wind Turbine

Linping Lu, Yiping Wang, Weimin Ge, Enhong Xing and Teresa Zielińska
School of Chemical Engineering and Technology, Tianjin University
Tianjin, China

- The 3Rs-HAWT (3 Rotors-Horizontal Axis Wind Turbine) which installed three 2kW HAWTs was the research subject.
- The finite element model was constructed, and the verification of the model was carried out by experiments.
- Transient response analysis was applied to study the dynamics of the tower when the El Centro earthquake wave applied.
- The seismic performance of the 3Rs-HAWT is better than that of the single rotor HAWT.



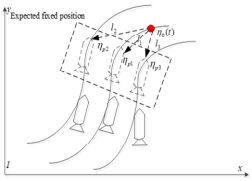
The 3Rs-HAWT

MA1-P(100) 11:00-12:00

Multi-AUV Fixed-point and Positioning Control Based on Virtual Leader

Li Juan1, 2,Ruikun Yuan2, Huixin Wang2, Du Xue2
1.Science and Technology on Underwater Vehicle Technology, Harbin Engineering University
2.College of Automation Harbin Engineering University

- Using the control law to enable the multi-AUV to stabilize to the desired target position and target posture.
- Guidance system and controller design.
- Illustrates the effectiveness of the multi-AUV fixed-point position control law based on virtual pilot.



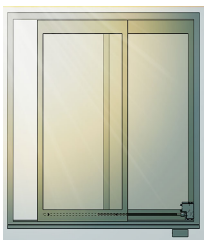
Schematic diagram of formation fixed-point positioning during multiple navigation

MA1-P(101) 11:00-12:00

Design and Implementation of Automatic Window Closer Based on Intelligent Control Algorithm

Keping Zhang, Guangtian Shi, and Zhihao Zhai
School of Mechanical Engineering, Lanzhou Jiaotong University
Lanzhou, China

- The device can achieve high temperature automatic open window, low temperature automatically close the window.
- It can automatically close the window and keeping alarm at the same time if someone from outside close to the window.
- The device can also realize automatic power saving function



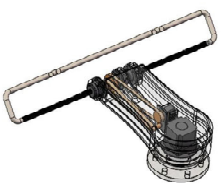
Automatic Window Closer

MA1-P(102) 11:00-12:00

Structural Design and Analysis of 3-DOF Manipulator for Spraying Operation

Xinhua Zhao, Mengchen Ma and Bin Li
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, National Demonstration Center for Experimental mechanical and Electrical Engineering Education, Tianjin University of Technology
Tianjin, China

- A 3-DOF manipulator for the ship spraying operation with flexibility, high speed and high precision.
- The core components suitable for different speeds, accelerations and loads are designed.
- The trajectory planning and simulation by MATLAB Robotics Toolbox.
- Static analysis and modal analysis by ANSYS Workbench.



Spray Actuator

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

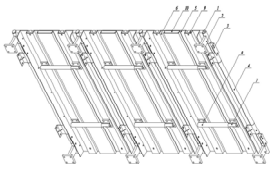
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

MA1-P(103) 11:00-12:00

Design of Wave Pushing Plate of Multi-Directional Wave Maker with Embeddable Wave Height Sensor

Liu[1], Haozhi Mu[1,2*], Renzhe Wei[1], Peng Zhang[1], Qingsong Ning[3], Tao Xue[1,2], Shoujun Wang[1,2*]
[1]National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology), Tianjin 300384, China
[2]Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, Tianjin 300384, China
[3]Department of Information and Intelligent Technology, Tianjin Research Institute of Construction Machinery Co., Ltd., Tianjin 300409, China

- This paper proposed a wave pushing plate of multi-directional wave maker with embeddable wave height sensor to meet the needs of non-reflective multi-directional wave experiment on physical models.



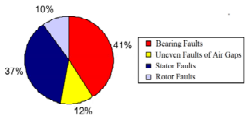
wave maker structure

MA1-P(104) 11:00-12:00

Research on Fault Diagnosis Method of Asynchronous Motor

Gao Ya
Xi'an Technological University ,China

- According to EPRI reports, 53% of motor faults are caused by mechanical faults, such as bearing faults, unbalance, mechanical loosening, dirt and lubrication; 47% by electrical reasons, including 10% by rotor, 41% air gap unbalance caused by casting defects and installation, broken rotor bars; 37% by poor contact of stator windings or short-circuit heating.



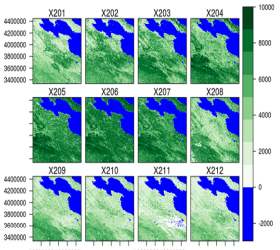
Distribution chart of main faults of asynchronous motorg

MA1-P(105) 11:00-12:00

Phenological Prediction Algorithm Based on Deep Learning

Huixuan Fu, Shuhe Liu, Yunpeng Sun and Yuchao Wang
College of Automation
Harbin Engineering University

- Using a deep learning approach to predict the vegetation density and infer the phenology by observing the vegetation density.
- The accuracy of the algorithm is determined by calculating the loss of the verification set and the corresponding label. Discuss the effects of changes in each hyperparameter on loss.



The Vegetation density

MA1-P(106) 11:00-12:00

Study on the Effect of Relative Disparity and Horizontal Position of Two Lines of 3D Subtitles on Visual Comfort

Yan Wu, Qi Li, and Hua Li
Changchun University of Science and Technology
Changchun, China

1、When the viewing distance was 1m, the relative disparity of two-line 3D subtitles was +42.64 arc min that was more comfortable for the viewers.

2、The horizontal displacement of two lines of 3D subtitles could not impact the visual comfort.

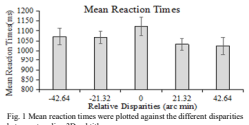


Fig. 1 Mean reaction times were plotted against the different disparities between two-line 3D subtitles

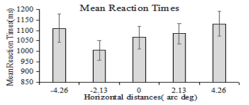


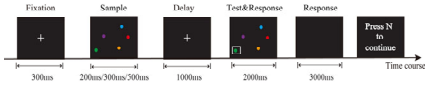
Fig. 2 Mean reaction times were plotted against the different horizontal displacement between the first line and the second line subtitles

MA1-P(107) 11:00-12:00

A basic study on capacity and reaction time of visual working memory for elderly memory training on ICMA 2019

Ting Guo, Yinghua Yu, Yanna Ren, Yiyang Yu, Hasegawa Yuuki, Qiong Wu, Jiajia Yang, Satoshi Takahashi, Yoshimichi Ejima, Jinglong Wu
The Graduate School of Natural Science and Technology, Okayama University, Okayama, Japan

In present research, we selected a modified visual spatial task with visual cue to evaluate the memory capacity and processing speed of our younger and older subject, we also attempt to found the main course of aging effect via this task.



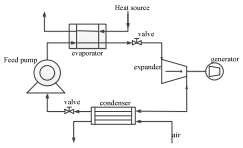
Design of visual spatial task for older subjects.

MA1-P(108) 11:00-12:00

Fuzzy PID Control Applied in Evaporator of Organic Rankine Cycle System

Zhigang Wang, Zhihao Yu, Shuang Guo and Xiuli Li
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China

- The organic Rankine recycling system is one of the effective ways to recover waste heat.
- The outlet temperature of evaporator affects the efficiency of orc system.
- Fuzzy PID control is adopted to control the evaporator outlet temperature.



The principle diagram of the ORC

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

Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

MA1-P(109) 11:00-12:00

Design of Motor Mechanism of 126kV High Voltage Circuit Breaker and Control Strategy of Stroke Subsection

Hongkui Yan, Xin Lin, Jianyuan Xu and Tianyan Tang
Department of College of Electrical Engineering, Shenyang University of Technology, Shenyang, Liaoning Provice, China

- Combining load characteristics of 126kV high voltage circuit breaker, a design scheme of high power density permanent magnet motor is proposed .
- The experimental results show that the requirements of the opening and closing time and speed of 126kV vacuum interrupter can be satisfied. The opening and closing time have good stability.

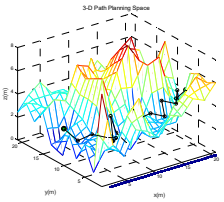
Motor Operating Mechanism of 126 kV Vacuum Circuit Breaker

MA1-P(110) 11:00-12:00

Three-dimensional Local Path Planning of Robot Based on AR-ANT Algorithm and B-spline Curve

Hongjun Wang, Rong Ye
Complex Systems Control Theory Lab., Tianjin University of Technology
Tianjin, China

- A new robot model and heuristic function are established.
- Using temperature to update the ant colony algorithm.
- It can quickly converge to the optimal polyline path and has fewer iterations.
- B spline function is used to fit broken line interpolation.



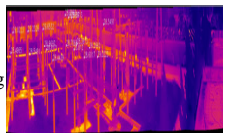
3-D path space

MA1-P(111) 11:00-12:00

Improved ORB Algorithm used in Image Mosaic

Hong Yu1, Yuesheng Dai2
1.*Electrical Research Institute of Yunnan Electric Power Grid Co,Ltd*
2.Graduate workstation Yunnan Electric Power Grid (Group) Co ,Ltd
Kunming China

- Improving the robustness of extracted features by using improved ORB operators.
- Full description of feature points using the FREAK operator.
- Quickly remove mismatches.
- Considering the constraint relationship between images to achieve multiple image stitching.



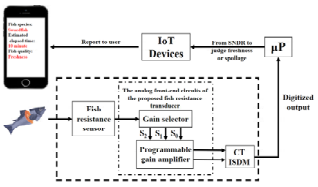
The result image

MA1-P(112) 11:00-12:00

A CMOS Fish Freshness to Continuous-Time Incremental Sigma-Delta Modulator for Monitoring Fish Freshness in Fish Markets

Cheng-Ta Chiang and Lian-Teng Lin
Department of Electrical Engineering, National Chia Yi University
Chia Yi, Taiwan

- The proposed chip is aimed to be applied in detecting fish freshness in fish markets.
- By using ISDM, it can immune the environmental noise in fish markets.



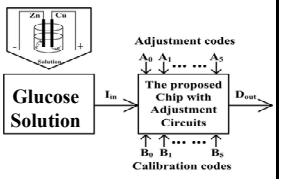
Block diagram of the proposed chip

MA1-P(113) 11:00-12:00

A Wide-Range Sugar Concentration to Duty Cycle Converter with Scaling Circuits for Detecting Sugar Concentration Applications

Cheng-Ta Chiang, Lu-Shen Shie, and Bin-Hong Wang
Department of Electrical Engineering
National Chia Yi University, Chia Yi, Taiwan

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



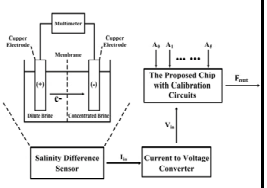
Block diagram of the proposed chip

MA1-P(114) 11:00-12:00

A CMOS Salinity Difference to Frequency Converter with Auto-Sensitivity Selection Circuits for Applications in Aquaculture

Cheng-Ta Chiang, Tsung-Yuan Chen, and Yi-Ting Wu
Department of Electrical Engineering, National Chia Yi University
Chia Yi, Taiwan

- The proposed chip is simple and low-cost, furthermore, it can monitor the salinity difference without using some special metarials as membrane.
- decrease the non-linear effect by the proposed calibration technique.
- Being a salinity difference detector, it can measure the salinity difference easily in real time.



Block diagram of the proposed chip

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

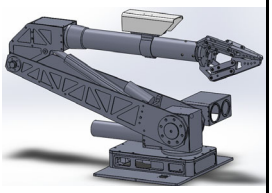
Session Chairs: Jian Guo, Tianjin University of Technology
Qiang Fu, Tianjin University of Technology
GRAND BALLROOM, 11:00-12:00, Monday, 5 August 2019

MA1-P(115) 11:00-12:00

Kinematic Analysis, Simulation and Manipulating of a 5-DOF Robotic Manipulator for Service Robot

Song Kang and Wusheng Chou
Robotics Institute Beihang University Beijing, China

- **A light weighted 5-DOF robotic manipulator with a three-finger end effector was designed and manufactured for service robot.**
- **a series of analysis and simulation of the 5-DOF robotic manipulator are carried out**
- **A force control model of the end effector based on BP neural network algorithm was presented to control the clip force.**



The 5-DOF Robotic Manipulator

MP1-1: Micro and Nano Systems

Session Chairs: Xiaoming Liu, Beijing Institute of Technology
Hongbiao Xiang, Tianjin University of Technology

Conference Room 1, 13:30-15:00, Monday, 5 August 2019

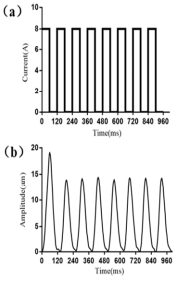
MP1-1(1) 13:30-13:45

Dexterous Vibrationless Micromanipulation by Magnetic-Field Driven Micro-gripper

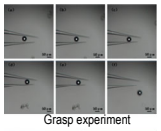
Dan Liu, Xiaoming Liu, Pengyun Li, Xiaoqing Tang, Yuqing Lin, Qiang Huang, Tatsuo Arai
Department of Mechatronic Engineering, Beijing Institute of Technology Beijing, 100081, China

Diagram of micro-gripper

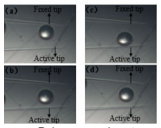
- Use magnetic driven micro-gripper to achieve stable grasp
- Release based on vibration generated by magnetic drive



Input and output signal



Grasp experiment



Release experiment

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

A Novel Auto-Focusing Algorithm for Automated Cell Immobilization

Huipeng Zhang[1], Liying Su*[1], Hongmiao Wei[1], Yueqing Yu[1] , and Xuping Zhang*[2]
1.College of mechanic Engineering and Applied Electronics Technology, Beijing University of Technology
Beijing,China
2.Department of Engineering, Aarhus University
Aarhus,Denmark

- The macro-micro conversation strategy is used to move the micro-injection tools into the microscopic filed of view.
- The active window-based autofocusing algorithm is adopted to immobilize the embryo cell to be injected.
- The technologies and strategies significantly improved the automation level of the cell microinjection.

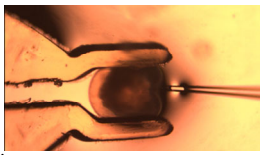
Automated microinjection system

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

A Mechanic Model and Velocity Optimization of Cell Microinjection

Hongmiao Wei[1], Liying Su*[1], Huipeng Zhang[1],Yueqing Yu[1] , and Xuping Zhang*[2]
1.College of mechanic Engineering and Applied Electronics Technology.,Beijing University of Technology
Beijing,China
2.Department of Engineering & Aarhus School of Engineering., Aarhus University
Aarhus,Denmark

- A viscoelastic mechanic model of a compressed cell under puncture is established.
- Explicit dynamics simulation to solve the puncture force by ANSYS.
- Parameter identification by MATLAB.
- Solve the optimization problem with the minimum cell deformation as the objective function.



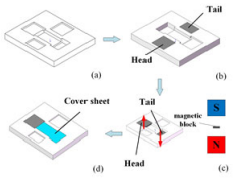
Cell puncture under the compression of microgripper

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

Study on Tetherless Micro-Soft Robot Based on Magnetic Elastic Composite Material

Hongbiao Xiang, Jiancheng Ba, Yan Li, Tilei Zhang, Shoujun Wang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology
Tianjin, China
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education , Tianjin University of Technology
Tianjin, China

- Micro-soft robot based on magnetic elastic composite material.
- Rolling and crawling is controlled by different applied magnetic field.
- The rolling velocity of the robot is linearly related to the frequency .
- The crawling velocity of the robot is positively correlated both with the amplitude and frequency.



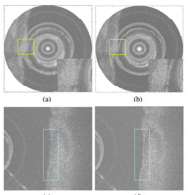
Micro-soft robot fabrication process

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

Dispersion Correction for Optical Coherence Tomography by Parameter Estimation in Fractional Fourier Domain

Di Liu, Yi Xin, Qin Li and Ran Tao
School of Information and Electronic Engineering, Beijing Institute of Technology, Beijing, China

- A new fractional Fourier domain dispersion compensation approach based on Quasi-Newton optimization.
- The method Achieves in a computation reduction with high accuracy guaranteed.
- A signal separation method is proposed to detect depth-dependent dispersion.
- Resolving the obfuscation problems in Intravascular Optical Coherence Tomography.



Blood Vessel Imaging

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

Piezoelectric Single Crystal-based Nano-scale Actuator and Its Amplifying Mechanism

Tianlu Zhang[1], Chao Zhou[1], Zhangming Du[1], Lu Deng[2], Zhiqiang Cao[1] , Shuo Wang[1]and Long Cheng[1]
1.Institute of Automation,Chinese Academy of Sciences
2. School of Statistics and Mathematics, Central University of Finance and Economics
Beijing, China

- Design a set of performance test device to measure the performance of the PZN-5.5%PT single crystal actuator.
- Single crystal show the good linearity and negligible hysteresis.
- Develop a flexible hinge amplifying mechanism to improve the range of the displacement.

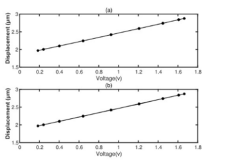


Fig. 6. The diagram of the hysteresis driven by the sine wave with different frequency: (a) 1 Hz (b) 50 Hz.

The negligible hysteresis

MP1-2: Manipulator Control and Manipulation (I)

Session Chairs: Weimin Ge, Tianjin University of Technology
Dongdong Bu, Beijing Institute of Technology
Conference Room 2, 13:30-15:00, Monday, 5 August 2019

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

Leader-Following Consensus of Multiple Electrohydraulic Actuators with Unknown External Disturbances

Xiaochai Li, Fan Guo, and Qing Guo
University of Electronic Science and Technology of China, Aircraft Swarm Intelligent Sensing and Cooperative Control Key Laboratory of Sichuan Province

- Leader-following consensus of multiple electrohydraulic actuators (MEHAs).
- Input-output feedback linearization techniques and pole configuration.
- A distributed controller combined with the disturbance observer is constructed.
- The effectiveness of distributed controller is demonstrated by both simulation and experiment.

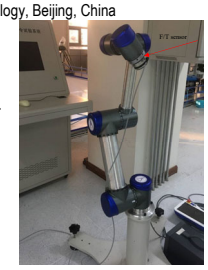
Two-DOF robotic bench

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

End-Effector Force Estimation for Robotic Manipulators from Motor Current Measurements

Xiaoqi Li, Yanbo Wang, Zelin Yang, and Haiping Zhou
Beijing Institute of Precise Mechatronics and Controls,
China Academy of Launch Vehicle Technology, Beijing, China

- Propose an approach to estimate the end-effector contact force of a manipulator utilizing the motor current measurement without additional sensors.
- Utilize the friction torque model of the joints to improve the precise of the wrench estimation.
- Introduce a parameter identification method based on non-linear least squares regression to identify the parameters of motors and the friction torque model.



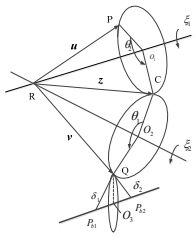
The 6-DOF manipulator IRIC-I developed in our laboratory

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

Kinematics Modeling and Analysis of Manipulator Using the Dual Quaternion

Weimin Ge, Lei Chen, Xiaofeng Wang, Enhong Xing*
Teresa Zielinska
School of mechanical engineering Tianjin University of Technology

- Solving the forward kinematics and inverse kinematics using Dual Quaternion
- Appling a novel sub-problems algorithm based on Dual Quaternion.
- The proposed method has higher computational efficiency than the existing method..

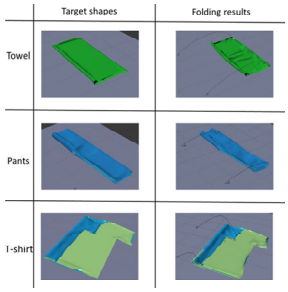


MP1-2(4) 14:15-14:30

A Learning Method of Dual-arm Manipulation for Cloth Folding Using Physics Simulator

Daisuke Tanaka, Sho Tsuda, and Kimitoshi Yamazaki
Shinshu University, Nagano, Japan

- We propose a learning method of cloth folding manipulation for dual-arm robot with physics simulator.
- By three kinds of actual measurement, we determine simulation parameters to reproduce realistic movements of cloth.
- By using Bayesian optimization, we obtain folding manipulation efficiently with a small number of trials.
- We confirmed the effectiveness of our proposed method by experiments using simulation and actual robot.



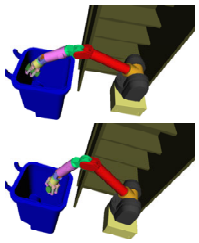
Folding results by acquired manipulation

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

A Motion Planning Algorithm Based on Trajectory Optimization with Workspace Goal Region

Kai Mi, Peng Hao, Jun Zheng, Yunkuan Wang, Jianhua Hu
Institute of Automation Chinese Academy of Sciences
Beijing, China

- Construct a signed distance field to solve the problem of irregular goal region constraints.
- Define a goal-region-constrained likelihood and convert the planning problem to a maximum a posteriori (MAP) problem.
- Adopt an optimized method and the quality of the planning trajectory is effectively improved.



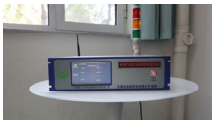
the WAM arm throws objects in different poses

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

Multi-Component Toxic Gas Monitoring System Based on Internet of Things

Junchao Zhu[1,2], Ye Fu[1,2], Yunlong Xing[1,2], Yao Zhang[1,2], Qian Qiao[1,2]
[1]Engineering Research Center of Optoelectronic Devices & Communication Technology, Ministry of Education, Tianjin, China
[2]Tianjin Key Laboratory for Control Theory & Application in Complicated Systems ,Tianjin University of Technology, Tianjin, China

- A multi-component toxic gas monitoring system based on the Internet of things is designed for personal safety.
- A monitoring system designed for restoration of contaminated sites.
- If the environmental parameter exceeds the safety threshold, it will give an alarm in time.



Multi-component toxic gas monitoring node

MP1-3: Biomimetic Measurement and Control in Robotics

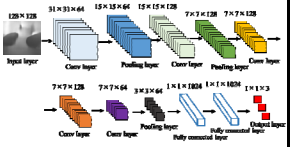
Session Chairs: Keigo Watanabe, Okayama University
Liwei Shi, Beijing Institute of Technology
Conference Room 3, 13:30-15:00, Monday, 5 August 2019

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

Proposal of an Environment Recognition Method for Automatic Parking by an Image-based CNN

Kazuki Yamamoto, Keigo Watanabe and Isaku Nagai
Graduate School of Natural Science and Technology, Okayama University
Okayama, Japan

- The goal of this research is to recognize the surrounding environment for parking control from only images.
- Object detection is used to judge the parking applicability.
- A CNN with the depth image is used to classify the space to turn the wheel.



Structure of a CNN using the Depth image at Input Layer

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

Development of an Anemometer to Assist a Quadrotor with Auxiliary Thrusters

Satoshi Kato, Keigo Watanabe, and Isaku Nagai
Graduate School of Natural Science and Technology, Okayama University
Okayama, Japan

- Anemometer is developed to assist the proposed airframe.
- Anemometer enables feedforward control.
- The vibration caused by the airframe and the effect of the wind on the anemometer were investigated.
- The experimental results showed that the manufactured anemometer needs to be redesigned.

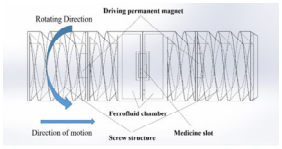
A Quadrotor with Auxiliary Thrusters

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

The Structural Design of a Magnetic Driven Wireless Capsule Robot for Drug Delivery

Shuxiang Guo, Lining Zhang and Qiuxia Yang
The Institute of Advanced Biomedical Engineering System, Beijing Institute of Technology
Beijing, China

- A structure design of multi-capsule robotic group fixed-point drug release based on Ferro fluid is proposed.
- The robots group is composed of a front robot and a rear robot.
- The experimental results show that the capsule robots group can reach the designated location for drug release by rotating magnetic field and external permanent magnet.



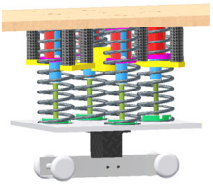
The mechanical structure of the capsule robots group.

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

Development of a Leaping Mechanism for Electric Skateboards

Toshiki Aoki, Isaku Nagai, and Keigo Watanabe
Graduate Sclool of Natural Science and Technology
Okayama, Japan

- Electric skateboards have high portability as one of the personal mobility vehicles.
- The compressed state of the springs is maintained by the permanent magnets and the electromagnet.
- The skateboard leaps when the elastic energy of springs is released.
- The experiments are carried out to evaluate the leap.



The leaping mechanism

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

An adaptive control for pure-feedback systems with non-linearly parameterized uncertainty

Shixin Li, Hailiaing Zhou, Shun Gao, Yong Ran
Tianjin Institute of Metrological Supervision and Testing(TIMST), Tianjin City, China

- Based on immersion and invariance, an adaptive control is designed for non-linearly parameterized pure-feedback systems.
- Command filtered backstepping technology is constructed to address the problem of "explosion of complexity" and the "circular construction problem". Adaptive update laws via immersion and invariance method are constructed.
- The input-to-state stability and small-gain theorem are adopted to discuss the closed-loop system's stability.

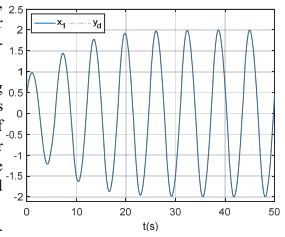


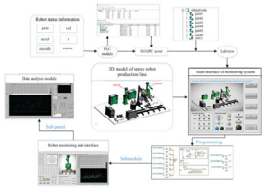
Fig.1 output and reference signal

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

Real-time Dynamic Monitoring of a Multi-robot Cooperative Spraying System

Jingfeng Pan, Bin Zi, Zhengyu Wang, Sen Qian, Daoming Wang
School of Mechanical Engineering, Hefei University of Technology, Hefei, Anhui Province, China

- The architecture of spraying monitoring system.
- The visual monitoring interface of the spraying production line based on Labview.
- The communication between PLC and Labview based on OPC.
- The dynamic monitoring of spraying trajectory in real time.



The monitoring system

MP1-4: Neuro, Fuzzy, and Intelligent Control (I)

Session Chairs: Aryuanto Soetedjo, National Institute of Technology (ITN) Malang Indonesia
Maosu Zhao, Beijing Institute of Technology

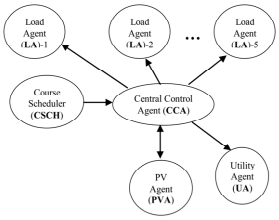
Conference Room 4, 13:30-15:00, Monday, 5 August 2019

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

Intelligent Multi Agent System for Energy Management in the Classrooms with Grid Connected PV

Aryuanto Soetedjo, Yusuf Ismail Nakhoda and Choirul Saleh
Department of Electrical Engineering,National Institute of Technology (ITN) Malang
Jalan Raya Karanglo KM 2 Malang, Indonesia

- Manage energy in the classroom using Multi Agent System (MAS)
- Optimize energy cost and user comfort
- Fuzzy logic controller adjusts the temperature set-point of Air conditioner according to the available power from PV



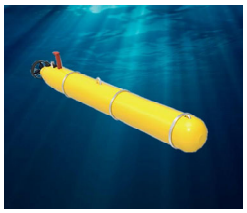
MAS Configuration

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

A Fuzzy Based Parallel Filtering Matching Algorithm for Gravity Aided Navigation

Maosu Zhao, Lingjuan Miao, Haijun Shao, and Tian Dai
School of Automation, Beijing Institute of Technology
Beijing, China

- The accuracy of EKF-matching algorithm is sensitive to the accumulation error of INS and the distribution of gravity anomaly.
- Design a bank of parallel filters by using multiple model adaptive estimation(MMAE).
- Assign the optimum weights to fitting points in stochastic process by using fuzzy theory.



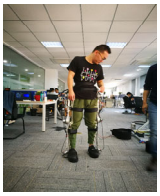
AUV with GAINS

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

Research on Fuzzy Adaptive Impedance Control of Lower Extremity Exoskeleton

Zhicheng Qu, Wei Wei, Wei Wang, Shijia Zha, Tianyi Li,Chunfeng Yue and Jihua Gu
Department of Detection Technology and Automation Device., Soochow University
Suzhou, China

By using Lagrangian method, the inverse dynamics model of one-leg swing is established and the control effect of impedance parameters is studied. And then, a adaptive impedance control algorithm, including fuzzy logic control theory and the structure of fuzzy controller, is proposed.



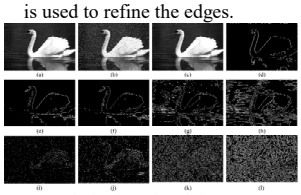
exoskeleton system

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

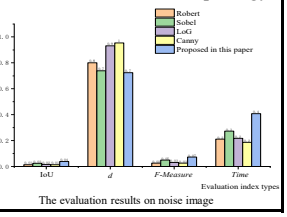
Edge Detection Algorithm based on Morphology and Grey Relation Analysis

Zhen ZHENG ， Bingting ZHA，Hailu YUAN ang Youshi XUCHEN
ZNDY of Ministerial Key Laboratory, Nanjing University of Science and Technology Nanjing, China

- Grey relation analysis is used to denoise pre-processing of images.
- Ostu is used to adaptively generate the binarized image.
- Computing model based on mathematical morphology is designed to detect edges.
- The edge refinement algorithm based on mathematical morphology is used to refine the edges.



Edge detection results on the image



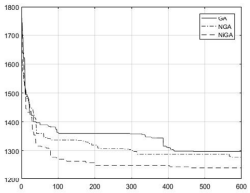
The evaluation results on noise image

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

Algorithm Based on Improved Algorithm for Job Shop Scheduling Problem

Xiaohan Chen, Beike Zhang, Dong Gao
College of Information Science and Technology, Beijing University of Chemical Technology
Beijing, China

- Niche Adaptive Genetic Algorithm was proposed to solve job shop scheduling problem.
- Niche technology was used to enhance to the optimization ability of algorithm.
- Adaptive mechanism was used to accelerate the convergence speed of the algorithm.
- Comparing proposed algorithm with niche genetic algorithm and genetic algorithm.



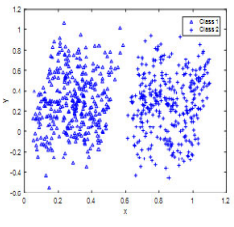
Evolution Process for FT10

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

Support Vectors Classification Method Based on Matrix Exponent Boundary Fisher Projection

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

- Support vectors classification method based on matrix exponent boundary fisher projection is proposed.
- The algorithm for linear separable problems and non-linear separable problems are proposed.
- The proposed method can void singularity problems.
- Experiments on two artificial data sets and UCI standard databases have verified the efficacy of the proposed.



Exponent Boundary Fisher Projection data distribution

MP1-5: Vision System and Robotic Vision (I)

Session Chairs: Yubin Liu, Harbin Institute of Technology
Yu Song, Tianjin University of Technology

Conference Room 5, 13:30-15:00, Monday, 5 August 2019

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

Optimal design of monocular stereo vision system

Yuanhao Cheng, Sun'an Wang and Dehong Yu
School of Mechanical Engineering,Xi'an Jiaotong University
Shaanxi, China

- The completely consistent camera parameters and measurement posture.
- Accurate baseline length (0.01 mm).
- Large measurable range (114°).
- High measuringaccuracy (16.8 mm of 5 m).

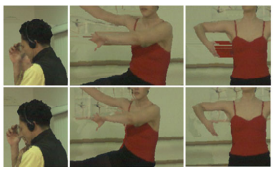
Monocular Stereo Vision System

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

New Real-time View Synthesis Method Using Spatiotemporal Background Information

Jian Li, Yubin Liu, Ge Li, and Jie Zhao
State Key Laboratory of Robot Technology and Systems, Harbin Institute of Technology
Harbin, Heilongjiang Province, China

- An improved DIBR technique is proposed, which includes auto-selection of hole-filling methods and a depth erode process.
- A structure called background table is proposed to extract and store background information.
- The proposed method can synthesize virtual views with high quality in a real-time speed.



Comparison of inpainting results of background table method and non-background table method

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

A Method of Performing Loop Closing Using Mask R-CNN Model in SLAM System

Xiangyang Chen, Zhangli Zhou, Wei Liang, and Meiling Wang
Department of Automation, University of Science and Technology of China
Hefei, China

- In the traditional method, only the geometric features of the image are analyzed, and there is no semantic information, so the anti-interference ability of the system is insufficient.
- We propose a method of loop closing using the Mask R-CNN model, and proves the feasibility and accuracy of the algorithm.

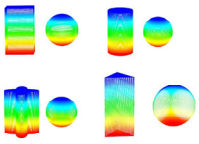
The Turtlebot2 robot

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

A Novel Recognition Algorithm in 3D Point Clouds based on Local Spherical Harmonics

Cao Hui, Riwei WANG, Xianbin WEN, Jindong ZHAO, Wei Chen, Xuping Zhang
School of Computer Science and Engineering, Tianjin University of Technology
Tianjin, China

- A novel recognition algorithm of a 3D object in point clouds.
- A method to solve the problem of incomplete point cloud recognition.
- Include one picture/graph of your work with >300 dpi resolution.
- It has achieved 95.1% on the Princeton Shape Benchmark and 92.9% on the UWA Data-set.



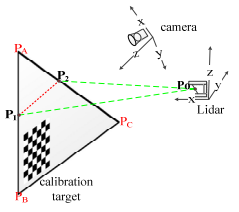
Peg and Hole

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

Extrinsic Calibration of a Monocular Camera and a Single Line Scanning Lidar

Quan Ye[1,2], Leizheng Shu[2,3], and Wei Zhang[2]
1 University of Chinese Academy of Sciences, Beijing 100049, China
2 Key Laboratory of Space Utilization, Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, Beijing 100094, China
3 shuleizheng@csu.ac.cn, +86 10 8217 8219

- A calibration method for monocular cameras and 2D Lidar external parameters.
- The point and line features are automatically extracted.
- The point line constraint and the proposed European transformation invariance constraint.
- The error characteristics of camera-lidar external parameters are analyzed.

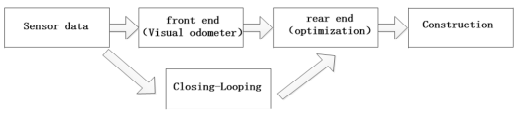


Triangle calibration target

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

Research on V-SLAM Methods

Haoxin Zhang, Biao Liu, Chuangyun Shen, Haibo Zhou, Shucheng Liu
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.
Tianjin University of Technology Tianjin, China



Visual SLAM framework

- Classic V-SLAM
  - A.Filter V-SLAM
  - B.Key Frame BA V-SLAM
  - C.Direct Tracking V-SLAM
  - D.Spatial Occupancy SLAM
- Directions for the development
  - A.Multi-sensor fusion SLAM
  - B. Semantic V-SLAM
  - C.Deep Learning V-SLAM

MP1-6: Control Theory and Application (I)

Session Chairs: Aiguo Ming, University of Electro-Communications
Wei Zhou, Beijing Institute of Technology

Conference Room 6, 13:30-15:00, Monday, 5 August 2019

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

UVMS Controller Design Based on Double Close-loop Integral Sliding Mode

Yanhui Wei, Zhi Zheng, Shanshan Luo, Pengfei Yang
College of Automation., Harbin Engineering University
Harbin, China

- A improved sliding mode controller is designed to resolve the trajectory tracking problem of the UVMS.
- Double close-loop integral sliding mode controller is designed to handle the trajectory tracking problem and overcome the total uncertainty .
- The controller uses a hyperbolic tangent function instead of a symbol function to reduce the sliding mode chattering.

