IEEE-CYBER

Xi'an, China October 10-13, 2020

PROGRAM

The 10th IEEE International Conference on

CYBER Technology

in Automation Control and Intelligent Systems

IEEE IEEE Robotics & Automation Society

The 10th IEEE International Conference

on CYBER Technology

in Automation, Control, and Intelligent Systems

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Conference Digest

Xi'an, China

October 10-13, 2020

IEEE-CYBER 2020 PROCEEDINGS

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Welcome Message

Welcome to the 10th IEEE International Conference on ***CYBER*** Technology in Automation, Control, and Intelligent Systems. The IEEE-CYBER is a key international conference focusing on advanced research areas related to cyber physical systems, control/automation, robotics, Internet of things and sensor network. This year, the IEEE-CYBER conference will be held from Oct. 10 to Oct.13, at Xi'an, China, with the spirit of bring together researchers and engineers all over the world to present their latest research findings, accomplishments, innovations, and visions in the related fields.

With 111 paper submissions from 5 countries or regions, 81 papers have been selected for presentation at the conference after going through a rigorous review process. The technical program of the IEEE-CYBER 2020 consists of 2 plenary talks, 4 keynote talks, 2 panel discussions, 3 workshops, 12 technical sessions organized into 2 parallel tracks, and 2 poster sessions. The goal of IEEE-CYBER 2020 is to create an opportunity for participants to present their latest research results to international audience. Moreover, networking with other researchers has always been a cornerstone of the IEEE-CYBER conference series, and several networking activities have been scheduled during the IEEE- CYBER 2020, including welcome reception, banquet, and farewell reception. We hope the IEEE-CYBER 2020 will be a valuable, memorable and exciting platform for people to exchange ideas and information, identify new research interests, establish collaborations, make friends, and find new opportunities for their careers.

The IEEE-CYBER 2020 will give out two technical awards: *Best Conference Paper Award* and *Best Student Paper Award*. The nominated papers are arranged in separate sessions for presentation, which is convenient for those who specially want to attend the presentations from the nominees.

We would like to express our deepest gratitude to the great contributions from the Program Committee members, the Organizing Committee members, local staff, and student volunteers. The IEEE-CYBER 2020 would not have been possible without your commitment and efforts. Last but not least, our heartfelt thanks go to the authors, the reviewers, the conference participants, and the sponsors. It is your participation and contribution that will make the IEEE-CYBER 2020 unique, enjoyable, and successful.

Besides enjoying the technical programs and networking activities during the conference, we highly suggest you spend some time in enjoying the city of Xi'an.

Finally, we wish you a wonderful and joyful stay in Xi'an, China!

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CYBER 2020 Sponsors

We acknowledge the support of the following Sponsors to the 9th IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (IEEE-CYBER 2020).

GENERAL INFORMATION

Conference Date and Venue

Date: October 10-13, 2020
Venue: Jianguo Hotel Xi'an
No.2 Huzhu Road, Beilin District, Xi’an, China

Registration Desk

October 10 (Saturday)	10:00 to 17:00
October 11 (Sunday)	08:15 to 17:45
October 12 (Monday)	09:00 to 17:20
October 13 (Tuesday)	09:00 to 16:00

Conference Events

Welcome Reception	October 10	18:00
Lunches	October 10-12	12:00 - 13:30
Conference Banquet and Award Presentation	October 11	18:00
Farewell Reception	October 12	17:30
Technical Tour	October 13	09:00-16:00

Official Language

The official language of the conference is English.
All presentations, including discussions and paper submissions, shall be made in English.

Conference Attire

Casual attire is generally recommended for the Welcome and Farewell Receptions while a business suit or a white shirt with a neck-tie at all technical sessions and at the Conference Banquet.

Presentation Specifications

In each oral presentation room, one LED projector will be available. The presenters have to bring their own laptop. The presenters should prepare Power Point Slides to facilitate their presentations. The slides and the presentations must be in English. Please test the slides before session start to avoid potential format problems caused by different software versions.

Duration for each category of oral presentation is listed below:

- Plenary Lectures are scheduled for 60 minutes (including Q&A) each.
- Keynote Lectures are schedule for 40 minutes (including Q&A) each.
- Regular Sessions are schedule for 12 minutes with 3 min Q&A each.

Poster Specifications

Poster session represents an effective and valuable means for authors to present their research results. It offers an opportunity of meeting with interested attendees for in-depth scientific and technical discussions, and establishing new collaborations. Therefore, it is important that you display your results clearly to attract people who have an interest in your team's research work.

Your poster should cover the KEY POINTS of your paper, which include but not limited to background, methods, results and conclusion. Make your poster as self-explanatory as possible. This will save your time for discussions and questions with fellow researchers.

POSTER DIMENSIONS

- Your poster SHOULD have the following dimensions:
- **Poster Size: 90cm wide x 120cm high.**
- Please note that printing out your submitted full paper in A4 size format is NOT acceptable as a poster.

POSTER CONTENT

- **Title:** The title of your poster should appear at the top with lettering of at least **42 pt** font size). Below the title, place the names of authors and their affiliations.

- **Text:** Text should be readable from five feet away. Use a minimum font size of **17 pt**. Keep the text brief. Try to use text to introduce the study, explain visuals and direct viewers' attention to significant data trends and relationships portrayed in the visuals, state and explain the interpretations that follow from the data. It is also a good idea to put future research plans or questions for discussion with viewers in your text.

- **Figures:** Each figure should have a brief title. Figures should be numbered consecutively according to the order in which they are first mentioned in the text. Try to use color figures rather than only black and white text to make your poster attractive and highlight the important technical content of your paper. Make sure that the text and the visuals are integrated.

About to Xi’an

Xi'an, which was called Chang'an in ancient times, is the capital city of China's Shaanxi province and the largest designated central city in Northwest China. It exercises jurisdiction over 11 districts and two counties, including the districts of Xincheng, Beilin, Lianhu, Yanta, Baqiao, Weiyang, Yanliang, Lintong, Chang'an,Huyi, and Gaoling, and the counties of Lantian and Zhouzhi. In addition, it is home to the National Xi'an Hi-tech Industries Development Zone, National Xi'an Economic and Technological Development Zone, Xi'an Qujiang New Zone, Xi'an Chanba Ecological Zone, Xi'an Yanliang National Aviation Hi-tech Industrial Base, Xi'an National Civil Space Industry Base, Xi'an International Port, Xi'an Fengdong New Town Zone , and Xi'an Fengxi New Town Zone. The total area of Xi'an is 10,752 square kilometers, and its population is 12 million.

Located in the middle of the Guanzhong Plain, Xi'an is one of the three international metropolises and the 9th Regional Central City of China designated by China's central government. It has earned the honorary titles of National Sanitary City, National Garden City, China City with Best Images, China City with Best International Images, and China's Civilized City. Remarkably, it has been named China Happiest City seven years in a row.

Xi'an has five distinguishing features:

First, Xi'an was the ancient capital of China and a cradle of civilization together with Athens, Cairo and Rome. It was the starting point of the ancient Silk Road. As a famous historical cultural city, Xi'an boasts the world’s richest cultural heritage and the most complete preservation of the ancient city and moat system. With more than 7,000 years of civilization, more than 3,100 years of city building and over 1,100 years of capital establishment, Xi'an can justly be called an "Open Air Historical Museum"; and indeed it has a total of 126 museums. The Qin Shihuang Mausoleum Terracotta Warriors and Horses, Big Wild Goose Pagoda, Little Wild Goose Pagoda, Tang Chang'an City Daming Palace Site, Han Chang'an City Weiyang Palace Site, and Xingjiao Temple Pagoda have all been inscribed in the World Heritage List.

Second, Xi'an is a highland of science and education, as well as a key post of military industry. The comprehensive strength of science and education ranks third in the country, with 63 universities and colleges, seven military academies, 43 graduate training institutes, 62 academicians of the "Two Academies" (of sciences and engineering) and 95 scientific research institutes. It has been rated as “China's leading smart city” and one of “the country's top ten innovative cities". Xi'an is second only to Beijing in basic strength of defense science and technology, with 44 military units and 207 investment and management units. In 2017, 400 enterprises joined the military industry, and the business income of the civil-military integration industry exceeded

200 billion yuan. That industry had gathered more than 1/3 of the domestic aerospace, weaponry and nearly 1/4 of the aeronautical research institutes, professionals and production forces. In September 2015, Xi'an was approved as a National Comprehensive Innovation and Reform Pilot Zone, and the Xi'an High-tech Industries Development Zone was approved as a National Independent Innovation Demonstration Zone.

Third, the industry base is complete and strong. It boasts electronics, machinery, chemicals, materials, surveying, automatic controls, aerospace, aviation and other fields at a first-class and world-leading level. Xi'an is building a "3+1" trillion-level industrial cluster around advanced manufacturing, high-tech industry, modern service industry and cultural tourism industry, and a “global metropolis of hard science and technology” around "eight pillar forces" of hard science and technology such as aerospace, optoelectronic chips, new energy, new materials, intelligent manufacturing, information technology, life science and artificial intelligence. In 2017, Samsung Phase II, Geely, Kevo, China Resources, Overseas Chinese Town, Alibaba, Tencent and Amazon signed contracts for a large number of major projects involving 44 Fortune 500 enterprises from around the world, with an additional investment of over 10 billion yuan in 40 projects. The establishment of Xi’an as a “Made in China 2025” pilot demonstration city has been approved through national evaluation. The national general aviation industry comprehensive demonstration zone has also been endorsed.