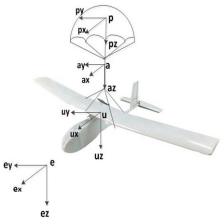
Underwater Vehicle and Manipulator Systems

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

Modeling of Small UAV Parachute Recovery System Based on Lagrangian Method

Han Wu[1], Zhengping Wang[1], Zhou Zhou[1], Jieyu Jia[1] and Rui Wang[2]
1.School of Aeronautics; 2. UAV Research Institute, Northwestern Polytechnical University,
Xi'an City, Shannxi Province, China

- The small UAV parachute recovery system is considered as a multibody system consisting of a parachute and a small UAV.
- Based on Lagrangian equation, a six-degree-of-freedom dynamics model of the small UAV parachute recovery system is established .
- The model established in this paper can provide some references for the formulation of recycling strategy.



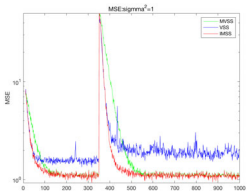
Small UAV parachute recovery system

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

Simulation Study on Noise Control Algorithm in Logging While Drilling

Zeyang Zhang and Lin Fa
Xi 'an University of Posts and Telecommunications
Xi 'an, China

- Improve the traditional LMS algorithm for special environments.
- Applying adaptive filtering technology to drilling noise control for the first time.
- Through software simulation calculation and analysis, it is proved that the improved algorithm has good noise removal effect in the harsh drilling environment.



Simulation results

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

Simulation and Research on Position Servo Control System of Opposite Vertex Hydraulic Cylinder based on Fuzzy Neural Network

Jinjin Guo[1,2], Can Ye[1,2]
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control[1]
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education[2]

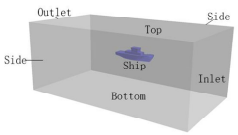
•Design the fuzzy neural network controller
• Establish the Control Model of hydraulic system and carry on the simulation.

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

Identification of hydrodynamic derivative and motion modeling of underactuated ship based on CFD

Shouzheng Yuan, Zhilin Liu and Linhe Zheng
College of Automation, Harbin Engineering University
Harbin, Heilongjiang Province, China

- Aiming at the problem of inaccurate motion modeling for non-standard ship types.
- A three-degree-of freedom motion model of an under-actuated ship was established based on the motion of the ship in still water.
- CFD is used to simulate various sports conditions of the ship.



Numerical calculation domain

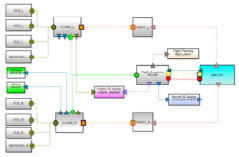
MP1-6(6) 14:45-15:00

Integrated Aircraft and Propulsion System Simulation for Control and Performance Optimization

Min Wang and Weiqun Gu and Lijun Wei
AECC Commercial Aircraft Engine Co.
Shanghai, China

Lionel Belmon
Global Crown Technology
Beijing, China

- Present a co-simulation platform that enables integration of flight dynamics, aircraft engine, engine control, flight planning and GIS.
- Validate the simulation infrastructure and architecture on actual flight route from Beijing to Shanghai.
- The simulation platform will be used for control and performance optimization of integrated aircraft and propulsion system.



Architecture of the Simulation Platform

MP1-7: Rotor Dynamics, Vibration Analysis and Vibration Control

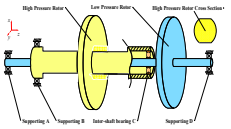
Session Chairs: Jun Liu, Tianjin University of Technology
Yu Song, Tianjin University of Technology
Conference Room 7, 13:30-15:00, Monday, 5 August 2019

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

Study on Vibration Characteristics of an Asymmetric Dual-rotor System

Jun Liu, Zhu Han, Chang Wang, Weimin Ge
1. Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, Tianjin, 300384, China.
2. National Demonstration Centre for Experimental Mechanical and Electrical Engineering Education, Tianjin University of technology, Tianjin, China.

- An asymmetric dual-rotor coupling dynamic model is proposed .
- The natural frequencies, coupled natural frequencies and vibration responses of the high pressure rotor and the low pressure rotor are analyzed.
- The asymmetry of system will produce multiple unstable regions.
- The system produces harmonic and super-harmonic resonance.



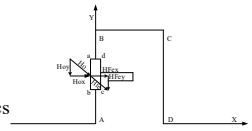
Asymmetric dual-rotor system model

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

The Character Analysis and Testing on Vibration Noise of Permanent Magnet Synchronous Motor in Marine Electric Propulsion System

Lanyong Zhang 1, Lei Zhang 1, Wugui Wang 2 and Sheng Liu 1
1.College of Automation, Harbin Engineering University, Harbin, China
2.China Ship Development and Design Center, Wuhan, China

- The noise source of PMSM-radial electromagnetic force (REF)
- The effect of REF and different slot/pole combination for PMSM on the noise frequency
- Obtained the spectrum characteristics of PMSM under normal operation conditions and calibrated the characteristic frequency range



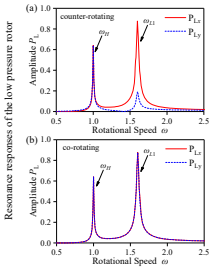
Boundary condition model of the PMSM slots

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

Research of the Dual-rotor System with Spring Characteristics

Jun Liu, Chang Wang, and Teresa Zielińska
Tianjin Key Laboratory of the Design and Intelligent Control of the Advanced Mechanical System, National Demonstration Centre for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, China

- Spring characteristics of rotor are introduced into the research of the dual-rotor system for the first time.
- The coupling critical speed of the low pressure rotor is obtained by systematic mathematical deduction.
- The counter rotation leads to the difference between vibrations of the low pressure rotor in *x* and *y* directions.

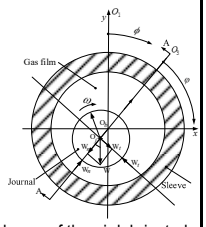


MP1-7(4) 14:15-14:30

Investigation on the Nonlinear Dynamic Characteristics of the Air Lubricated Bearing Concerning Frequency of Perturbation Effect

Baisong Yang, Sheng Feng, Jiale Tian and Lie Yu
State Key Laboratory for Strength and Vibration of Mechanical Structures
Xi'an Jiaotong University, Xi'an, Shaanxi, China

- With the increase of the Sommerfeld number, the stiffness/damping item becomes smaller.
- The results reveal that with the increase of Sommerfeld number, K_{x20}^{ij} (i,j=x,y) and K_{y20}^{xy} are decreasing, while K_{y20}^{xx} is always negative and increases with the acceleration of Sommerfeld number. The K_{x20}^{yy} item increases from negative to positive as the Sommerfeld number increases.



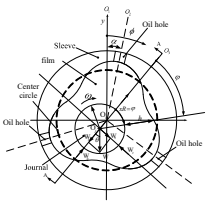
Scheme of the air lubricated dynamic bearing

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

Investigation on the Stability Performance of Wave Journal Bearing Rotor System with Geometry Parameters

Baisong Yang, Sheng Feng, Jiale Tian and Lie Yu
State Key Laboratory for Strength and Vibration of Mechanical Structures
Xi'an Jiaotong University, Xi'an, Shaanxi, China

- It is beneficial to improve the relative instability frequency ω_{st}/ω_k of the rotor by increasing relative deflection $\Delta\mu$ and bearing load W.
- The increase of natural frequency ω_k is conducive to the improvement of instability frequency ω_{st} in the case of small value of the relative dimensionless bearing load coefficient S_{0k} and large value of the relative deflection $\Delta\mu$.



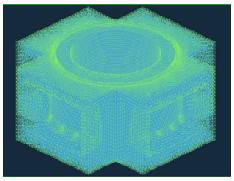
Scheme of the wave bearing

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

Study on Low-Pressure Casting Technique and Mold Design of the Aluminum Wheel

Wang, Kaijie Lu, Qingchun Zheng, WenPeng Ma, Pai Peng, Cong Chen, Jiehe Li, Peixin Li and Dawei Zheng
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China

- The lightweight design of low- pressure casting die is completed and the casting quality is improved.
- The main causes of defects are found and the optimal solution is obtained by multi-objective optimization.
- Microscopically, the microstructure was uniform without shrinkage cavity and porosity.



Grid Generation of Mold

MP2-1: Sensor Networks, Distributed Sensor Systems

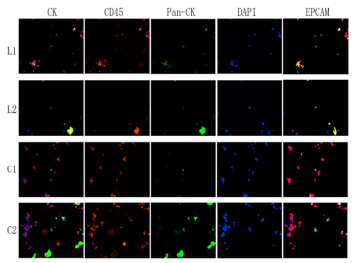
Session Chairs: Keigo Watanabe, Okayama University
Shoujun Wang, Tianjin University of Technology
Conference Room 1, 15:15-16:45, Monday, 5 August 2019

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

Study on Circulating Tumor Cell Separation Sensing System Based on Size Selection

Zhe Wang, Yuanhua Yu*, Qimeng Chen, Ru Zheng, Xiangkai Meng, Luyang Duanmu, Zhen Zhang, Jian Li
Changchun University of Science and Technology
Changchun, China

- Using the CTCs sensor proposed in this paper, high purity CTCs can be detected in blood within 30 minutes in vitro. Under more optimized operating conditions, 100 white blood cells were captured with 3.5mL whole blood, which was 20 times lower than that obtained with the basic size-based CTCs isolation device. In clinical validation, the standardized CTCs count changed from 10 to 60, with detection rates of 55% and 42% in 3.5 ml blood from patients with lung cancer and cervical cancer, respectively.
- The results show that the CTCs detection sensor designed in this study has the characteristics of fast, unmarked and high purity capture, which provides a theoretical basis for clinical improvement of high purity and high capture efficiency of CTCs.

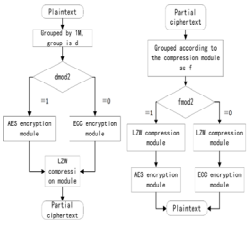


MP2-1(2) 15:30-15:45

Hybrid Encryption Algorithm Based on Wireless Sensor Networks

Tong-xu YUE, Chuang WANG, Zhi-xiang ZHU
Institute of Internet of Things and IT-based Industrialization, Xi'an University of Posts & Telecommunications, Xi'an, China

- A hybrid encryption algorithm based on wireless sensor networks is proposed.
- Firstly, by grouping plaintext messages, AES and ECC are used to encrypt plaintext blocks, and then the data compression technology is used to get the cipher blocks. Finally, the encrypted MAC address and AES key are connected to form a complete ciphertext.



Core cryptographic & decryption module

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

A novel deformation estimation method based on Robust Student's t Kalman filter

Yonggang Zhang, Geng Xu, Guangle Jia, and Yongxu He
Department of Automation, Harbin Engineering University, China

- Solve the carrier deformation estimation with non-Gaussian distributed process and measurement noises
- Robust Student's t Kalman filter based deformation estimation method.
- Variational Bayesian method to obtain the approximate joint posterior PDF within the assumption of Student's t distributed one-step predicted PDF and likelihood PDF

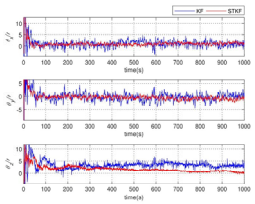


Fig.1 The deformation angles estimation error

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

Wave Height Measuring Device Based on Gyroscope and Accelerometer

Lu Liu1, Shoujun Wang2, Songgui Chen, and Ruijia Jin
Tianjin Key Laboratory for Advanced Mechanical SystemDesign and Intelligent Control
Tianjin Research Institute for Water TransportEngineering,M.O.T.

- Kalman filtered signal for centralization and trend item removal.
- Carrier coordinate system to geographic coordinate system conversion.
- The acceleration signal undergoes a second integral after Fourier transform to the frequency domain.
- Wave direction determination using X, Y axis displacement and electronic compass correction.

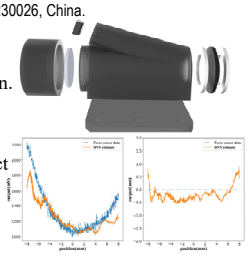
Mti

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

An Optical Tactile Sensor with Structural Color Using Deep Learning Method

Jiawen Hao, Yin Zhu and Erbao Dong*
CAS Key Laboratory of Mechanical Behavior and Design of Materials, Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, Hefei, Anhui Province, 230026, China.

- Tactile sensor based on structured light principle. Extraction of tactile information from image information.
- Deep learning method is used to process abstract image features.
- Sensor accuracy is related to contact position and contact force.
- Within an appropriate range, the sensor error can be less than 1 mm.



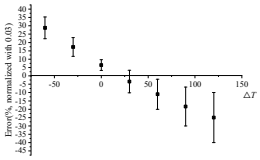
The Optical Tactile Sensor and the Output Performance

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

Improvement and Analysis of Piezoresistive Effect Model of Suspended Graphene Pressure Sensor

Xin, Yong Zhang, Ying Liu, Xianzhe Cheng, Jing Qiu and Guanjun Liu
College of Intelligence Science and Technology, National University of Defense Technology
Changsha, China

- The change of the temperature and the gas volume in the cavity results in an increase of error of traditional piezoresistive effect model.
- The error generally increases as the absolute value of the temperature change increases or as the cavity volume decreases.



Percentage errors of the graphene Resistance change rate of traditional piezoresistive effect model

MP2-2: Manipulator Control and Manipulation (II)

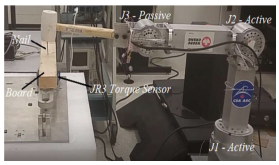
Session Chairs: Guangjun Liu, Ryerson University
Jian Guo, Tianjin University of Technology
Conference Room 2, 15:15-16:45, Monday, 5 August 2019

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

A Multiple Working Mode Approach to Hammering with a Modular Reconfigurable Robot

Vladyslav Romanyuk, Sina Soleymanpour and Guangjun Liu, Senior Member, IEEE
Department of Aerospace Engineering, Ryerson University
Toronto, Ontario, Canada

- Multiple working mode approach is applied to switch the selected joint to passive mode.
- Impulse models are used to predict joint impulses.
- Savings on space, weight, costs, and complexity for a limited range of nail/board environments.



Experimental Setup for Investigating a Multiple Working Mode Approach to Robotic Hammering with a Modular Reconfigurable Robot

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

Autonomous Two-stage Object Retrieval Using Supervised and Reinforcement Learning

Thibault Rouillard, Ian Howard and Lei Cui
School of Civil and Mechanical Engineering, Curtin University
Bentley, Perth, WA , 6151, Australia

- Occluded object retrieval via manipulation is a challenging task for a robot.
- The approach developed uses two stages, search and retrieve, to find an object buried under a pile.
- Stage 1 uses RL and supervised learning leading to a 70% success rate during validation.
- Stage 2 uses RL only leading to a 80% success rate during validation

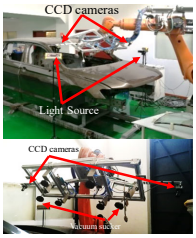
Hardware used during validation.

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

A Distant Optical-Center Binocular Servo System Based on TDNN with Online Fine-tuning

Jiang Xuesong, Jiang Yudi, and Yin Yuehong
State Key Laboratory of Mechanism System and Vibration,
Institute of Robotics, Shanghai Jiao Tong University, Shanghai, China

- This paper proposes and investigates a distant optical-center binocular uncalibrated visual servoing system.
- The method has the property of high accuracy at low cost.
- The experimental results have verified the efficacy of the method in assembling large parts, for example, an automobile front windshield.



The System Hardware

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

A Case Study on Automated Manipulation for Hooking Wiring of Flexible Flat Cables

Kazuki Sano[1*], Siguma Iijima[2*], Kimitoshi Yamazaki[1*]
[1*]Shinsu University,[2*]SEIKO-EPSON Corp., Japan

- We focus on a hooking manipulation which is one step of wiring work. Through implementing the hooking, we have extracted know-how on FFC manipulation.
- We propose a procedure and hooking methods suitable for wiring of FFC by a dual-arm robot.
- We propose a novel design of end-effectors suitable for the hooking, and also propose the manipulation method of FFC using them.

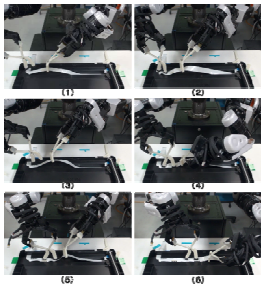


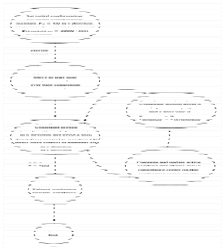
Fig. hooking wiring by a dual-arm robot

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

A Strategy for Large Workpiece Assembly Based on Hybrid Impedance Control

Gang He, Shicai Shi, Da Wang and Hong Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, China

- Propose a novel strategy for large workpiece assembly.
- Both compliant motion and direct force control are achieved in task space during insertion.
- The active compliance center is computed on-line and updated dynamically.
- Capable of generating satisfactory compliant motion control with a stable contact state.



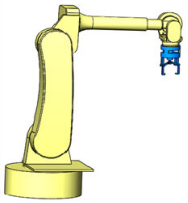
The block diagram of the proposed assembly strategy

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

Structural Design and Kinematics Analysis of a Heavy Load Manipulator

Weimin Ge, Shuangshuang Zhang, Xiaofeng Wang, Enhong Xing,Teresa Zielinska
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control
Tianjin University of Technology, Tianjin, China

- The robot can grasp the weight and move it to meet the job requirements.
- The three-dimensional model and the kinematic equations of the proposed manipulator are established.
- The working space and the modal analysis of the manipulator are performed.



Heavy Load Manipulator

MP2-3: Human-System Interaction and Interface (I)

Session Chairs: Jun Kinugawa, Tohoku University
Kazuhiro Kosuge, Tohoku University

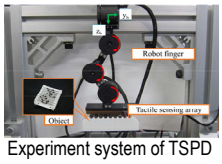
Conference Room 3, 15:15-16:45, Monday, 5 August 2019

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

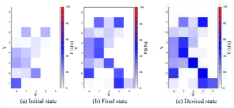
Tactile Servo Based on Pressure Distribution

Chen-Ting Wen, Jun Kinugawa, Shogo Arai, and Kazuhiro Kosuge
System Robotics Lab., Tohoku University
Japan

- Our objective is to provide a new idea of processing tactile image from tactile sensation to refine tactile servo.
- Whole pressure distribution was used for tactile servo instead of conventional tactile features, and it is called tactile servo based on pressure distribution (TSPD).
- Controlling the robot with the tactile sensing array to match the practical pressure distribution to the desired pressure distribution is the principle.
- Feasibility of TSPD was illustrated and presented.



Experiment system of TSPD

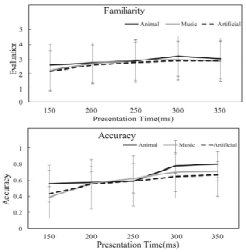

Results of pressure distribution

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

The Identification and Evaluation for Animal and Other Sounds: The Effect of Presentation Time

Qingqing Li, Qiong Wu*, Jiajia Yang, Yiyang Yu, Fengxia Wu, Wu Wang
Satoshi Takahashi, Yoshimichi Ejima, Jinglong Wu
Cognitive Neuroscience Laboratory, Okayama University, Okayama,Japan

- The aim of present study is to explore the impact of the length of presentation time on the recognition of different category sounds.
- We collected the identification and Evaluation data which come from different categories (animal, music, artificial) by controlling five time periods (150, 200, 250, 300, 350ms).
- For all the category sounds, as the presentation time increases, the accuracy of recognition increases.



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

Influence of different feature selection methods on EMG pattern recognition

Anyuan Zhang, Qi Li *, Ning Gao, Liang Wang and Yan Wu
School of Computer Science and Technology
Changchun University of Science and Technology
Changchun, 130022, China

- Feature extraction is an important method in electromyography (EMG) pattern recognition.
- We compared different feature selection method in EMG pattern recognition.
- PSO is a proper feature selection for EMG pattern recognition

Feature selection method

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

Visual Perception Design and Evaluation of Electric Working Robots

Weimian Zhou, Jing Zhu, Yutao Chen, Jie Yang and Erbao Dong*, Member, IEEE
CAS Key Laboratory of Mechanical Behavior and Design of Materials, University of Science and Technology of China

- This article integrates virtual reality into robot teleoperation.
- In the scene of the live working robot with distribution network, the introduction of stereo vision greatly enhances the sense of presence in the virtual scene.
- A questionnaire based on the robot teleoperation scene is obtained.

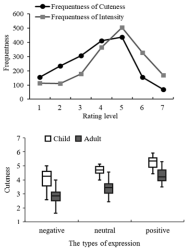

Visual Perception System

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

A basic study on relationship between facial expression and cuteness for human-robot emotional communication

Lichang Yao, Qi Dai, Ting Guo, Jiajia Yang, Satoshi Takahashi, Yoshimichi Ejima, Jinglong Wu, Qiong Wu*
Cognitive Neuroscience Laboratory, Okayama University, Okayama,Japan

- The purpose of this experiment was to discuss the relationship between types or intensity of expression and cuteness in two ages (adult vs children).
- Positive facial expressions are cuter than negative and neutral. Regardless of adults or children, the higher the intensity of negative expressions, the lower the cuteness.
- We believe this research will help provide new ideas for computer algorithms for identifying human facial expressions.

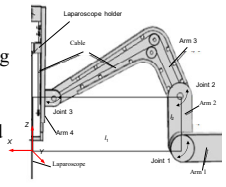


MP2-3(6) 16:30-16:45

Configuration of Laparoscope Holding Manipulator

Xiaofei Wang, Yao Li, Jiliang Shao, Xu Zhu and Jinsong Gao
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering; National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)
Tianjin, China

- The distal mechanism is developed from existing double parallelogram structure with high stiffness by using cable structure and it can realize the RCM movement.
- The qucik-changing box is designed for holding laoparoscope and for clamping instruments. It can realize clamping action and other multi-DoF motions.



The distal mechanism

MP2-4: Neuro, Fuzzy, and Intelligent Control (II)

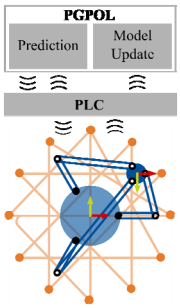
Session Chairs: Toshio Fukuda, Beijing Institute of Technology
Nagata Fusaomi, Sanyo-Onoda City University
Conference Room 4, 15:15-16:45, Monday, 5 August 2019

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

Online Learning of the Inverse Dynamics with Parallel Drifting Gaussian Processes

Tim-Lukas Habich, Daniel Kaczor, Svenja Tappe and Tobias Ortmaier
Institute of Mechatronic Systems, Gottfried Wilhelm Leibniz University Hanover, Germany

- Implementation of an approach for feedforward control of a parallel kinematic industrial robot
- Done by using two parallel threads: prediction is decoupled from training
- Highly dynamic pick-and-place experiment for investigation of possible changes in system dynamics
- Comparison with identified rigid body model including friction and with offline trained model
- Significant reduction of tracking errors

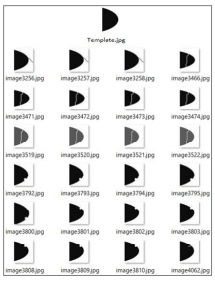


MP2-4(2) 15:30-15:45

Fusion Method of Convolutional Neural Network and Support Vector Machine for High Accuracy Anomaly Detection

Fusaomi Nagata[1)], Kenta Tokuno[1)], Kento Nakashima[1)], Akimasa Otsuka[1)], Takeshi Ikeda[1)], Hiroyuki Ochi[1)], Keigo Watanabe[2)] and M.K. Habib[3)]
[1)]Sanyo-Onoda City University, [2)]Okayama University, [3)]American University in Cairo

- CNN&SVM design tool is proposed.
- Two types of one-class learning based SVMs are designed and evaluated for binary classification.
- Another type of SVM obtained by two-class learning is designed and evaluated for binary classification.
- Template matching technique is successfully used together with the SVM using AlexNet to narrow the important featured areas in training and test images



Resin molded articles with a defect

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

Position Adjustment Control of A Nursing-care Robot Holding A Patient in Its Arms

Yang Li, Shijie Guo, and Toshiharu Mukai
Department of Mechanical Engineering., Hebei University of Technology
Tianjin, China

- The demand for robotics to tackle the problems of the ageing society is increasing.
- Proposes a novel control strategy for motion control for the safety of a dual-arm transfer robot which can lift and move a care receiver.
- The manipulation was divided into posture adjustment of the subject in holding and arm-position adjustment when the arms leave the subject for an instance to avoid friction.

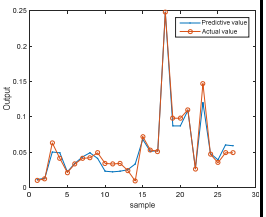
Two cooperative Manipulators robot

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

PCA-CIPSO-GRNN-based Cyclic Cooling Water Corrosion Prediction

Chao Dong, Zeyao Feng, Jingxian Li
Tianjin Key Laboratory of Control Theory & Application in Complicated System, Tianjin, China
Tianjin Branch of China Petroleum & Chemical Corporation, Tianjin, China

- This paper analyzes the three-year measurement data of a petrochemical company.
- Principal component analysis (PCA) is used to reduce the dimension of GRNN input sample parameter information
- Using chaotic immune particle swarm optimization (CIPSO) algorithm to optimize the smoothing factor in GRNN



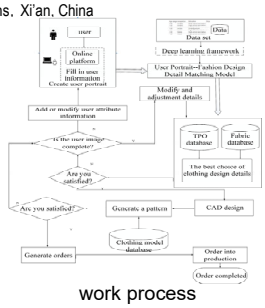
PSO-GRNN Simulation

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

User-depth customized men's shirt design framework based on BI-LSTM

Manyu Tian, Chuang Wang, Zhixiang ZHU
Institute of Internet of Things and IT-based Industrialization, Xi'an University of Posts & Telecommunications, Xi'an, China

- A BI-LSTM-based clothing personalized design framework is proposed.By processing and analyzing the existing data and training the data through the deep learning framework, a user attribute-fashion design detail matching model is obtained. By inputting relevant personal information, the model will recommend appropriate clothing design details to the user.



work process

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

Application of deep learning in interturn short circuit fault diagnosis of PMSM

Jieqiu Bao[1] ,Sen Wang[1] ,Siyang Li[2] ,Di Tang[1]
1.Department of College of Automation,Shenyang Institute of Engineering
Shenyang China
2.China Electric Power Equipment and Technology Co.,LTD
Beijing China

- Analysis of interturn short circuit characteristics of PMSM.
- Establishment of deep learning neural network model Include. Generative antagonistic network, Sparse self-coding network and optimization.
- Experimental analysis.Network parameter optimization,Validity analysis of sample expansion.

Results of different diagnostic methods compared

Sample	Characteristic	Method	Accuracy
10000	Negative order+torque	PCA+ SVM	69.8%
10000	Negative order+torque	EDM+ SVM	81.6%
10000	Negative order+torque	BP	89.7%
10000	Negative order+torque	DSAE	97.1%
10000	Optmize Negative order+torque	DSAE	98.8%
10000	Optmize Negative order+torque	GAN+ SAN	99.4%

MP2-5: Vision System and Robotic Vision (II)

Session Chairs: Kai Cao, Xi'an Technological University
Weimin Ge, Tianjin University of Technology

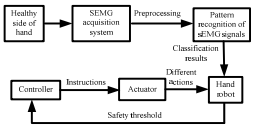
Conference Room 5, 15:15-16:45, Monday, 5 August 2019

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

Study on Motion Recognition for a Hand Rehabilitation Robot Based on sEMG Signals

Shuxiang Guo[1,2], Zhi Wang[1], Jian Guo[1]
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 hand robot rehabilitation training system based on surface electromyography signals.
- In this study, the wavelet neural network was used as a classifier to achieve the purpose of recognizing six hand movements.
- This system we designed can effectively help stroke patients with self-rehabilitation training.



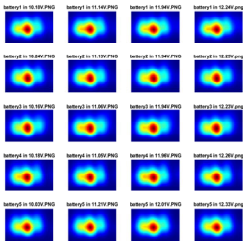
Block diagram of self-rehabilitation training control system.

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

Lithium-ion Battery Face Imaging with Contactless Walabot and Machine Learning

Yanan Wang[1], Yangquan Chen[2], Xiaozhong Liao[1], and Lei Dong[1]
1 School of Automation, Beijing Institute of Technology, Beijing, China
2 School of Engineering, University of California, Merced, CA, United States

- Construct "battery face" images for voltage classification of lithium-ion batteries (LIBs) in different voltages.
- By using a radio-frequency based sensor called Walabot, LIBs images related to different voltage values were sampled in a contactless way.
- A convolutional neural network (CNN) is trained and validated by the "battery face" images to classify different voltage values of LIBs.



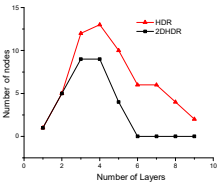
"Battery Face" Images by Walabot

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

Hierarchical Discriminant Regression Tree algorithm based on BDPCA and its application in object recognition

Weimin Ge, Kaikai Yuan, Xiaofeng Wang and Gang Wu
Tianjin Key Laboratory of the Design and Intelligent Control of the Advanced Mechanical System., Tianjin University of Technology Tianjin, China

- Aiming at the problem of the slow speed of the clustering and regression for high-dimensional data, the process of the hierarchical discriminant regression tree (HDR) is firstly analyzed, we propose a new construction and retrieval algorithm, called 2-dimension HDR (2DHDR), which can reduce the depth of the tree and accelerate the processing speed of samples.



Number of nodes per layer

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

Real-time Motion Detection with High-speed Vision and Local Parallel Processing

Luxin Yang, Wenbo Dong
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences Beijing, China

- To achieve highly real-time motion detection
- FPGA processing
- Using local parallel processing method to speed up
- Realized real-time detection of 1146fps at a resolution of 560 × 480
- Detection latency: 6.59us@90Mhz

High-speed Vision Detection System Based on FPGA

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

Optimization of Time Domain Moving Target Detection Algorithm Based on Improved FT

Hui Wang, Chaoda Liu, Lijun Yu, Yizhuo Liu
College of Automation, Harbin Engineering University, Harbin 150001, China

- The proposed algorithm is that a time domain moving target detection optimization algorithm based on improved FT algorithm.
- The FT algorithm is improved from the metric distance method and the feature map fusion method, so that the significant target detection effect is optimized.
- Compared with the GMM algorithm, the algorithm can effectively optimize the speed of moving target detection while guaranteeing detection accuracy.

Original video frame image a

GMM

SR + GMM

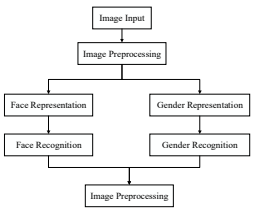
Improved FT+GMM

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

Face and Gender Recognition System Based on Convolutional Neural Networks

Yuxiang Zhou, Hongjun Ni, Fuji Ren, Xin Kang
Nantong University / Tokushima University
Nantong, China / Tokushima,Japan

- Propose the Face and Gender Recognition System that uses CNN.
- Use the Global Average Pool (GAP) instead of the fully connected layer.
- Train Resnet50 in LFW, YTF and VGGFace2 datasets to do face recognition.
- Train Resnet50 in Adience dataset to do gender recognition.



Face and Gender Recognition System

MP2-6: Control Theory and Application (II)

Session Chairs: Fudong Ge, China University of Geosciences
Cheng Yang, Beijing Institute of Technology

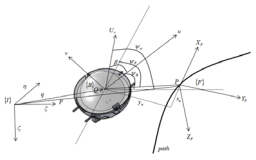
Conference Room 6, 15:15-16:45, Monday, 5 August 2019

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

Study on Horizontal Path Tracking Control Method for the Spherical Amphibious Robot

Shuxiang Guo[1, 2], Xujie Yang[1], Jian Guo[1],
[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 Faculty of Engineering Kagawa University, Hayashi-cho, Takamatsu, Japan

- This paper proposed a horizontal path tracking control method for the spherical amphibious robot.
- A path tracking controller for spherical amphibious robot based on backstepping sliding mode method was designed.
- The simulation results verified the effectiveness of the path tracking control method for the spherical amphibious robot.



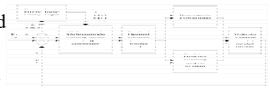
Sketch of Horizontal Path Tracking for the Robot

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

Longitudinal Dynamic Control under Complex Driving Conditions via Fuzzy Logic Sliding-mode Control

Ruiqi Zhang, Yuzhuang Zhao, Sizhong Chen, Zhicheng Wu, Lin Yang
School of Mechanical Engineering
Beijing Institute of Technology
Beijing, China

- A longitudinal dynamic model of a three-axis vehicle was established.
- The power transmission system and braking system were modeled.
- A fuzzy logic sliding-mode control strategy was designed.
- The simulation results show that the proposed control strategy has high accuracy and strong robustness.



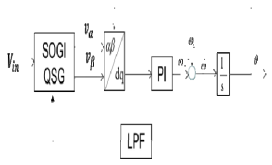
Structure of longitudinal control system

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

Research and Analysis of SOGI-QSG Integral Saturation in the Application of Grid Synchronization

Guangjun Zhu, Qiping Yuan and Xiaoping Yang
School of Electrical and Electronic Engineering.,Tianjin University of Technology
Tianjin ,China

- Power grid synchronization is the key link of distributed power grid connection.
- Power grid synchronization unit based on SOGI has been widely used
- Adding Damping Link to Feedback Link
- Stability under Voltage Abrupt Change



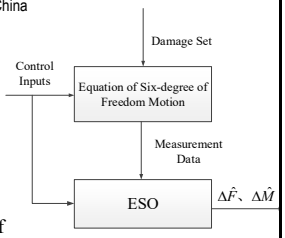
The structure of system

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

Parameters Estimation of Damage Water for Undersurface Submarine Based on Extended State Observer

Haiying Nie, Changbo Liu, Kun Hu, Haifeng Huang , and Bingli Tian
Department of Operation and Command, PLA Naval Submarine Academy
Qingdao, China

- Motion mode of underwater damaged and flooded submarine.
- Estimation of Damage water based on ESO.
- Simulation under four conditions.
- Conclusion: ESO is able to accurately estimate the force and moment caused by damage water of submarine.



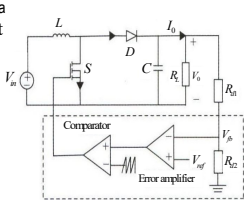
The Estimation Structure

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

Application of Active Disturbance Rejection Technology in Boost Converter

Kang Li, Yunliang Wang, Xuesong Zhou and Youjie Ma
Key Research Laboratory for Control Theory & Applications in Complicated Systems
Tianjin University of Technology
Tianjin, China

- Taking the control strategy of Boost converter as the study object, the active disturbance rejection control is applied to the control strategy of Boost converter.
- The basic principle of parameter tuning for active disturbance rejection control is introduced, and the simulation of active disturbance rejection control of Boost converter is carried out and compared with PID control.



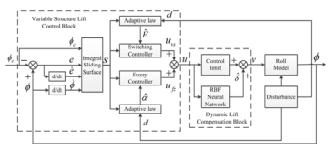
DC/DC converter voltage type control schematic

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

An Adaptive Control Method for Fin Stabilizer Using Saturated Nonlinear Lift

Sun Mingxiao, Luan Tiantian and Xu Jun
School of Automation, Harbin University of Science and Technology
Harbin, China

- A variable structure lift controller with lift compensation is designed.
- In order to prevent dynamic stall and ensure safety, fin angle limit and lift limit are designed, which results in the limitation of lift input control in some cases.