Fourth, Xi’an is a transport hub and open frontier. It is an important fulcrum city on the Belt and Road, and the central city in the west of the China section of the New Eurasian Continental Bridge. It is located in the geometrical center of China and is the national geodetic origin. Xi'an's Xianyang International Airport, its railways and highways are one of the six hubs in China, and its international land port is the only inland port with National and International double codes. With the establishment of the China (Shaanxi) Free Trade Pilot Zone the Xi’an Comprehensive Bonded Zone, Xi’an High-tech Comprehensive Bonded Zone, Xi'an Export Processing Zone A Zone B and other special customs supervision areas have become new highlights and growth poles of the open economy. In 2017, the first Nordic (Xi'an-Kovora, Finland) international freight train route was opened, and has carried 480 runs of the "Chang'an", carrying 659,000 tons of cargo. In 2019, there are also 19 new international passenger routes, and a passenger throughput of 47.2 million passengers at Xi'an Xianyang International Airport. The Eurasian Economic Forum 2019 and the Silk Road Economic Belt Round Table of Cities were successfully held, hosting 33 international sister cities and 21 foreign affairs agencies.

Fifth, Xi’an is a beautiful and livable city of mountains and rivers. Xi’an lies on the Qinling Mountains in the south and crosses the Weihe River in the north, with four distinct seasons and a pleasant climate. The Qinling Mountains, which stretch for thousands of miles, are the geographical dividing line between the north and the south of China and a natural ecological barrier. Since ancient times, Xi’an has been protected by the “eight rivers around Chang’an” – the Jing, Wei, Chan, Ba, Yu, Hao, Feng, and Lao, all watering the city. Xi’an, with the most abundant tourist resources of any urban distribution center in China, is one of the world’s most famous tourist destinations.

Technical Tour on October 13

Tuesday, October 13, 2020
09:00-16:00, gather at hotel entrance
Free of charge
Please register at conference registration desk.

Introduction of iHarbour Academy of Frontier Equipment

The iHarbour Academy of Frontier Equipment(IAFE), established in 2019, is affiliated with the School of Mechanical Engineering, Xi'an Jiaotong University, with an area of 100,000 square meters. IAFE pursues its new mission of "Building for China, Cultivating for Future" to make key technological breakthroughs and innovations in the field of frontier equipment and intelligent manufacturing and to provide a new platform for talent training.

In the world ranking by subject released by Shanghai Ranking and U.S. News, our discipline of mechanical engineering has been continuously rated as No. 2 worldwide since 2018.

Listed here are some of the IAFE research institutes and centers.

- **International Center for Machinery**
- **Institute of Aero-Engine**
- **Institute of Robotics and Intelligent Systems**
- **Institute of Design Science and Basic Components**
- **Institute of Engineering & Medicine Interdisciplinary Studies**
- **Institute of Advanced Manufacturing Technology**
- **Institute of Precision Engineering**
- **Institute of Intelligent Diagnosis and Control for Equipment**
- **Institute of New Energy Equipment and Quality Engineering**

Institute of Robotics and Intelligent Systems is one of the main research institutes of the IAFE and has 35 faculty members, including 10 professors, 16 PhD supervisors.

The institute is driven by a shared goal: to cultivate outstanding, talented people for China, through constructing a world-class Robot and Intelligent System science research.

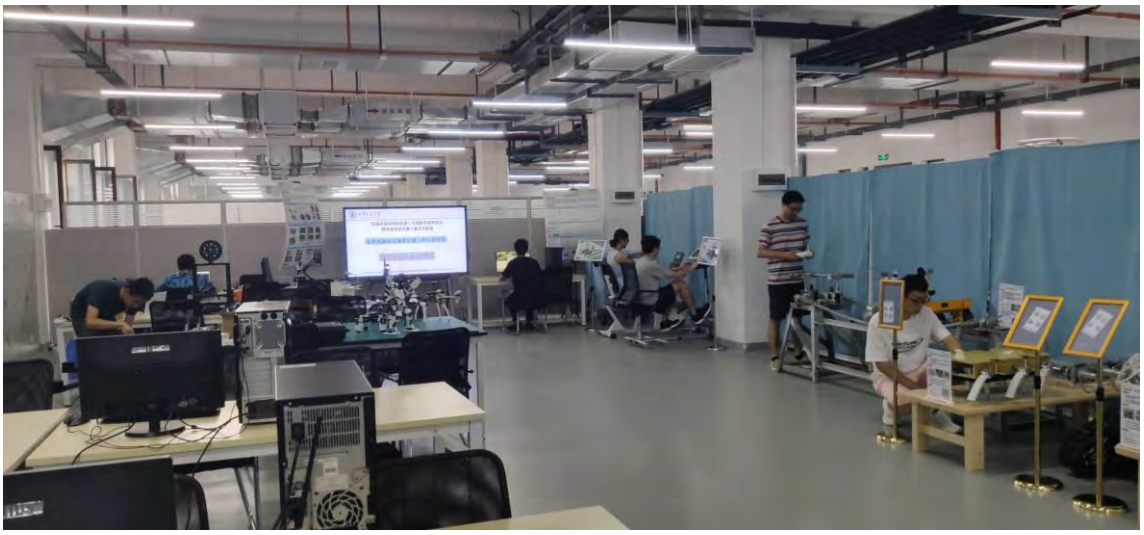
Research:

- **Key technologies and applications for autonomous operation of Tri-Co (coexisting-cooperative-cognitive) robot**
- **Biomechanical integration and service robot**
- **Intelligent perception and special robot**
- **Intelligent material and software robot**
- **Intelligent system and laser processing**

The school has cultivated a large number of outstanding talents, including 21 academicians of the Chinese Academy of Sciences and Chinese Academy of Engineering. Xuesen QIAN, a famous Chinese physicist and world-renowned rocket expert, known as the " Father of Chinese Missiles", is one of our most accomplished alumni.

Today, we are proud of a high-level faculty team led by 8 academicians, including a wide range of global famous professors and national talents!

The iHarbour campus is the first 5G campus in China. It is a "university without walls" and a smart town that integrates education, research, entrepreneurship and life.



IAFE Website: http://iafe.xjtu.edu.cn/en/index.htm

Contact Info:

iHarbour Academy of Frontier Equipment, Western China Science and Technology Innovation Harbour, Chang' An District, XI' AN, CHINA

Introduction of the State Key Laboratory for Manufacturing System Engineering

The State Key Laboratory (SKL) for Manufacturing System Engineering was established in 1995. The major goal of the SKL was to develop the new processes and the new technologies in manufacturing industry, by integrating the modern information technology and management engineering with manufacturing technology and by taking the full advantages of the innovative achievements of computers, telecommunication, automatization, management engineering etc. The SKL is a multidisciplinary key lab, supported by three primary categories: the mechanical manufacturing and automation, the system engineering and the management science and engineering. The primary research directions of the SKL are: advanced manufacturing in theory and technology, manufacturing information and manufacturing system engineering, the control and integration of manufacturing system and facilities, and the management and strategy in advanced manufacturing system. Recently, several research directions taking the domestic lead has been formed, including the additive manufacturing technology (3D printing), the micro/nano-imprinting technology and sensor manufacturing, the high-speed and high-precision manufacturing, the high-precision measurement, the fault diagnose and detection of machine, and the service-embedded manufacturing.

The SKL consists of 66 research staff and 15 technical staff in total. The research team includes 3 Academicians of the Chinese Academy of Engineering, 5 Specially-invited Experts of the National "Thousand Talent Program", 3 chief Scientists of the national “973 Program”, 8 Changjiang Scholars, 5 Distinctive Young Scholars etc. In the past six years, the SKL has been awarded about 250 research funding programs, has won 3 second-prizes of the National Award for Technological Invention, 4 second-prizes of the National Award for Science and Technology Progress, 1 second-prize of the National Award for Natural Sicence, and 20 other provincial awards. Over 400 patents have been issued, and more than 1000 international paper have been published in total.

The SKL has built a solid foundation of international academic communication, including participating in the “Nanomanucaturing Joint Laboratory of Major Plan” organized by NSFC, cooperating with UK in “micro/nano-manucaturing and nano test” through the “111 Engineering Plan”, and building the International Joint Laboratory of “micro/nano-manufacturing and testing technique” with the University of New South Wales.

The SKL has passed the CMA certificate covering more than 70 facilities. It is now providing open services to the public via the established appointment-booking online system.

Micro/nano-manufacturing laboratory

3D printing laboratory

International communication

CMA certificate

Website of the SKL: http://sklms.xjtu.edu.cn/

Plenary Talks

Plenary Talk 1: Sunday, Oct 11, 2020 09:30-10:30
Session Chair: Lianqing Liu, Shenyang Institute of Automation Chinese Academy of Sciences

ARIE Based Intelligent Operational Framework to Achieve High-precision Manipulation with Low-precision Systems

Hong Qiao

Professor
Institute of Automation, Chinese Academy of Sciences

Abstract:

In recent years, robotic manipulation technologies with high precision and flexibility have received significant attention, especially in the fields of aerospace, electronics, and industrial engineering. The method to achieve high precision manipulation mainly including active methods using full sensor information and passive compliance methods. Attractive region in environment (ARIE) based method is one of the passive compliance methods which can effectively achieve high-precision manipulation with low-precision systems by using the constraints formed by the environment.