Lift Compensation Controller for Fin Stabilizer

MP2-7: Biomimetic Systems

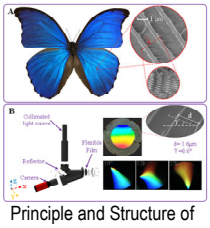
Session Chairs: Enzeng Dong, Tianjin University of Technology
Xin Wang, Tianjin University of Technology
Conference Room 7, 15:15-16:45, Monday, 5 August 2019

MP2-7(1) 15:15-15:30

Subtle vibration sensing and dimension measurement with a bio-inspired optical tactile sensor

Yin Zhu, Jiawen Hao, Jie Yang and Erbao Dong*, Member, IEEE
CAS Key Laboratory of Mechanical Behavior and Design of Materials, University of Science and Technology of China

- This paper presents a new robotic tactile sensor inspired by the structural color in nature.
- Parallel grooves in micron scale are transferred onto a flexible film, and chromatic diffraction patterns will be observed when illustrated by light.
- By incorporating ML method, the sensor performs well in sensing subtle vibration and small structures.



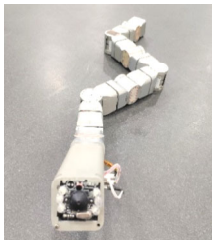
Principle and Structure of the Tactile Sensor

MP2-7(2) 15:30-15:45

Design of a Hierarchical Control System for Tetherless Snake Robot

Fenglei Ni, Yongqiang Li, Yunhu Zhou, Liangliang Zhao, Hong Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, Heilongjiang Province, China

- A hierarchical control architecture for the tetherless snake robot is presented.
- The snake robot has a relatively small size, flexible movement and strong adaptability.
- The head controller communicates with PC via Wifi.
- The multisensory system and hardware architecture provide the snake robot with the ability to sense the state of itself and the environment.



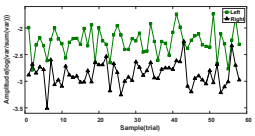
The Tetherless Snake Robot

MP2-7(3) 15:45-16:00

Phase Space Reconstruction Based Multi-Task Classification for Motor Imagery EEG

Enzeng Dong, Kairui Zhou, Shengzhi Du
Complex System Control Theory and Application Key Laboratory School of Electrical and Electronic Engineering, Tianjin University of Technology
Tianjin, China

- Electroencephalogram.
- Motor Imagery (MI)
- Phase Space Reconstruction (PSR)
- Phase Space Common Spatial Pattern (PSCSP)
- Machine Pattern Recognition
- Relevance Vector Machine (RVM)



CSP feature after PSR

MP2-7(4) 16:00-16:15

Stable Control Gait Planning Strategy for A Rehabilitation Exoskeleton Robot

Ziming Guo, Can Wang*, Zefeng Yan, Lufeng Zhang, Xunju Ma and Xinyu Wu
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences
Shenzhen, China

- How to use the canes making the exoskeleton robot to achieve the most stable in different gaits.
- Faster grasp and use of the exoskeleton. Achieve labor-saving purpose.
- Using the law of motion to construct a control layer gait algorithm.
- The COP motion trajectory is obtained by ZMP and to analyze the motion state.

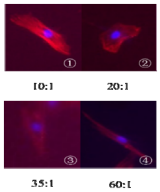
SIAT Exoskeleton Robot

MP2-7(5) 16:15-16:30

Directing Multiphenotypic Differentiation of Rat Bone Marrow Mesenchymal Stem Cells under Mechanical Gradient Field

Xin Wang[1,2]*, Yang Li[1,2], Chunqiu Zhang[1,2]
[1]Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
[2]National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- Isolation, culturenof rat bone marrow mesenchymal stem cells by using the whole bone marrow adherence method
- Making culture basement with different Young's modulus and planting cells
- The nucleus and cytoskeleton were stained and observed.
- With the increase of Young's modulus of basement, it is more difficult for cells to spread.



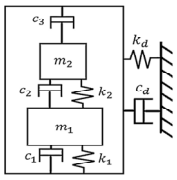
Cell morphology

MP2-7(6) 16:30-16:45

A Novel Optimization Design Method for Multi-Degree of Freedom Vibratory Gyroscope

shuying Hao, yulun Zhu, chenqing Zhang, Jingjing Feng, Wei Chen and Kunpeng Zhang
Tianjin Key Laboratory of Advanced Electromechanical System Design and Intelligent Control., Tianjin University of TechnologyTianjin, China

- Constraints of feature extraction
- Establishment of second-order approximation model of response surface
- Computational optimization of design variables
- Obtain the results of comparative optimization



Fully Coupled 2-DOF-Sense Model Gyroscope

MP3-1: Laser Technology and Laser processing

Session Chairs: Qiang Fu, Tianjin University of Technology
Shuoxin Gu, Kagawa University

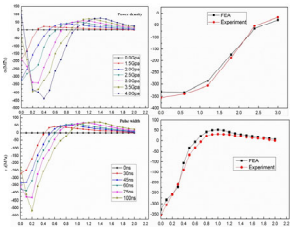
Conference Room 1, 17:00-18:00, Monday, 5 August 2019

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

Simulation and Experimental Research on Residual Stress Field of Cemented Carbide YG8 by Laser Shock Processing

Guanglin Wu, Chong Peng, Shenhua Peng, Wei Guo
School of Mechanical Engineering and Automation, Beihang University
Beijing, China

- A three-dimensional FEA model is established.
- Fitting simulation results and the experimental data to validate the availability of FEA model.
- Influences of LSP parameters including laser power density and pulse width upon residual stress distribution are analysed.



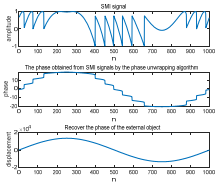
Simulation and Experimental Results

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

Research On Self-Mixing Interference Displacement Reconstruction Method Based On Ensemble Empirical Mode Decomposition

Baofeng Zhang ,Haitong Zhang, Junchao Zhu, Honghong Xu, Yan Zhao
Tianjin Key Laboratory for Control Theory & Applications in Complicated System,
Tianjin University of Technology, Tianjin, China
Engineering Research Center of Optoelectronic Devices & Communication Technology
Ministry of Education,China

- Establishing a laser self-mixing interferometry system.
- Denoising using the Ensemble Empirical Mode Decomposition.
- The displacement of the signal is reconstructed according to the phase unwrapping principle.



Reconstructed displacement

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

Influence of Residual Stress on Fatigue Lives of AISI9310 Gear Processed by Laser Shock Peening

Hedong Wang, Chong Peng, Yuzhe Xiao
Beijing University of Aeronautics and Astronautics
Beijing, China

- The effect of LSP on the fatigue life of gears was studied.
- Influence of residual stress on gears fatigue lives is investigated further both at the crack initiation and propagation stage.
- Bending fatigue test is employed to validate the research results.
- The influence of LSP on the fatigue life of gears is clearly obtained.

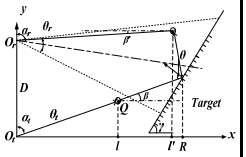
bending fatigue test process

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

Schattering Power of Laser in Aerosol Medium

Hailu Yuan, Bingting Zha*, Zhen Zheng and Youshi Xuchen
ZNDY of Ministerial Key Laboratory, Nanjing University of Science and Technology
Nanjing, China

- There is a schattering power model that fully describes the working process of the laser ranging system.
- The power attenuation during the process of receiving the laser beam through the aerosol medium and being reflected by the target is analyzed.
- The schattering power model of laser ranging system working in aerosol medium is obtained.
- The method adopted in this paper is more accurate in short-range detection.



Aerosol particle scattering model

MP3-2: Manipulator Control and Manipulation (III)

Session Chairs: Gang Chen, Nanjing University of Science and Technology
Aiguo Ming, University of Electro-Communications

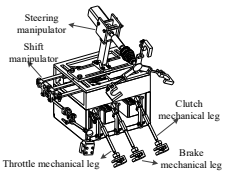
Conference Room 2, 17:00-18:00, Monday, 5 August 2019

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

Control System Design for Electromagnetic Driving Robot Used for Vehicle Test

Gang Chen; Weigong Zhang
School of Mechanical Engineering Nanjing University of Science and Technology, Nanjing, China
School of Instrument Science and Engineering Southeast University, Nanjing, China

- Design structure and control system of electromagnetic driving robot.
- Use the vehicle performance self-learning algorithm and multiple manipulator collaborative control method to complete the vehicle test.
- Experiment results shown that the electromagnetic driving robot can complete vehicle test, which meets the requirements of national standards.



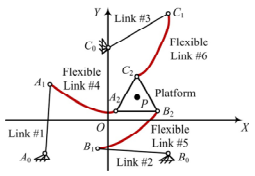
Electromagnetic Driving Robot

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

Inverse Dynamics of a Rigid-flexible Parallel Mechanism

Chenyang Shi[1,2], Liang Liu[1,2,*], Xinhua Zhao[1,2], Jiabin Wang[1], Lei Zhao[1,2], Zhifeng Xie[1], Jianling Li[1]
1. Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control Tianjin University of Technology, Tianjin, China
2. National Demonstration Center for Experimental Mechanical and Electrical Engineering Education,Tianjin University of Technology, Tianjin, China

- Establishing the flexible robotic dynamics by Lagrange's equations based on NCF and ANCF.
- Combining the Newton-Raphson and generalized-α iterative method to achieve the multibody dynamic solutions.
- The approach is verified by the circular motion simulation.



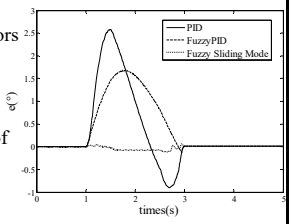
Rigid-flexible Parallel Robot

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

Sliding mode control for manipulator based on fuzzy switching gain adjustment

Jingyi Chen, Longmiao Chen, Quan Zou
School of Mechanical Engineering, Nanjing University of Science and Technology
Nanjing, China

- Establish a transfer manipulator dynamics model with friction factors
- A sliding mode control algorithm based on fuzzy switching gain adjustment is proposed.
- Comparing the rotation accuracy of the manipulator under the PID, fuzzy PID and fuzzy sliding mode control algorithm through the co-simulation of Adams and MATLAB/Simulink.



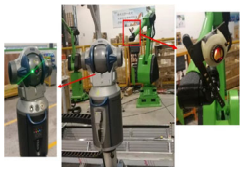
Error tracking curve of robot under no-load condition

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

Kinematics Calibration of Spraying Robot based on Laser Tracker

Yajun Liu1, Bin Zi1, Zhengyu Wang1, Daoming Wang1, Lei Zheng2
1. School of Mechanical Engineering, Hefei University of Technology, Hefei, Anhui Province, China 2. CMA (WUHU) Robotics co.,ltd, Wuhu, Anhui Province, China

- the kinematics model and error model of spraying robot is established.
- laser tracker is used to measure the actual position.
- the compensation values of the D-H parameters are iteratively obtained by the least square method.
- the absolute precision of the robot is improved.



Laser tracker and target ball installation position

MP3-3: Human-System Interaction and Interface (II)

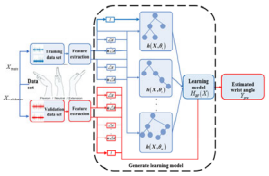
Session Chairs: James K. Mills, University of Toronto
Dongdong Bu, Beijing Institute of Technology
Conference Room 3, 17:00-18:00, Monday, 5 August 2019

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

Continuous Estimation of a sEMG-Based Upper Limb Joint

Dongdong Bu[1], Shuxiang Guo[1,2*], and Wenyang Gao[1]
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, the multiple features and some corresponding time-delayed features are extracted to improve the estimation accuracy for motion estimation.
- In terms of execution time and accuracy of estimation, the multi-features of sEMG are extracted to estimate the continuous joint motion based on Random Forests (RF) algorithms.
- The multiple time-delayed features of sEMG perform good the availability for the motion continuous estimation from the experiment results.



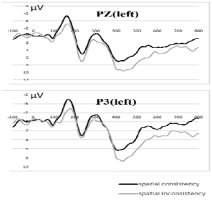
The structural diagram of the RF based on time-domain and time-delay features of sEMG

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

The Effect of Spatial Consistence on Character Recognition of Brain-Computer Interface

Jingjing Yang, Qi Wu, Xiao Dong, Xiujun Li, Qi Li and Jinglong Wu
The School of Computer Science and Technology, Changchun University of Science and Technology, Jilin, China

This study investigated the effect of spatial consistence on character recognition of BCI. Through analysis of experimental results, it was found that spatial inconsistency induced N1 and P2 components were significantly less than consistent stimuli. Inconsistent stimuli induced P300 components were significantly greater than consistent stimulation.



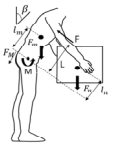
ERP results of consistent and inconsistent stimuli

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

Research on Human Stoop Activity Energy Expenditure Detection Algorithm Based on AHRS Transduce

Wei Wang, Wei Wei, Zhicheng Qu,Lidan Cheng Jihua Gu and Xichuan Lin
Department of Detection Technology and Automation Device
Soochow University
Suzhou, Jiangsu Province, China

- a new system of detection SAEE based on AHRS transducer was presented. With collecting and analyzing data, a method for calculating the motion parameters and a new algorithm of detection SAEE was developed. The experimental results prove that the algorithm can accurately estimate bending energy consumption, and the accuracy can reach 84%.



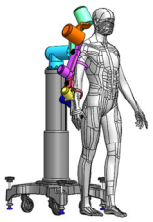
The lifting model

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

Configuration Comparison and Design of an Upper Limb Exoskeleton for Robot Teleoperation

Chang Liu[1], Haiyuan Li[2], and Qinjian Zhang[3]
[1] Beijing Jiaotong University, [2]Beijing University of Posts and Telecommunications, [3] Beijing Information Science & Technology University, Beijing, China

- Analyze anatomical motion structure of the human upper arm, and propose four types of configuration of upper limb exoskeleton for robot teleoperation.
- Study interference between Type I~IV exoskeleton and body, and obtain the optimal configuration.
- At the end, structural analysis and workspace simulation of the overall mechanism are performed.



An Upper Limb Exoskeleton

MP3-4: Neuro, Fuzzy, and Intelligent Control (III)

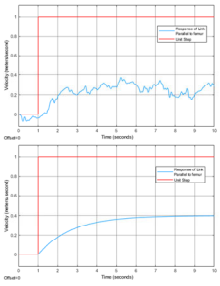
Session Chairs: Muhammad Tallal Saeed, Beihang University
Cheng Yang, Beijing Institute of Technology
Conference Room 4, 17:00-18:00, Monday, 5 August 2019

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

Robust Control of a Mechatronic Exoskeleton for Motion Rehabilitation

Muhammad Tallal Saeed[1+], Shiyin Qin[2+]
+Department of Intelligent Systems and Control Engineering, Beihang University, Beijing, China

- Introduction
- Modified Exoskeleton Model with Human Leg
- Robust Optimization Problem Formulation
- H-Infinity Robust Control Design
- Simulation Results and Comparative Analysis



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

Optimization of MVDCPower System of All Electric Ship Based on Hybrid Energy Storage

Xiuyan Peng, Luo Zhao
College of Automation, Harbin Engineering University
Harbin, China

- A hybrid energy storage system is introduced in the MVDC ship
- The energy storage module is used to stabilize the power fluctuation of the ship network and improve the system stability and power quality.
- The FL controller based ESM system can change the charging and discharging rate based on the SOC of the energy storages

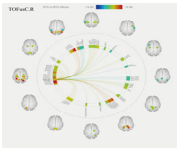
All Electric Ship

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

Graph-based Analysis of Functional Brain Networks for Processing Semantic Auditory and Visual Stimuli

Yang Xi [1,2], Qi Li [1,*], Siyuan He [1], Jinxing Zhang [1], MengChao Zhang [3] and Lin Liu [3,*]
[1] School of Computer Science and Technology, Changchun University of Science and Technology, Changchun, China;
[2] School of Computer Science, Northeast Electric Power University, Jilin, China;
[3] Department of radiology, China-Japan Union Hospital of Jilin University, Changchun, China
*: liqi@cust.edu.cn, liulin5413@126.com

- Increased demand for complex semantic inputs was associated with more efficient communication and less specialized processing.
- Regions in the temporo-parieto-occipital network were found to be highly efficient in the task-state condition.



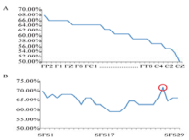
Functional Connectivity

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

A Novel Feature Analysis Method for EEG Signal Classification of Attended and Unattended Audiovisual Integration

Yang Xi [1,2], Anyuan Zhang [1], Qi Li [1,*], Xingjian Yang [1], Mengchao Zhang [3] and Lin Liu [3,*]
[1] School of Computer Science and Technology, Changchun University of Science and Technology, Changchun, China;
[2] School of Information Engineering, Northeast Electric Power University, Jilin, China;
[3] Department of radiology, China-Japan Union Hospital of Jilin University, Changchun, China
*: liqi@cust.edu.cn, liulin5413@126.com

- A SVM classification model was obtained through the feature analysis method we proposed
- classification accuracy was increased to more than 70%, indicating that the evaluation model based on this method was effective.



classification accuracy

MP3-5: Vision System and Robotic Vision (III)

Session Chairs: Enzeng Dong, Tianjin University of Technology
Hui Wang, Harbin Engineering University

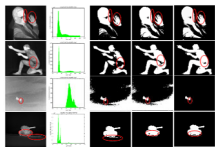
Conference Room 5, 17:00-18:00, Monday, 5 August 2019

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

An improved genetic algorithm based on immune theory in target segmentation of infrared images

Enzeng Dong, Hao Jian, Jigang Tong
Complex system control theory and application key lab., Tianjin University of Technology
Tianjin, China

- An improved genetic algorithm based on immune thought is proposed.
- The adaptive ability of the immune system is used to improve the optimization ability of the genetic algorithm.
- Compared with several segmentation methods, the proposed algorithm has better effect and more advantageous performance indexes.



(a) (b) (c) (d) (e)

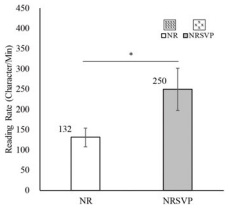
Experimental result (a)image (b) gray histogram(c)NSA (d)IPSO (e)ours

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

A Reading Assistant System of Chinese Text for Persons with Central Visual Field Loss

Yiyang Yu[1], Qiong Wu[2], Yang Feng[1], Meng Wang[1], Yulong Liu[2], Jiajia Yang[2], Satoshi Takahashi[2], Yoshimichi Ejima[2] and Jinglong Wu[2]
1. The Graduate School of Natural Science and Technology, 2. Cognitive Neuroscience Laboratory, Graduate School of Interdisciplinary Science and Engineering in Health Okayama University, 3-1-1Tsushima-naka, Okayama, Japan.

- There was an improvement in measures of oral reading speed (90%) with NRSVP than the natural reading mode.
- These findings illustrate the potential benefits of NRSVP as a reading aid method for the patients who loss central vision.



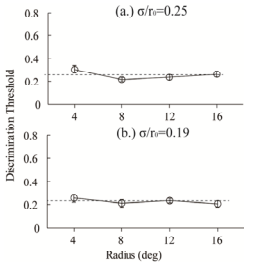
Improvement of Reading Speed

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

Contrast Discrimination of Circular Contour Patterns Across Visual Field for VR

Yang Feng , Qiong Wu, Keisuke Okamoto, Jiajia Yang, Yoshimichi Ejima , Jinglong Wu
The Graduate School of Natural Science and Technology, Okayama University, Japan.

- The contrast discrimination thresholds for the standard stimuli increased with increasing the retinal eccentricity.
- However, those for the cortically magnified stimuli remained constant irrespective of change of retinal eccentricity.
- Contrast discrimination thresholds, once scaling by cortically magnification transformation, were similar at all eccentricities.



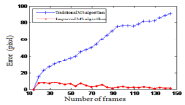
Result for magnified condition

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

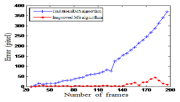
Design of Mean Shift Tracking Algorithm Based on Target Position Prediction

Hui Wang, Xueying Wang, Lijun Yu and Fei Zhong
College of Automation, Harbin Engineering University, Harbin, 150001, China

- This paper proposes an improved Mean Shift tracking algorithm based on target position prediction.
- Through a series of simulation comparisons in a complex environment, the Mean Shift tracking algorithm based on target position prediction is superior to the traditional Mean Shift tracking algorithm.
- The improved algorithm can accurately track the moving targets in the video stream in real time.



Tracking error curve of Experiment 1



Tracking error curve of Experiment 2

MP3-6: Control Theory and Application (III)

Session Chairs: Chunjie Wang, Tianjin University of Technology
Junling Wang, Harbin Engineering University

Conference Room 6, 17:00-18:00, Monday, 5 August 2019

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

Research and Design of Low Voltage and High Current DC Power Supply Based on Hybrid Energy Storage

Chunjie Wang, Yang Xiao, Peng Chen and Jinliang Yin
Tianjin University of Technology
Tianjin, China

- Proposes a low-voltage and high-current DC power supply design based on battery-super capacitor hybrid energy storage used for dc circuit breaker test.
- Set up the mathematical model of the whole phase-shifting bridge.
- Established the mathematical model of the hybrid energy storage system
- Run simulation to the whole system.

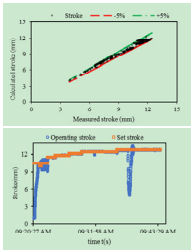
Low Voltage DC Circuit Breaker

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

Stroke estimation for linear compressor with energy method

Mingsheng Tang1, Huiming Zou2, Xuan Li3 and Changqing Tian4
Technical Institute of Physics and Chemistry, CAS
Beijing, China

- The stroke have a strong impact on the capacity of linear compressor as well as the efficiency.
- An energy method for the stroke estimation is proposed.
- The estimated stroke results are verified with the measured stroke, and the errors would be achieved within ±5% under different working condition.
- A segmentation stroke control could decrease the risk of collision between the piston and the cylinder when linear compressor startup with pressure varying dramatically..



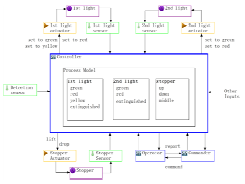
A segmentation stroke control

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

Safety Requirements Analysis for Submarine Torpedo Weapon System Based on STPA

Qin Nan, Ma Liang
Department of Missile and Underwater Weapon., Naval Submarine Academy
Qingdao, Shandong Province, China

- STPA method is used as a new safety analysis approach for submarine torpedo weapon system.
- One typical control action is taken as an example for analysis.
- With XSTAMPP safety engineering platform, the unsafe control actions are analyzed, refined system safety requirements are generated and the descriptions are standardized by linear temporal logic (LTL).



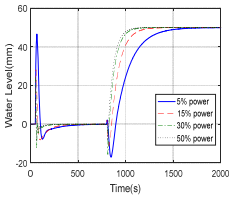
Control structure with process model

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

L_1 Gain Scheduled Adaptive Control to Water Level of Nuclear Steam Generator

Junling Wang, Jie Zhou, Xiuchun Luan and Zhida Yang
Fundamental Science on Nuclear Safety and Simulation Technology Laboratory,Harbin Engineering University, Harbin, China

- A piecewise affine LPV model with uncertainties is developed to describe steam generator.
- Optimal guaranteed cost state feedback controllers are designed to stabilize the nominal system.
- L_1 adaptive controllers are constructed to control the water level.
- Numerical simulations demonstrate that the proposed controllers can achieve good performance.



Water level response

Tuesday
August 6, 2019

Morning Sessions

TA1-1 Medical, Biomedical and Rehabilitation Systems (I)
TA1-2 Mobile Robot System (I)
TA1-3 Signal and Image Processing (I)
TA1-4 Industrial, Manufacturing Process and Automation (I)
TA1-5 Intelligent Mechatronics and Application (I)
TA1-6 Control Theory and Application (IV)
TA1-7 Modeling, Simulation Techniques and Methodology (I)
TA2-1 Medical, Biomedical and Rehabilitation Systems (II)
TA2-2 Mobile Robot System (II)
TA2-3 Signal and Image Processing (II)
TA2-4 Industrial, Manufacturing Process and Automation (II)
TA2-5 Intelligent Mechatronics and Application (II)
TA2-6 Control Theory and Application (V)
TA2-7 Modeling, Simulation Techniques and Methodologies (II)

Tuesday
August 6, 2019

Afternoon Sessions

TP1-1 Medical, Biomedical and Rehabilitation Systems (III)
TP1-2 Mobile Robot System (III)
TP1-3 Signal and Image Processing (III)
TP1-4 Industrial, Manufacturing Process and Automation (III)
TP1-5 Intelligent Mechatronics and Application (III)
TP1-6 Control Theory and Application (VI)
TP1-7 Modeling, Simulation Techniques and Methodologies (III)
TP2-1 Medical, Biomedical and Rehabilitation Systems (IV)
TP2-2 Mobile Robot System (IV)
TP2-3 Signal and Image Processing (IV)
TP2-4 Industrial, Manufacturing Process and Automation (IV)
TP2-5 Intelligent Mechatronics and Application (IV)
TP2-6 Control Theory and Application (VII)
TP2-7 Modeling, Simulation Techniques and Methodologies (IV)

TA1-1: Medical, Biomedical and Rehabilitation Systems (I)

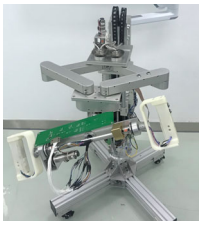
Session Chairs: Chaoyang Shi, Tianjin University
Kazuhiro Kosuge, Tohoku University
Conference Room 1, 9:30-11:00, Tuesday, 6 August 2019

TA1-1(1) 9:30-9:45

A Novel Master Manipulator with Force Feedback for Robot-Assisted Natural Orifice Transluminal Endoscopic Surgery

Chenglong Wang, Jianchang Zhao, Shuxin Wang, Jianmin Li* and Chaoyang Shi*
Key Laboratory of Mechanism Theory and Equipment Design of Ministry of Education
Tianjin University, Tianjin, China

- A new type of master manipulator in a combined parallel and serial configuration.
- Adopting a rotational form to replace the traditional approach using a linear guide rai
- Providing advantages in terms of improved stiffness and accuracy, large workspace, low damping ratio, easy implementation of force feedback.
- Both simulation and experiments have been performed to validate its effectiveness and advantages



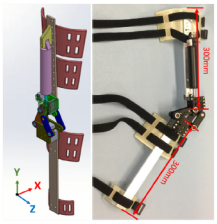
The Master Manipulator

TA1-1(2) 9:45-10:00

Development of a training system to increase knee extension load during walking - Design and evaluation of training device -

Z. Gu, Mazoon S. Al Maamari, D. Zhang, Y. Kawakami, S. Cosentino and A. Takanishi
Waseda University, Tokyo, Japan

- A training device to apply additional mechanical load on the knee during walking.
- Extend the training effect of simple walking to knee extensors.
- Designed for maximum versatility using a compact oil damper with no need for electrical power.
- Uses a four-bar linkage instead of a pure rotational joint.



Knee extensors training device

TA1-1(3) 10:00-10:15

Design and Implementation of the Lower Extremity Robotic Exoskeleton with Magnetorheological Actuators

Jiajun Xu, Linsen Xu, Youfu Li
University of Science and Technology of China, China
Hefei Institutes of Physical Science, CAS, China
City University of Hong Kong, China

- MR actuator works as a clutch for assistance-mode rehabilitation training
- MR actuator works as a brake for resistance-mode rehabilitation training
- MR actuator provides flexible output torque by changing input current

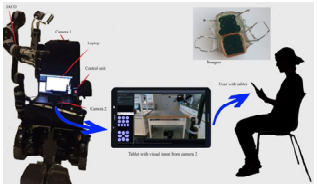
The lower extremity robotic exoskeleton with MR actuators.

TA1-1(4) 10:15-10:30

Remote Tongue Based Control of a Wheelchair Mounted Assistive Robotic Arm – a proof of concept study

Ásgerður Arna Pálsdóttir, Strahinja Dosen,
Mostafa Mohammadi and Lotte N. S. Andreasen Struijk
Center for Sensory Motor Interaction, Department of Health Science and Technology
Aalborg University, Denmark

- Two subjects controlled and navigated a wheelchair mounted assistive robotic manipulator, remotely and wirelessly, using a tongue control interface (Itongue)
- Visual feedback was given through tablet

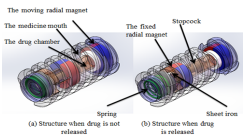


TA1-1(5) 10:30-10:45

Design and Evaluation of A New Push-type Targeted Drug Delivery Capsule Robot

Jian Guo[1], Zihong Bao[1], Shuxiang Guo[1,2], Qiang Fu[1]
1 Tianjin Key Laboratory for Control Theory & Application in Complicated Systems and Biomedical Robot LaboratoryTianjin University of Technology,Tianjin, China
2 Intelligent Mechanical Systems Engineering Department, Kagawa University, Takamatsu, Kagawa, Japan

- This paper proposed the novel push-type robot driven by the external magnetic field.
- The module robot can move autonomously and give medicine at specific area. .
- The developed capsule robot can be used to improve the capsule robotic system and help people do experiments in vivo in the future.



The 3D structural model of drug release robot

TA1-1(6) 10:45-11:00

A Finite Element Analysis of Anterior Cervical Discectomy and Fusion Compared with Percutaneous Full-endoscopic Anterior Cervical Discectomy

Cheng-Fei Du, Chen-Xi Yuchi, Xin-Yi Cai, Meng-Si Sun
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control
School of Mechanical Engineering, Tianjin University of Technology, Tianjin, China
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, China

- The aim of this study was to analyze the biomechanical changes after PECAD and compare them with anterior cervical decompression and fusion (ACDF)

Three-dimensional model of intact, ACDF and PEACD cervical vertebra

TA1-2: Mobile Robot System (I)

Session Chairs: Yili Fu, Harbin Institute of Technology
Zixu Wang, Kagawa University

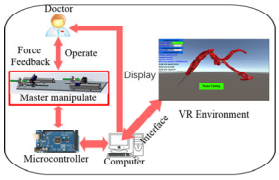
Conference Room 2, 9:30-11:00, Tuesday, 6 August 2019

TA1-2(1) 9:30-9:45

A Novel Vascular Interventional Surgeon Training System with Cooperation between Catheter and Guidewire

Shuxiang Guo[1,2], Qi Zhan[1], Jian Guo[1], Cheng Meng[1] and Lei Qi[1]
1 Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology, China
2 Intelligent Mechanical Systems Engineering Department, Kagawa University, Japan

- This paper proposed a novel vascular interventional manipulator that meets the surgeon's operating habits.
- This paper proposed a novel VR training environment with catheter guidewire operation.
- The experimental results showed that the training system has a good axial tracking performance and can help surgeon improve training effect



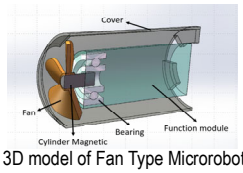
The concept diagram for training system

TA1-2(2) 9:45-10:00

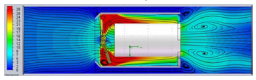
Motion Performance of a Novel Fan Type Magnetic Microrobot in Pipe

Zixu Wang, Shuxiang Guo, Wei Wei
Kagawa University, Takamatsu, Japan

- Design of novel fan type microrobot
- Magnetic operation system
- Movement and working principle
- Simulation of motion performance
- Experiments of motion performance



3D model of Fan Type Microrobot



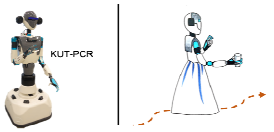
Simulation result of fan blade

TA1-2(3) 10:00-10:15

Modeling and Control of a Personal Care Robot Considering Posture Adjustment

Guang Yang and Shuoyu Wang
School of Systems Engineering
Kochi University of Technology
Kochi, Japan

- In this paper, we propose an upper body posture adjust mechanism referring to planar motion for our personal care robot.
- So that the robot can behave with higher stability and additional personality during navigation tasks.
- Evaluation experiments in real household scenarios prove that the proposed approach works as expected.



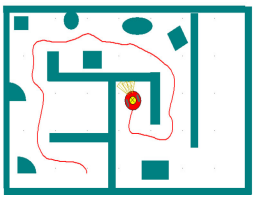
KUT-PCR

TA1-2(4) 10:15-10:30

Study on the Path Planning of the Spherical Mobile Robot based on Fuzzy Control

Jian Guo[1], Chunying Li[1], Shuxiang Guo[1, 2]
[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 Faculty of Engineering, Kagawa University, Kagawa, Japan

- This paper proposed a behavior-based fuzzy control method which integrated fuzzy obstacle avoidance strategy. And multi-sensor could be used to detect obstacles and target position information.
- The robot behavior was controlled by fuzzy controller and priority decision. The experimental results verified the effectiveness of the fuzzy control system.



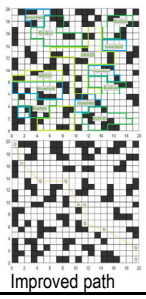
Obstacle Avoidance Results in Complex Environment

TA1-2(5) 10:30-10:45

Path Planning of the Omni-directional Mobile Vehicle in Warehouse Environment

Yazhe Ding, Hongbin Ma, Shan Li
School of automation, Beijing Institute of Technology, China

- The terrain slope and the surface condition are analyzed and escribed in order to set up terrain table and vehicle capacity table.
- The initial pheromone distribution, path point selection strategy, pheromone updating method are optimized.
- the posture change of the vehicle and the path points of the result are reduced.



Improved path

TA1-2(6) 10:45-11:00

Modeling and Control of a Two-wheel Mobile Robot with Auxiliary Arms

Zhensheng Xie, Haitao Zhou, Haibo Feng, Songyuan Zhang, Xu Li, Jiacheng Li and Yili Fu
The State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, China

- Focus on a new form of two-wheel robot with auxiliary arms.
- Propose a control strategy based on center of gravity which can keep the body of robot upright during acceleration and deceleration.
- Relationship between acceleration and center of gravity is investigated.

2WMR with arms

TA1-3: Signal and Image Processing (I)

Session Chairs: Xinyu Zhang, East China Normal University
Jinglong Wu, Okayama University

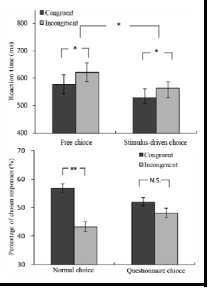
Conference Room 3, 9:30-11:00, Tuesday, 6 August 2019

TA1-3(1) 9:30-9:45

The impacts of subliminal priming effect on normal choice and questionnaire choice

Qi Dai, Lichang Yao, Yiyang Yu, Qiong Wu* ,Jiajia Yang, Satoshi Takahashi, Yoshimichi Ejima, and Jinglong Wu
Cognitive Neuroscience Laboratory., Okayama University
Okayama, Japan

- The aim of this study was to investigate how the subliminal priming effect occurs in the subject's normal choice and questionnaire choice, and how it affects free choice or stimulus-driven choice.
- The results show that the subliminal priming priming effect is significantly different among different types of choices.
- This study suggest that this is of some significance to the interpretation of the mechanism of human free choice.



TA1-3(2) 9:45-10:00

Real-Time Facial Expression Recognition Using Deep Convolutional Neural Network

Yuwen Zeng1, Nan Xiao, Kaidi Wang, Hang Yuan, and Shuxiang Guo
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, School of Life Science, Beijing Institute of Technology, Beijing

- Performance comparison on data sets with different scale and resolution.
- Confusion matrix for experimental evaluation.
- Transfer learning on paradigm for fast convergence and test.

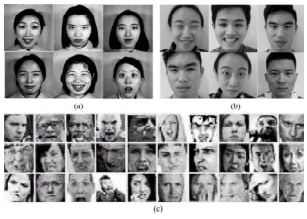


Image samples of the JAFFE (a), self-built data set (b) and FER-2013 (c).

TA1-3(3) 10:00-10:15

Uyghur Text Detection in Natural Scene Images

Xinming Li, Junfang Li, Qiang Gao, and Xiao Yu
Tianjin Key Laboratory for Control Theory & Applications in Complicated Systems, Tianjin University of Technology
Tianjin, China

- Use an effective and accurate Uyghur text detection method based on Sobel edge detection algorithm for Uyghur text detection.
- Binarization, morphology operation and connected components analysis are used to detect Uyghur text regions successively.
- Use text regions merging for location of Uyghur text.

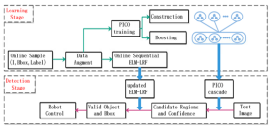
The Result of Detection and Location

TA1-3(4) 10:15-10:30

PICO and OS-ELM-LRF Based Online Learning System for Object Detection

Man Luo, Hongbin Ma, Xin Wang and Xiaofei Zhang
School of Automation, Beijing University of Technology
Beijing, China

- Online learning framework for object detection system.
- First, PICO is used as the object detector to obtain core candidate regions with high confidence.
- Second, OS-ELM-LRF is applied as the object classifier to recognize the specific target.
- The face recognition system is realized to verify the effectiveness of this framework.



Our Proposed Framework

TA1-3(5) 10:30-10:45

Efficient Pose Estimation using Random Forest and Hash Voting

Bin Sun and Xinyu Zhang
Shanghai Key Laboratory of Trustworthy Computing
School of Computer Science & Software Engineering, East China Normal University
Shanghai, CHINA

An efficient pose estimation pipeline using RGBD images

- Random Forest for segmentation
- Point pair feature & hash voting for hypotheses generation
- 2D & 3D error joint optimization
- Robust and precise

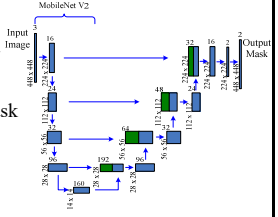
Tests for textureless objects

TA1-3(6) 10:45-11:00

Text detection for natural scene based on MobileNet V2 and U-Net

Kangwei Fu, Ling Sun, Xin Kang, Fuji Ren
Nantong University / Tokushima University
Nantong, China / Tokushima, Japan

- Detect text area from natural scenes.
- Design network architecture inspired by MobileNet V2 and U-Net.
- Input natural scene image, output mask of text area.
- Find mask contour with OpenCV (boundingRect and minAreaRect).
- Light-weight architecture, suitable for mobile device.



network architecture

TA1-4: Industrial, Manufacturing Process and Automation (I)

Session Chairs: HuiGeon Hwang, Changwon National University
Hua Qiu, Kyushu Sangyo University

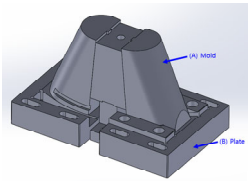
Conference Room 4, 9:30-11:00, Tuesday, 6 August 2019

TA1-4(1) 9:30-9:45

Development of Variable Mold for Transition Nozzle Automation Process using TRIZ and DEFORM

Hui Geon Hwang, Seung Min Bae, Won Jee Chung, Sang Suk Sul, Jung Gwon Kim, I Man Kim and Seong Gi seo
Robotics&System Lab., Changwon National University of South Korea

- In order to improve efficiency and reduce costs, this paper will derive the method of designing one variable mold instead of several molds.
- Using DEFORM, this study will carry out forging analysis of transition nozzles of various schedules for one variable



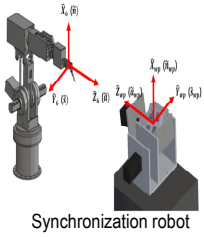
Flexible Forging Methods

TA1-4(2) 9:45-10:00

Cooperative Kinematic Synchronization of a 2-Axis Additional System and a 6-Axis Articulated Robot using Simulink

Seung Min, Won Jee Chung, Hui Geon Hwang, Sung Joo Kim and Yeon Joo Ahn
Robotics and System Lab., Changwon University
Changwon, Korea

- An kinematic analysis of robot and additional system was conducted.
- An robot and additional system are synchronized by a direction vector.
- The synchronization between robot and additional system was verified by using Simulink of MATLAB and RecurDyn.



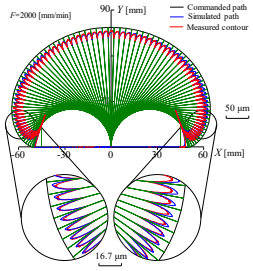
Synchronization robot and additional system

TA1-4(3) 10:00-10:15

Application and Experimental Verification of Practical Estimation Approach to Interpolation Cutter Path Error Caused by NC Servo Characteristics of Machining Center

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

- For further improving the convenience of the estimation approach previously developed, a simple and practical method is proposed to replace expensive KGM measurement.
- Comparison results of simulated cutter path trajectory and workpiece contour error sufficiently verify the effect of proposed method and the application possibility of the approach to newer model of MC.



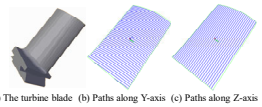
Comparison example

TA1-4(4) 10:15-10:30

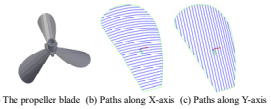
Path Generation for Robotic Polishing of Free-form Surfaces

Zhaosheng Li[1,2], Linlin Shang[1,2], Wei Wang[1] and Taiwen Qiu[3]
[1]Institute of Automation, Chinese Academy of Sciences, Beijing, China
[2]University of Chinese Academy of Sciences, Beijing, China
[3]Shanghai Aircraft Manufacturing Co., Ltd., Shanghai, China

- Incorporate topology relations of triangular facets into the direction-parallel path generation algorithm with equal axis intervals.
- Propose the constant contour interval path generation algorithm, which can generate paths with equal contour intervals.



(a) The turbine blade (b) Paths along Y-axis (c) Paths along Z-axis



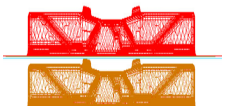
(a) The propeller blade (b) Paths along X-axis (c) Paths along Y-axis

TA1-4(5) 10:30-10:45

Research on Stamping Process Parameters of Reinforcing Plate in Automobile Side Sill

Ling Chen, Hui Li,YanLing Wang
1.Tianjin Key Laboratory of the Design and Intelligent Control of the Advanced Mechanical System 2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, 300384, China 3.Tianjin University, Tianjin, 300072, China

- The technological parameters of strengthening sheet forming process were studied.
- Establishment of Reinforcement Plate Model by Three-dimensional Software.
- Finite Element Analysis of Reinforced Plate Model.
- The optimum parameters are obtained by orthogonal experiment.



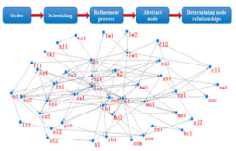
Sheet-Metal Press Working

TA1-4(6) 10:45-11:00

Intelligent Workshop Bottleneck Prediction Based on Complex Network

Feng ZHU, Ruigang WANG, Chuang WANG
Institute of Internet of Things and IT-based Industrialization, Xi'an University of Posts & Telecommunications, Xi'an, China

- Select four parameters DC, BC, C and CC which describe the local relationship between nodes.
- Taking four parameters as decision attributes, calculating node importance by Multiple Attribute Decision.
- Introducing network efficiency values to describe global relationship between nodes.
- Production capability



Step Flow of Model Establishment

TA1-5: Intelligent Mechatronics and Application (I)

Session Chairs: Andrew Keong Ng, Singapore Institute of Technology
Yong Yu, Kagoshima University

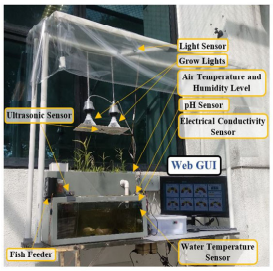
Conference Room 5, 9:30-11:00, Tuesday, 6 August 2019

TA1-5(1) 9:30-9:45

Intelligent Outdoor Aquaponics with Automated Grow Lights and Internet of Things

Zheng Jie Ong[1], Andrew Keong Ng[2,*], Thu Ya Kyaw[3]
[1]University of Glasgow Singapore, [2]Singapore Institute of Technology, [3]AI Singapore

- Designed and developed an intelligent outdoor aquaponics system with automated grow lights and internet of things.
- Improved food security and sustainability, with reduced human labour and operating costs, creating liveable cities and urban areas.



Intelligent Outdoor Aquaponics

TA1-5(2) 9:45-10:00

Development of an Anti-Sway Positioning Controller for Rotary Cranes

Lihong Zhang, Zhiming Zhang, and Chunquan Xu*
Department of Control Science & Engineering, Tongji University
Shanghai, China

- Engineering application of an anti-sway positioning controller.
- Designed for rotary cranes.
- Hybrid control scheme combining the angular velocity feed-forward, the PID feedback, and the ZVD.
- The sway of the crane's lifting rope is within 0.2 degrees, the error of the rotational motion is within 0.1 degrees, and the error of the pitch motion is within 0.05 degrees.

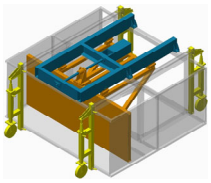

The Rotary Crane

TA1-5(3) 10:00-10:15

Structural Design and Test of Movable Wake Maker

Liu[1], Haozhi Mu[1,2*], Renzhe Wei[1], Peng Zhang[1], Qingsong Ning[3], Tao Xue[1,2], Shoujun Wang[1,2*]
[1]National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology), Tianjin 300384, China
[2]Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, Tianjin 300384, China
[3]Department of Information and Intelligent Technology, Tianjin Research Institute of Construction Machinery Co., Ltd., Tianjin 300409, China

- This paper proposed a wave maker with movable function to meet the needs of multi-side wave experiment on physical models.
- Mechanical structure of the wave maker, its assembly and working mode are described in detail

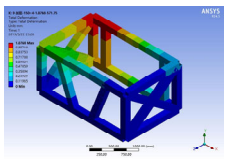

movable wave maker structure

TA1-5(4) 10:15-10:30

Finite Element Analysis and Optimization of Movable Wave Maker Based on Workbench

Liu[1], Haozhi Mu[1,2*], Renzhe Wei[1], Peng Zhang[1], Lili Zhao[3], Tao Xue[1,2], Shoujun Wang[1,2*]
[1]National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology), Tianjin 300384, China
[2]Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, Tianjin 300384, China
[3]Tianjin Jinfang Thermal Energy Technology Development Co., Ltd., Tianjin 300192, China

- Different optimization models are imported into Mechanical Modeler of Workbench for mesh generation and load calculation.
- By comparing the results of different optimization schemes, the optimized structure form and parameters of the base are obtained.

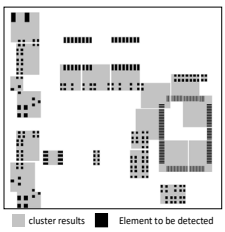

optimization results

TA1-5(5) 10:30-10:45

AOI Planning Method Based on Genetic Algorithm

Xiaohui Jia, Tao Wang, Yang Li, Jinyue Liu and Yunlong Zhang
Robotics and Automation Institute., Hebei University of Technology
Tianjin, China

- The genetic algorithm is used for clustering component to be detected, thus determine the area for detecting.
- Generate the individual of local optimal solution on the basis of actual constraints.
- This algorithm effectively solves the problem of detection range optimization during the automated optical detection.



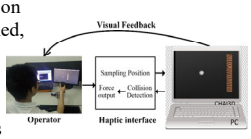
Cluster result

TA1-5(6) 10:45-11:00

2-DOF Haptic Device based on Closed-loop EBA Controller for Gastroscope Intervention

Zhaoyang Xue, Chongyang Wang, Xiao He, Tao Yu, Xinyu Dong and Hao Liu
Northeastern University, State Key Laboratory of Robotics, Shenyang Institute of Automation Chinese Academy of Sciences
Shenyang, China

- A 2-DOF haptic device based on the joystick structure is designed, controlled and evaluated.
- Considering the most spread control architecture for haptic interfaces, a virtual wall test is conducted to compare the different controller algorithms in CHAI3D.



The Haptic Display System

TA1-6: Control Theory and Application (IV)

Session Chairs: Jingnan Zhang, Harbin Engineering University
Peng Shi, Kagawa University

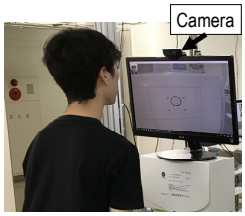
Conference Room 6, 9:30-11:00, Tuesday, 6 August 2019

TA1-6(1) 9:30-9:45

Tele-Operation of Robot using Facial Feature Point Detection

Masahiko Minamoto, Hidaka Sato
Tokyo Metropolitan College of Industrial Technology, Tokyo, Japan
Takahiro Kanno, Tetsuro Miyazaki, Toshihiro Kawase, Kenji Kawashima
Tokyo Medical and Dental University, Tokyo, Japan

- We developed an interface for remote control of robots with the operator's face movement using facial feature point detection.
- The interface allows three degrees of freedom of a robot, right and left, up and down, and zoom in and out.
- A laparoscope holder robot EMARO was controlled by the developed interface.



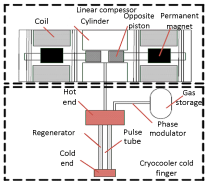
Proposed Interface

TA1-6(2) 9:45-10:00

The Temperature Control of a Pulse Tube Cryocooler System Using Model Identification and Dynamic Matrix Control

Ziyin Chen, Zhe Lin, Han Zhang and Yu Wang
Department of Control Engineering, Beijing Institute of Space Mechanics & Electricity
Beijing, China

- Hardware platform is setup for temperature control of a pulse tube cryocooler system.
- Relay feedback identification method is applied to obtain the process model of the system.
- A high-order model is proposed and identified using least square fitting.
- DMC method is adopted to achieve better performance.



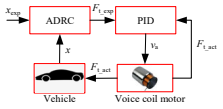
Strucure of pulse tube cryocooler

TA1-6(3) 10:00-10:15

Vertical Dynamics of Voice Coil Motor Active Suspension with Active Disturbance Rejection Control

Junlin Luo, Wei Wu and Likun Ge
National Key Laboratory of Vehicle Transmissions., Beijing Institute of Technology, Beijing, China

- An active suspension with voice coil motor (VCM) actuator.
- Cascade control scheme based on PID and ADRC is proposed.
- A single wheel active suspension experiment setup.
- Significant improvement of vibration reduce performance.



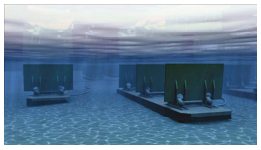
The control system

TA1-6(4) 10:15-10:30

Research on Maximum Power Point Tracking of Pendulum Wave Energy Generator

Chunjie Wang, Xiaochun Zhao, Peng Chen, Lin Cui and Yunqi Duan
Tianjin University of Technology, National Ocean Technology Center
Tianjin, China

- Analyze the dynamic model of pendulum wave energy generator.
- Derive the relationship between the system power and the permanent magnet synchronous generator.
- Propose a maximum power point tracking (MPPT) control strategy.
- Build a simulation model of each part of the system.



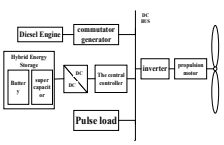
The Pendulum Wave Capture

TA1-6(5) 10:00-10:45

Research on DC Bus Voltage Control of Ship Based on Hybrid Energy Storage

Jingnan Zhang, Ruochen Bai
Department of Electrical Engineering,Harbin Engineering University
Harbin, China

- Determination of Topological Structure of Ship Propulsion System.
- Model Selection of Super Capacitor and Battery.
- Control Strategy of Super Capacitor and Battery.
- Simulation analysis of special working conditions



Topological Structure of Ship Propulsion System

TA1-6(6) 10:45-11:00

Analysis and Design of Self-propelled Trolley Based on Spatial RSSR Mechanism

Hongbiao Xiang, Yan Li, Jiancheng Ba, Tilei Zhang and Shoujun Wang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control,
School of Mechanical Engineering, Tianjin University of Technology
Tianjin, China
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education , Tianjin University of Technology
Tianjin, China

- A self-propelled trolley based on spatial RSSR mechanism.
- The sensitivity of the fine adjustment mechanism are analyzed .
- The material selection for the trolley is analyzed.
- The motion characteristics of the trolley is analyzed compared with the calculation and experiments .

The self-propelled trolley

TA1-7: Modeling, Simulation Techniques and Methodology (I)

Session Chairs: James K. Mills, University of Toronto
Zixu Wang, Kagawa University

Conference Room 7, 9:30-11:00, Tuesday, 6 August 2019

TA1-7(1) 9:30-9:45

State Evaluation of Large Ships Diesel Engine Based on SOM Neural Network

Jinxin Zhao, Jian Zhou, Peng Shang, Pengpeng Liu, Youlin Xu
School of Mechanical Engineering, Xi'an Jiaotong UniversityXi'an, Shaanxi , China

- The SOM self-organizing map neural network model is applied to judge and evaluate the state of the marine diesel engine.
- Firstly, the selection and establishment of scientific indicators should be carried out on the principle of evaluating indicators. Then, after the selected state indicator parameters are normalized, the data is input to the SOM neural network for training, and finally use the trained network to evaluate the state of the input parameters.
- The trained SOM neural network can effectively improve the evaluation efficiency and reduce the influence of some subjective factors, and the experimental results show that the model is feasible in the state evaluation of Marine diesel engines.

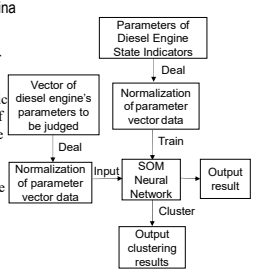


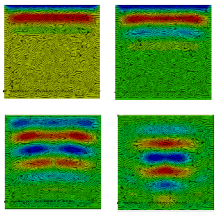
Fig. State Evaluation Model and Flow of Diesel Engine Based on SOM Neural Network.

TA1-7(2) 9:45-10:00

Microscopic Analysis of Ultrasonic Attenuation of Polymer Bonded Explosives

Qinxue Pan, Xiaoyu Xu, Xiaohao Liu, Dingguo Xiao, Ruipeng Pan, Meile Chang, Chang Shao
Key Lab. of Fundamental Science for National Defense for Advanced Machining Technology
Beijing Institute of Technology
Beijing, China

- A two-phase finite element model of PBX with different volume fractions was established and analyzed.
- Multi-frequency ultrasonic simulation of the finite element model from zero volume fraction to 60 percent was performed and discussed.
- According to the ultrasonic attenuation law of different density of PBX, the experimental verification was carried out and the effective law was obtained.



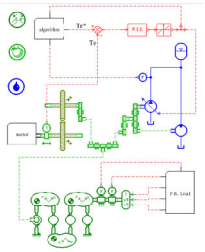
Microscopic Simulation of Ultrasound

TA1-7(3) 10:00-10:15

Simulation research on hydraulic energy regulation system of beam pumping unit

College of Mechanical Engineering, Inner Mongolia University for the Nationalities , tongliao,Inner Mongolia, China

- Energy saving analysis of pumping unit.
- Hybrid power technology.
- Pumping unit load simulation
- Control algorithm design
- Simulation research



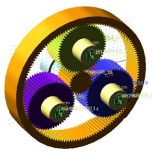
Energy Saving System Model

TA1-7(4) 10:15-10:30

Equal Load Property Simulation Analysis of Planetary Gear Transmission of Deep-Sea Geological Winch

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

- The deep-sea geological winch needs to change speed frequently to adapt to the change of cable tension in the recovering.
- Adding the planetary gear mechanism between the servo motor and the winch can effectively improve the carrying capacity of the winch
- Design a planetary gear transmission system with flexible pins
- Verify the load sharing effect of flexible pin



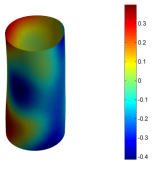
Transmission Model of Planetary Gear

TA1-7(5) 10:30-10:45

Geometric Tolerance Modeling Method Based on B-spline Parameter Space Envelope

Chenming Song, Yijun Zhou, and Chen Luo
School of Mechanical Engineering Southeast University
Nanjing, China

- This paper proposed a novel geometric tolerance modeling method based on B-spline parameter space envelop.
- The proposed method can achieve complex deformation results and can handle parts with any shape or topological properties.
- Both global and local simulations have conducted, the experiment result shows the validity of the proposed method.



Deformation result of a cylindrical part

TA1-7(6) 10:45-11:00

Research on the Control of Wheel-rail Noise by Wheel Sound-proof Skirt for High-speed Train

Huanhuan Zhang, Guangtian Shi, Xiaoan Zhang, Zhidan Huang, Xiaoyun Zhang and Zhengxiao Xu
School of Mechanical Engineering, Lanzhou Jiaotong University
Lanzhou, China

- In this paper, transmission loss is taken as an evaluation index, and acoustic theory and statistical energy method are used.
- This paper calculates and analyses the influence of different shape and material parameters on noise reduction effect of sound-proof skirt.
- This paper provides a theoretical basis for reducing noise radiation of high-speed train wheels and choosing sound-proof skirt.

sound-proof skirt

TA2-1: Medical, Biomedical and Rehabilitation Systems (II)

Session Chairs: Yong Yu, Kagoshima University
Xiujun Li, Changchun University of Science and Technology
Conference Room 1, 11:15-12:15, Tuesday, 6 August 2019

TA2-1(1) 11:15-11:30

Estimation of Fatigue Status by sEMG Signal Using SVM Algorithm in Massage Assessment

Dafan Long, Xingsong Wang*, Mengqian Tian, Yuliang Mao, and Yanzhong He
School of Mechanical Engineering, Southeast University
Nanjing, China

- Wavelet de-noising filter is designed to remove the white Gaussian noise of measured raw sEMG signal.
- Seven relevant features of muscular fatigue are extracted from the denoised signal.
- The muscular fatigue status classifier was built using seven relevant features by the SVM clustering algorithm.

Massage Assessment

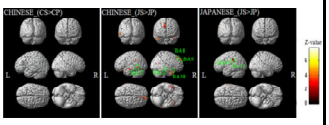
TA2-1(2) 11:30-11:45

Different brain activation of phonological and semantic processing with bilinguals speakers: An fMRI study

Xiujun Li, Jingjing Yang and Qi Li
The School of Computer Science and Technology Changchun University of Science and Technology
7089 Weixing Road, Changchun
Jilin, China
lixiujun@ cust.edu.cn;

Dan Tong; Jinglong Wu
Department of Radiology, No.1 Hospital of Jilin University; The Graduate School of Natural Science and Technology
Jilin University; Okayama University
Jilin, China; Okayama, Japan
tongdan2012@126.com; wu@mech.okayama-u.ac.jp

In this study, we used fMRI and behavioral experiments to investigate the difference in bilingual by Chinese-Japanese bilingual and Japanese subject in semantic and phonological processing of brain activity. Study on the use of Japanese subjects and Chinese-Japanese bilingual subjects, using Chinese or Japanese semantic or phonological judgment task, through the two groups of subjects their judgment task, discussion of bilingual Chinese and Japanese subjects differences between brain activity in semantic and phonological processing.



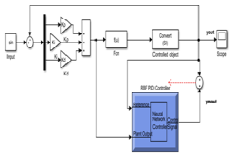
Differences in brain activation in semantic and phonological judgment between Chinese and Japanese bilingual subjects P<0.001,cluster size > 50 voxels Uncorrected. L: left; R: right.

TA2-1(3) 11:45-12:00

Radial Basis Function Neural Network-based Control Method for a Upper Limb Rehabilitation Robot

Shuxiang, Guo Wenyang Gao, Dongdong Bu
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, Haidian District, Beijing 100081, China

- Static Analysis of Mechanical Structure Based on ANSYS
- MATLAB simulation experiment verification based on RBF neural network
- Determine the feasibility of the network based on the comparison of the experimental results



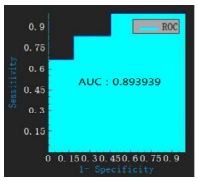
Feedback linearization control algorithm structure diagram.

TA2-1(4) 12:00-12:15

Assessment of Pathological Grading of Bladder Cancer Using Texture Features from MRI

Zhe Zhou, Lin Liu, Kaiming Xue, Yue Ma, Jiayan Liu and Mengchao Zhang
Department of Radiology, China-Japan Union Hospital of JILIN University
Changchun, jilin Province, China

- A total of 108 patients with bladder cancer confirmed by postoperative pathology were analyzed retrospectively.
- A.K. software was used for texture extraction, and Logistic multiple regression correlation analysis was carried out.
- Texture Features from MRI can access Bladder Cancer grade effectively.



Testing Data's ROC Graph

TA2-2: Mobile Robot System (II)

Session Chairs: Hakan Temeltas, Istanbul Technical University
Shoujun Wang, Tianjin University of Technology

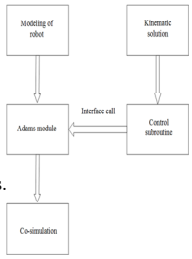
Conference Room 2, 11:15-12:15, Tuesday, 6 August 2019

TA2-2(1) 11:15-11:30

Application of ADAMS User-Written Subroutine to Simulation of Multi-gait for Spherical Robot

Debin Xia, Shuxiang Guo, Liwei Shi, Huiming Xing, Xihuan Hou, Yu Liu , Huikang Liu, Yao Hu, Zan Li.
Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, the Ministry of Industry and Information Technology, Beijing Institute of Technology

- Considering the complexity of robot structure and the influence of experimental environment, an Adams and C based method for multi-step joint simulation of robots was proposed.
- To demonstrate the method was helpful for the underwater spherical robot's experiments, we carried out some comparative experiments.
- The simulation results show the effectiveness and accuracy of the scheme. It is concluded that the simulation results can present the real situation well.



The construction of co-simulation system

TA2-2(2) 11:30-11:45

Dynamic Modeling and Optimizing Analysis of Rigid-Flexible Coupling for Bundling Manipulator Based on ADAMS

Shoujun Wang[1,2],Longrui Mao[1,2],Tao Xue[1,2]
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control[1]
National Demonstration Center for Experimental Mechanical and Electrical Engineering Education[2]

- Establishment of a flexible body model of steel strip in combination with Adams and SolidWorks.
- Establishment of Rigid-Flexible Coupled Dynamic Model of Manipulator by Lagrange Equation Method.

TA2-2(3) 11:45-12:00

Design of A Negative Pressure Adsorption Pipeline Robot for Omni-directional Mobility

Gangfeng Liu, Hao Mo, Changle Li* and Ge Li
State Key Laboratory of Robotic Technology and System, Harbin Institute of Technology
Harbin,China

Liyi Li
School of Electrical Engineering and Automation, Harbin Institute of Technology
Harbin,China

- Principle of negative pressure adsorption and omni-directional mobility.
- Mechanical Analysis Model of omni-directional mobility.
- Mechanical analysis of robot with arbitrary attitude.
- Simulation analysis and verification.

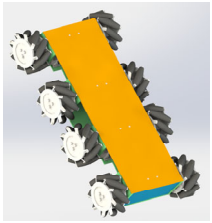
Negative Pressure Adsorption Pipeline Robot

TA2-2(4) 12:00-12:15

Movement Performance Analysis of Mecanum Wheeled Omnidirectional Mobile Robot

Changlong Ye, Jianhui Zhang, Guanglin Ding and Suyang Yu
School of Mechatronics Engineering, Shenyang Aerospace University, Shenyang, China

- The geometric model is established for the optimal structural design of Mecanum wheel.
- The kinematics model and error model are established to analyze the influence of the movement accuracy and error of the robot.
- The optimal design parameters of the robot is proposed.
- The movement precision of robot is obviously improved.



The Mecanum Wheeled Omnidirectional Mobile Robot

TA2-3: Signal and Image Processing (II)

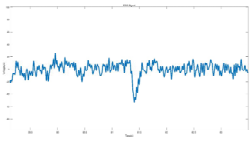
Session Chairs: Shuxiang Guo, Kagawa University
Yu Song, Tianjin University of Technology
Conference Room 3, 11:15-12:15, Tuesday, 6 August 2019

TA2-3(1) 11:15-11:30

Effect Evaluation System of Massage Chair Based on EEG

Jiawei Li, Mengqian Tian, Yanzhong He, Xingsong Wang*
Department of Mechanical Engineering, Southeast University
Nanjing, China

- A system which can measure people's fatigue status based on EEG.
- HHT and wavelet packet decomposition is used to de-noising and extract features.
- EEG is analyzed by training NN, SVM and LGB models and samples are obtained by experiments.
- Fuse models under Stacking framework and further improve model performance.



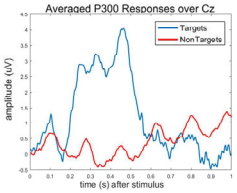
The EEG Signal

TA2-3(2) 11:30-11:45

P300 Detection with Adaptive Filtering and EEG Spectrogram Graph

Hao Meng, Hongwei Wei, Tianhao Yan and Weihao Zhou
College of Automation, Harbin Engineering University
Harbin, China

- A new method of EEG adaptive filter reference signal selection.
- Noise reduction method based on RLS adaptive filter.
- Feature extraction method based on EEG spectrogram graph.
- Using CNN network to classify the EEG with and without P300 Response.



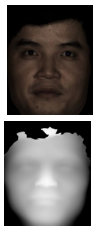
The P300 Response

TA2-3(3) 11:45-12:00

3D Face Recognition Based on Deep Learning

Jing Luo, Fei Hu and Ruihuan Wang
College of Electrical Engineering and Automation., Tianjin Technology University
Tianjin, China

- Experimental data is two-dimensional face images and face depth maps which converted from 3D poi nt clound data.
- Then, we fuse the abstract features of the 2D face a bstract feature and the face depth map,use the merg ed image as the input of the classification layer.
- Reasonable use of depth information of 3D face ca n effectively reduce the impact of illumination, attit ude and expression on face recognition. Therefore, this paper proposed a 3D face recognition method based on depth learning.



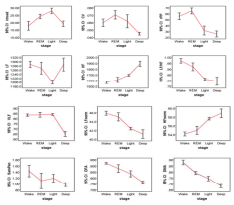
Face Image

TA2-3(4) 12:00-12:15

A Joint Classifier for Sleep Staging with Pulse Rate Variability Based on Automatic Weight Assignment

Dong He, Min Li, Haonan Yang, Wenbo Kang and Yanglei Ou
Department of Mechatronic Engineering and Automation, Shanghai University,
Shanghai, China

- This paper proposes a joint classifier using automatic weight assignment strategy for distinguishing sleep stages by analyzing PRV signal.
- The features of PRV are found to significantly differ across sleep stages.
- Average accuracy of the classifier reaches 82.19%, which verifies its feasibility and effectiveness.



Error bar in different sleep stages

TA2-4: Industrial, Manufacturing Process and Automation (II)

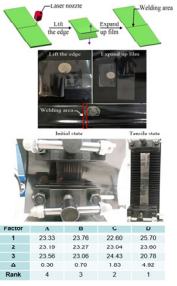
Session Chairs: Xiaoliang Jin, Kagawa University
Xianqiang Bao, Beijing Institute of Technology
Conference Room 4, 11:15-12:15, Tuesday, 6 August 2019

TA2-4(1) 11:15-11:30

A Novel Manufacturing Method for Thermoplastic Polyurethane Welding Using CO2 Laser

Daofu Zhang, Xingsong Wang, Mengqian Tian, Donghua Shen and Yuliang Mao*
School of Mechanical and Engineering
Southeast University
Nanjing, China

- Use laser to weld the heated and pressed films.
- Edge was lifted and the film was expanded up for the preparation of the experiment.
- Experiments were conducted using universal tensile testing machine.
- Factors like laser power(A), cutting/welding speed(B), spot diameter(C) and material thickness(D) influence the welding strength.
- Factors were ranked according to S/N ratio value table.



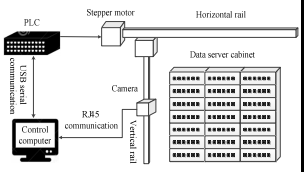
Factor	A	B	C	D
1	23.33	23.76	22.60	25.70
2	23.19	23.27	23.04	23.00
3	23.56	23.06	24.43	20.78
Δ	0.36	0.70	1.83	4.92
Rank	4	3	2	1

TA2-4(2) 11:30-11:45

Design of Bank Server Fault Diagnosis System Based on Machine Vision

Xu Jun, Wu Shunyi, and Sun Mingxiao
School of Automation, Harbin University of Science and Technology
Harbin, China

- This paper proposes an automatic detection method for server operation based on image processing.
- It is verified through engineering that the recognition accuracy can reach 98.85%, and the recognition speed can reach about 40 frames per second, which can better meet the industrial needs.



System hardware organization

TA2-4(3) 11:45-12:00

The Temperature Control of Blackbody Radiation Source Based on IMC-PID

Lei Shao,Chang Liu,Jinghui Wang,Zhigang Wang,Xue Yang
Tianjin Key Laboratory for Control Theory & Application in
Complicated Systems, Tianjin University of Technoloy,Tianjin, China

- In industry, traditional PID control has large overshoot and long adjustment time, the temperature control efficiency is greatly reduced. IMC-PID is introduced to improve the dynamic performance of blackbody radiation source.
- MATLAB/SIMULINK platform is used to compare the conventional PID algorithm with IMC-PID algorithm.The simulation results show that IMC-PID shortens plant stable times and it is without overshoot.

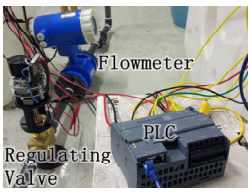
Blackbody radiation source

TA2-4(4) 12:00-12:15

Real-Time Flow Control System Based on Siemens PLC

Zeyu Quan, Xin Yuan, Yuntao Zhu and Zhengyang Wang
College of Automation, Harbin Engineering University
Harbin, Heilongjiang Province, China

- Use Siemens PLC, electromagnetic flow meter, regulating valve and Human Machine Interface.
- Use decision tree algorithm to improve fuzzy control rulers.
- Use simulation and experiments to verify control effect.
- Having designed flow system and interactive interface and put them into use in the industry.



Real-Time Flow Control System

TA2-5: Intelligent Mechatronics and Application (II)

Session Chairs: Gang Li, Beijing Institute of Control Engineering
Hao Fu, Tianjin Polytechnic University

Conference Room 5, 11:15-12:15, Tuesday, 6 August 2019

TA2-5(1) 11:15-11:30

Development of Miniature Control Moment Gyroscope Engineering Prototype

Li Gang, Lai Lin, Wei Wenshan, Xue Bing and Liu Jinghui
Beijing Institute of Control Engineering,
China Aerospace Science and Technology Corporation, Beijing, P.R.China

- Design principle of miniature CMG are discussed.
- The technical methods of MCMG are compared and selected.
- The tuning fork rotor module and hollow gimbal module are proposed for design optimization.
- COTS devices are used to reduce cost.
- An engineering prototype was developed and passed the qualification environmental test.