In order to promote the widely application of ARIE on robot, we established an operational framework that integrates the intelligent manipulation strategy and compliant motion control based on ARIE. Through a unique method of formulation and utilization of the attractive region in the configuration space, the feasible and reliable manipulation strategy to attain the high-precision assembly in physical space without a force sensor and flexible wrist could be designed, and the approach to achieve 2-D and 3-D part orientation by sensorless grasping and pushing actions was also provided. Through the ARIE-guided online compliant control, the operation fulfills high precision, high reliability, high speed, and high flexibility all at once during one robotic manipulation task.

Biography:

Hong Qiao is deputy director of State Key Laboratory of Management and Control for Complex Systems, the group leader of Robotic Theory and Application (more than 50 researchers) in Institute of Automation, CAS. She is Winner of National Natural Science Funds for Distinguished Young Scholar, IEEE Fellow, IEEE Award Board Member and IEEE RAS AdCom Member. Prof. Qiao has made excellent contributions to interdisciplinary research between robotics and other areas and also among different directions in robotic area. She is an internationally-recognized and highly-cited pioneer researcher in high-precision robotic manipulation and biologically-inspired robotic cognition and manipulation. Her contributions are evidenced by more than 230 international journal and conference papers (150 SCI Indexed) with 2900+ total citation and H-Index of 28, and 56 patents. Her theory of "Attractive Region in Environment (ARIE)" —reported as "Qiao's Concept" —has been widely applied in industrial robots in China. She was awarded Second Prize of the National Natural Science Award (the highest fundamental research award in China) in 2014. She also serves as AEs of 6 IEEE Transactions and Editor-in-chief of Assembly Automation (SCI). She established three industrialization bases in China for robotic assembly and detection. Some of the products became standardized and achieved best seller in local market. The base in Huizhou also got rewarded as New-type R & D institutions by local government.

Plenary Talk 2: Monday, Oct 12, 2020 16:20-17:20
Session Chair: Xiaodong Zhang, Xi'an Jiaotong University

Evolution and Future Trend of AI and Robotic Systems

Huosheng Hu

Professor
School of Computer Science and Electronic Engineering
University of Essex, United Kingdom

Abstract:

After recent advancement of AI and robotics technologies, autonomous robots are gradually serving us in our home, hospital, office and everywhere. They are intelligent and interactive, inspired from behaviour demonstration of biological systems. However, these robots face several engineering challenges. Firstly, they must deal with uncertainty within the systems, such as sensor noise, actuator inaccuracy, and components failure. Secondly, they must deal with a huge uncertainty in the real world, which is dynamically changing over time. Thirdly, they must communicate with humans in order to provide services. In this talk, I will firstly outline the evolution and future trend of AI and robotics technologies, and then present our research work toward the advanced robotic systems, based on inspiration from biological systems. More specifically, behaviour modelling, sensor data fusion and sensor-based control are discussed respectively, and some preliminary experimental results are demonstrated through video.

Biography:

Huosheng Hu is Professor and Head of Robotics and Mechatronics Group in the School of Computer Science and Electronic Engineering at the University of Essex, United Kingdom. He received the MSc degree in industrial automation from the Central South University in China in 1982 and the PhD degree in robotics from the University of Oxford in the U.K. in 1993. His research interests include autonomous robots, embedded systems, data fusion, human-robot interaction, machine learning algorithms, cloud computing and mechatronics. He has published over 500 papers in journals, books and conferences in these areas. Prof. Hu is a Fellow of Institute of Engineering & Technology, a Fellow of Institute of Measurement & Control, a founding member of IEEE Robotics & Automation Society Technical committee on Networked Robots. He has been a Program Chair or a member of Advisory Committee for many international conferences such as IEEE ICRA, IROS, ICMA, ROBIO. He is currently Editor-in-Chief for International Journal of Automation and Computing, and Executive Editor for International Journal of Mechatronics and Automation.

Keynote Talks

Keynote Talk 1: Sunday, Oct 11, 2020 11:00-11:40
Session Chair: Guangzhong Cao, Shenzhen University

Industrial Robot Control: Evolutional Advancement and Proposed Trend

George Zhang

Shenzhen Academy of Robotics, China

Abstract:

Industrial robotics with various applications has become a group of critical components for manufacturing automation and intelligent operation. As a typical mechatronics device, a robotic system composes of one or more mechanical arm(s) and an electronic controller. While the mechanical arms are relatively long-lasting in their structural form and life span, robot controller has evolved rather rapidly for several generations since the beginning of the dawn of the robotics being.

This talk reviews the evolutional advancement of industrial control hardware and software development, focusing on computational hardware, the micro-processing chip, and structural software, the real-time operating system. The interface element between the mechanical robotic arm and programable robotic controller, mainly drives/motors and I/O units, will be mentioned; From manufacturing application point of view, typical robotic arm structures, motor/drive configuration, and motion control schemes are presented and analysed. Advanced robotic control technologies such as force control and vision-based control are introduced and discussed; Newly developed industrial manipulator types and corresponding motion control requirement and practice are dealt with and foreseen. Finally, some trends for industrial robotic control and hardware/software integration as well as their applications are going to be proposed and evaluated.

Biography:

George Zhang is Senior Researcher and Director of Science and Technology Committee in Shenzhen Academy of Robotics. He has served as Senior Principal Scientist with Robotics and Intelligent Machines group, ABB US Corporate Research Center, and R&D Director in Powertrain Assembly Department, ABB Robotics (Shanghai). George received his Ph. D. degree in Mechanical Engineering from Kansas University and has been working in the area of Industrial Robotics and Manufacturing Automation for more than 20 years. He is an inventor of more than 15 patents and published about 60 journal and conference papers. His research focused on Engineering Mechanics and Industrial Automation, including robotic kinematics, dynamics and control, robotics and manufacturing automation, manufacturing process optimization, and advanced manufacturing technologies.

Keynote Talk 2: Sunday, Oct 11, 2020 11:40-12:20
Session Chair: Xuguang Lan, Xi'an Jiaotong University

Fuzzy Dynamical Systems (FDS): Origin and Development

Ye-Hwa Chen

Professor
The George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology, USA

Abstract:

Rudolf E. Kalman (1930-2016) made groundbreaking contributions to modern systems and control theory in the 50's and 60's. His Kalman filtering, LQG, based on probability theory, and state space representations have set the foundations for researchers and practitioners in this area for the past 70 years.

Lotfi A. Zadeh (1921-2017) proposed the unique idea of fuzzy theory in 1965. Since then, numerous development in the theory and applications in this area have emerged.

In 1972, they met in a conference in France. After Zadeh delivered a presentation regarding fuzzy decision making, Kalman fiercely criticized the very idea of fuzzy theory. The criticism not only represented Kalman's own lack of confidence in this new area, but also set the tone for all major skepticism toward fuzzy theory in the years to come.

In 1994, Kalman publicly disavowed the probability theory, claiming "probabilities do not exist." Yet he still refused to endorse the fuzzy theory.

We will review the history of the contentions among the two pioneers in system and control theory, which provides the origin for the Fuzzy Dynamical System (FDS) theory. We will then outline the major development of this new subject. The topics include practical stability, fuzzy uncertainty bound, control scheme, optimization, game-theoretic design.

Biography:

Ye-Hwa Chen received his B.S. in Chemical Engineering from the National Taiwan University in 1979. He then received his M.S. and Ph.D. in Mechanical Engineering from the University of California, Berkeley, in 1983 and 1985, respectively. He served as a faculty in Syracuse University during 1986-1988. Since 1988, he has been with the George W. Woodruff School of Mechanical Engineering of Georgia Institute of Technology (Atlanta, USA) where he is currently a professor.

He has been serving as regional editor and associate editor for six journals. He has published over 230 refereed journal papers. He has received the IEEE Transactions on Fuzzy Systems Outstanding Paper Award, Sigma Xi Best Research Paper Award, and Sigma Xi Junior Faculty Award. A paper of his received the second highest citation in the IEEE Transactions on Industrial Electronics. He received the Passport Award, the Monopoly Award, and the "As Good As It Gets" Award from the Georgia Institute of Technology. He is the recipient of the Campanile Award from the Georgia Institute of Technology, the highest honor of the institute. His research interests include dynamical systems and mechatronic systems modeling and analysis, fuzzy systems, and control.

Keynote Talk 3: Monday, Oct 12, 2020 14:30-15:10
Session Chair: Guangrui Wen, Xi'an Jiaotong University

Human-Robot Interaction Teleoperation Robot with Force Feedback

Aiguo Song

Professor
Southeast University, China

Abstract:

Human-robot Interaction teleoperation robot is currently the frontier and hot-point of the robotics research. It combines the human intelligence with robot viability in unknown environments or hazard environments, so that it is able to perform the complex tasks in pre-unknown or hazard environments. Telepresence is always the pursued goal of the human-robot interaction teleoperation. In this report, we review the history of the force feedback teleoperation robot, and illustrate the architecture of the human-robot interaction teleoperation robot system with force feedback. Force feedback teleoperation system allows humans to perform complex tasks in a remote or pre-unknown environment, while providing realistic force feedback to the human operator. The incorporation of real-time force feedback as well as visual information in the teleoperation control loop can lead to significant improvements in task performance, and feeling of telepresence. Then we discuss its four key techniques, that is force/tactile sensor technique, force feedback technique, force control strategy, predictive virtual environment modeling. At last, we briefly introduce the development of human-robot interaction teleoperation robot and its applications in rehabilitation therapy and prosthetic limb areas at Southeast University.