The MCMG Prototype

TA2-5(2) 11:30-11:45

The Wireless Electric Vehicle System Based on Super- capacitor Power Supply

Tao Lan, Shengjie Cao, Zhiqiang Cheng and Qiqi Huang,Zhengchun Yang*andLiqiang XieMechatronics Research Lab., Tianjin University of Technology
Tianjin, China

- In recent years, the invention of electric vehicles solved problems like lacking of resources, but at the same time, other problems raised, including aging of electric vehicles and low energy efficiency.With the background of global development of electric vehicles, we launched a wireless electric vehicle system, using wireless energy, supercapacitor energy storage and re-release to charge electric vehicles better.

Wireless Electric Vehicle

TA2-5(3) 11:45-12:00

Design of 3-D Magnetic Field Sensor and Calibration Platform for TMS

Hui Xiong[1,2]*, Hao Fu1,2, Jianguo Zhu1,3,Jinzhen Liu1,2, Xiaohui Luo1,2, Bowen Qiu[1,2]
(1.Tianjin Polytechnic University School of Electrical Engineering and Automation
2.Tianjin Key Laboratory of Advanced Technology of Electrical Engineering and Energy
3.Schoolof Electrical and Information Engineering, University of Sydney, NSW, 2006, Sydney, Australia)

- A 3-D magnetic field measurement structure is designed for TMS pre-testing.
- A 3-D calibration platform is designed to calibrate the 3-D magnetic field sensors.

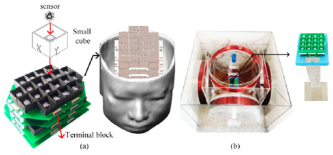


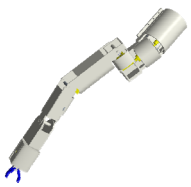
Fig.1 (a) 3-D magnetic field measurement structure (b) Diagram of sensors fixed in the middle of 3-D calibration platform

TA2-5(4) 12:00-12:15

Research on the Motion and Dynamics of Biomimetic Ma-nipulator with Seven Degrees of Freedom

Liang Xuan, Siyuan Peng[1], Tianmin Guan and Ning Li[2]
[1]School of mechanical and electrical engineering, Jianghan University, Wuhan, China
[2]School of mechanical engineering, Dalian Jiaotong University, Dalian, China

- This paper puts forward a design of 7-DOF (seven degrees of freedom) biomimetic manipulator based on human anatomy.
- The article mainly includes three parts.
- Biomimetic manipulator structure design;Kinematics analysis of biomimetic manipulator and dynamics analysis of biomimetic manipulator.



A model of a biomimetic manipulator

TA2-6: Control Theory and Application (V)

Session Chairs: Songyuan Zhang, Harbin Institute of Technology
Wei Zhou, Beijing Institute of Technology

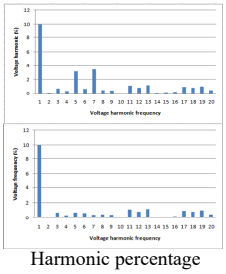
Conference Room 6, 11:15-12:15, Tuesday, 6 August 2019

TA2-6(1) 11:15-11:30

An improved Power Quality Control Method of Micro-grid Converter based on Equivalent Impedance Calculation

Tianyi Ma, Jinyao Li and Haichao Li
Beijing Institute of Graphic Communication
Beijing, China

- The calculation method of micro-grid converter (MGC) equivalent impedance based on droop control is given.
- The equivalent circuit of MGC with droop control is also calculated.
- A control method to reduce MGC output harmonic voltage is proposed.
- The power quality improvement method proposed in this paper is verified by experiments.



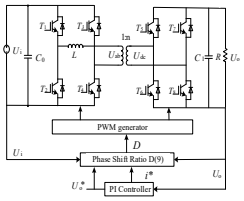
Harmonic percentage of MCG

TA2-6(2) 11:30-11:45

Virtual Current Based Direct Power Control Strategy of Dual-active-bridge DC-DC Converter

Xueping Gao, Lijun Fu, Feng Ji and You Wu
Mechatronics Research LabNational Key Laboratory of Science and Technology on Vessel Integrated Power System, Naval University of Engineering
Wuhan, China

- The proposed strategy is based on the direct power control.
- The transmitted power is obtained by the product of the output voltage and current.
- The output current here is replaced by the virtual current obtained from the PI controller.
- Simulation result verified the effective -ness of the proposed strategy.



Control Diagram of the Converter

TA2-6(3) 11:45-12:00

Research on Immunity of Permanent Magnet Synchronous Motor Vector Control System

Guohong Li, Yongqing Xu
Tianjin University of Technology
Tianjin, China

- Analyse the motor decoupling vector control theory.
- Propose a method for replacing the traditional PI controller with a sliding mode speed controller.
- The sliding mode speed controller replaces the traditional PI controller system with better anti-interference performance and better dynamic performance.

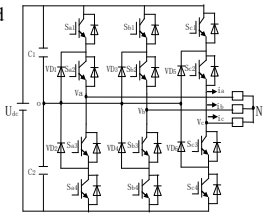
Permanent magnet motor

TA2-6(4) 12:00-12:15

An Improved SVPWM Modulation Strategy for Three-Level Inverter Based on 60° Coordinate System

Xiaojie Lou and Qiping Yuan
School of Electrical and Electronic Engineering, Tianjin University of Technology
Tianjin, China

- Combine the deadbeat control and the SVPWM strategy in the 60° coordinate system.
- Introduce the adjustment factor k.
- The midpoint potential offset range is reduced from (-1.75, 1.75) V to (-0.38, 0.38)V.
- The midpoint potential balance time is reduced to 0.015s when there is a 10V voltage difference between the two series capacitors on the DC side.



Three-level NPC inverter stucture diagram

TA2-7: Modeling, Simulation Techniques and Methodologies (II)

Session Chairs: Qiang Fu, Tianjin University of Technology
Baisong Yang, Xi'an Jiaotong University

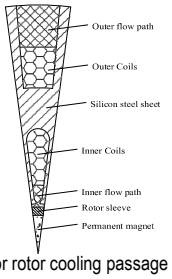
Conference Room 7, 11:15-12:15, Tuesday, 6 August 2019

TA2-7(1) 11:15-11:30

Research on Temperature Field of Rotor with Small Clearance of Axial-Flow High Speed PMSM

Baisong Yang, Sheng Feng, Jiale Tian and Lie Yu
State Key Laboratory for Strength and Vibration of Mechanical Structures
Xi'an Jiaotong University, Xi'an, Shaanxi, China

- The temperature in the radial direction decreases rapidly from the highest outer diameter of the rotor to the minimum temperature at the inner diameter of the stator, and then rises slowly.
- The convective heat transfer coefficient decreases dramatically from the maximum 1100W/(m^2 · K) zone to the minimum 700W/(m^2·K) at x=0, and then increases slowly along the axial direction to 780W/(m^2·K).



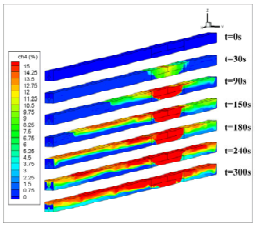
stator rotor cooling passage

TA2-7(2) 11:30-11:45

Research on Diffusion Behaviors of Leaked Natural Gas in Urban Underground Utility Tunnels

Chengcheng Liu, Deguo Wang, Yanbao Guo*, Songzhao Zhang, Haitao Wang and Renyang He
College of Mechanical and Transportation Engineering, China University of Petroleum-Beijing
Beijing, China

- A CFD model was used to study the natural gas diffusion in urban utility tunnels.
- The rise of temperature influences diffusion of methane in urban utility tunnels.
- Mechanism of diffusion implicates on future code and standard to leak inspection.



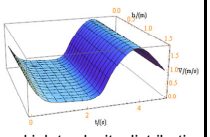
Dispersion Process of Natural Gas

TA2-7(3) 11:45-12:00

Study on the Influence of Carrier Motion of Vertical Axis Turbine Power Station on Turbine Performance

Fankai Kong , Binghan Wang, HuaQiu Ding, LinHui Su and Zhenyang Wang
Department of Mechanical Engineering, Harbin Engineering University
Harbin, China

- The carrier movement has great impact on the turbine performance.
- The performance parameters of the stationary turbine are solved with flux-tube model and the blade element theory.
- By solving the local flow velocity of the spindle, the hydrodynamic force of the turbine impeller, when the carrier is moving, is obtained.



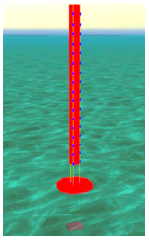
Local inlet velocity distribution on turbine spindle

TA2-7(4) 12:00-12:15

Dynamic Response Analysis of Marine Evacuation Chute System

Fankai Kong, Hongyang Xu, Zhenyang Wang, Hengchong Ge and BingHan Wang
Department of Mechanical Engineering, Harbin Engineering University
Harbin, China

- In view of the researching lack on the marine evacuation chute system, the dynamic response analysis is carried out.
- The numerical model of the system was established by OrcaFlex to simulate the dynamic response under the wind-wave-current coupling.
- Obtain the optimal weight is 400kg and the optimal water entry depth is 8m for the counterweight in this system.



Marine Evacuation Chute System

TP1-1: Medical, Biomedical and Rehabilitation Systems (III)

Session Chairs: Chunqiu Zhang, Tianjin University of Technology
Wei Zhou, Beijing Institute of Technology

Conference Room 1, 13:30-15:00, Tuesday, 6 August 2019

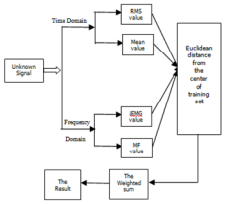
TP1-1(1) 13:30-13:45

A Method of Evaluating Rehabilitation Stage by sEMG Signals for the Upper Limb Rehabilitation Robot

Shuxiang Guo[1,2], Huimin Cai[1] , Jian Guo[1]

[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 Faculty of Engineering, Kagawa University, Kagawa, Japan

- In this paper, a new method of evaluating rehabilitation stage using sEMG signals are proposed.
- Several features to evaluate muscle strength were summarized.
- The feasibility of this method were tested by experiment.



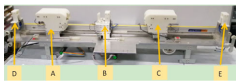
Data relationships diagram

TP1-1(2) 13:45-14:00

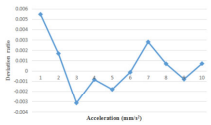
Evaluation Method of Linear Displacement Precision for a Rope-driven Vascular Intervention Surgery Robot

Wei Zhou [1], Shuxiang Guo[1,2*], Xianqiang Bao[1], Yangming Guo[1]
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

- To improve the linear displacement precision of the slave manipulator , the linear displacement model of rope-driven for VIS is established.
- To evaluate the performance of the model, some experiments are carried out.
- To improve the precision of the model further, a compensation model is proposed.



Slave manipulator



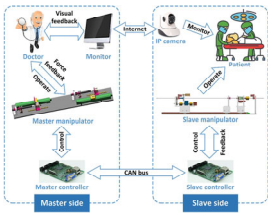
Deviation ratio in accelerated state.

TP1-1(3) 14:00-14:15

Design and Evaluation of a Novel Slave Manipulator for the Vascular Interventional Robotic System

Jian Guo[1], Cheng Meng[1], Shuxiang Guo[1,2], Qiang Fu[1], Qi Zhan[1] and Lei Qi[1]
[1] Tianjin Key Laboratory for Control Theory & ApplicationComplicated Systems and Biomedical Robot Laboratory, Tianjin University of Technology, Tianjin, China
[2] Intelligent Mechanical Systems Engineering Department, Kagawa University, Takamatsu, Japan

- This paper designed a novel slave manipulator.
- The proposed slave manipulator can operate catheter and guide wire simultaneously.
- The proposed slave manipulator can measure the force of catheter and guide wire during operation in real time.



The master-slave teleoperation system

TP1-1(4) 14:15-14:30

Effects of Femur and Pelvis Material Parameters on Hip Replacment

Limin Dong 1[1,2],Zhe Liu2[1,2],Hanxiang Li3[1,2],Jinduo Ye 4[1,2],Chunqiu Zhang5[1,2],Nian Liu 6[3], Wei Chen7[3]
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education（Tianjin University of Technology）Tianjin
3.Tianjin Just Huajian Medical Instrument Co.,Ltd,Tianjin

- The stress and strain distribution in the bone and prosthesis were studied by numerical simulation and the results validated experimentally.
- The mechanical parameters of bone density could significantly affect the stress and strain distribution of the bone and prosthesis.

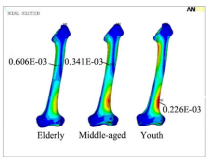


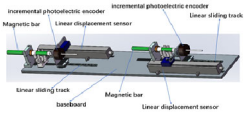
Fig.1 Femoral

TP1-1(5) 14:30-14:45

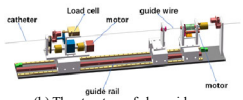
Study on Robust Control for the Vascular Interventional Surgical Robot

Jian Guo[1], Shuai Yang[1] Shuxiang Guo[1,2*], Cheng Meng[1] , Lei Qi[1]
[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 Japan

- A robust control algorithm was proposed to reduce the displacement error between master side and slave side.
- The system identification technology was used to establish the mathematical model of the interventional robot system.
- Stability analysis was carried out by using lyapunov function method and experimental method, and the experimental results showed that the system with robust control algorithm has better performance.



(a) The structure of master side



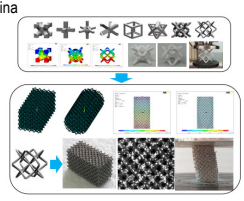
(b) The structure of slave side

TP1-1(6) 14:45-15:00

Morphological Characteristics and Stress Analysis of 3D Printed Trabeculae

Chunqiu Zhang[1]*, Lan Zhang[1], Xin Wang[1], Lu Liu[2], Xiankang Wang[2], Linwei Lv[1] and Jinduo Ye[2]*
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Department of Mechanical Engineering, Tianjin University of Technology; National Demonstration Center for Experimental Mechanical and Electrical Engineering Education.
2. JUST HUAJIAN Medical Device (Tianjin) Co., Ltd.
Tianjin, China

- Analysis of Morphological Characteristics and Mechanical Properties of Cellular Structures.
- Design and Calculation of Bone Trabecular Model.
- Fabrication and Experiment of 3D Printing Titanium Alloy Bone Trabecular Specimens.



Structure Study from Cell to Trabeculae

TP1-2: Mobile Robot System (III)

Session Chairs: Teresa Zielinska, Warsaw University of Technology
Sijia Gu, Shanghai University

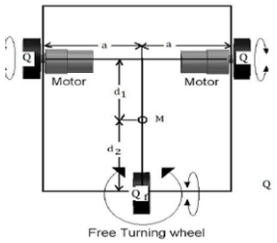
Conference Room 2, 13:30-15:00, Tuesday, 6 August 2019

TP1-2(1) 13:30-13:45

Model Based Control for Slip Reduction

Teresa Zielinska,
Faculty of Power and Aeron. Eng., Warsaw University of Technology, Poland
Weimin Ge,
School of Mechanical Eng., Tianjin Univ. of Technology, China

- Tractive force
- Friction model
- Slip reduction
- Model Based Control
- Control Synthesis for a Simple Mobile Robot
- Experiment, conclusions



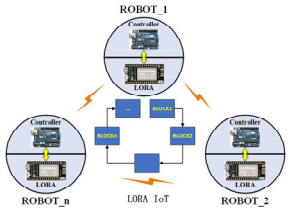
Mobile robot

TP1-2(2) 13:45-14:00

Study on Collaborative Algorithm for a Spherical Multi-robot System based on Micro-blockchain

Shuxiang Guo[1,2] ,Sheng Cao[1] ,Jian Guo[1]
[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 Faculty of Engineering, Kagawa University, Kagawa, Japan

- This paper proposed the decentralized architecture and collaborative algorithm.
- Network architecture of the spherical multi-robot system based on blockchain can avoid the possibility of invasion, solve the Byzantine general problem and improve the flexibility and intelligence.
- The Micro-blockchain network increased wireless communication distance, improved anti-interference ability and reduced power loss of communication.
- The results showed that collaborative algorithm of the spherical multi-robot system based on Micro-blockchain can be used to achieve action in the multi-robot application.



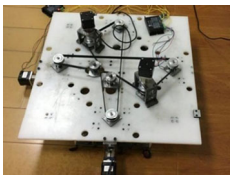
Micro-blockchain Network based on LORA

TP1-2(3) 14:00-14:15

Research on Gait Stability of a Foot-Type Wall-Climbing Robot

Zili Xu, Sijia Gu, Hua Tian and Ming'en Zhao
School of Mechatronic Engineering and Automation, Shanghai University
Shanghai Electric Central Research Institute
Shanghai, China

- A new type of walking mechanism: the gear-and-pinion mechanism and the electromagnets.
- Walks in two orthogonal directions and without turning.
- The walking stability criterions of two kinds of inclined walls.
- Experiments are carried out to verify the validity of the mechanism and stability criterions.



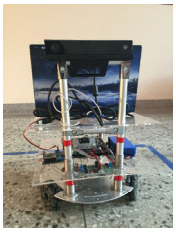
The Foot-type Wall-climbing Robot (FTWR)

TP1-2(4) 14:15-14:30

Trajectory Tracking Use Linear Active Disturbance Control of The Omnidirectional Mobile Robot

Huixuan Fu, Liang Xin, Bingyu Wang and Yuchao Wang
College of Automation
Harbin Engineering University

- Using double closed-loop Linear Active Disturbance Rejection Control (LADRC).
- Discussing the problem of time-varying uncertain of system dynamics model parameters for the omnidirectional mobile robot when it is moving with rotating.
- A trajectory tracking experiment is performed to validate the proposed control approach.



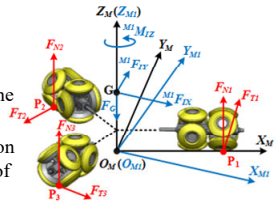
Omnidirectional Mobile Robot

TP1-2(5) 14:30-14:45

A Study on Slippage and Tip-over Stability for an Omnidirectional Mobile Robot with Longitudinal MY-wheels

Suyang Yu, Changlong Ye,Chunying Jiang and Han Li
School of Mechatronics Engineering, Shenyang Aerospace University
Shenyang, China

- This paper presents an omnidirectional mobile robot (OMR) with MY-wheels.
- A parameterized model based on the cycloidal curve is established.
- The influence of different models on the slippage and tip-over stability of the OMR is analyzed.



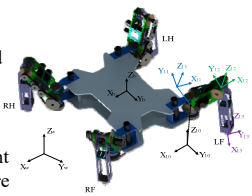
Force system of the OMR

TP1-2(6) 14:45-15:00

Crawling Gait Planning Based on Foot Trajectory Optimization for Quadruped Robot

Shuaidong Yuan, Yijun Zhou and Chen Luo
School of Mechanical Engineering, Southeast University
Nanjing, China

- A quadruped robot is designed and analyzed by kinematics.
- A foot trajectory gait planning based on a compound cycloid is proposed to improve the ability to overcome obstacles.
- Crawling gait and posture adjustment strategy on slope and step terrains are designed based on ZMP method.
- The simulation of walking on different terrains is completed and the result is analyzed.



The quadruped robot model

TP1-3: Signal and Image Processing (III)

Session Chairs: Simarjot Sidhu, University of Toronto
Ronghao Yang, Harbin Engineering University

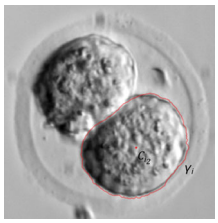
Conference Room 3, 13:30-15:00, Tuesday, 6 August 2019

TP1-3(1) 13:30-13:45

Automated Blastomere Segmentation for Early-Stage Embryo Using 3D Imaging Techniques

Simarjot S. Sidhu, and James K. Mills
Laboratory for Nonlinear Systems Control, University of Toronto
Toronto, Canada

- 3D embryo coordinate data is crucial for automation of embryo biopsy tasks, such as blastomere aspiration and extraction.
- An energy-based segmentation approach on z-stack images, captured by brightfield microscope, is used to determine 3D centroid coordinates of blastomeres.
- Results verify the method's coordinate computing accuracy.



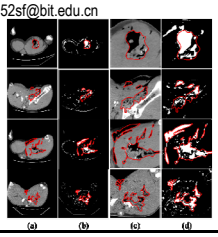
Energy-based Segmentation of Z-Stack Image

TP1-3(2) 13:45-14:00

Multi-Feature Clustering Approach for Firearm Wound Identification on CT Images

Lian Luo1, Yong Chao2, Shuai Liu3, Wanjun Shuai2, Fei Shang1*
1 Department of Biomedical Engineering, School of Life Science, Beijing Institute of Technology, Beijing, China.
2 Fourth medical center of PLA general hospital, Beijing, China
3 Department of Biomedical Engineering, Center for Biomedical Imaging Research, Tsinghua University School of Medicine, Beijing, China
* Corresponding author, bit552sf@bit.edu.cn

- Firearm wound;
- Multi-feature;
- Clustering;
- Identification;
- CT Image

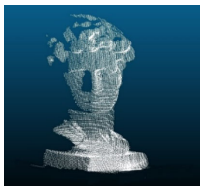


TP1-3(3) 14:00-14:15

Research on 3D Reconstruction Method Based on Laser Rotation Scanning

Liu Tao,Wang Ningning,Fu Qiang, Zhang Yi,Wang Minghui
College of Automation, Harbin Engineering University, China

- A three-dimensional reconstruction algorithm based on line laser rotation scanning is proposed.
- The system calibration method consisting of laser, camera and turntable is studied.
- The axis-eye calibration algorithm is introduced to register the point cloud in the same coordinate.
- The method can obtain the point cloud information of the object by linear laser rotation scanning.



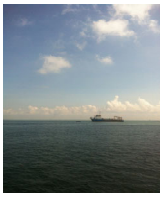
Three-dimensional reconstruction of the David image

TP1-3(4) 14:15-14:30

Image Fusion Processing Method Based on Infrared and Visible Light

LIN Xiaogong, YANG Ronghao
College of Automation, Harbin Engineering University
Harbin, China

- Infrared sensors and visible light sensors have their own imaging combination.
- In the process of collecting surface images, surface ships are easily affected by various complex marine environments.
- The optical equipment itself may also interfere with the surface image due to the instability of the photographic equipment.



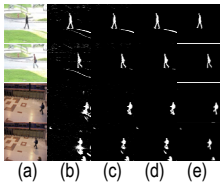
Sea surface image

TP1-3(5) 14:30-14:45

The Moving Target Detection based on Multi-feature Adaptive Background Model

Peiye Sun, Lianrong Lv, Juan Qin, Linghui Lin
School of Electrical and Electronic Engineering, Tianjin University of Technology
Tianjin, China

- For the problems of shadow and the influence of dynamic background, a improved method is presented.
- Establish chromaticity model and texture model and adjust the model according to the background complexity.
- The test results show that the presented method can eliminate the influence of shadow and dynamic background well.



(a) (b) (c) (d) (e)

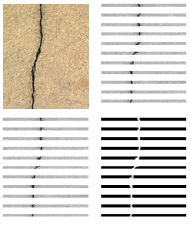
Experimental results: (a) input image; (b) Codebook; (c) ViBe; (d) ViBe+; (e) Ours

TP1-3(6) 14:45-15:00

The Method of the Road Surface Crack Detection by the Improved Otsu Threshold

Yuwen Quan, Jie Sun ,Yang Zhang and Haiwei Zhang
School of the Electrical and Electronic Engieering , Tianjin University of Technology
Tianjin, China

- Proposed an improved Otsu threshold crack detection method based on gray histogram .
- Modified the weighting factor of the gray histogram , improved the target extraction precision , and solved the road image processing problem.
- The experiment results show that the proposed method not only has good consistency in detecting cracks on different pavements, but also has fast calculation speed.



Pavement Crack Image Processing and Results

TP1-4: Industrial, Manufacturing Process and Automation (III)

Session Chairs: Yahui Hu, Tianjin University of Technology
Lingling Zheng, Kagawa University

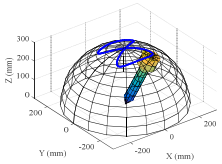
Conference Room 4, 13:30-15:00, Tuesday, 6 August 2019

TP1-4(1) 13:30-13:45

RTCP Detection for Five-axis CNC Machine Tool Dynamic Performance Based on 8-shape Trajectory

Qicheng Ding, Wei Wang, Zhong Jiang, Jing Zhang, Li Du and Jiexiong Ding
School of Mechanical and Electrical Engineering
University of Electronic Science and Technology of China
Chengdu, Sichuan province, China

- 8-shape is an effective trajectory for measurement by RTCP function
- In this paper, 8-shape RTCP trajectory is adapted to different types machine tools
- The effects of the servo position gains, initial setup position and feed rate are summarized by simulation

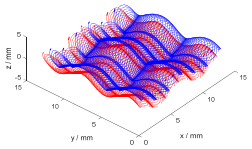


TP1-4(2) 13:45-14:00

A Tool Path Generation Method for Three-dimensional Vibration-assisted Machining

Guilian Wang, Bingrui Lv, Bin Liu and Haozhi Mu
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control,
School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China

- A new tool path generation method is proposed for the three dimensional vibration assisted six degree of freedom machine tool processing.
- The influence of tool shape on tool path is compared and analyzed.
- Tool path generation method is suitable for cutting tools and workpieces of various shapes.



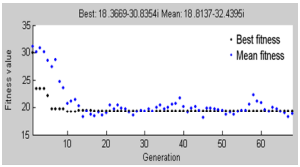
Tool path and machining path

TP1-4(3) 14:00-14:15

Machining Parameters Optimization of Ultrasonically-Assisted Drilling Cortical Bone

Yahui Hu, Huaiyu Zhang, Longfei Wei, Weihua Fu, Chunqiu Zhang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control,
Tianjin University of Technology, Tianjin, China;
Tianjin Medical University General Hospital, Tianjin, China.

- This study carries out the bone test of ultrasonically-assisted drilling.
- A response surface model was developed, which was used as a fitness function for genetic algorithm.
- The investigation showed that the technique of can effectively estimate the optimal setting for thrust force value.



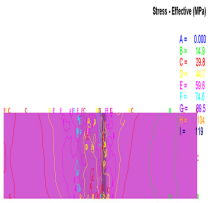
Generation

TP1-4(4) 14:15-14:30

Simulation and Analysis of residual stress and tool wear in Mechanical repeated ruling process

Chaochao Shi,Guangfeng Shi and Guoquan Shi
Mechanical and Electrical Engineering., Changchun University of Science and Technology
Changchun, China

- In order to study the superiority of mechanical repeated ruling grating blank compared with single mechanical ruling, the residual stress and tool wear are analyzed in this paper.
- The first group is a single ruling test, and the last three groups are mechanical repeated ruling tests.
- The results in mechanical repeated ruling grating blank are more regular than that in single one.



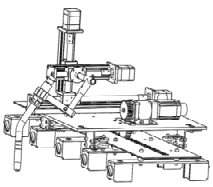
The residual stress distribution

TP1-4(5) 14:30-14:45

An All Position Automatic Welding Machine of Large Diameter Penstock

Jiacheng Qi, Qiang Fu, Yifei Wu, Mo Yang, Yu Liu
Mechanical and Electrical Engineering College, Hohai University
Changzhou, Jiangsu, China

- Flexible track is adopted to adapt to different diameters.
- Welding torch swing device is applied to meet the needs of different welding grooves.
- The deviation between weld seam and welding torch is reduced by the device.
- The welding control system uses ARM microcontroller for welding process control.



The Automatic Welding Machine

TP1-4(6) 14:45-15:00

Pumping Unit Design and Control Research

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

- An energy-saving pumping unit.
- The gear speed reducer was instead by using a planetary gear reducer with a compact structure and a large reduction ratio.
- The designed motor control system enables flexible starting of the switched reluctance motor, avoiding mechanical shock during commutation..
- Work efficiency has been improved.

The energy-saving pumping unit

TP1-5: Intelligent Mechatronics and Application (III)

Session Chairs: Bin Liu, ABB Corporate Research
Weimin Ge, Tianjin University of Technology
Conference Room 5, 13:30-15:00, Tuesday, 6 August 2019

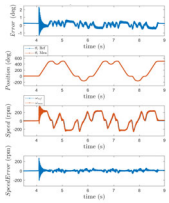
TP1-5(1) 13:30-13:45

A Hybrid Stepper Motor Control Solution based on a Low-cost position sensor

Chuyao Zhou
Department of Electrical Engineering
KTH, Sweden

Bin Liu
Department of Automation Solutions
ABB Corporate Research, Sweden

- A stepper motor control solution has been proposed based on a low-cost position sensor.
- Linear regression and harmonic compensation have been applied into low cost sensor signal.
- EKF sensor fusion results have been used for stepper motor vector control.
- Experimental verification shows the effectiveness of the proposed method.



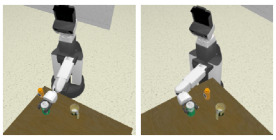
Industrial trajectory test results

TP1-5(2) 13:45-14:00

A Method of Online Motion Generation Using Swept Volumes Collected in Advance

Rui Zhu*1, Kotaro Nagahama*1, Keisuke Takeshita*2, and Kimitoshi Yamazaki*1
*1 AIS Lab., Faculty of Engineering, Shinshu University, Nagano, Japan
*2 Toyota Motor Corporation

- The purpose of this study is to establish a high-speed motion generation method.
- The key point of the method is swept volume by using voxel representation so that can be easy to complete collision check.
- We clarified the effectiveness and the remaining issue of the proposed method through experiments using a mobile manipulator.



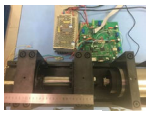
Reaching and grasping the object by a mobile manipulator

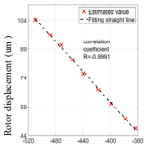
TP1-5(3) 14:00-14:15

A Rotor Displacement Estimation Methodfor Magnetic Bearings with Direct Measurement of the Ripple Current Slope

Zhongliang Tian,Zhengyuan Wei,Bin Guo,Yanhua Sun
School of Mechanical Engineering., Xi'an Jiaotong University
Xi'an, China

- A method to estimate the position of the rotor supported by active magnetic bearings (AMBs) is proposed.
- Position of the rotor could be obtained with the estimated current slope.
- Results showed good accuracy of the estimated position in static.





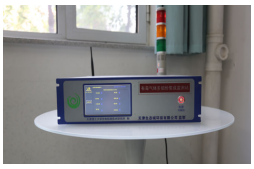
Ripple slope

P1-5(4) 14:15-14:30

Embedded Toxic Gas Monitor Based on µCOS-II

Yunlong Xing, Junchao Zhu, Ye Fu, Yao Zhang, Qian Qiao
Tianjin Key Laboratory for Control Theory & Applications in Complicated System,
Tianjin University of Technology, Tianjin, China
Engineering Research Center of Optoelectronic Devices & Communication Technology
Ministry of Education,China

- Multi-component toxic gas monitoring system
- Six smart electrochemical sensors of toxic gas
- µCOS-II embedded operating system
- HMI is used to display parameters and set threshold
- Sound-light alarm will be triggered when the parameters exceeds the threshold



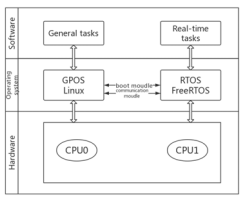
The Toxic gas monitoring

TP1-5(5) 14:30-14:45

Design of a Dual-core Processor Based Controller with RTOS-GPOS Dual Operating System

Yuansong Sun1,3, En Li1, Guodong Yang1, Zize Liang1, Rui Guo2
1. The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation Chinese Academy of Sciences, Beijing 100190, China
2. State Grid Shandong Electric Power Company, Jinan 250001, China
3. The University of Chinese Academy of Sciences, Beijing 100049, China

- In this paper, a robot controller scheme that can balance the versatility and real-time of the controller is proposed.
- Dual-core chip works as the core of the controller hardware platform.
- Linux and FreeRTOS are transplanted as master-slave system on different core, and the asymmetric multi-processing architecture is introduced as the working framework.



Dual operating system controller structure

TP1-5(6) 14:45-15:00

Research And Design Of Intelligent Traffic Signal Light Handheld Control Terminal Based On STM32

Xiao Chen, Feng Chen
School of electrical engineering, Nantong University
Nantong, Jiangsu Province, China

- Radio frequency communication remains stable and efficient.
- The handheld control terminal has good man-machine interaction and is easy to use.

The Portable Control Terminal

TP1-6: Control Theory and Application (VI)

Session Chairs: Kemo Zhang, Beijing Institute of Technology
Cheng Yang, Beijing Institute of Technology

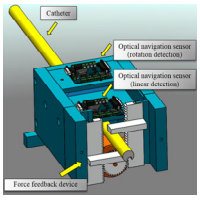
Conference Room 6, 13:30-15:00, Tuesday, 6 August 2019

TP1-6(1) 13:30-13:45

Development of a Novel Remote Controller for Interventional Surgical Robots

Cheng Yang 1, Shuxiang Guo1, 2 *, Yangming Guo1
1. 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.
2. Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa, Japan.

- Proposed a novel remote controller for interventional surgical robots, and evaluate its displacement measuring system accuracy through experiments. The novel controller has a smaller size and more maneuverable compared to the master side in our previous research.
- This paper mainly focused on controller's linear and rotation movement detection method. The accuracy evaluation experiments shows that the proposed controller can meet the requirements of the master side movement detection.



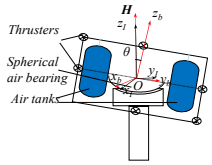
Virtual prototype of the proposed remote controller.

TP1-6(2) 13:45-14:00

Pneumatic Attitude Control of the Air Bearing Tesbed to Simulate the Three Axis Free Tumbling Motion of an Uncooperative Target

Qiang Zhang[1], Kemo Zhang[1], Yong Lu[2], Xiaoguang Liu[2] and Yuanhao Yin[2]
[1]Beijing Institute of Control Engineering, Beijing, China
[2]School of Mechatronics Engineering, Harbin Institute of Technology, Harbin, China

- Design the pneumatic system of three axis testbed to reproduce the tumbling motion of space debris.
- Control the angular momentum and nutation angle of the testbed simultaneously.
- A PWPF regulator is used to regulate the amplitude of the pulsed control torque.



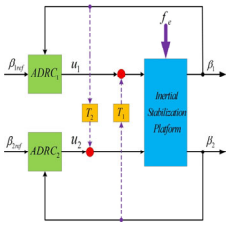
Three Axis Air Bearing Testbed

TP1-6(3) 14:00-14:15

Finite-Time Active Disturbance Rejection Control on High-Order Sliding Mode

Jianzhao Jin, Suoliang Ge
School of Electrical Engineering and Automation, Hefei University of Technology
Hefei, Anhui Province, China

- The study is concerned with the finite-time ADRC method for inertial stabilization platform (ISP).
- It uses the high-order sliding mode method to construct an ESO for lumped estimation and compensation. Then the general PD control law realizes the feedback control.
- The improved controller has better stability and improves the anti-interference ability.