Biography:

Aiguo Song received the Ph.D degree in Measurement and Control from Southeast University, Nanjing, China in 1996. From 1996 to 1998, he was an Associate Researcher with the Intelligent Information Processing Laboratory, Southeast University, China. From 1998 to 2000, He was an associate Professor with the School of Instrument Science and Engineering, Southeast University, China. From 2000 to 2003, he was the Director of the Robot Sensor and Control Lab, Southeast University, China. From April, 2003 to April, 2004, he was a visiting scientist with the Lab for Intelligent Mechanical Systems (LIMS), Northwestern University, Evanston, USA. He is currently the Professor with the School of Instrument Science and Engineering, Southeast University, China, and also the Director of Robot Sensor and Control Laboratory, the President of Nanjing Advanced Robotics Research Institute. His current interests concentrate on human-robot interaction teleoperation robot, force/tactile sensors, haptic display, space robot, and rehabilitation robot. He has published more than 280 peer reviewed journal papers, and 180+ papers have been indexed by SCIE, and SCI cited time is 2000+. He received the best paper awards 12 times. He is a member of Chinese Instrument and Control Association, IEEE senior member, Chair of IEEE Nanjing Section Robotics and Automation Society Chapter. He serves as Associate Editor for 5 SCIE indexed Journals, and served as Chair or Co-Chair of 30+ International Conference/Symposium. He was recipient of the second prize of the National Scientific and Technological Progress in 2017, and recipient of the National Outstanding Youth Fund of National Natural Science Foundation of China.

Keynote Talk 4: Monday, Oct 12, 2020 15:40-16:20
Session Chair: Mingxing Lin, Shandong University

Cognitive Robotics: Recent Developments and Research Challenges

Meng Joo Er

Professor
School of Marine Electrical Engineering
Dalian Maritime University, China

Abstract:

The quest for building human-like intelligence has gained enormous momentum in recent decades. Since the seminal works on Artificial Intelligence (AI), the desire of realizing the quest has become stronger. With the rapid developments in Science, Engineering and Technology, machines that mimic human intelligence have become a reality and sometimes indispensable parts in our daily life, such as Apple Siri and Google Voice. Cognition is a group of mental processes that include attention, memory, producing and understanding language, solving problems and making decisions and making decisions. Cognitive robotics is concerned with endowing robots with intelligent behavior by providing a processing architecture that will allow it to learn and reason about how to behave in response to complex goals in a complex world. In this talk, recent developments of cognitive robotics with applications in the healthcare industry, domestic services, marine vehicles etc will be reviewed. The futuristic trends and research challenges will also be discussed.

Biography:

Professor Er Meng Joo is currently Changjiang Scholar Distinguished Professor and Director of Research Institute on Artificial Intelligence and Marine Vehicles at the School of Marine Electrical Engineering, Dalian Maritime University， China. He was Professor in Electrical and Electronic Engineering, Nanyang Technological University, Singapore from 1992-2020. He served as the Founding Director of Renaissance Engineering Programme and an elected member of the NTU Advisory Board and from 2009 to 2012. He served as a member of the NTU Senate Steering Committee from 2010 to 2012.

He has authored six books entitled “Dynamic Fuzzy Neural Networks: Architectures, Algorithms and Applications” and “Engineering Mathematics with Real-World Applications” published by McGraw Hill in 2003 and 2005 respectively, and “Theory and Novel Applications of Machine Learning” published by In-Tech in 2009, “New Trends in Technology: Control, Management, Computational Intelligence and Network Systems” and “New Trends in Technology: Devices, Computer, Communication and Industrial Systems”, both published by SCIYO, “Intelligent Control of Unmanned Marine and Aerial Vehicles”, published by Nova Science Publishers 2018, 21 book chapters and more than 500 refereed journal and conference papers in his research areas of interest.

Professor Er was bestowed the Web of Science Top 1 % Best Cited Paper and the Elsevier Top 20 Best Cited Paper Award in 2007 and 2008 respectively. In recognition of the significant and impactful contributions to Singapore’s development by his research projects, Professor Er won the Institution of Engineers, Singapore (IES) Prestigious Engineering Achievement Award twice (2011 and 2015). He is also the only dual winner in Singapore IES Prestigious Publication Award in Application (1996) and IES Prestigious Publication Award in Theory (2001). Recently, he was bestowed the Amity Researcher Award 2018 for his outstanding and significant contributions in Robotics and Automation.

He received the Teacher of the Year Award for the School of EEE in 1999, School of EEE Year 2 Teaching Excellence Award in 2008, the Most Zealous Professor of the Year Award in 2009 and the

Outstanding Mentor Award in 2014. He also received the Best Session Presentation Award at the World Congress on Computational Intelligence in 2006, Best Paper Award (First Prize) at the International Automatic Control Conference 2016, Best Presentation Award at the IEEE-sponsored International Conference on Intelligent Control, Power and Instrumentation (ICICPI) 2016, Best Presentation Award at the IEEE-sponsored International Conference on Intelligent Autonomous System (ICoIAS'2018) and the Best Presentation Award at ICoIAS'2019. On top of this, he has more than 70 awards received at international and local competitions.

Currently, Professor Er serves as the Editor-in-Chief of 2 international journals, namely Transactions on Machine Learning and Artificial Intelligence and the International Journal of Electrical and Electronic Engineering and Telecommunications. He also serves an Area Editor of International Journal of Intelligent Systems Science and an Associate Editor of 14 refereed international journals, namely IEEE Transaction on Cybernetics, Information Sciences, Neurocomputing, Asian Journal of Control, International Journal of Fuzzy Systems, ETRI Journal, International Journal of Humanoid Robots, International Journal of Modelling, Simulation and Scientific Computing, International Journal of Applied Computational Intelligence and Soft Computing, International Journal of Business Intelligence and Data Mining, International Journal of Fuzzy and Uncertain Systems, International Journal of Automation and Smart Technology, International Journal of Intelligent Information Processing and an editorial board member of the Open Automation and Control Systems Journal and the EE Times.

Professor Er has been invited to deliver more than 100 keynote speeches and invited talks overseas. He has also been active in professional bodies. Under his leadership, the IEEE CIS Singapore Chapter won the CIS Outstanding Chapter Award in 2012 (The Singapore Chapter is the first chapter in Asia to win the award). He was bestowed the IEEE Outstanding Volunteer Award (Singapore Section) and the IES Silver Medal in 2011. He is listed in Who's Who in Engineering, Singapore, Edition 2013.

Panel Discussion 1: Industrial internet and 5G

Sunday, Oct 11, 2020 08:30-09:30

Panel Members:

Haibin Yu (Host), Shenyang Institute of Automation, Chinese Academy of Sciences

Xuesong Mei, Xi'an Jiaotong University

Zhiyong Feng, Beijing University of Posts and Telecommunications

Dan Liu, Instrumentation Technology and Economy Institute

Jiadong Du, China Academy of Information and Communication Technology

Haibin Yu

Haibin Yu is a professor and the director of Shenyang Institute of Automation (SIA), Chinese Academy of Sciences(CAS). He is the deputy editor-in-chief of information and control. He is also the vice-chairman of china national technical committee for automation systems and integration standardization, the deputy director of chinese association of automation, the council members of china instrument and control society. He is also one of the expert members for intelligent manufacturing fund of the ministry of science and technology of the P. R of China. He served as peer-reviewer in automation for national natural sciences foundation of China. His primary research interests are in industrial communication and control systems, and the development of industrial sensor network technology and system. His research has been funded by both basic and applied research agencies in China. His research group at SIA has published more than 200 technical papers and two books.

Xuesong Mei

Xuesong Mei is a professor of Xi'an Jiaotong University, a distinguished expert from the Ministry of Education of the Changjiang River, an expert in the advanced manufacturing field of the National 863 Program, and an expert in the "Numerical Control Generation" expert group of the Ministry of Science and Technology. He is the party secretary of the mechanical engineering college. His main research directions include 1) High-speed, high-precision electromechanical system realization method and control technology and 2) laser precision machining theory and method. He has presided over more than 20 projects of 973, 863, National Natural Science Foundation of China, provincial and ministerial funds, and enterprise cooperation projects. As the first person in charge, he won the first prize of Science and Technology Progress Award of the Ministry of Education, the first prize of Shanxi Province Science and Technology Progress Award, and the first prize of Shanxi Province Teaching Achievement Award. He is an inventor of more than 18 patents and published about 140 papers，including more than 100 papers included in SCI/EI.

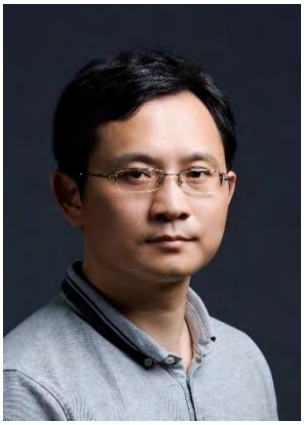
Zhiyong Feng

Zhiyong Feng received the B.S., M.S. and Ph.D. degrees from Beijing University of Posts and Telecommunications (BUPT), China. Now she is a professor at BUPT and the Director of Key Laboratory of Universal Wireless Communications, Ministry of Education, China. She received Outstanding Young Researcher Award from Natural Science Foundation of China (NSFC) in 2015. Currently, she is serving as Associate Editors-in-Chief for China Communications, and a technological advisor for NGMN. She is a member of Expert Committee of China Intelligent Transportation Systems Association, vice chair of the Information and Communication Test Committee of the Chinese Institute of Communications. Her main research interests include the cognitive wireless network, wireless network virtualization for 5G, and joint wireless communication and radar sensing system.