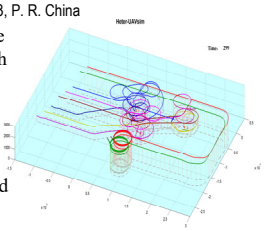
The Control System Structure

TP1-6(4) 14:15-14:30

Task Assignment of Heterogeneous UAV for Anti-radar Mission Using CTAP Models

Siqi Yi , Zhiqiang Long, Juncan Lin
College of Intelligent Science
National University of Defense Technology
Changsha 410073, P. R. China

- Analyze task assignment about the anti-radar cooperative combat with heterogeneous UAV formation.
- The CTAP model is adapted to represent the problem.
- The fast and efficient large-scale minimum cost algorithm combined with the tree search is proposed to get the final task plan.



UAV paths for iterative CTAP example

TP1-6(5) 14:30-14:45

Disturbance observers for general exogenous disturbances

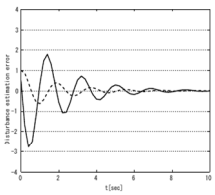
Zang chuanfeng, Jessada Juntawongso, Kotaro Hashikura, Md Abdus Samad Kamal and Kou Yamada
Department of Mechanical Science and Technology, Graduate School of Science and Technology , Gunma University

We examine a method of linear disturbance observers for general exogenous disturbances.

An numerical example is shown to confirm the validity of our method.

Compared with traditional disturbance observer, there is intercommunity.

The linear disturbance observer designed by our method can be also applied to constant disturbances.



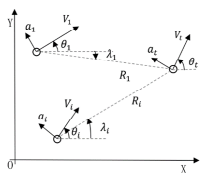
Estimation error

TP1-6(6) 14:45-15:00

Adaptive Fixed-Time Cooperative Intercept Guidance Law with Line-of-sight Angle Constraint

Mingjie Zhang and Jianjun Ma
College of Intelligent Science and Technology, National University of Defense Technology
Changsha, China

- Transform simultaneous attack issues into consensus problems.
- Use adaptive law to estimate target acceleration.
- Design a new fixed-time collaborative guidance law on the LOS direction to ensure the consistency of impact time.
- Deduce a integral sliding mode-based acceleration command in the vertical direction of LOS to achieve the desired LOS angle within fixed time.



Planar guidance geometry

TP1-7: Modeling, Simulation Techniques and Methodologies (III)

Session Chairs: Hideyuki Hirata, Kagawa University
Xiaoliang Jin, Kagawa University

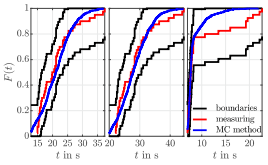
Conference Room 7, 13:30-15:00, Tuesday, 6 August 2019

TP1-7(1) 13:30-13:45

Probabilistic Simulation and Determination of Sojourn Time Distribution in Manufacturing Processes

Johannes Zumsande, Karl-Philipp Kortmann, Mark Wielitzka, and Tobias Ortmaier
Institute of Mechatronic Systems, Leibniz University Hannover
Hanover, Germany

- Investigation of stochastic work piece flow in industrial processes
- Process modeling and simulation via directed graph representations
- Determination of sojourn time distributions
- Validation by one and two sample Kolmogorov-Smirnov test



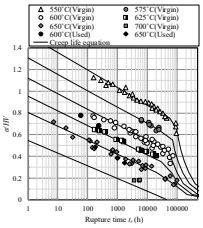
Results of Kolmogorov-Smirnov test

TP1-7(2) 13:45-14:00

Modelling of Creep Property of Base Material for Life Assessment of Mod.9Cr-1Mo Steel Welded Joint

Takuya Nakamura*1, Oga Kataoka*2, Hidenori Yoshimura*3, Hideyuki Hirata*3, Shuxiang Guo*3,Kazunari Fujiyama*4
*1 Shikoku Research Institute Inc.,Takamatsu, JAPAN,
*2 Graduate School of Engineering, Kagawa University,
*3 Faculty of Engineering and Design ,Kagawa University,
*4 Faculty of Science and Technology ,Meijo University

- Evaluation by the analysis is expected for the creep damage of the Mod.9Cr-1Mo steel welded joint of the thermal power plant.
- In order to improve the accuracy of the evaluation by analysis, it is necessary to apply a highly accurate creep strain equation to the welded joint.
- In the first research, creep strain equation was constructed from the creep life equation constructed for the base material.



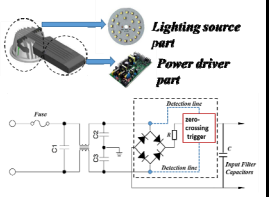
Relationship between σ/HV and rupture time

TP1-7(3) 14:00-14:15

The Application Research of Soft Starting Technology in Marine LED Lighting System

Fang Liu, Zhichao Tao, and Xuehui Zhang
Shanghai WaiGaoQiao Shipbuilding Co., Ltd & CSSC Cruise Technology Development Co., Ltd
Shanghai, China

- LED luminaire will generate a huge inrush current at the moment of power-on.
- Soft start technology make sure that LED power circuit to be closed only when the voltage crosses zero.
- Soft start method is proved effective in start inrush current suppression.
- Soft start method will optimize the reliability of LED lighting system.



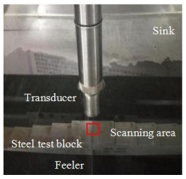
The LED light with technology of soft start

TP1-7(4) 14:15-14:30

Research of Ultrasonic C-scan Imaging Lateral Resolution

Ran Liu, Qinxue Pan, Dingguo Xiao, Pengzhi Ma, and Ming Cheng
Key Lab. of Fundamental Science for National Defense for Advanced Machining Technology, Beijing Institute of Technology
Beijing, China

- Use the right-angle crack reflection method to measure the lateral resolution of ultrasonic transducers.
- Simulate the theoretical sound field distribution, the corresponding line response function and the right-angle crack reflection edge response function.The simulation results are verified by C-scan experiments.
- Use the -6dB intensity threshold to discriminate the ultrasonic C-scan lateral resolution in the amplitude curve.



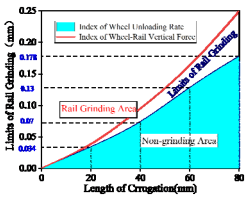
Experimental platform

TP1-7(5) 14:30-14:45

Study on the Safety Limit of Rail Corrugation of Metro Lines

Yukui Wang , Guangtian Shi ,Zhenxin He and Xiaoan Zhang
University of lanzhoujiaotong,Lanzhou, Gansu Province, ChinaTianjin, China

- Using multi-body dynamics simulation software Universal Mechanism(UM)studies the influence of short wave grinding
- By comparing the influence of wave grinding on different linear types on vehicle-orbit dynamics
- The wheel-rail vertical force at the easement curve of outer rail and the wheel unloading rate at the circular curve of inner rail are used as the control index to determine the limit value of rail grinding.



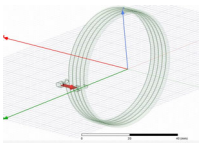
Control limit of railgrinding amplitude

TP1-7(6) 14:45-15:00

Influence of Coil Radius, Distance and Working Frequency on Efficiency in Two-Coil Magnetically Coupled Resonant Wireless Power Transmission System

Kun Li, Haibo Zhao, Lianrong Lv*, Zhuang Sun, Qing Liu, Yankai Shi and Yujie Hua
Tianjin Key Laboratory of Film Electronic and Communication Device, Tianjin University of Technology
Tianjin, China

- The efficiency is an important parameter in the Magnetic Coupling Resonance Wireless Power Transfer (MCR-WPT) system.
- In this paper, the coupling degree between the emitter and receiver coils in an MCR-WPT system is studied with S21 at different radius of coils, working frequency and the distance.



The designed solenoid-shaped coil in HFSS

TP2-1: Medical, Biomedical and Rehabilitation Systems (IV)

Session Chairs: Chunqiu Zhang, Tianjin University of Technology
Xin Wang, Tianjin University of Technology

Conference Room 1, 15:30-17:00, Tuesday, 6 August 2019

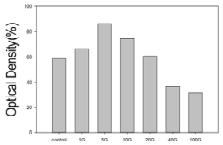
TP2-1(1) 15:30-15:45

Biomechanical Study of MC3T3-E1 Osteoblasts under Hypergravity

Xin Wang, Wenkai Yang, Chunqiu Zhang, Jinduo Ye
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin , China

The growth and proliferation of MC3T3-E1 cells were significantly affected by hypergravity environment.

The cytoskeleton of MC3T3-E1 cells loaded by high gravity was not obvious by AFM(atomic force microscopy).



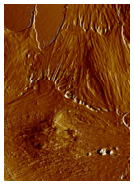
MC3T3-E1 Optical Density

TP2-1(2) 15:45-16:00

Biomechanical Study on Elastic and Viscoelastic Properties of Osteoblasts Using Atomic Force Microscopy

Xin Wang[1,2*], Xiaoshuang Zhang[1,2]
[1] Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
[2] National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- Cell response to external mechanical load play an significant role in multitudinous clinical issues.
- Atomic Force Microscopy is used as quantitative nanoscale biometric tool.
- Cytoskeleton is arranged longitudinally along its long axis and cell morphology is a polygon.
- Significant regional differences in the elasticity and viscoelastic properties of osteoblasts.



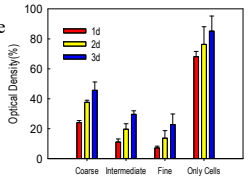
AFM topography of osteoblasts MC3T3-E1

TP2-1(3) 16:00-16:15

Biocompatibility of 3D-printed Titanium Alloy Porous Scaffold using Osteoblasts

Xin Wang[1,2*], Guanwen Han[1,2], Jinduo Ye[1,2], Chunqiu Zhang[1,2]
1 Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2 National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)
Tianjin, China

- In this paper, titanium alloy porous scaffolds were manufactured with three different pore sizes by 3D printing. Surface characterization was performed using SEM for porosity, pore size and wire size.
- Detection of cell growth on titanium alloy samples by MTT.
- The results showed that the samples with large aperture showed enhanced cell viability.



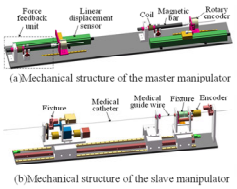
MTT experimental data indicating cell viability

TP2-1(4) 16:15-16:30

Study on Tracking Stability for a Master–slave Vascular Interventional Robotic System

Jian Guo[1], Lei Qi[1], Shuxiang Guo[1,2], Cheng Meng[1] and Qi Zhan[1]
[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 Faculty of Engineering, Kagawa University, Kagawa, Japan

- This paper solved the tracking stability of the master-slave vascular interventional robot system.
- The linear attenuation filter follower circuit enhanced the stability of the master-slave tracking system.
- The Kalman filter algorithm effectively enhanced the stability of the master-slave tracking system.



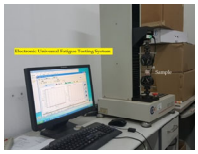
The master-slave manipulators

TP2-1(5) 16:30-16:45

Mechanical Response of Intervertebral Disc Under Cyclic Compression

Chunqiu Zhang*, Tao Zhang, Qing Liu, Chengfei Du, Haiying Liu, Xin Wang
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education(Tianjin University of Technology), Tianjin 300384, China

- Loading displacement of sheep lumbar discs decreases with the increase of the number of cycles.
- Loading and unloading displacements of discs increase with the increase of pressure peak, but decrease with the increase of pressure rate.



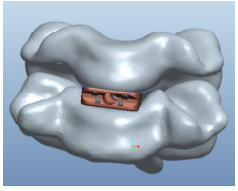
Testing sample and setup

TP2-1(6) 16:45-17:00

Mechanical Test and Stability Study of Cervical Fusion Cage

Ling Chen, Zhi-Wen Nian, Yu-tao Men, Jie Tian
1.Tianjin Key Laboratory of the Design and Intelligent Control of the Advanced Mechanical System 2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, 300384, China

- A new type of fusion cage is designed.
- Making fusion cage model by 3D printing.
- The fusion cage was implanted into animal cervical vertebra and biomechanical experiments were carried out.
- Finite element analysis of fusion cage model.



The Fusion Cage

TP2-2: Mobile Robot System (IV)

Session Chairs: Liwei Shi, Beijing Institute of Technology
Huiming Xing, Beijing Institute of Technology
Conference Room 2, 15:30-17:00, Tuesday, 6 August 2019

TP2-2(1) 15:30-15:45

CFD-based Underwater Formation Analysis for Multiple Amphibious Spherical Robots

Xihuan Hou, Shuxiang Guo, Liwei Shi, Huiming Xing,Yu Liu,
Yao Hu, Debin Xia, Zan Li
Key Laboratory of Convergence Medical Engineering System and Healthcare Technology,
Beijing Institute of Technology, Beijing, China

- Utilize Computational Fluid Dynamics (CFD) to simulate multiple amphibious spherical robots formation.
- Analyze and the drags of every robot and total system in three different formation shapes.
- Provide foundation for decreasing the energy consumption of a multiple robots system.

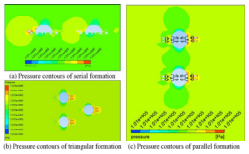


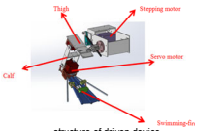
Fig. Pressure contours of three formation shapes

TP2-2(2) 15:45-16:00

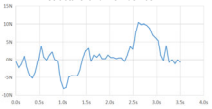
Investigation on Forward Thrust of Bionic Duck's Swimming-fin

Shuxiang Guo, Liwei Shi, Zan Li, Xihuan Hou, Huiming Xing,
Yu Liu, Huikang Liu,Yao Hu,Debin Xia
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

- According to the designed bionic duck's fin structure, two swimming postures are designed to match the fin structure.
- The propulsion force of two swimming postures was measured by force sensor, and the average forward propulsion force of two postures was analyzed.
- The average forward propulsion of the two swimming postures was compared, two strategies for controlling the swimming of bionic ducks were proposed.



structure of driven device



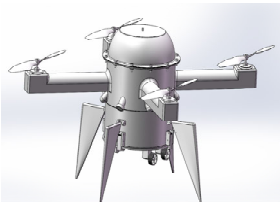
3s period's forward force of swimming mode I.

TP2-2(3) 16:00-16:15

Design of a New Type of Tri-habitat Robot

Jian Guo[1], Kaitian Zhang[1], Shuxiang Guo[1, 2], Chunying Li[1], Xujie Yang[1]
[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 Faculty of Engineering, Kagawa University, Kagawa, Japan

- A new type of tri-habitat robot was designed.
- By analyzing the dynamics of the amphibious robot, the motion mode and mechanism in different environments were studied and designed.
- It could be used in line inspection, aerial photography, military equipment and cluster attack.



The Design of New Tri-habitat Robot

TP2-2(4) 16:15-16:30

Implementation and Performance Assessment of Triphibious Robot

Yiduo Zhu, Tao Li, Ziyi Guo, and Meiling Wang
University of Science and Technology of China
Hefei, China

- Triphibious robot can swim underwater, roll on the land and fly in the air.
- It is composed of rotor institution, cylinder protection mechanism, and waterproof sealing mechanism.
- Performance evaluation was carried out to find out the shortcomings of current research and we can explore further improvement strategies and lay a solid foundation for further research in the future.

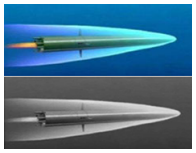
The Triphibious Robot

TP2-2(5) 16:30-16:45

Research on the Image Enhancement Technology of Underwater Image of Supercavitation Vehicle

Zhao Xinhua, Wang Yue, Du Zeshuai, Ye Xiufen
Heilongjiang Province, Harbin Engineering University, School of Automation, 150001

- Image enhancement and edge detection techniques are applied to process the supercavitating images. For the network image, the Roberts edge detection operator with a threshold 100. Finally, based on the edge image, the cavity edge is obtained, and the curve fitting function of Matlab and Excel is used to perform modeling based on polynomial form.



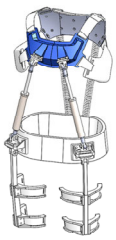
Supercavity network download image and its grayscale image

TP2-2(6) 16:45-17:00

Design of a booster exoskeleton for lumbar spine protection of physical workers

Ming Han, Tiejun Li*, Shijie Wang, Tao Ma and Ningyi Ai
School of Mechanical Engineering, Hebei University of Technology
Tianjin, China

- We designed and manufactured a booster exoskeleton to solve the problem of lumbar painfulness of field workers in construction sites.
- This exoskeleton uses springs to recover the gravity energy to reduce the burden on the lumber.
- This work lays a theoretical and experimental foundation for developing high quality yet massive manufacture booster exoskeleton products.



The Booster Exoskeleton

TP2-3: Signal and Image Processing (IV)

Session Chairs: Xiufen Ye, Harbin Engineering University
Peng Shi, Kagawa University

Conference Room 3, 15:30-17:00, Tuesday, 6 August 2019

TP2-3(1) 15:30-15:45

Design of an Ultrasonic Nondestructive Testing System for Composite Materials

Qinxue Pan, Xiaoyu Xu, Xiaohao Liu, Dingguo Xiao, Ruipeng Pan, Meile Chang, Chang ShaoKey
Lab. of Fundamental Science for National Defense for Advanced Machining Technology
Beijing Institute of Technology
Beijing, China

- Based on ultrasonic nondestructive testing, a set of monitoring system for composite materials was established.
- Aiming at the composite materials, we designed and selected the amplifiers and signal transceivers that can meet the conditions and the ultrasonic wedges of the related materials.
- It is proved by experiments that the system can achieve high detection accuracy for composite materials.

Basic Structure of the System

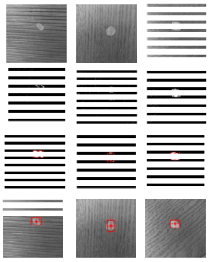
TP2-3(2) 15:45-16:00

Study of Defect Segmentation from a Mode Background Image

Fangfang Han, Fuhua Xie, Baofeng Zhang, Junchao Zhu

Tianjin Key Laboratory for Control Theory and Applications in Complicated Systems, Tianjin University of Technology; Engineering Research Center of Optoelectronic Devices & Communication Technology, Ministry of Education, China

- This paper focuses on the defect segmentation of pattern background image and discusses the defect segmentation of pattern background image in several cases.
- In this paper, the method of removing transverse and longitudinal texture based on wavelet transform and slant texture based on discrete cosine transform is proposed, and the defect of pattern background image is converted into the contrast defect of non-pattern background image, so as to simplify the segmentation algorithm and improve the segmentation speed.



TP2-3(3) 16:00-16:15

A Variable Sampling Compressed Sensing Reconstruction Algorithm Based on Texture Information

Yu Lijun, Zhong Fei, Wang Hui, Zhou Shuai
College of Automation, Harbin Engineering University, Harbin 150001, China

- The proposed algorithm used improved OMP (orthogonal matching pursuit) algorithm to improve the quality of the reconstructed image.
- Compared original and other algorithm, the proposed method can reduce random noise and block effects of the reconstructed image.
- This algorithm improved reconstruction quality at the low sampling rate.

Original image | Algorithm in this paper | OMP | StOMP

TP2-3(4) 16:15-16:30

Adaptive Filtering Fuzzy C-means Image Segmentation with Inclusion Degree

Hui Wang, Shuai Zhou, Lijun Yu and Jinyuan Zhao
College of Automation, Harbin Engineering University, Harbin 150001, China

- The algorithm combines the local pixel neighborhood gray value information to propose a new filtering method to adaptively filter the original image, and introduces the inclusion degree as the second clustering criterion into the clustering process.
- Compared with the traditional FCM algorithm, the segmentation results are improved in both visual quality and segmentation accuracy.

Traditional FCM algorithm | Proposed algorithm

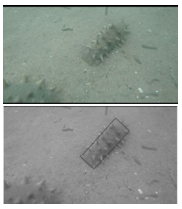
Segmentation result of Gaussian noise image

TP2-3(5) 16:30-16:45

Method for Determining Grasping Position and Angle of Sea Cucumber by Rotatable Bounding Box

Shuguo Xiao, Xiufen Ye*, Hao Chen* and Wenzhi Liu
College of Automation, Harbin Engineering University, Heilongjiang, China

- Improved full convolution image segmentation network model.
- Data setting and data extension.
- Segment and determine the grasping position and angle of sea cucumber.
- Experiments and results analysis.



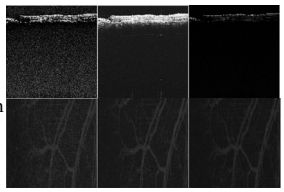
Rotatable Bounding Box

TP2-3(6) 16:45-17:00

The Algorithm based on the Improved Image Intensity Subtraction for the Optical Coherence Tomography Angiography

Yang Zhang, Jie Sun, Yuwen Quan, and Haiwei Zhang
Tianjin University of Technology. Tianjin, China

- We proposed an improved image intensity subtraction OCTA algorithm (IS-OCTA) to improve the contrast image of vasculature network to overcome the limitation in traditional OCTA.
- We performed experiments on mouse's ear to verify the ability of IS-OCTA, and compared with the previous reported algorithms (SC-OCTA and ISUB-OCTA).



Comparison between three intensity-based angiography algorithms: SC, ISUB, and IS

TP2-4: Industrial, Manufacturing Process and Automation (IV)

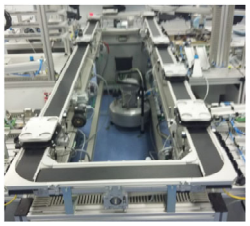
Session Chairs: Tohid Alizadeh, Nazarbayev University
Guilian Wang, Tianjin University of Technology
Conference Room 4, 15:30-17:00, Tuesday, 6 August 2019

TP2-4(1) 15:30-15:45

A hands-on course on mechatronics, based on modular production systems

Tohid Alizadeh, Mohamad Mosadeghzad
Department of robotics and mechatronics, Nazarbayev University
Nur-Sultan, Kazakhstan

- A hands-on course on mechatronics is designed and delivered.
- The course is based on a modular production system from Festo.
- The course covers sensors, electric and pneumatic actuators, PLC systems, and a robotic manipulator.
- Students evaluated the course highly practical and collaborative, compared to the other courses offered.



The conveyor system used in the MPS, used to design a course on mechatronics.

TP2-4(2) 15:45-16:00

Towards Enhancing Modular Production Systems by Integrating a Collaborative Robotic Manipulator

Mohamad Mosadeghzad, Daryn Kalym, Zhassulan Kaliyanurov, Tohid Alizadeh
Department of robotics and mechatronics, Nazarbayev University
Nur-Sultan, Kazakhstan

- A collaborative robotic manipulator is integrated into a modular production system.
- The collaborative manipulator is easy to program and enhances the performance of the overall system.
- A gripper is also designed, implemented and attached to the manipulator.

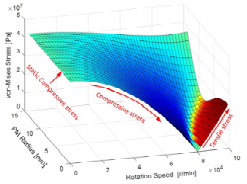
FESTO Modular Production System (MPS) 500 with UR5 manipulator

TP2-4(3) 16:00-16:15

The Rotor Design and Analysis of a High Speed Permanent Magnet Synchronous Motor for Cryogenic Centrifugal pump

Hao Xu, Haipeng Geng, Hao Lin, Yonghong Qi, Xiliang Yin
Key Laboratory for Strength and Vibration of Mechanical Structures.,Xi'an Jiaotong University, China

- Analytical solution of equivalent stress between PM and sleeve during operation is analyzed.
- Interaction of rotational speed and radius on rotor equivalent stress is studied.
- The optimal numerical value of the shrink fit is determined by analyzing the equivalent stress.



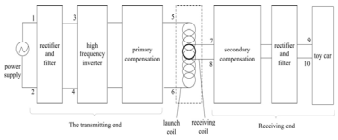
Equivalent Stress of Permanent Magnet

TP2-4(4) 16:15-16:30

Theoretical and Experimental Analysis of Spiral Tiled Combined Wireless Power Supply for Track Based on Electromagnetic Induction

Shitai Ma, Haibo Zhou, Gang Liu, Shoujun Wang, Guilian Wang*
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Education School of Mechanical Engineering,
National Demonstration Center for Experimental Mechanical and electrical engineering
Tianjin University of Technology, Tianjin, China

- A spiral tiled combined electromagnetic induction wireless power supply system is proposed.
- Building a theoretical formula of transmission efficiency of WPT system and analyses the relevant variables.



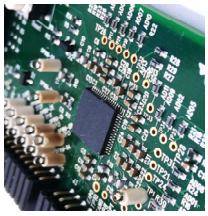
The Construction of WPT System

TP2-4(5) 16:30-16:45

Digitally Controlled Power Supply Design with Continuously Adjustable Input Voltage Based on UCD3138

Zhiqiang Cheng, Tao Lan, Yifei Xie, Jiaqi Fan Huimin Liu* Zijuan Chen and Zengjia Wang
Tianjin Key Lab of Film Electronics and Communication Devices, School of Electrical and Electronic Engineering, Tianjin University of Technology

- The maximum output power of the system is 28W, the output precision is 4 bits, the output ripple is 10mV, the efficiency is 91%, and the no-load power consumption is 2.62W.
- it could realize 24V to 72V DC input, and the output voltage could reach 12V stably.



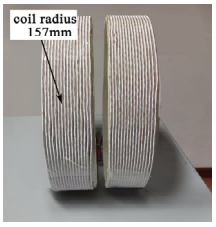
UCD3138

TP2-4(6) 16:45-17:00

Wireless power transmission system via magnetic resonance coupling platform

YuLing Ye1, ChongSen Peng1, YiZhang Wang1, JunLi Chen2, etc.
1. State Key Laboratory of Power Transmission Equipment & System Security and New Technology(Chongqing University), Chongqing, China
2. Chongqing Vehicle Test &Research Institute Co. Ltd

- Study the influence of coil radius, coil turns, and coil wire diameter on the output power and transmission efficiency of the system,and realize the design of coil parameters under constraint conditions
- Under the condition of the coil radius is 157mm, the number of coil turns is 16 turns, and the wire diameter is around 3.65mm. The output power is 309.8W and the transmission efficiency is up to 80%.



The Coil

TP2-5: Intelligent Mechatronics and Application (IV)

Session Chairs: Lianyu Zhao, Tianjin University of Technology
Wei Zhou, Beijing Institute of Technology

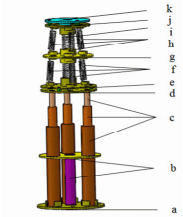
Conference Room 5, 15:30-17:00, Tuesday, 6 August 2019

TP2-5(1) 15:30-15:45

Design and Kinematics Analysis of Modular Soft Robot with Two-stage Driven Mechanism

Weimin Ge, Zhijie Pan and Haozhi Mu
School of Mechanical Engineering, Tianjin University of Technology
Tianjin, China

- The mechanism including expansion module and flexural module.
- Expansion rate can reach 50%, and can provide greater driving force, bending module bending angle can reach 70° .
- By means of screw theory, the kinematic equation of the mechanism is derived.
- the relationship between the current and the deformation of SMA springs can be obtained.



3D model of the modular soft robot with two-stage driven mechanism

TP2-5(2) 15:45-16:00

A Step-wise Feature Selection Scheme for a Prognostics and Health Management System in Autonomous Ferry Crossing Operation

Xu Cheng, Andre Listou Ellefsen, Guoyuan Li, Finn Tore Holmeset, Shengyong Chen, Houxiang Zhang
Tianjin University of Technology, Tianjin, China
Norwegian University of Science and Technology, Aalesund, Norway

- A novel step-wise feature selection scheme for prognostics and health management (PHM) system in autonomous ferries is proposed.
- Pearson correlation analysis to reduce the redundant information among sensors.
- Sensitivity analysis is applied to identify the importance of sensors.

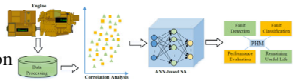


Illustration of step-wise feature selection

TP2-5(3) 16:00-16:15

Pitch Motion Control of a Soft Bionic Robot Fish Based on Centroid Adjustment

Weiping Shao and Chunquan Xu*
Department of Control Science and Engineering, Tongji University
Shanghai, China

- Smart materials made soft bionic robot fish.
- Pitch motion control based on a centroid adjustment mechanism.
- PID based pitch motion control algorithm.

The Robot Fish

TP2-5(4) 16:15-16:30

Research on Joint-Assisted Exoskeleton Control System of Lower Extremity in Active Spacesuit

Zhaoyang Li, Junyao Wang, Shengyong Yan, Peipeng Hao, Peng Tang, Yuehong Dai
University of Electronic Science and Technology of China
Chengdu, China

- Mechanical Structure of The Joint-Assisted Exoskeleton Robot;
- Kinematics and Dynamic Analysis of Lower Extremity Joints;
- Resistance Torque of Preisach model in Active Spacesuit;
- Traditional CTC Method Based on PD Feedback;
- RBF Neural Network Control Based on CTC Method;

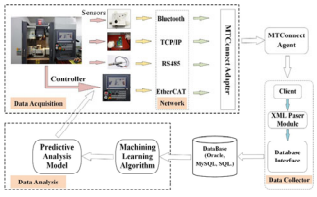
The Joint-Assisted Exoskeleton

TP2-5(5) 16:30-16:45

Application of Big Data Processing Method in Intelligent Manufacturing

Yao Xiao, Qiang Liu
School of Mechanical Engineering and Automation, Beihang University
Beijing, China

- Developing data sensing and acquisition system
- Building data transmission and storage system
- Constructing BP neural network model of power estimation



System overall architecture

TP2-5(6) 16:45-17:00

Path Planning of Sand Blasting Robot based on improved RRT Algorithm

Lianyu Zhao, Jianpeng Liu,Jutao Wang
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin, 300384, China
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, 300384, China

- Discuss the advantages and disadvantages of the rrt algorithm.
- Proposed an improved trajectory planning algorithm for sand blasting robot.
- Simulated experiments with improved algorithms to verify their feasibility and their advantages and disadvantages.

Sand Blasting Robot

TP2-6: Control Theory and Application (VII)

Session Chairs: Hakan Temeltas, Istanbul Technical University
Yeye Liu, Harbin Engineering University

Conference Room 6, 15:30-17:00, Tuesday, 6 August 2019

TP2-6(1) 15:30-15:45

Multi-Robot Collaborative Coverage Under Localization Uncertainty

Mert TURANLI, Hakan TEMELTAS
Robotics Lab., Istanbul Technical University, Istanbul, Turkey

- A new concept for coordination of mobile agents is defined..
- The Guaranteed Power Voronoi Diagrams take positioning uncertainties of the agents into account.
- The adaptive coordination algorithm is represented.
- Simulation and Experimental results are presented.

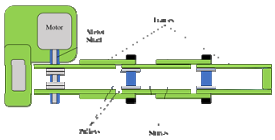
Experimental set up

TP2-6(2) 15:45-16:00

Comprehensive Modeling and Optimal Control of an Anthropomorphic Mechatronic Prosthetic Hand

Muhammad Tallal Saeed[1+], Sardor Khaydarov[2+], Biniam Legesse Ashagre[3+], M. S. Zafar[4#]
+Department of Intelligent Systems and Control Engineering, Beihang University, Beijing, China
#Department of Computer Science and Engineering, Beihang University, Beijing, China

- Introduction
- Structural Details of Robotic Hand
- Mathematical Modeling of Robotic Hand using Bond Graph
- Optimal LQR and H_2 Controller Design and Analysis
- Conclusion

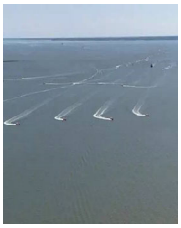


TP2-6(3) 16:00-16:15

Research on Multi-USV Cooperative Search Method

Xiaogong Lin, Yeye Liu
College of Automation, Harbin Engineering University
Harbin, China

- A pheromone-based multi-USV search method is proposed to search target USV in unknown environment.
- The motion model, collision type and communication mode of multi-USV system are analyzed.
- On this basis, the fitness function is established



Multi-USV Cooperative

TP2-6(4) 16:15-16:30

Research on Thrust Allocation Optimization with Main Propeller-rudder Based on Improved Genetic Algorithm

Guoqing Xia , Pengfei Sun and Binyuan Xia
Department of Automation ,Harbin Engineering University
Harbin, China

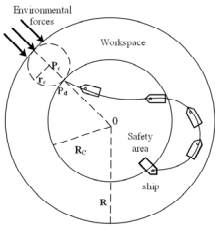
- This paper presents a method to deal with the non-convex thrust region of main propeller-rudder, which is divided into several non-convex regions.
- In view of the shortcomings of genetic algorithm, this paper improves the genetic algorithm.
- The optimal solution obtained from the last sampling time will be inherited to the next sampling time.

TP2-6(5) 16:30-16:45

Optimal Area Keeping Control for USV based on Minimum Energy Consumption

Mingyu Fu, Zhiyi Liu, Yujie Xu
College of Automation, Harbin Engineering University
Harbin, China

- deal with the area keeping control problem for USV
- a novel discontinuous area keeping control strategy based on minimum energy consumption.
- a discontinuous control area keeping strategy.
- simulation results show that the proposed controller can guarantee the USV working in the prescribed area while energy consumption of the propeller can also be reduced.



Schematic diagram

TP2-6(6) 16:45-17:00

Research on Adaptive Control of Four-Rotor Aircraft Posture Stability

Pang Jia yuan
Zhonghuan Information College Tianjin University of Technology
Tianjin, China

- Discussing the background and necessity to study the Four-Rotor Aircraft Posture Stability.
- Establishing the nonlinear mathematical model and linearizing it by the method of LVP.
- Designing the PID+MRAC controller which can eliminate the influence of the uncertainty of the parameters of the vehicle.

Four-Rotor Aircraft

TP2-7: Modeling, Simulation Techniques and Methodologies (IV)

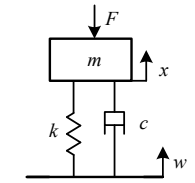
Session Chairs: Jin Li, Harbin Engineering University
Yili Fu, Harbin Institute of Technology
Conference Room 7, 15:30-17:00, Tuesday, 6 August 2019

TP2-7(1) 15:30-15:45

Review on the Development and Applications of Vibration Isolators

Wei Chen, Zhen Qin, and Xuping Zhang
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384,China.
Department of Engineering, Aarhus University, Aarhus, Denmark.

- Firstly, the basic principle of vibration isolator is overviewed.
- Then, this paper summarizes the classification and the research methods of vibration isolators.
- In the end, the applications of vibration isolators are introduced, including suspension system, semiconductor industry, machine tools, microscopes and parallel mechanism.



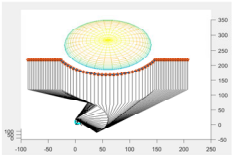
Vibration Isolation System

TP2-7(2) 15:45-16:00

A general method to solve inverse kinematics of spherical wrist manipulators

Jiajing Wei, Minghe Jin, Yechao Liu
State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, Heilongjiang Province, China

- Closed method and numerical method.
- Decoupling of position and attitude.
- Using Newton's method to get the last three joint.
- Using the attitude matrix to get the first three joint variables.
- Three case studies.

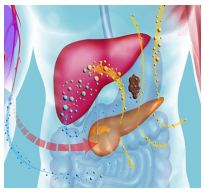

Visulation of inverse kinematic

TP2-7(3) 16:00-16:15

Related Factors and Risk Prediction of Type 2 Diabetes Complicated with Liver Cancer

Hui Chen, Yi Xin, Yuting Yang, Fei li, Guoliang Cheng and Xinxin Zhang
Beijing Institute of Technology ,Beijing 100081,China

- Model 1: a comparison of T2DM combined liver cancer patients and T2DM combined other cancer patients.
- Model 2: a comparison of T2DM combined liver cancer patients and T2DM patients without cancer
- Modeling and classification : the logistic multivariate regression model with a stepwise forward conditional method.
- Gender, aspartate aminotransferase, γ-glutamic transfer, triglyceride, and high-density lipoprotein cholesterol are specific factors for liver cancer in diabetes

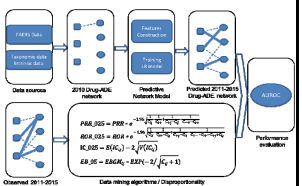

Pancreas and Liver

TP2-7(4) 16:15-16:30

A Comparison of Methods of Data Mining Algorithms Directed Predictive Pharmacosafety Networks for Adverse Drug Event Detection

Xiangmin Ji1,2, Liyan Hua1, Xueying Wang1, Yunfei Zhang2 and Jin Li1*
1.College of Automation, Harbin Engineering University, Heilongjiang, China
2. Ordos Institute of Technology Ordos, Inner Mongolia, China

- Data mining algorithms directed predictive pharmacosafety networks (DPA-PPNs).
- Data processing.
- Combination between DPA and PPNs.
- Experiments and results analysis.

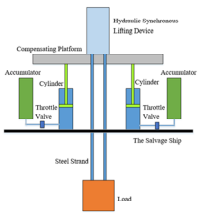

The detailed description of DPA-PPNs

TP2-7(5) 16:30-16:45

Research on Passive Heave Compensation System for Synchronous Lifting and Salvage of Shipwreck

Xu Jianan, Zheng Shanglong, Zhan Yong, Liu Jing
Marine Electromechanical Systems Research Institute, Harbin Engineering University, Harbin ,China

- A PHC system is designed and its mathematical model is developed from the perspective of vibration theory.
- A set of parameters were designed for simulation and result shows the compensation efficiency is 72.67%.
- The effects of different parameters were studied by simulation, including the gas volume, the size of pipe, and the valve opening of the throttle valve.



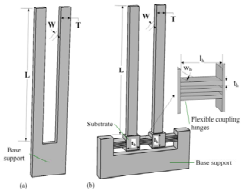
The PHC System Model

TP2-7(6) 16:45-17:00

Impact of Inter Tine Coupling on the Spring Constant of the Quartz Tuning Fork

Sajid Parveez, Danish Hussain and Usman Asad
Mechatronics Engineering, College of E & ME, National University of Sciences & Technology Islamabad, Pakistan

- We have investigated the impact of coupling spring constant (k_c) on the eigenfrequencies, k_{eff} ,TF sensitivity and proposes new design.
- The results show that by changing geometry of hinges, we can reduce the k_c as well as k_{eff} which can enhance the TF sensitivity.
- For lower k_c and higher sensitivity We need coupling hinges with small length and relatively higher width and thickness.



(a) Standard Quartz Tuning Fork. (b) Schematic view for proposed design of QTF.

Wednesday
August 7, 2019

Morning Sessions

WA1-1	Medical, Biomedical and Rehabilitation Systems (V)
WA1-2	Medical Robots for Minimal Invasive Surgery (I)
WA1-3	Signal and Image Processing (V)
WA1-4	Elements, Structures, and Mechanisms (I)
WA1-5	Robot Navigation and Control Algorithm (I)
WA1-6	Biomimetic Underwater Robots
WA2-1	Intelligent Control Strategies and Algorithms
WA2-2	Medical Robots for Minimal Invasive Surgery (II)
WA2-3	Signal and Image Processing (VI)
WA2-4	Elements, Structures, and Mechanisms (II)
WA2-5	Robot Navigation and Control Algorithm (II)
WA2-6	Rescue Robots and Field Robot Systems

WA1-1: Medical, Biomedical and Rehabilitation Systems (V)

Session Chairs: Yi Liu, Kagawa University
Yan Zhao, Beijing Institute of Technology

Conference Room 1, 8:30-10:00, Wednesday, 7 August 2019

WA1-1(1) 8:30-8:45

Performance Evaluation of a Powered Variable-stiffness Exoskeleton Device for Bilateral Training

Yi Liu, Shuxiang Guo and Ziyi Yang
Guo Lab., Kagawa University
Kagawa, Japan

- The integrated variable stiffness actuator can achieve appropriate power assistance in accordance with the specific impairment level of the patient's upper limb
- The proposed bilateral training method can allow the exoskeleton device to smoothly drive the user's right arm to follow the movements of his left arm.

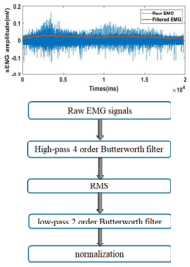
Physical Prototype

WA1-1(2) 8:45-9:00

EMG-based Continuous Prediction of the Upper Limb Elbow Joint Angle Using GRNN

Shuxiang Guo, Ziyi Yang, and Yi Liu
Department of Intelligent Mechanical Systems Engineering, Graduate School of Engineering, Kagawa University
Takamatsu, Japan

- Use electromyograph (EMG) signals from the biceps to predict the upper limb elbow joint angle
- General Regression Neural network (GRNN) is implemented to map the relationship between the real angle and EMG signals
- The best performance of the proposed method is no more than 5% error rate.

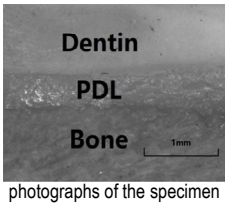


WA1-1(3) 9:00-9:15

Research on Stress-Relaxation Property of Different Layers PDL under Compression

Jinlai Zhou1,2, Yang Song • 1,2, Xue Shi3, Chenguang Xu1,2
1. Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2. National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)
3. Periodontitis Department, Tianjin Stomatological Hospital, Tianjin 300041, China

- PDL is a kind of viscoelastic solid biological material with nonlinear and anisotropic mechanical characteristics
- The fitting accuracy of generalized maxwell model is higher than that of zener model
- A method for preparing PDL specimens



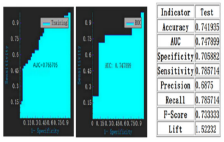
photographs of the specimen

WA1-1(4) 9:15-9:30

In Non-small Cell Lung Cancer, Can Radiomic Features Predict EGFR Mutations?

Jiayan Liu,Lin Liu ,Yue Ma,Kaiming Xue,Zhe Zhou,Mengchao Zhang.
Department of Radiology,China-Japan Union Hospital of Jilin University
Changchun, Jilin Province, China

- It is very important to identify EGFR mutations for targeted therapy of non-small cell lung cancer(NSCLC).
- 170 patients with NSCLC who received surgery-based treatment were included in this retrospective study.
- EGFR mutation status can be predicted well by radiomic features.



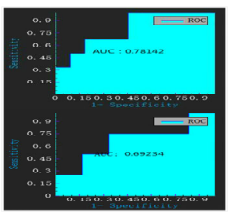
our results

WA1-1(5) 9:30-9:45

Application of CT texture analysis in predicting preoperative Lauren classification of gastric cancer

Kaiming Xue, Lin Liu, Zhe Zhou, Yue Ma, Jiayan Liu, Mengchao Zhang
Department of Radiology, China-Japan Union Hospital Of JiLin University
Changchun, China

- To explore the application of CT texture analysis in predicting Lauren classification of gastric cancers.
- Establishment of prediction model by radiomics for analysis.
- CT texture analysis held great potential in predicting Lauren classification of gastric cancers.



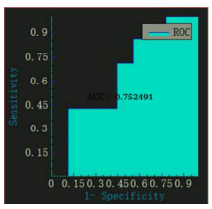
Testing Data's ROC Graph

WA1-1(6) 9:45-10:00

Prediction of benign and malignant thymic tumors based on radiomics features

Yue Ma,Lin Liu,Jiayan Liu,Kaiming Xue,Zhe Zhou,Mengchao Zhang
Department of Radiology, China-Japan Union Hospital of Jilin University
Changchun,China

- We analyze the CT image data of 100 patients with pathologically confirmed thymic tumors and find relevant radiomics features to establish a prediction mode.And it has good diagnostic efficacy in differentiating benign from malignant thymoma.
- The accuracy and specificity of the model in the test set were 82.4% and 88.9%.



The area under ROC curve (AUC) of test set

WA1-2: Medical Robots for Minimal Invasive Surgery (I)

Session Chairs: Xin Wang, Tianjin University of Technology
Lingling Zheng, Kagawa University

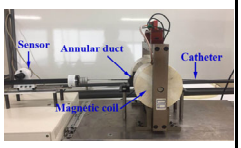
Conference Room 2, 8:30-10:00, Wednesday, 7 August 2019

WA1-2(1) 8:30-8:45

Preliminarily Design and Evaluation of Tremor Reduction Based on Magnetorheological Damper for Catheter Minimally Invasive Surgery

Lingling Zheng[1], Shuxiang Guo[2,3], and Linshui Zhang[1]
[1]Faculty of Engineering and Design, Kagawa University, Takamatsu, Kagawa 761-0396, Japan
[2]Department of Intelligent Mechanical Systems Engineering, Kagawa University, Takamatsu, Kagawa 761-0396, Japan
[3]Key Laboratory of Convergence Medical Engineering System and Healthcare Technology, Beijing Institute of Technology, Haidian District, Beijing 100081, China

- When a surgeon operates performs surgeries with tremor, the operational accuracy will be seriously affected.
- The tremor suppression is introduced into the robot-assisted invasive surgery to reduce the surgeons' tremor.
- A novel method using magnetorheological damper is proposed, and its performance is preliminarily evaluated by simulation.



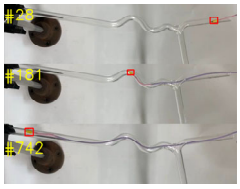
Master manipulator

WA1-2(2) 8:45-9:00

Guidewire Tracking based on Visual Algorithm for Endovascular Interventional Robotic System

Peng Shi[1], Shuxiang Guo[1,2], Linshuai Zhang[1], Xiaoliang Jin[1], Dapeng Song[1] and Weihao Wang[1]
[1]Department of Intelligent Mechanical Systems Engineering Faculty of Engineering and Design, Kagawa University, Takamatsu, Japan.
[2]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, Beijing, China.

- Use the visual-based tracking method to assist the operator in guidewire positioning.
- The experimental results show that the ratio of frames with the center location error less than 5 pixels is 97.6% in two designed task, and the average processing speed for each frame is 1.24ms.



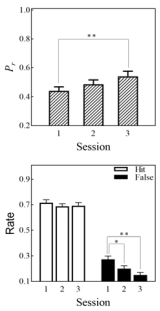
Tracking performance

WA1-2(3) 9:00-9:15

Tactile Training Improvement of Same-orientation but Not Different-orientation Discrimination

Wu Wang, Jiajia Yang, Yinghua Yu, Qiong Wu, Qingqing Li, Jiabin Yu, Satoshi Takahashi, Yoshimichi Ejima, Jinglong Wu
Cognitive Neuroscience Lab, Okayama University, Okayama, 7008530, Japan.

- Recognition ability of the tactile orientation discrimination task could improve with consecutive training.
- This improvement results from an increase in the number of correct responses to the same orientations, while the floor effect occurred in the task of distinguishing the different orientations.
- Training can only improve tactile discrimination ability, but cannot make human beings break through the limit. Therefore, physiological limits should be considered in relevant training tasks.

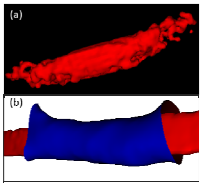


WA1-2(4) 9:15-9:30

Blood Flow Simulation of Virtual Simulation System for Vascular Interventional Surgery

Baofeng Gao[1], Lamei Shang[1], Xiaojuan Cai[1], Yuhua Jiang[2], Shu Yang[2]
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,
2 Beijing Tiantan Hospital
Beijing, China

- Use SPH method to simulate the flow of blood.
- Use the Marching Cube method to render the physical model.
- Achieve blood flow in blood vessels.



Blood flow and blood flow in blood vessels

WA1-2(5) 9:30-9:45

Position-Free Hand Gesture Recognition Using Single Shot MultiBox Detector Based Neural Network

Jingwei Tang[1,2], Xingtian Yao[1], Xin Kang[2], Shun Nishide[2] and Fuji Ren[2]
[1]School of Mechanical Engineering, Nantong University
Nantong, China
[2]Faculty of Engineering, Tokushima University
Tokushima, Japan

- Noncontact human-computer interaction.
- Use only monocular camera.
- New way for hand gesture recognition.

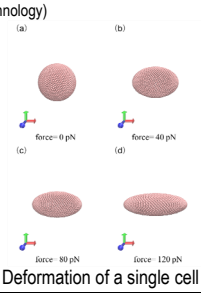
Sample of Experience Result

WA1-2(6) 9:45-10:00

Dissipative Particle Dynamics Simulation on Cells Deformation under Tensile Loading

Xin Wang[1,2*], Yandong Qu[1,2]
1 Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin 300384, China
2 National Demonstration Center for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- Dissipative Particle Dynamics (DPD) is used to establish a discrete three-dimensional cell mechanics model in suspension state to study cell morphology remodeling under tension load, and to analyze its mechanical properties
- The greater the tension, the greater the degree of deformation of cells. When the simulation step is fixed, the stretching time of the cells becomes longer and longer with the increase of the stretching force.



Deformation of a single cell

WA1-3: Signal and Image Processing (V)

Session Chairs: Enzeng Dong, Tianjin University of Technology
Dongdong Bu, Beijing Institute of Technology

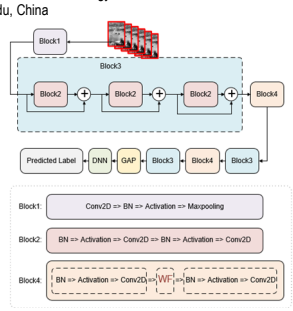
Conference Room 3, 8:30-10:00, Wednesday, 7 August 2019

WA1-3(1) 8:30-8:45

Deep CNN Framework for Environmental Sound Classification using Weighting Filters

Baolong Tang, Yuanqing Li, Xuesheng Li, Limei Xu, Yingchun Yan and Qin Yang
University of Electronic Science and Technology of China
Chengdu, China

- An algorithm named Weighting Filters(WF) based on Dropout is proposed.
- An CNN-based framework with WF(CNN-WF) is designed to classify environmental sound.
- Simulation results on ESC-50 have verified that WF is an effective way to improve the accuracy of the classification model.



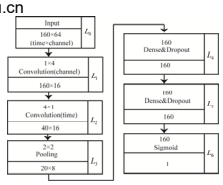
Construction of CNN-WF

WA1-3(2) 8:45-9:00

A Convolutional Neural Network based on Batch Normalization and Residual Block for P300 Signal Detection of P300-speller System

Zhaohua Lu[1], Qi Li[1,*], Ning Gao[1], Taiyue Wang[1], Jingjing Yang[1], and Ou Bai[2]
1 School of Computer Science and Technology, Changchun University of Science and Technology, Changchun 130022, P.R. China
2 Department of Electrical and Computer Engineering, Florida International University, Miami 33174, USA
*: liqi@cust.edu.cn

- P300 signal and Experimental data.
- CNN model, BN-RB model
- The architecture of classical CNN model
- The architecture of BN-RB model.
- The results and analysis



The architecture of classical CNN model for P300 detection

WA1-3(3) 9:00-9:15

An Improved Struck Tracking Algorithm Based on Scale Adaptation and Selective Updating

Enzeng Dong, Mengtao Deng, Jigang Tong
Complex System Control Theory and Application Key Laboratory School of Electrical and Electronic Engineering, Tianjin University of Technology
Tianjin, China

- Introduction
- Basic theory of Structured SVM tracker
- The selective updating ASMS-Struck tracker
- Experiment result and analysis

Tracking results on "Tiger1"

WA1-3(4) 9:15-9:30

State and Parameter Estimation Algorithm for State Space Model Based on Linear Neural Network and Kalman Filter

Yuhang Yang, Ying Shi
College of Electronic Engineering, Heilongjiang University,
Harbin, China

- In this paper, based on Kalman filter and Linear Neural Network, state and parameter estimation problem are researched for a controlled state space system with unknown model parameters.
- A computer simulation illustration is given to verify the availability of the presented algorithm.

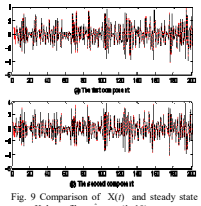


Fig. 9 Comparison of $X(t)$ and steady state Kalman filter $\hat{x}_{(t|t)}$ $(k=10)$

WA1-3(5) 9:30-9:45

An Improved SSD Algorithm and Its Mobile Terminal Implementation

Enzeng Dong, Yao Lu , Shengzhi Du
Complex System Control Theory and Application Key Laboratory
Tianjin University of Technology (TJUT) ,Tianjin, China

- Firstly, the Improved SSD algorithm improves the detection speed and reduces the memory footprint on the basis of ensuring the detection accuracy.
- Secondly, the Improved SSD algorithm can basically achieve real-time target detection at the mobile end.

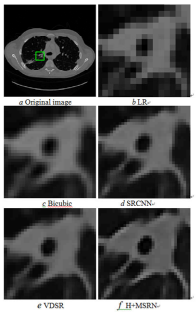
Detection effect

WA1-3(6) 9:45-10:00

Low-dose CT image super resolution using a model-based framework

Lei Sun, Shijie Guo
Tianjin Key Lab., Tianjin University of Technology
Tianjin, China

Improve low-dose CT(LDCT) imaging quality is a hot research issue in the medical imaging field. However, current image post-processing method mainly focus on denoising, ignoring the limitations of image resolution. To this end, a new model-based LDCT image super resolution based on CNN prior is proposed in this paper. Meanwhile, the Half Quadratic Splitting (HQS) algorithm is selected to accelerate high resolution LDCT calculation process. The convolutional neural network(CNN) prior is pre-trained and integrated into the HQS algorithm to regularize the model-based LDCT SISR problem. Experimental results demonstrate that our method can improve the resolution of low-dose CT images effectively.



WA1-4: Elements, Structures, and Mechanisms (I)

Session Chairs: Jun Liu, Tianjin University of Technology
Zixu Wang, Kagawa University

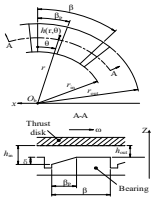
Conference Room 4, 8:30-10:00, Wednesday, 7 August 2019

WA1-4(1) 8:30-8:45

Theoretical and Numerical Analysis on the Load Capacity of Hydrodynamic Thrust Bearings with Fourier Series Decomposition

Baisong Yang, Sheng Feng, Jiale Tian and Lie Yu
State Key Laboratory for Strength and Vibration of Mechanical Structures
Xi'an Jiaotong University, Xi'an, Shaanxi, China

- In any the circumferential cross sections, the number of local maxima and local minima of the k-th order of pressure composite $P_{0,k}$ is k.
- In any radial direction section, $P_{0,k}$ has only one local extreme value.
- As the harmonic order k increases, the amplitude of $P_{0,k}$ also becomes smaller.
- This is also directly reflected in its contribution to the static bearing capacity.



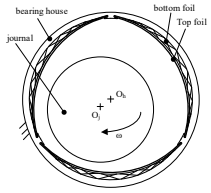
thrust bearing

WA1-4(2) 8:45-9:00

Research on the Static Performance of Multi-Cantilever Foil Bearing with the Fully Coupled Elastic Hydrodynamic Solution

Baisong Yang, Sheng Feng, Jiale Tian and Lie Yu
State Key Laboratory for Strength and Vibration of Mechanical Structures
Xi'an Jiaotong University, Xi'an, Shaanxi, China

- With the increasing of eccentricity, the load capacity of the bearing is increased.
- The method proposed in this paper perfect solves the problem of the coupling between the top foil deformation and its Reynolds equation which greatly facilitates the solution of the elastohydrodynamic coupling solution.



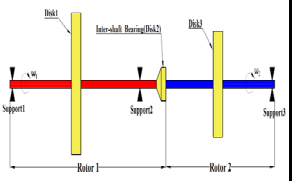
Scheme of the multicantilever foil bearing

WA1-4(3) 9:00-9:15

Modeling and Coupled Vibration Analysis of Two-Span Series Dual-Rotor System

Jun Liu, Ruiguo Zhu, and Weimin Ge
1. Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, Tianjin 300384, China
2. National Demonstration Centre for Experimental Mechanical and Electrical Engineering Education (Tianjin University of Technology)

- The vibration equations of each rotor are established based on the Lagrange equation.
- The vibration characteristics and the influence of the inter-shaft bearing on coupled vibrations of rotors are investigated systematically.
- The coupled vibration response characteristics of the series dual-rotor system are studied.



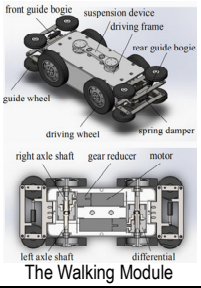
Two Span Series Dual Rotor System

WA1-4(4) 9:15-9:30

Mechanism Design and Curve Passing Performance Research on Walking Module of Orbital Cable Pipe Gallery Inspection Robot

Jianjun Ke, Yingqiu Xu, and Ruiming Qian
School of Mechanical Engineering, Southeast University
Nanjing, China

- Introduce running condition analysis of the walking module and its mechanism design.
- Propose the influence of bogie on the curve passing performance of the robot walking module.
- Detail the dynamic model of the walking module over the curved track and analyze the stability of the system.
- Build the dynamic model in ADAMS and analyze the simulation results.



The Walking Module

WA1-4(5) 9:30-9:45

Study on Mechanism of Shaft Fault Suppression Based on Squeeze Film Damper

Jun Liu , Meiling Wang , Haozhi Mu
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, Tianjin University of Technology, Tianjin , China

- Considering the action of the SFD, based on Lagrange equation, the dynamic model of a rotor-rolling bearing system with the rub-impact fault and the SFD was established by using the finite element method.
- The Newmark method was used to solve equations of the model.
- Study the influence of a key parameter of SFD (the oil film clearance) on the dynamic response of rotor system under rub-impact fault.

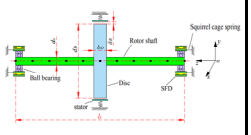


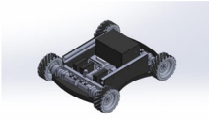
Fig.1 Dynamic model of rotor-rolling bearing system with rub-impact fault and the SFD

WA1-4(6) 9:45-10:00

Analysis of Intelligent Vehicle Climbing Force and Battery Selection

Lianyu Zhao, Zhenghan Jin
1.Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control, School of Mechanical Engineering, Tianjin University of Technology, Tianjin, China
2.National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, China
3. Tianjin Municipal Key Laboratory for Precision Parts Manufacturing and Non-standard Equipments Manufacturing Technology Enterprises, Tianjin, China

- A Wheelchair Base Intelligent Vehicle affiliations.
- Analysis of the Force on Vehicle's Climbing and Staying on the Slope.
- Finite Element Analysis of the Effect of Battery Quality on Welding Frame.



Intelligent Vehicle

WA1-5: Robot Navigation and Control Algorithm (I)

Session Chairs: Huiming Xing, Beijing Institute of Technology
Liang Zheng, Kagawa University

Conference Room 5, 8:30-10:00, Wednesday, 7 August 2019

WA1-5(1) 8:30-8:45

Vision-based Waypoints Tracking Control for an Amphibious Spherical Robot

Yao Hu, Liwei Shi, Shuxiang Guo, Huiming Xing, Xihuan Hou, Yu LiuHuikang Liu, Debin Xia, Zan Li
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

- we propose a method for locating underwater robots using computer vision.
- we carried a waypoints tracking experiment to verify the performance of this method on amphibious spherical robots.
- The result shows that the trajectory tracking error does not exceed 0.2m.

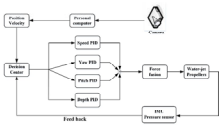
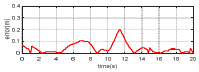


Diagram of Waypoints Tracking Control



Trajectory tracking error

WA1-5(2) 8:45-9:00

Adaptive Sliding Control for Lower Exoskeleton Robot Driven by The Series Elastic Actuator

Shuqiao Chen, Jianghai Zhao, Zhipeng Yu
the Department of Automation., University of Science and Technology of China
Hefei, China

- **The purpose of this paper is to design a control method for elastic actuation of the lower exoskeleton robot, which can enhance performance of the human-machine interactive system and assistant human walking steadily.**
- **Take full account of the uncertainties in both robotic exoskeleton dynamics and SEA dynamics, therefore we proven the stability of the proposed controller which could enable to ensuring the safe of human-machine interaction by applying the Lyapunvo method.**
- **An experiment has been conducted and presented for illustrating the reliability and security of the proposed controller.**

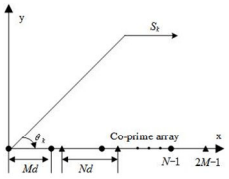
Lower Exoskeleton Robot Driven by The Series Elastic Actuator

WA1-5(3) 9:00-9:15

Particle filter algorithm for underwater acoustic source DOA tracking with co-prime array

Feibiao Dong, Limei Xu, Xuesheng Li, Shihao Wang ,and Xiaomei Xie
Department of Aeronautics and Astronautics, University of Electronic Science and Technology of China

- The problem of direction of arrival (DOA) tracking based on the co-prime array is studied.
- The framework of particle filter is adopted to cope with DOA tracking .
- Spatial smoothing MUSIC .
- Enhanced likelihood function.



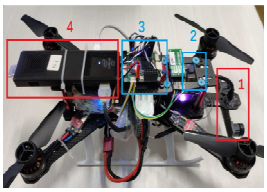
DOA tracking with co-prime array

WA1-5(4) 9:15-9:30

Real-time Indoor Navigation of UAV Based on Visual Delay Compensation

Jian Li,Shaokai Xu,Yanmin Liu,Xiangdong Liu,Zhen Li
School of Automation Beijing Institute of Technology, Beijing, China

- Use a variant of ICP to estimate the delay between inertial data and visual data.
- Use pre-integration,the corrected inertial data are integrated to compensate the visual delay.
- EKF is used to fuse position information.
- The method of visual delay compensation is used in a UAV platform,the position error merely is 15.69% of the raw visual.



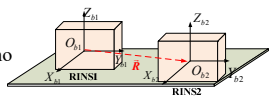
The UAV experimental platform

WA1-5(5) 9:30-9:45

An Improved Calibration and Compensation Method for Lever-arm Errors between Two Rotational Inertial Navigation Systems

Qi Wu, Kui Li and Wenwei Liang
School of Instrumentation and Optoelectronic Engineering, Beihang University
Beijing, China

- The improved method and model is distinct with the traditional acceleration errors.
- Use angular velocity merely and no longer use angular acceleration information of the carrier.
- The improved method is more convenient and accuracy in actual applications.



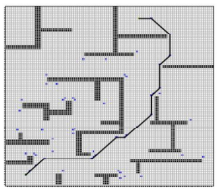
The Lever-arm Errors between two RINSs

WA1-5(6) 9:45-10:00

Improved JPS Algorithm Using New Jump Point for Path Planning of Mobile Robot

Xue Zheng, Xiaowei Tu, Qinghua Yang
Department of Mechatronic Engineering and Automation, Shanghai University
Shanghai, China

- This paper presents a new search algorithm for path planning.
- The different effects of SD-JPS and A*algorithm on the number of search nodes, planned routes and planning time are also studied.
- Simulation results show that SD-JPS can obtain different safety distances, shorter time,good sensitivity in complex environments.



Jump Point Search Algorithm

WA1-6: Biomimetic Underwater Robots

Session Chairs: Ruochen An, Kagawa University
Xihuan Hou, Beijing Institute of Technology

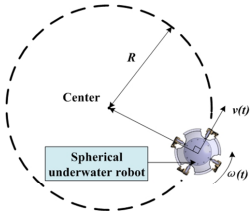
Conference Room 6, 8:30-10:00, Wednesday, 7 August 2019

WA1-6(1) 8:30-8:45

Turning Locomotion Analysis and Performance Evaluation for a Spherical Underwater Robot

Shuoxin Gu, Shuxiang Guo, Liang Zheng, Ruochen An
Graduate School of Engineering, Kagawa University, Takamatsu, Kagawa 761-0396, Japan

- Propose the novel spherical underwater robot;
- Analyze the turning radius of the SUR IV;
- Experiments of the turning locomotion of the SUR IV as clockwise and anticlockwise;
- The experimental results show that various turning radius of the SUR IV.



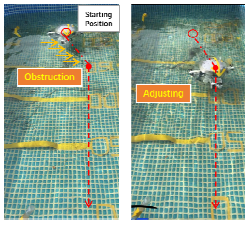
Turning locomotion model for SUR IV

WA1-6(2) 8:45-9:00

Improvement and Evaluation for the Stability of Mobile Spherical Underwater Robots (SUR III)

Ruochen An, Shuxiang Guo, Shuoxin Gu, Liang Zheng
Kagawa University, Takamatsu, Japan

- Collaboration ability and stability of the Spherical Underwater Robots (SUR III)
- A certain offset occurs of SUR III under the disturbance of the wind
- Control system for the third-generation spherical underwater robot (SUR III)
- PID control



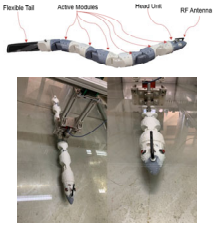
Straight forward motion

WA1-6(3) 9:00-9:15

Performance Study of an Underwater Snake-like Robot with a Flexible Caudal Fin

Zhong Huang, Detian Kong, Chao Ren, Shan Li, and Shugen Ma
School of Electrical and Information Engineering,
Tianjin University, Tianjin, China

- An underwater snake-like robot prototype with a caudal fin is introduced.
- Study the influence of various parameters on the performance of the underwater snake-like robot's thrust.
- Find out the relationship between these various parameters and the thrust generated by the underwater snake-like robot.



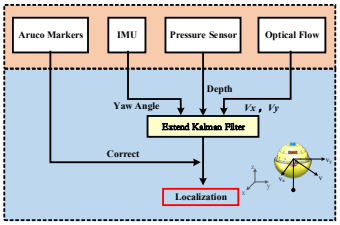
The Underwater Snake-like Robot

WA1-6(4) 9:15-9:30

Multi-Sensor Fusion Based Localization System for an Amphibious Spherical Robot

Yu Liu, Shuxiang Guo, Liwei Shi, Huiming Xing, Xihuan Hou, Huikang Liu, YaoHu, Debin Xia, Zan Li
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

- This paper presents a multi-sensor fusion based localization system which has a good real-time performance, high-precision and low-cost assumption for a compact amphibious spherical robot.
- The proposed approach combines various information using extend EKF, include depth information from a pressure sensor, pose from IMU, velocity from optical flow and pose estimation from multiple planar markers.



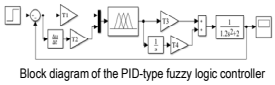
Localization system

WA1-6(5) 9:30-9:45

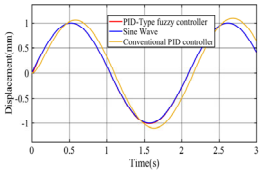
A PID-type Fuzzy Logic Controller for A Interventional Surgical Robot

Shuxiang Guo, Yangming Guo, Xianqiang Bao and Cheng Yang
Key Laboratory of Convergence Medical Engineering System and Healthcare Technology,
School of Automation, Beijing Institute of Technology
Beijing, China

- This paper proposed a PID-type fuzzy logic controller for a interventional surgical robot.
- Compared the conventional PID controller and PID-Type fuzzy logic controller.
- The proposed controller can greatly reduce the oscillation and shorten the settling time of the system.



Block diagram of the PID-type fuzzy logic controller



Sinusoidal response of the plant for different controllers

WA1-6(6) 9:45-10:00

Platform Design and Three-dimensional Underwater Experiment of Robotic Tuna Swimming

Yi Zhao, Dan Xia, Po Dai
Southeast University, Harbin Institute of Technology
Nanjing, China Harbin, China

•Propose a valid structure and control system design to achieve straight line, turn, rise and dive motion of robotic tuna.

•Verify the feasibility of the design through three-dimensional underwater experiment.

•Provide an effective way of searching for future autonomous fish swimming.

The prototype of robotic tuna

WA2-1: Intelligent Control Strategies and Algorithms

Session Chairs: Andre Ellefsen, Norwegian University of Science and Technology
Hui Wang, Harbin Engineering University

Conference Room 1, 10:30-12:00, Wednesday, 7 August 2019

WA2-1(1) 10:30-10:45

Automatic Fault Detection for Marine Diesel Engine Degradation in Autonomous Ferry Crossing Operation

André Listou Ellefsen, Xu Cheng, Finn Tore Holmeset, Sergey Ushakov, Vilmar Æsøy, Houxiang Zhang
Norwegian University of Science and Technology, Aalesund, Norway

- An unsupervised reconstruction-based fault detection algorithm is used to predict faults automatically on marine diesel engine degradation data in a simulated autonomous ferry crossing operation.
- The algorithm achieved an average accuracy of 97.88% when the input data were subjected to a feature selection process.

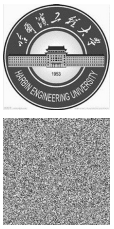
The marine diesel engine.

WA2-1 (2) 10:45-11:00

Image Encryption Algorithm Based on Double Scrambling

Hui Wang, Qiang Wang, Lijun Yu and Jingyuan Zhao
College of Automation, Harbin Engineering University, Harbin, 150001, China

- This paper proposes a double-encryption scrambling algorithm based on order adjustment.
- The newly constructed position scrambling method is used to encrypt the image, which greatly increases the amount of keys and can effectively resist illegal attacks.
- The algorithm has the advantages of low similarity and high scrambling across the simulation results.



The original image and the scrambling effect

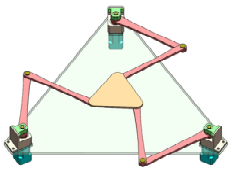
WA2-1(3) 11:00-11:15

Optimum platform design of 3-RRR planar parallel manipulators with a parameterized model

Kun Wang and Zhijiang Xie
College of Mechanical Engineering
Chongqing University, Chongqing, China

Shaoping Bai
Department of Materials and Production
Aalborg University, Aalborg, Denmark

- A kinematic model for optimum platform design of 3-RRR planar parallel manipulators is presented.
- Optimum design of shape and dimensional parameters is carried out with sensitivity analysis.
- Optimal configurations are obtained from the numerical simulation results, including both symmetrical and asymmetrical topologies.



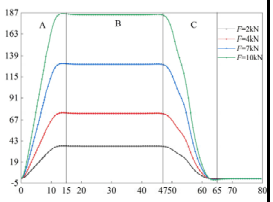
Planar 3-RRR parallel manipulator

WA2-1(4) 11:15-11:30

Reliability Evaluation of Bolt Fastening Force Based on Ultrasonic Measurement Method

Qinxue Pan, Ruipeng Pan, Meile Chang, Chang Shao, Xiaohao Liu and Xiaoyu Xu
Key Lab. of Fundamental Science for National Defense for Advanced Machining Technology
Beijing Institute of Technology
Beijing, China

- The theoretical models of the ultrasonic measurement for bolt fastening force are reviewed.
- Main influencing factors are analyzed and methods of calibration and compensation are reviewed.
- Aiming at the issue that the axial stress inside the bolt is not uniformly distributed, new proposed theories and methods are discussed.



Distribution of bolt fastening force

WA2-1(5) 11:30-11:45

Moving Object Detection Based on Adaptive Loci Frame Difference Method

Zixuan Bai, Qiang Gao, and Xiao Yu
Control Theory & Applications in Complicated Systems Lab., Tianjin University of Technology
Tianjin, China

- A moving object detection method based on improved inter-frame difference algorithm is proposed.
- The appropriate number of frames is determined by combining the characteristics of the image.
- After detecting the target, the ambient noise and other interference are filtered out by setting the threshold method to realize binarization.