Dan Liu

Dan Liu is Professor Level Senior Engineer and vice chief engineer of Instrumentation Technology & Economy Institute (ITEI). She has about 20-year experiences on research, development, standardization and testing of industrial communication network protocol, automation, and smart manufacturing. Dan Liu received her Ph.D. degree in Mechatronic Engineering from the Shenyang Institute of Automation, Chinese Academy of Sciences, and has been working in ITEI for 15 years. She has prepared more than 40 standards on industrial communication, established several certification test labs of PROFIBUS, PROFINET, HART, OPC UA, etc., and once won the first prize of China Standard Innovation Contribution Award.

Jiajin Du



Jiajin Du is deputy director of the 5G Application Innovation Center of the Institute of Technology and Standards of China Academy of Information and Communications Technology (CATR). Mr. Du has long been engaged in technical research and standardization of Internet of Things, wireless communication technology, mobile core network, etc., and has deep research on 5G and Internet of Things, Internet of Vehicles, Industrial Internet, etc. Mr. Du is also responsible for international and China standardization work in the Internet of Things. Internationally, Mr. Du participates in the relevant standardization work of international standardization organizations such as 3GPP, IEEE 802.11/802.15, oneM2M, etc.; In China, Mr. Du is responsible for the standardization of China Internet of Things wireless technologies and applications.

Panel Discussion 2: Opportunities and Challenges of Risc-v Based Open Architecture Robot Controllers

Monday, Oct 12, 2020 13:30-14:30

Panel Members:

Steve Deng (Host), Tsinghua University

Pengcheng Zou, ThunderSoft

Eric Wu, Xidian University

George Zhang, Shenzhen Academy of Robotics

Wu Gang

Wu Gang was graduated from the bachelor degree in TeleCommunication Engineering at Xidian University in 2003.He is CEO of Hangzhou Speedcury Technology Co., Ltd. Now.

Wu Gang acted as a senior logic engineer and product manager, Huawei Technologies Co., Ltd., had founded a number of companies, and has a keen vision on market technologies and rich product definition and design experiences. With over 15 years of experiences in FPGA design, verification and project management, as well as in-depth research on SOC design, circuit algorithm design and verification, he has designed and developed multiple chips used in ATM, GE/10GE, OTN, WCDMA and other applications, which have been used widely in optical network products of Huawei. He has rich experiences in FPGA-based high-performance algorithm, ultra-high-speed communication implementation and optimization. He had led a team to complete the first deep learning implementation on FPGA in China, and developed the first FPGA deep learning acceleration library based on RTL-level code in China; led the team to develop multiple FPGA-based complex systems: FPGA-based ultra-wide dynamic ISP, FPGA-based 3D display algorithm, FPGA-based OPENBLAS acceleration library, FPGA-based high-performance EW system and beam forming system. In 2018, he led the team to develop the first digital/mixed-signal semiconductor packaging and testing machine above 200MHz, which broke the monopoly of American and Japanese companies in related fields.

Yangdong Deng

Yangdong Deng received his Ph.D. degree in Electrical and Computer Engineering from Carnegie Mellon University, Pittsburgh, PA. He received his ME and BE degrees in Electronic Department from Tsinghua University, Beijing.

Since 2013, he has been with School of Software, Tsinghua University as an associate professor. His research interests include data driven predictive maintenance and computer architecture. His research is supported by the National Key Project of China Ministry of Science and Technology, NVidia Professor Partnership Awards, Intel University Program, and others.

His team won many lead AI competitions including Pascal VoC, Microsoft CoCo, and CVPR WAD. He received a best paper award from International Conference on Computer Design.

Pengcheng Zou

Pengcheng holds a bachelor degree of EE of Tsinghua University, and master degree of Computer Science of the University of Notre Dame. Pengcheng has 20+ years of experience in Operating System and Open Source related business and technology. He has worked in NEC and Red Flag on various Operating System related projects, including the 1st Mobile Linux platform (Midinux) on Intel Platform, Smartbook OS, Qualcomm Reference Design (QRD) and many OS related products. He jointly established ThunderSoft in 2008, as CTO of ThunderSoft, he manages the technology strategy, R&D and strategic cooperations.

George Zhang

George Zhang is Senior Researcher and Director of Science and Technology Committee in Shenzhen Academy of Robotics. He has served as Senior Principal Scientist with Robotics and Intelligent Machines group, ABB US Corporate Research Center, and R&D Director in Powertrain Assembly Department, ABB Robotics (Shanghai). George received his Ph. D. degree in Mechanical Engineering from Kansas University and has been working in the area of Industrial Robotics and Manufacturing Automation for more than 20 years. He is an inventor of more than 15 patents and published about 60 journal and conference papers. His research focused on Engineering Mechanics and Industrial Automation, including robotic kinematics, dynamics and control, robotics and manufacturing automation, manufacturing process optimization, and advanced manufacturing technologies.

IEEE-CYBER 2020 Conference Program

<table>
<tr><th colspan="4">Oct 10 (Saturday)</th></tr>
<tr><td></td><td></td><td colspan="2">Peony Room</td></tr>
<tr><td>08:00-10:00</td><td></td><td colspan="2" rowspan="2">Workshop on Manufacturing Automation (CUSMA2020)
Language: Chinese</td></tr>
<tr><td>10:00-12:00</td><td rowspan="4">Registration</td></tr>
<tr><td>12:00-14:00</td><td colspan="2">Lunch
(for all Workshop attendees)</td></tr>
<tr><td></td><td>Lily Room 1-2</td><td>Lily Room 4-5</td></tr>
<tr><td>14:00-17:00</td><td>Workshop on Manufacturing Automation (CUSMA2020)
Language: Chinese</td><td>Workshop on Manufacturing Automation (CUSMA2020)
Language: Chinese</td></tr>
<tr><td>18:00</td><td></td><td colspan="2">Welcome Reception
(for all registered attendees)</td></tr>
</table>

Oct 11 (Sunday)

<table>
<tr><td></td><td></td><td colspan="2">Peony Room</td></tr>
<tr><td>08:15-08:30</td><td rowspan="11">Registration</td><td colspan="2">Opening Ceremony</td></tr>
<tr><td>08:30-09:30</td><td colspan="2">Panel Discussion 1: Industrial internet and 5G
Haibin Yu (Host), Shenyang Institute of Automation, Chinese Academy of Sciences
Xuesong Mei, Xi’an Jiaotong University
Zhiyong Feng, Beijing University of Posts and Telecommunications
Dan Liu, Instrumentation Technology and Economy Institute
Jiadong Du, China Academy of Information and Communication Technology</td></tr>
<tr><td>09:30-10:30</td><td colspan="2">Plenary Talk 1: Hong Qiao, Institute of Automation, Chinese Academy of Sciences, China
ARIE based intelligent operational framework to achieve high-precision manipulation with low-precision systems</td></tr>
<tr><td>10:30-11:00</td><td>Coffee Break</td><td>Poster Session 1
(ID:217, 227, 234, 236, 238, 240, 244, 246, 248, 249, 251, 252, 257, 259, 266)</td></tr>
<tr><td>11:00-11:40</td><td colspan="2">Keynote Talk 1: George Zhang, Shenzhen Academy of Robotics, China
Industrial Robot Control_Evolutional Advancement and Proposed Trend</td></tr>
<tr><td>11:40-12:20</td><td colspan="2">Keynote Talk 2: Ye-Hwa Chen, Georgia Institute of Technology, USA
Fuzzy Dynamical Systems (FDS): Origin and Development</td></tr>
<tr><td>12:20-13:30</td><td colspan="2">Lunch
(for all registered attendees)</td></tr>
<tr><td></td><td>Lily Room 1-2</td><td>Lily Room 4-5</td></tr>
<tr><td>13:30-14:45</td><td>Best Paper Session 1
(ID: 278, 272, 270, 237, 231)</td><td>Robot Control and Planning
(ID:265, 287, 318, 283, 302)</td></tr>
<tr><td>14:45-15:15</td><td colspan="2">Coffee Break</td></tr>
<tr><td>15:15-16:30</td><td>Best Paper Session 2
(ID: 323, 317, 297, 295, 294)</td><td>Sensing and Recognition
(ID:223, 242, 316, 256)</td></tr>
<tr><td>16:30-17:45</td><td>Bio-inspired Systems
(ID:306, 298, 289, 296, 307)</td><td>Mechanism Design and Analysis
(ID:268, 254, 308)</td></tr>
<tr><td>18:00</td><td></td><td colspan="2">Conference Banquet
(for all registered attendees)</td></tr>
</table>

Oct 12 (Monday)

		Lily Room 1-2	Lily Room 4-5
09:00-10:15		Human-Machine Interaction (ID: 221, 314, 250, 224, 325)	Intelligent Diagnosis and Analysis (ID: 215, 277, 304, 216, 293)
10:15-10:45		*Coffee Break*	Poster Session 2 (ID: 269, 271, 273, 274, 276, 280, 282, 285, 286, 288, 291, 300, 303, 310, 312, 315, 322, 324)
10:45-12:00		Intelligent Control (ID: 219, 247, 220, 301, 261)	Human Intention Understanding (ID: 255, 262, 267, 245, 264)
12:00-13:30		*Lunch* *(for all registered attendees)*	
		Peony Room	
13:30-14:30		Panel Discussion 2: **Opportunities and challenges of risc-v based open architecture robot controllers** **Steve Deng** (Host), Tsinghua University **Pengcheng Zou**, ThunderSoft **Eric Wu**, Xidian University **George Zhang**, Shenzhen Academy of Robotics	
14:30-15:10		Keynote Talk 3: **Aiguo Song,** Southeast University, China ***Human-Robot Interaction Teleoperation Robot with Force Feedback***	
15:10-15:40		*Coffee Break*	
15:40-16:20		Keynote Talk 4: **Meng Joo Er,** Dalian Maritime University, China **Cognitive Robotics: Recent Developments and Research Challenges**	
16:20-17:20		Plenary Talk 2: **Huosheng Hu,** University of Essex, United Kingdom ***Evolution and Future Trend of AI and Robotic Systems***	
17:30		Farewell Reception (for all registered attendees)	

Oct 13 (Tuesday)	
09:00-16:00	**Technical Tour** (Pre-reservation is required; Free of charge) *Shuttle bus return to hotel at around 18:00*

Technical Sessions

SuA1: Best Paper Session 1

Session Chairs: Lianqing Liu and Zhidong Wang

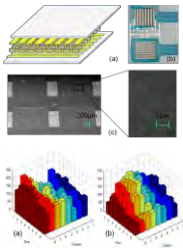
Room : Lily Room 1-2, 13:30-14:45, Sunday, October 11

SuA1(1) 13:30-13:45

A Flexible Force Tactile Sensor Array

Kai He, Lianqing Liu, *Member, IEEE*
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- An array tactile sensor: tactile element density is 30 elements per square centimetre (64 sensing elements in 1.45 cm*1.45 cm area).
- A radial artery pulse detection experiment based on a single-point tactile sensor whose sensing material was the same as that of the array sensor was carried out, Based on the results of radial artery pulse detection, the equipotential shielding method and the uCOS real-time operating system, an array tactile sensor system that can be used in robot electronic palpation was designed.

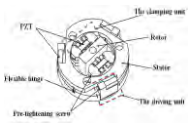


SuA1(2) 13:45-14:00

Structure Design and Nonlinear Control of a Precision Rotating Stage

Hao Wang[1] ,Yuqian Liu[1], Lina Hao[1] and Jiaming Chen[1]
1.School of Mechanical Engineering and Automation, Northeastern University, Shenyang, China

- Based on the principle of inchworm movement, a rotary piezoelectric actuated micro platform was designed.
- The hysteresis model of the micro platform is established and the corresponding control is given.
- The feasibility of the precise rotating mechanism and the effectiveness of the controller are verified



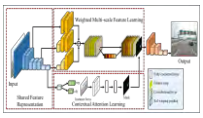
Schematic diagram of rotating mechanism

SuA1(3) 14:00-14:15

Contextual and Multi-Scale Feature Fusion Network for Traffic Sign Detection

Wei Zhang, Qiang Wang, Huijie Fan, and Yandong Tang
Shenyang Insititutes of Automation, Chinese Academy of Sciences, China

- We proposed an end-to-end deep learning network for traffic sign detection
- The model extracts multi-scale features and calculates weights of each feature map layer
- A contextual attention learning channel learns the mask of interference terms to reduce detection false
- Our model outperforms the state-of-the-arts, especially on very small size traffic signs



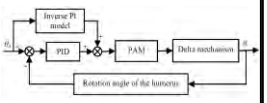
Details of the Contextual and Multi-Scale Feature Fusion Network.

SuA1(4) 14:15-14:30

Direct Inverse Hysteresis Compensation of a Pneumatic Artificial Muscles Actuated Delta Mechanism

Pengxiu Geng, Yanding Qin, Liangjian Zhong, Feng Qu, Dongyang Bie, Jianda Han
College of Artificial Intelligence, Nankai University, China

- Compensating for the hysteresis nonlinearity of the PAM in a 2-DOF Delta mechanism using composite control method
- Direct inverse modeling approach was utilized to obtain the PAM's inverse hysteresis model
- A modified PI model was used to model the hysteresis in the mechanism



Block diagram of the feedforward-feedback composite controller

SuA1(5) 14:30-14:45

Wavelet-Based Electromyographic Feature Selection Method for Real-Time Ankle Movement Recognition

Wen-Zhou Li and Guang-Zhong Cao
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, Shenzhen University, China
Yulong Wang and Xing Lyu
The First Affiliated Hospital of Shenzhen University, China

- Ankle movement classification based on EMG signal with feature set of small size is still challenging so far.
- This paper tries to tackle this problem by proposing a feature selection method utilizing wavelet transform and sequential forward selection.
- The method proposed is verified through real-time classification result with highest accuracy of 97.32% (Fig. 1).

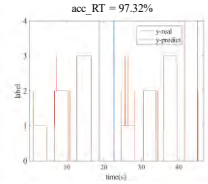


Fig. 1 Real-time classification result

SuA2: Robot Control and Planning

Session Chairs: Imad H. Elhajj and Aibing Zhu

Room : Lily Room 4-5, 13:30-14:45, Sunday, October 11

SuA2(1) 13:30-13:45

Experimental Analysis of the Performance of a Hexapod Robot based on the Dynamic Parameters

Muhammad Affan Arif, Aibin Zhu, Han Mao, Pengcheng Zhu, Jiyuan Song, Yao Tu
Institute of Robotics & Intelligent Systems, Shaanxi Key Laboratory of Intelligent Robots, Xi'an Jiaotong University, China
Huang Shen
Institute of Robotics & Intelligent Systems, and Key Laboratory of Education Ministry for Modern Design and Rotor-Bearing System, Xi'an Jiaotong University, China

- Kinematic Modeling of a small hexapod robot driven by C-shaped legs.
- Triangle gait phase-parameters selection.
- Experimental analysis of the chosen triangle gait phase parameters.

Hexapod robot

SuA2(2) 13:45-14:00

Kinematic Analysis Of Ophthalmic Surgical Robot

Ning Wang,Xiaodong Zhang,Mingyang Li and Xiaojing Feng
School of Mechanical Engineering, Xi'an Jiao tong University,China.
Hongbing Zhang
No.1 Xi'an Hospital，China

- The ophthalmic surgery robot with 6 degrees of freedom and double parallelogram structure
- Calculate and analyze the forward and inverse kinematics
- Simulate the spatial point distribution and trajectory of the robot end effector
- Caculate the inverse kinematics and driving motor of each joint

Ophthalmic Surgical Robot

SuA2(3) 14:00-14:15

Novel Objects Detection for Robotics Grasp Planning

Shengchang Zhang and Jindong Tan
Department of Mechanical, Aerospace, and Biomedical Engineering, University of Tennessee, Knoxville, USA
Zheng Nie
Department of Computer Science, Stanford University, USA

- A new model utilizing two paralleled reinforcing loops for fast and robust grasp planning.
- A perception framework for recognizing novel objects without extra data collection.
- A systematical benchmark testing the effectiveness of different vision tasks for grasping learning.

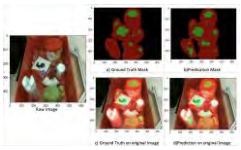


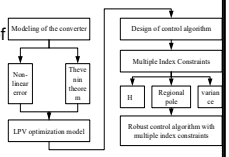
Fig. comparison between prediction and ground truth

SuA2(4) 14:15-14:30

Research on Robust Control Method of Hybrid Energy Storage System under Multiple Index Constraints

Shaoyu Feng, Zhimin Feng, Yunfei Shi and Xiaofeng Liu
Faculty of Maritime and Transportation, Ningbo University, China
Longfei Wang
Ningbo Maritime Police College, China

- Considering the nonlinear error in the modeling process, the multi-cell LPV model of the converter is optimized
- A robust control algorithm with multiple index constraints is proposed for the converter
- Based on H∞ and regional pole indicators, variance is introduced to characterize response speed
- Building a SIMULINK model for simulation, the results show that the robust performance is good



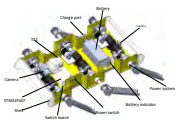
Flow chart of the overall idea

SuA2(5) 14:30-14:45

Design and Experimental Study of Bidirectional Deformable Hexapod Robot

Pengcheng Zhu, Aibin Zhu, Muhammad Affan Arif, Han Mao
Institute of Robotics & Intelligent Systems, Shaanxi Key Laboratory of Intelligent Robots, Xi'an Jiaotong University, China
Zhifu Guo
Taiyuan Institute Co.Ltd. of China Coal Technology and Engineering Group, Taiyuan, China

- Bidirectional Deformable Hexapod Robot
- Transmission shaft: driving the foot to make rotary motion or reciprocate swing
- Take-upshaft: When deformation, the power output shaft



Hexapod robot structure

SuB1: Best Paper Session 2

Session Chairs: Lianqing Liu and Zhidong Wang

Room : Lily Room 1-2, 15:15-16:30, Sunday, October 11

SuB1(1) 15:15-15:30

Terrain Classification for Bipedal Robots: A Comparative Study

Zahraa Awad, Raja Akel, Noel Maalouf and Imad H. Elhajj
Electrical and Computer Engineering Depratment, American University of Beirut, Lebanon

- The research aims to identify the best classification technique with the best feature reduction method for terrain identification.
- This is done by comparing four different classification techniques with three distinct feature reduction methods.
- Support Vector Machine while performing Linear Discriminant Analysis gave the highest accuracy result (85.89%).