Criminal Investigation Image

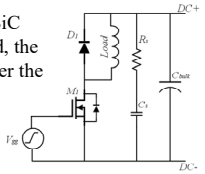
WA2-1(6) 11:45-12:00

Investigation of the Gate Resistance and the RC snubbers on the EMI Suppression in Applying of the SiC MOSFET

Wenjie Ma, Yingzhe Wu, Hui Li, and Doudou Chu
School of Aeronautics and Astronautics ,
University of Electronic Science and Technology of China
Chengdu, Sichuan Province, China

Evaluate the switching performance of SiC MOSFET in terms of the switching speed, the switching loss and the Vds spectrum under the following conditions:

- The variable gate resistance;
- The attachment of the RC snubbers



The classical double pulse test circuit

WA2-2: Medical Robots for Minimal Invasive Surgery (II)

Session Chairs: James K. Mills, University of Toronto
Xiaoliang Jin, Kagawa University

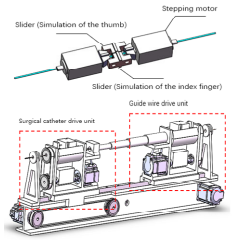
Conference Room 2, 10:30-12:00, Wednesday, 7 August 2019

WA2-2(1) 10:30-10:45

Development of a Grasper for Vascular Interventional Surgery Robotic System

Xiaoliang Jin[1], Shuxiang Guo[1,2,3*], Jian Guo[3*], Linshuai Zhang[1], Peng Shi[1], Dapeng Song[1] and Weihao Wang[1]
[1]Department of Intelligent Mechanical Systems Engineering, Faculty of Engineering and Design. Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa, Japan.
[2]Beijing Institute of Technology, Beijing, China. [3]Tianjin University of Technology, Tianjin, China.

- In this paper, A novel slave manipulator of the vascular interventional surgery robotic system is designed. In order to simulate the opening and closing of the doctor's thumb and index finger, we proposed a grasper for the vascular interventional surgery robotic system.
- To verify the feasibility of the grasper. The simulation experiment of the new grasper is completed by ANSYS simulation software. Simulation results showed that the grasper is not only effective. but also can prevent the surgical catheter from being damaged.



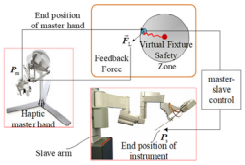
The prototype of novel slave manipulator

WA2-2(2) 10:45-11:00

Surgical Instruments Motion Safety Constraint Based on Haptic Virtual Fixture

Hao Qiu, Bo Pan, Yili Fu, Yue Ai
State Key Laboratory of Robotics and Systems, Harbin Institute of Technology
Harbin, China

- Aiming at improving the safety of master-slave control of surgical robots.
- A kind of virtual fixture with custom shape is proposed.
- Operators can set linear, planar, spherical virtual fixtures to guide paths and protect specific areas.
- Experiments show that the three haptic virtual fixtures can play a safe and protective role.



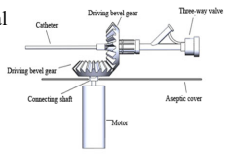
Virtual Fixture with Custom Shape

WA2-2(3) 11:00-11:15

A Novel Catheter Rotation Structure for Aseptic Environment of Interventional Surgery Robot

Kaidi Wang, Nan Xiao*, Yuwen Zeng, Hang Yuan
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, Haidian District, Beijing 100081, China

- Solved the existing problem that the sterile environment of the interventional surgery robot cannot be guaranteed.
- The accuracy of the catheter rotation structure is more precise.
- The driving mode of the motor is changed, and the reliability of the catheter rotation of the interventional robot is greatly enhanced.



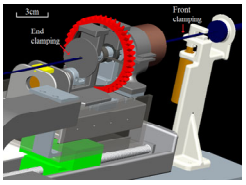
Catheter Rotation Structure

WA2-2(4) 11:15-11:30

Development of Collaborative Clamping Devices for a Vascular Interventional Catheter Operation

Shuxiang Guo1,2*, Youchun Ma1,Yan Zhao1,Yuxin Wang1, Jinxin Cui1
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, Beijing, China

- This paper proposed a reciprocating towed slave robot, which mainly included four degrees of freedom: linear motion, torsional motion, catheter front clamping release, and catheter end clamping release.
- This method was demonstrated to meet clinical operational requirements by experiments in a simulated vascular model and proved that the design of the front clamp was feasible.



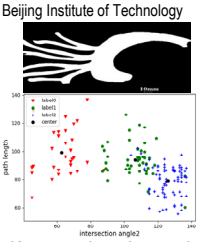
Conceptual Diagram of Front Clamping and End Clamping

WA2-2(5) 11:30-11:45

A Quantitive Description Method of Vascular basing on Unsupervised Learning towards Operation Skills Assessment of Endovascular Surgery

Jinxin Cui1, Shuxiang Guo1*, Yan Zhao1, Yuxin Wang1, Youchun Ma1
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, Beijing Institute of Technology

- In this paper, operating difficulty of different blood vessels is described for operation through the aortic arch by machine learning k-means models.
- Then difficulty levels of blood vessels can be taken as an important indicator for surgeons' endovascular operation evaluation in the following research.



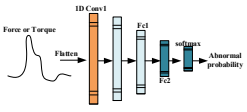
K-means clustering results

WA2-2(6) 11:45-12:00

A CNNs-based of Force and Torque Identification Model for Vascular Interventional Surgery Robot

Yuxin Wang, Shuxiang Guo, Yan Zhao , Jinxin Cun, Youchun Ma
Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, Beijing Institute of Technology

- This paper proposes a force and torque recognition model based on convolutional neural network for the robot-assisted interventional surgery.
- The risk possibility is used to adjust the proportional coefficient of motion between the master controller and slave-side in the surgical robot system, which can reduce the operating force and torque and increase the safety of the interventional surgery.



Operating State Recognition Model

WA2-3: Signal and Image Processing (VI)

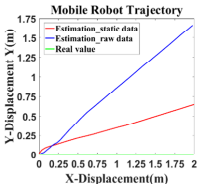
Session Chairs: Boqun Lv, Harbin Engineering University
Dagui Huang, University of Electronic Science and Technology of China
Conference Room 3, 10:30-12:00, Wednesday, 7 August 2019

WA2-3(1) 10:30-10:45

Dynamic Objects Detection Based on Stereo Visual-Inertial System in Highly Dynamic Environment

Jia He,Yanwu Zhai,Haibo Feng*,Songyuan Zhang and Yili Fu*
The State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, China

- Propose a detecting dynamic objects algorithm based on stereo visual-inertial system.
- Establish the rotation compensation model and feature point velocity model.
- Provide a dual filter strategy to filter dynamic feature points through feature point velocity.



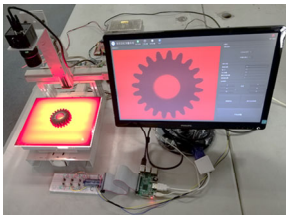
Experimental result of dynamic object detection in continuous motion

WA2-3(2) 10:45-11:00

Sub-pixel Gear Parameter Measurement Based on Zernike Moment

Yangyang Li, Dagui Huang, Xian' gang Wu, Silei Huang, Siyuan Huang, Youcheng Li and Xunkuai Zhou
Lab of Intelligent Mechatronics System, University of Electronic Science and Technology of China, Chengdu, China

- Subpixel edge detection based on Zernike moment
- Gear parameter measurement by machine vision running on Raspberry 3B
- Parallel Calculation: using VideoCore IV , a GPU integrated in Raspberry Pi 3B, achieves convolution operation in image processing



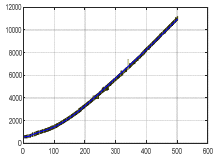
Machine Vision Measure System Based on Raspberry 3B

WA2-3(3) 11:00-11:15

High Speed Train Trajectory Algorithm through Fiber Optic Sensor

Yan, Fuyang Chen,Li Wang and Bin Jiang
Department of Automation Engineering,.Nanjing University Of Aeronautics And Astronautics
Nanjing, China

- This paper proposes a diagnosis scheme for detection of position and speed of high-speed trains.
- The algorithm consists of three parts: time-frequency analysis, data processing and data fitting.
- A data-driven method is used to set the adaptive threshold to deal with the nonlinear problem of optical fiber signals.



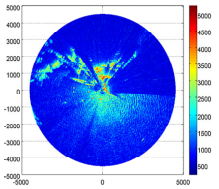
Train track after fitting

WA2-3(4) 11:15-11:30

Research on Rainfall Identification Based on the Echo Differential Value from X-band Navigation Radar Image

Zhizhong Lu, Boqun Lv, Lei Li, Shuyuan Guo
College of Automation, Harbin Engineering University
Harbin, China

- Echo difference value by the length of half a wavelength can improve the accuracy of identifying the rainfall image
- Echo difference value by the length of half a wavelength can improve the accuracy of identifying the rainfall image.



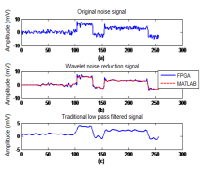
Radar Image

WA2-3(5) 11:30-11:45

Research on Optical Fiber IMU Signal Processing Based on Wavelet Algorithm

Xiaogong Lin, Ruxin Guo and Yuqi Yuan
Department of Automation, Harbin Engineering University
Harbin,China

- A new wavelet threshold denoising algorithm is proposed
- A new algorithm can effectively improve the performance of wavelet algorithm and simplify the calculation of wavelet analysis
- The implementation of the wavelet threshold algorithm on the FPGA is studied.



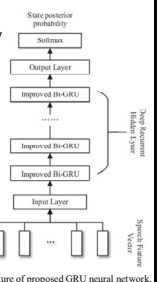
Comparison of wavelet denoising effects

WA2-3(6) 11:45-12:00

Research on Acoustic Model of Speech Recognition Based on Neural Network with Improved Gating Unit

Liu Wei, Yan Yan, Yu Jianqiang, Sun Yiming
School of Computer Science and Technology
Changchun University of Science and Technology
Changchun, Jilin Province, China

- Proposed a speech recognition acoustic model based on the bidirectional recurrent neural network with improved gated loop unit.
- Using the ReLU activation function instead of the hyperbolic tangent function
- Combined with the batch normalization method, helps the model to learn the long-term dependence of the network and maintain the stability of the output value.



The structure of proposed GRU neural network.

WA2-4: Elements, Structures, and Mechanisms (II)

Session Chairs: Andrew Michalak, University of Toronto
Lingling Zheng, Kagawa University

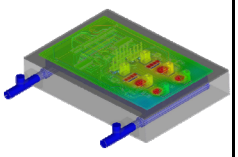
Conference Room 4, 10:30-12:00, Wednesday, 7 August 2019

WA2-4(1) 10:30-10:45

Genetic Optimization of Thermal Management Systems for EV Power Electronics via ANSYS Multiphysics

Andrew Michalak and James K. Mills
UTEV Research Centre, University of Toronto
Toronto, Canada

- Electric Mobility applications are putting more strain on the thermal requirements of energy conversion devices
- A more integrated design approach is needed to achieve maximum performance
- A genetic based optimization process provides intelligent, customized cooling structures, specific to electronic designs
- Initial designs see significant improvements through this iterative process, verified with detailed simulations



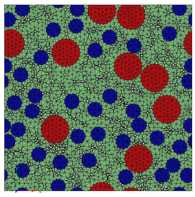
Electronic Thermal Optimization Design

WA2-4(2) 10:45-11:00

Prediction of Effective Elastic Modulus of Polymer Bonded Explosive Based on Digimat

Qinxue Pan, Xiaohao Liu, Xiaoyu Xu, Ruipeng Pan, Meile Chang, and Chang Shao
Key Laboratory of Fundamental Science for National Defense for Advanced Machining Technology, Beijing Institute of Technology
Beijing, China

- A RVE model of PBX consisting particles, binders, and pores was constructed.
- The higher the volume fraction of explosive particles, the larger the effctive elastic modulus of PBX.
- The morphology of explosive particles has little effect while the grading has a great effect.
- The increase of porosity reduces the effective elastic modulus exponentially.



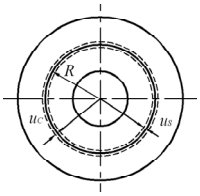
RVE Model of PBXs Explosives

WA2-4(3) 11:00-11:15

Maximum Torque and Limit Angular Velocity of High-speed Coupling for Interference Fit

Peng Shang, Yanhua Sun, Renjun Zhan, Ning Shan, Jinxin Zhao and Jian Zhou
Xi'an Jiaotong University, Engineering University of PAP
Xi'an, Shaanxi, China

- A model of the interference fit of the high-speed coupling is established to calculate the normal stresses and shear stress.
- The maximum torque and limit angular velocity of the contact area of the coupling are derived.
- The static friction coefficient and the structural characteristics are important influence factors for determining the load capacity.



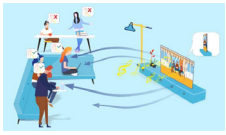
Interference Fit Between the Coupling and the Shaft

WA2-4(4) 11:15-11:30

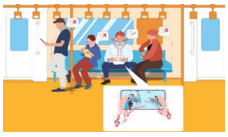
Transparent Glass-based Directional Loudspeaker

Yuxin Li, Limei Xu, Xuesheng Li, Xiaomei Xie, Min Chen, Cong Luo, Fang Zhu, Yalun Zhang
University of Electronic Science and Technology of China
Chengdu, China

- An ultra-thin transparent glass-based directional loudspeaker is proposed in the paper.
- This novel loudspeaker may provide a private listening service with the technology of the audio directional loudspeaker.
- And the prototype sample based on PVDF transducer array is constructed in the structure defined by simulation and its acoustic characteristics are measured.



Loudspeaker for home multimedia equipment



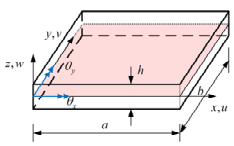
Loudspeaker for portable multimedia equipment

WA2-4(5) 11:30-11:45

Smoothed FE-Meshfree with Extended Moving Least-Square Method for Analysis of Reissner-Mindlin plates

Guangsong Chen, Jinsong Tang, and Zihan Wang
School of Mechanical Engineering, Nanjing University of Science and Technology
Nanjing, Jiangsu, China

- Basic equations for Reissner-Mindlin plate is given.
- SFE-Meshfree method with extended MLS method is proposed.
- The present method uses only DOFs at each vertex node.
- Higher accuracy solutions are obtained.
- The shear locking problem of Reissner-Mindlin plates is avoided.



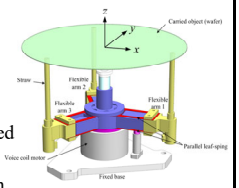
Reissner-Mindlin plate

WA2-4(6) 11:45-12:00

Compliance analysis of a parallel leaf-spring carrying mechanism

Peng Li
Engineering Research Center of Optoelectronic Devices & Communication Technology, Ministry of Education, Tianjin University of Technology,Tianjin, China

- The six-dimensional compliance of a parallel leaf-spring carrying mechanism (PLCM) was investigated using a compliance-matrix based approach.
- The Cartesian compliance matrix of PLCM is modeled.
- The compliant characteristics are analyzed through eigenscrew decomposition.
- The influence of structural parameters on the compliance characteristics is investigated, and suitable parameters are identified for the design.



The PLCM

WA2-5: Robot Navigation and Control Algorithm (II)

Session Chairs: Huiming Xing, Beijing Institute of Technology
Linshuai Zhang, Kagawa University

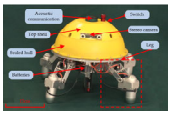
Conference Room 5, 10:30-12:00, Wednesday, 7 August 2019

WA2-5(1) 10:30-10:45

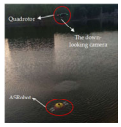
Quadrotor Vision-based Localization for Amphibious Robots in Amphibious Area

Huiming Xing[1,2], Shuxiang Guo[1,2,3*], Liwei Shi[2,3*], Xihuan Hou[1,2], Yu Liu[2], Yao Hu[2], Debin Xia[2], Zan Li[2]
[1] School of Automation, Beijing Institute of Technology, No.5, Zhongguancun South Street, Haidian District, Beijing 100081, China
[2] Key Laboratory of Convergence Biomedical Engineering System and Healthcare Technology, The Ministry of Industry and Information Technology, Beijing Institute of Technology,Beijing, China
[3] Faculty of Engineering, Kagawa University, Kagawa, Japan

- Using a quadrotor hovering over the head of robots, a vision-based localization approach for multiple amphibious robots was proposed in amphibious environment.
- In order to detect the amphibious robot, an improved Hough transform and a multiple size-varying template matching method are designed.



The amphibious robot



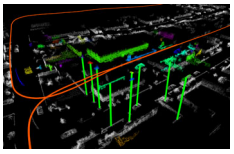
Localization using a quadrotor

WA2-5(2) 10:45-11:00

LLOAM: LiDAR Odometry and Mapping with Loop-closure Detection Based Correction

Xingliang Ji, Lin Zuo, Changhua Zhang, Yu Liu
Intelligent Learning Institute for Science and Application, University of Electronic Science and Technology of China
Chengdu, Sichuan, China

- This paper proposes a complete 3D LIDAR based SLAM system with loop-closure detection based correction.
- This SLAM system includes a front-end with a point clouds segmentation matching based loop-closure detection and a back-end based on factor graph optimization.
- This SLAM system has shown superior performance in terms of global consistency and local accuracy



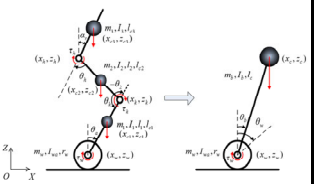
The Loop-closure Detection

WA2-5(3) 11:00-11:15

Gain Scheduling Control of Wheel-legged Robot LPV System Based on HOSVD

Jiachen Li, Haitao Zhou, Haibo Feng, Songyuan Zhang and Yili Fu
The State Key Laboratory of Robotics and System, Harbin Institute of Technology
Harbin, China

- Present the equivalent model with center of mass and corresponding mapping.
- Establish LPV system polytopic model by using HOSVD method.
- Design the robust controller of gain scheduling using H-infinity mixed regional pole configuration under the static output feedback framework.



Mapping of the COM equivalent model

WA2-5(4) 11:15-11:30

Fast and Accurate Robot Localization through Multi-Layer Pose Correction

Yuxiang Liu, Lin Zuo ,Changhua Zhang, and Fenglian Liu
Intelligent Learning Institute for Science and Application, University of Electronic Science and Technology of China
Chengdu, China

- We study the data fusion of odometry, IMU and 2D laser radar.
- The multi-sensor data is gradually integrated together with UKF, AMCL and 2D D2D NDT.
- The experimental results show that the localization accuracy of our method achieves centimeter level in a short time with a complex environment.

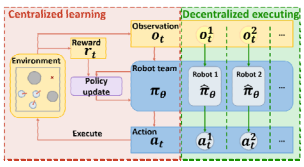
The mobile robot

WA2-5(5) 11:30-11:45

End-to-end Decentralized Multi-robot Navigation in Unknown Complex Environments via Deep Reinforcement Learning

Juntong Lin, Xuyun Yang, Peiwei Zheng and Hui Cheng*
School of Data and Computer Science, Sun Yat-sen University
Guangzhou, Guangdong Province, China

- Multi-robot system.
- Navigation.
- Deep reinforcement learning.



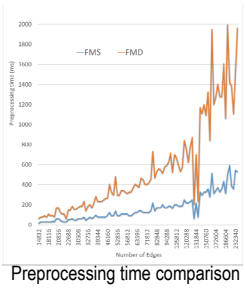
Framework

WA2-5(6) 11:45-12:00

Speeding up FastMap for Pathfinding on Grid Maps

Cong Hu, Quanjun Yin, Yue Hu, Junjie Zeng, and Long Qin
College of Systems Engineering, National University of Defense Technology
Hunan, China

- Replacing Dijkstra's Algorithm in FastMap By SPFA
- Saved more than 50% pre-processing time
- Scaling better on large maps
- Easier to implement



Preprocessing time comparison between FMS and FMD

WA2-6: Rescue Robots and Field Robot Systems

Session Chairs: Shuxiang Guo, Kagawa University
Cheng Yang, Beijing Institute of Technology
Conference Room 6, 10:30-12:00, Wednesday, 7 August 2019

WA2-6(1) 10:30-10:45

Mobile Robot Capable of Crossing Floors for Library Management

Han Yu, Lei Li, Jingge Chen, Yutong Wang, Yankun Wu, Mingyuan Li, Hui Li, Zhihong Jiang, Xiaoming Liu and Tatsuo Arai
School of Mechatronical Engineering, Beijing Institute of Technology
Beijing, China

- Application: developing unmanned management based on traditional library and promote present library robot.
- Functions: grasping and shelving books, crossing floors by elevator, autonomous navigation and obstacle avoidance, recognizing book data and convenient graphical user interface.
- Experiment: stability and accuracy are tested in experiments.

The Mobile Robot

WA2-6(2) 10:45-11:00

Real-time Riverbank Line Detection for USV System

Tianwei Feng,Junfeng Xiong,Jinchao Xiao,Jinqing Liu and Yuqing He
Key Laboratory of OptoElectronic Science and Technology for Medicine of Ministry of Education, Fujian Normal University, Fuzhou, China
Shenyang Institute of Automation, Guangzhou, Chinese Academy of Sciences
Guangzhou, Guangdong Province, China

- In the complex background, the detection of riverbank line is of great significance to the autonomous navigation of USV system.
- Different from the traditional method, this paper proposes a method of riverbank line detection based on morphology.
- Experiment result proves that our morphological approach can boost efficiency and performance significantly in multiple and complex environments.

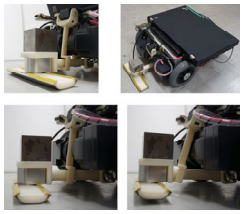
The result

WA2-6(3) 11:00-11:15

Floor Surface Property Estimation based on Measurement of Hardness and Viscosity Using Wiping-motion and Separating-motion

Koichiro Matsumoto, Kimitoshi Yamazaki
Mechanical System Engineering, Shinshu University, Nagano, Japan

- Proposing of Surface Property Measurement Method: Wiping-motion and Separating-motion.
- Surface measurement has been performed in 16 kind of surface property.
- Validity of proposed method was verified.



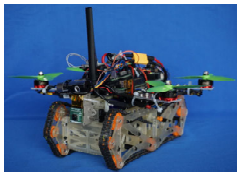
Measurement Apparatus

WA2-6(4) 11:15-11:30

Development of a Hybrid Locomotion Robot for Earthquake Search and Rescue in Partially Collapsed Building

Di ZHANG, Yukitoshi MINAMI Shiguematsu, Jia-Yeu LIN, Yi-Hsiang MA, Mazoon Salim Al MAAMARI and Atsuo TAKANISHI
Faculty of Science and Engineering, Waseda University

- Target: Search and Rescue in partially collapsed buildings
- Hybrid Locomotion (Flying and Moving on flat surfaces)
- Goods transportation mechanism
- Victim detection sensing system
- Victims position estimation system



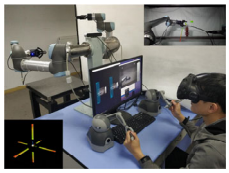
H-WAMORS

WA2-6(5) 11:30-11:45

Graphical Force and Haptic Feedback Teleoperation System for Live Power Lines Maintaining Robot

Jing Zhu, Yutao Chen, Ming Xu, Erbao Dong*, Hao Zhang and Xuming Tang
CAS Key Lab of Mechanical Behavior and Design of Materials, University of Science and Technology of China
Hefei, China

- Key content introduction of teleoperation system of live power lines maintaining robot.
- Theories and practice of graphical force feedback and direct force feedback.
- Experimental performance in a typical maintaining task with different modes.
- Conclusion of better performance with graphical force feedback.



The Teleoperation System of Live Power Lines Maintaining Robot

WA2-6(6) 11:45-12:00

Design of An Inspection Robot System with Hybrid Operation Modes for Power Transmission Lines

Han Wang[1,3], En Li[1], Guodong Yang[1], Rui Guo[2]
1. The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Science, Beijing 100190, China
2. State Grid Shandong Electric Power Company, Jinan 250001, China
3. University of Chinese Academy of Sciences, Beijing 100049, China

- In this paper, we design a kind of transmission line inspection hybrid robot with amphibious functions of on-wire crawling and flight.
- The on-wire-balance of the robot is verified by mechanical analysis.
- A ROS-based robot control system has been designed and a multi-mode switching control strategy has been proposed.

The mechanical structure of hybrid robot

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Memo

Memo

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IEEE ICMA 2020

2020 IEEE International Conference on Mechatronics and Automation
August 2-5, 2020, Beijing, China

Co-sponsors: IEEE Robotics and Automation Society, Beijing Institute of Technology, Kagawa University

Technical Co-sponsors: CAA, RSJ, JSME, SICE, JSPE, TJUT, HIT, HEU, UEC, UESTC, CUST

Call for Papers

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The 2020 IEEE International Conference on Mechatronics and Automation (IEEE ICMA 2020) will take place in Beijing, China from August 2 to August 5, 2020. Beijing is both a tribute to China's proud history and a gateway to China's future. The capital city during the Liao, Yuan, Ming and Qing Dynasties, Beijing has long been the political, cultural, and diplomatic center of China. It is now an international metropolis, home to 11 million people from all walks of life.

As the host city of IEEE ICMA 2020, Beijing not only provides the attendees with a great venue for this event, but also an unparalleled experience in Chinese history and culture. You are cordially invited to join us at IEEE ICMA 2020 in Beijing. The objective of ICMA 2020 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 2020 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, 2020.

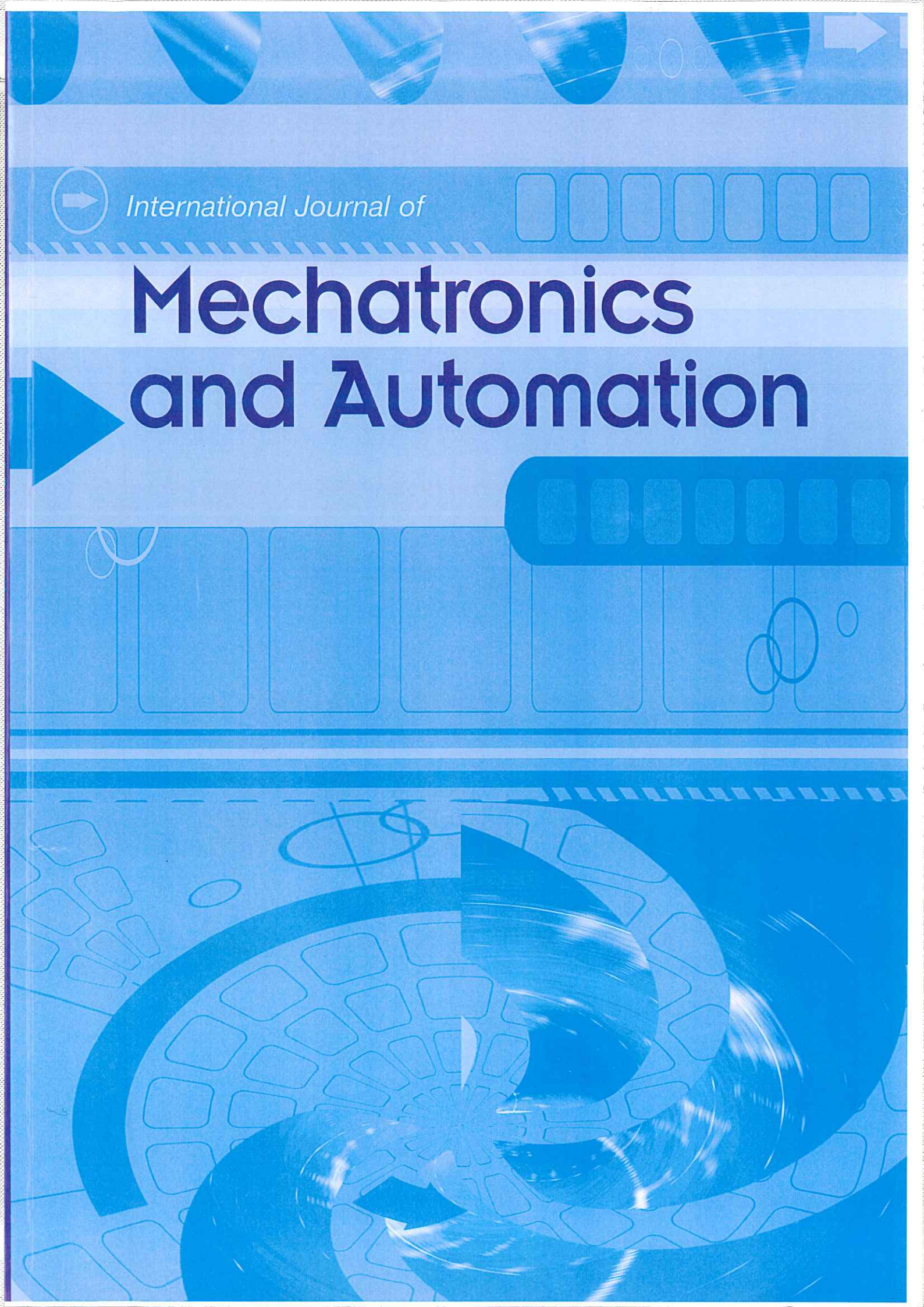
Tutorials & Workshops: Proposals for tutorials and workshops that address related topics must be submitted to one of the Tutorial/Workshop Chairs by May 1, 2020.

Important Dates:

April 10, 2020	**Full papers and organized session proposals**
May 1, 2020	**Proposals for tutorials and workshops**
May 15, 2020	**Notification of paper and session acceptance**
June 1, 2020	**Submission of final papers in IEEE PDF format**

For detailed up-to-date information, please visit the IEEE ICMA conference website at:

http://2020.ieee-icma.org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Scope of the Journal

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.

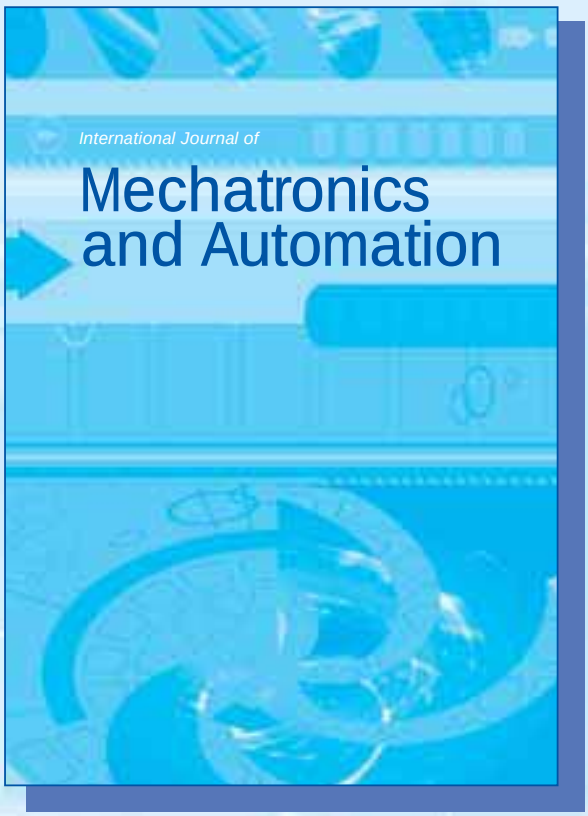
Contents

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
- Novel and unconventional mechatronic systems and robots
- Modelling and control of mechatronics systems and robots
- Elements, structures, mechanisms of micro and nano systems
- Sensors, wireless sensor networks and multi-sensor data fusion
- Biomedical and rehabilitation engineering, prosthetics and artificial organs
- AI, neural networks and fuzzy logic in mechatronics and robotics
- Industrial automation, process control and networked control systems
- Telerobotics, human computer interaction, human-robot interaction



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What the editors say about IJMA

The new IJMA will cover the area of mechatronics and automation that is currently very important and hot topics. I see that the technology of mechatronics and automation will play a major role in developing new technological products. Hence, I am expecting that the new journal will be a great hit with every researcher who is working on future innovations. It gives a great pleasure to be a part of the IJMA team.

Toshio Fukuda,
Nagoya University, Japan

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 mechatroronics and automation.

T.J. Tarn,
Washington University in St. Louis, USA

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.

William R. Hamel,
The University of Tennessee, USA

Mechatronics and industrial automation are at the heart of technological development and it is vital that researchers have high quality publications in which they can rapidly disseminate their results. IJMA will cover a vital and underrepresented area of research and I am confident that it will have a significant impact on the community, quickly becoming a leading journal in this field.

Darwin G Caldwell,
Italian Institute of Technology, Italy

I am honored to be invited to serve as an Editorial Board member of this new journal. Under the guidance of Editors and Editorial Board, this new journal will be an important forum for the publication of exciting new developments in emerging technological areas.

James K. Mills,
University of Toronto, Canada

The birth of the new journal is a big event in the exciting field of Mechatronics and Automation, and I am very proud to be a part of the strong editorial team that will maintain high quality and standards of all the papers published in it. The IJMA is certainly going to be a vital and unique source of information on the latest theoretical and practical achievements of the researchers in this multidisciplinary and very essential engineering area.

Nazim Mir-Nasiri,
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IEEE ICMA 2019
Program at a Glance

August 4-7, 2019

Tianjin Shangri-La Hotel, Tianjin, China
http://www.shangri-la.com/tianjin/shangrila/about/

Sunday, August 4, 2019	
13:30 - 18:30	Registration Desk Open
14:00 - 15:40	**World Premium Workshops on Robotics (GARNET ROOM on 1F)**
16:00 - 17:00	Keynote Speech (Dr. James K. Mills) **(GARNET ROOM on 1F)**
17:30 - 18:30	Reception **(DIAMOND ROOM on 1F)**
Monday, August 5, 2019	
8:30 - 9:00	Opening Ceremony **(BALLROOM 2&3 on 2F)**
9:00 - 9:50	Plenary Talk I (Dr. Tianyou Chai) **(BALLROOM 2&3 on 2F)**
9:50 - 10:40	Plenary Talk II (Dr. Cecilia Laschi) **(BALLROOM 2&3 on 2F)**
10:40 - 11:00	Morning Break
11:00 - 12:00	Technical Sessions MA1 (Poster Session) **(BALLROOM 2&3 on 2F)**
12:00 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions MP1
15:00 - 15:15	Afternoon Break
15:15 - 16:45	Technical Sessions MP2
17:00 - 18:30	Technical Sessions MP3
Tuesday, August 6, 2019	
8:30 - 9:20	Plenary Talk III (Dr. Ken Goldberg) **(GARNET ROOM on 1F)**
9:30 - 11:00	Technical Sessions TA1
11:00 - 11:15	Morning Break
11:15 - 12:15	Technical Sessions TA2
12:15 - 13:30	Lunch Break
13:30 - 15:00	Technical Sessions TP1
15:00 - 15:30	Afternoon Break
15:30 - 17:00	Technical Sessions TP2
18:30 - 21:00	Award Banquet in Tianjin Shangri-La Hotel **(BALLROOM 2&3 on 2F)**
Wednesday, August 7, 2019	
8:30 - 10:00	Technical Sessions WA1
10:00 - 10:30	Morning Break
10:30 - 12:00	Technical Sessions WA2
12:00 - 13:00	Farewell Party

* 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