Terrains involved in the research

SuB1(2) 15:30-15:45

Research on Intuitive Tele-operation Motion Mapping Algorithm for Omnidirectional Mobile Heterogeneous Slave Arm System *

Haiyang DENG, Daoxiong GONG, Jianjun YU and Guoyu ZUO
Beijing Key Lab of Computational Intelligence and Intelligent System, Beijing University of Technology, China

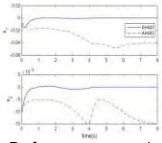
- To achieve the consistency of master-slave motion trajectory via combining the Omnidirectional Mobile platform
- Slove the problem of the limited working space of the slave arm in tele-operation
- Operator can tele-control the heterogeneous slave arm more intuitively and easily

SuB1(3) 15:45-16:00

Extended High-gain Observer Based Output Feedback Linearization of Robot Manipulator

Lai Wei
Electrical and Computer Engineering, Michigan State University, USA
Gengliang Chen
Shenzhen Technology University, CHINA
Shenzhen Academy of Robotics, CHINA

- An Extended High-Gain Observer (EHGO) based output feedback linearization technique for robot manipulators.
- EHGO is employed to estimate joint velocities and the extended term is used to estimate the model uncertainty.
- This method could suppress perturbation caused by model uncertainty and bounded external disturbance.



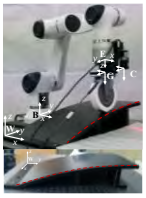
Performance comparison with Adaptive High-Gain Observer (AHGO) based control under parameter error and constant disturbance

SuB1(4) 16:00-16:15

Path Generation Method for Robotic Blades Grinding Based on Predictive Control and Extended Kalman Filter

Jiuming Guo, Dan Wu and Ken Chen
Department of Mechanical Engineering, Tsinghua University, China

- We propose a robotic system and vision-based path control method for blade edge area grinding.
- The method can be divided into prior measurement and performing task for safety.
- A predictive controller with designed transition sequences and error-based switch policy is raised.
- Experiments confirmed the method presented promoted stability and required accuracy for grinding.



SuB1(5) 16:15-16:30

Analysis method of importance degree of hobbing process parameters

You Guo, Ping Yan*, Dayuan Wu, Han Zhou and Yunzhong Yi
The State Key Laboratory of Mechanical Transmission, Chongqing University, China

- Analysis of hobbing quality inspection indicators based on DPCA and Mbirch
- Reduction of hobbing process parameters based on fuzzy rough set and AMODE
- Processing experiment verification

Analysis method of importance degree of hobbing process parameters

SuB2: Sensing and Recognition

Session Chairs: Aibing Zhu and Zheng Zhang

Room : Lily Room 4-5, 15:15-16:30, Sunday, October 11

SuB2(1) 15:15-15:30

Moving object detection for Camera Pose Estimation in dynamic environments

Xiaowei Zhang, Yeping Peng*, Mingbin Yang, Guangzhong Cao, and Chao Wu
College of Mechatronics and Control Engineering, Shenzhen University, Shenzhen, China

- Target objects are detected by the YOLOv3 model from the RGB images.
- The object features are clustered using the k-means algorithm by fusing the information of the depth images.
- Calculating the adaptive threshold value by multi-view geometry to judge whether the object is moving or not

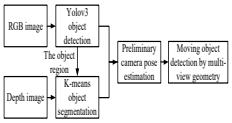


Fig. 1 Flowchart of the proposed method

SuB2(2) 15:30-15:45

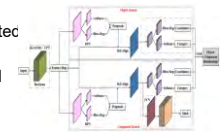
Abstract:
In this project, we mainly explore and construct the 3D indoor map. The goal of this paper is to merge the data from the laser and kinect sensor with Monte Carlo Location(MCL) in 2D map. We use the laser range sensor to construct the 2D map and get the robot's pose transformation matrix. Then, we obtain the color and depth image by using the kinect sensor and build 3D point cloud map by using the feature extraction method, getting the kinect's pose transformation matrix. After that, we get the optimal pose transformation by using the Kalman Filter to calibrate the robot's pose transformation matrix and the kinect's pose transformation matrix. Finally, the optimal pose transformation matrix is employed to accomplish the local 3D map and construct the global 3D indoor map. To show the superiority of our method, we make some experiments and compare with some other algorithms. Experimental results shown that our method has a better superiority.

SuB2(3) 15:45-16:00

A Simultaneous Object Detection and Component Segmentation Approach Based on Mask R-CNN

Deshuai Zheng, Jin Yan, Yong Liu* and Tao Xue
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- The features of the input which is supposed to a RGB image are extract by the backbone.
- Object box and component mask are detected by the two branches.
- The relationships between components and objects are derived according to the overlapping area ratio.

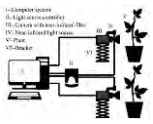


SuB2(4) 16:00-16:15

Smart Morphological Change Sensing System using an Automatic Non-destructive Method for Soybean Flower Bud Differentiation

Zhiyu Ma, Dailie Wang, Lixue Zhu, Hongyu Wei1, Hongli Liu and Xuan Chu
College of Mechanical and Electrical Engineering, Zhongkai University of Agriculture and Engineering, China
Yinghui Mu
College of Agriculture, South China Agricultural University, China

- An automatic threshold segmentation algorithm (OTSU) was used to segment a flower bud image.
- The optimal reference plate size in the algorithm was 220×230 pixels.
- The real-time monitoring method for FBD greatly eases the measuring workload and overcomes the limitations of manual measurements



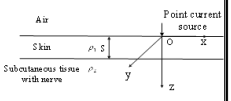
Non-destructive flower bud measuring

SuB2(5) 16:15-16:30

Analysis of Nerve Excitation for TENS under Point Current Source

Zhiming Jiang, Xiaodong Zhang, Teng Zhang, Yi Zhang, Yachun Wang
College of Mechanical Engineering, Xi'an Jiaotong University, China

- Nerve model and subcutaneous electric field distribution models under TENS have been extensively studied.
- Two-layer simplified model under point current source was proposed to analyze the distribution of electric filed on the forearm using electrical imaging method.
- Distribution of activating function and potential in subcutaneous tissue layer was discussed.



Human skin model for external electric stimulating

SuC1: Bio-inspired Systems

Session Chairs: Fei Wang and Jing Wang

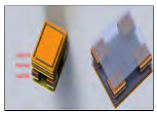
Room : Lily Room 1-2, 16:30-17:45, Sunday, October 11

SuC1(1) 16:15-16:45

Electronic skin based on flexible capacitor

Yinghan Wang, Qinshu Chen and Yuchen Li,
School of Mechanical Engineering and Automation,Beihang University,China
Sitong Lu, Zhe Liu and Diansheng Chen*
School of Mechanical Engineering and Automation,Beihang University,China

- Design a composite sensor that can realize proximity and small force haptics
- Design a new type of mixture of silica gel and super capacitor for sensor
- Design a double-layer sandwich structure to improve sensor performance



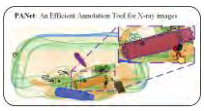
Overall Design

SuC1(2) 16:45-17:00

Automatic Annotation Approach for Prohibited Item in X-ray Image based on PANet

Bowen Ma and Tong Jia
College of Information Science and Engineering, Northeastern University, China

- We propose an efficient annotation tool for X-ray images
- We present a high-quality X-ray segmentation dataset named PIXray
- An adaptive multi-level attention module is used to eliminate the influence of overlapping phenomenon



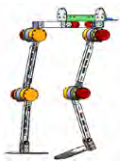
An Efficient Annotation Tool for X-ray images

SuC1(3) 17:00-17:15

Experimental Study of Lower Extremity Exoskeleton Robot

Hongyun Jia and Shuopeng Wang
College of mechanical engineering and automation, Northeasten University, China
Bohong Zhang and Lina Hao
College of mechanical engineering and automation, Northeasten University, China

- The lower extremity exoskeleton robot system is time-varying, nonlinear, and coupled
- The inertial sensor and plantar pressure sensor are used to collect human motion data
- the fuzzy PID control algorithm is researched
- the exoskeleton robot is worn under different road conditions for walking and assisting experiments.

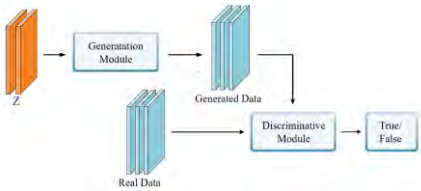


Structure of the lower limb assisted walking robot

SuC1(4) 17:15-17:30

Diversity amplification and data generation of Chinese Sign Language based on Generative Adversarial Network

Fei Wang, Zhen Zeng, Shizhuo Sun and Yanjun Liu
Robotics, Northeastern University, China



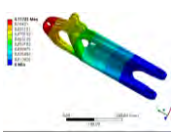
Overall flow chart

SuC1(5) 17:30-17:45

Design and Modal Analysis of Calf Structure of Hydraulic Biped Robot

Jianrui Zhang, Zhaohui Yuan and Sheng Dong
School of Automation, Northwestern Polytechnical University, China
Weidong Yuan
Technical Engineering Department, C&U GROUP, China

- We determined the size and shape of the calf structure that meets the function;
- We designed the initial structure of the calf, uses ANSYS Workbench software for topology optimization;
- The model of the lower limb structure is optimized and reconstructed, the optimized model is tested;
- The weight is reduced by 57.4% under the condition of satisfying the mechanical properties.



Strain cloud diagram after calf optimization

SuC2: Mechanism Design and Analysis

Session Chairs: Lingli Yu and Yingjie Zhang

Room : Lily Room 4-5, 16:30-17:45, Sunday, October 11

SuC2(1) 16:15-16:45

A Design of Lower Limb Rehabilitation Robot and its Control for Passive Training

Gilbert Masengo and Xiaodong Zhang
Mechanical Engineering , Xi'an Jiaotong University, China
Emmanuel Mudaheranwa
School of Engineering , Cardiff University , UK

- Encoder built -in servo motor will rotate the motor shaft angle,
- Then, the Information is feedback to the motor drive .
- Walker leg angle sensor mounted to the joint shaft angle;
- Then, the information is feedback to the host computer motion control program.

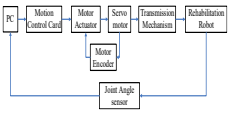


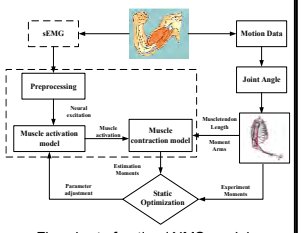
Figure. Basic structure of control system

SuC2(2) 16:45-17:00

A Subject-Specific Neuromusculoskeletal Model for Muscle Force Estimation Used in Rehabilitation

Lili Liu, Qing Tao, Quanbao Lai
Mechanical Engineering, XinJiang University, China

- Biomechanical analysis is very important in basic research and clinical custom treatment.
- Subject-Specific Neuromusculo-skeletal Model can help to accurately estimate internal muscle forces.
- Parameters of NMS model are optimized by surface electro-myography and motion data.



Flowchart of optimal NMS model parameters

SuC2(3) 17:00-17:15

Design of a New Soft Robot Hand for Grasping and Sorting Operation

Yaxi Wang and Qingsong Xu
Department of Electromechanical Engineering, University of Macau, Macau, China

- A new type of soft robot hand is designed and fabricated
- The robot hand is mainly composed of five soft actuators made of silicone material
- The robot integrates the visual control system and soft manipulator to realize the recognition and grasping of fragile objects
- It is applicable to the picking and sorting of small items in the warehouse

SuPo: Poster Session 1

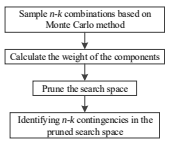
Room : Foyer, 10:30-11:00 (Core Time), Sunday, October 11

SuPo(1) 10:30-11:00

Identifying Critical Contingencies Using Search Space Pruning and Random Chemistry Algorithm

*Songlin Zuo, *Yanyan Ni, §Huizhou Liu, and †Ming Wang
*State Grid Anhui Electric Power Co., Ltd., Marketing Service Center (Measurement Center), Hefei, 230000, China
§State Grid Anhui Electric Power Co., Ltd., Hefei, 230000, China
†State Grid Anhui Electric Power Co., Ltd., Electric Power Research Institute, Hefei, 230000, China

- A certain amount of *n-k* contingencies is sampled by Monte Carlo method.
- The weight of the components is evaluated based on the sampling results.
- The critical components are gathered to generate a new search space.
- The RC algorithm is deployed to identify the set of critical n-k combinations.



Main steps of the proposed method

SuPo(2) 10:30-11:00

External Joint Calibration of A Novel Multi-Modal Perception System

Xiao Han and Hongpeng Wang
, Chongshan Fan,Yaojing Li

- We design a new multi-modal perception fusion system for the whole scene, which can be divided into two parts.Use Arial 28pt font in bold face for the title
- .Ourmainworkistodesigntheexperimental equipment of the proposed multi-modal perceptual fusion system, and to push forward the optimization theory with the re projection error as the objective function and analyze the multi-modal fusion sensing system

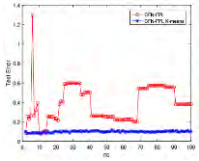
The general diagram of a new multimodal system

SuPo(3) 10:30-11:00

Improved Constructive Neural Network Learning with Local Polynomial Estimator

Yudong Xie
School of Computer and Information Engineering, Jiangxi Normal University, Nanchang, China

- We propose an improved constructive neural network learning method called CFN-FPL.
- The proposed method can significantly improve the performance, but increase a little more computational cost.
- Moreover, we suggest a K-means based generation way of data centers for the proposed method.



SuPo(4) 10:30-11:00

Research and Development of the Control System for Leather Cutting Machine

Weidi Zheng, Jianqun Liu, Weiqiang Gao
Guangdong Provincial Key Laboratory of Micro-Nano Manufacturing Technology and Equipment, School of Electromechanical Engineering, Guangdong University of Technology, Guangzhou, China

- A dual CPU hardware platform based on industrial personal computer and MC1004 motion controller was built.
- An improved ant colony algorithm was proposed to optimize the cutting path.
- The software of the control system was developed by the QT5.9 and Autothink software.

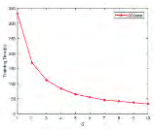
The Leather Cutting Machine

SuPo(5) 10:30-11:00

Efficient Super Greedy Boosting for Classification

Min Zhang and Minrun Wu
School of Computer and Information Engineering, Jiangxi Normal University, Nanchang , China

- In this paper, we propose an effective boosting method tosolve the binary classification.
- Our goal is to reduce the timeburden on the premise of improving certain accuracy.
- SGBoosting achieves similar accuracy to FCGBoosing and they are more accurate than some boosting methods.



For different number of dictionary selected on each iteration: s, this is the comparison of training time.

SuPo: Poster Session 1 (cont.)

Room : Foyer, 10:30-11:00 (Core Time), Sunday, October 11

SuPo_2(7) 10:30-11:00

Research Progress and Prospect of Assistive Standing Systems*

Yunjing Lei, Tong Zhang and Yilin Song

Sit-to-stand (STS) movement is one of the daily activities. With aging, the muscle strength of body weakens, and various joint problems are arising, STS movement may become difficult. At present, the domestic and foreign research on the assistive standing system is mainly aimed at the disabled and lower limb rehabilitation trainers, suitable for ordinary elderly people's assistive system is still very few. This paper briefly introduces the structure and movement mode of assistive standing systems at home and abroad, compares and analyzes the characteristics and performance of different assistive devices, and summarizes the adaptability and effectiveness of different assistive movement trajectories. At the same time, the research on the assistive standing device and its movement trajectory with the elderly as the main object in the future is proposed and prospected.

SuPo_2(8) 10:30-11:00

Abstract: Persistent surveillance of a target space using multiple UAVs has many applications. The persistent operation for monitoring is challenged by limited endurance of the persistent UAVs. We consider the problem for replenishing persistent UAVs using static charging station, where persistent UAVs collectively compute a set of paths to replace the batteries for persistent surveillance mission. Compared to the existing work, persistent UAVs based on static charging station recharge strategy can monitor more information. We formulate this problem as multiple traveling salesman problem on a complete graph. An efficient hybrid ant colony algorithm is proposed, which aims at planning a set of paths for UAVs to visit targets in order to collect the maximum surveillance benefit. In addition, considering the endurance of persistent UAVs, we also propose an Indirect Path Repair Algorithm to plan replenishment route of persistent UAVs. The simulation also shows that the proposed algorithm and application background are competitive and promising.

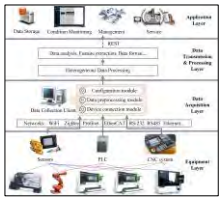
Jiezhi Xu
2020/7/20

SuPo_2(9) 10:30-11:00

Equipment Condition Monitoring System based on Multi-source Heterogeneous Data

Peijie Wang, Yan He*, Pengcheng Wu, Chuanpeng Hao, Yufeng Li and Ping Yan
State Key Lab of Mechanical Transmission, Chongqing University, China

- An equipment condition monitoring system framework base on multi-source heterogeneous data is proposed
- A configurable data collection client that integrates multiple communication protocols is developed
- A machining workshop monitoring case proves the effectiveness and benefits of the proposed system
- This work contributes to monitor and manage multi-source heterogeneous data for workshop equipment



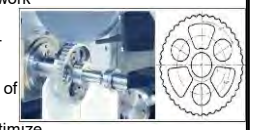
The framework of the equipment condition monitoring system

SuPo_2(10) 10:30-11:00

Optimization of Surface roughness of Grinding Cycloid Profile Based on Neural Network and Genetic Algorithm

Lanying Xu, Qiang Wu*, Baolan He and Peng Zhao
College of Electromechanical Engineering, Guangdong Polytechnic Normal University, China
Fangzheng Wu
computer science department, Rutgers, the State University of New Jersey,US

- A surface roughness prediction model with high accuracy is established by using neural network
- Based on genetic algorithm to optimize the grinding process parameters of cycloid gear profile
- By making use of the nonlinear fitting ability of neural networks, coupled with the global searching ability of genetic algorithms to optimize parameters, the surface roughness of cycloid gear after grinding can be effectively predicted



Site of grinding cycloid wheel

SuPo_2(11) 10:30-11:00

Experimental Study on the Surface Quality of Bearing Ring by Heating Turning

Lanying Xu, Qiang Wu*, Baolan He and Peng Zhao
College of Electromechanical Engineering, Guangdong Polytechnic Normal University, China

- Heating cutting induces a lower level of residual stress than ordinary hard cutting does.
- Heating cutting can obtain a smaller value of surface roughness than ordinary hard cutting does.
- The heating cutting method can obtain a regular morphology and a clear texture surface. It does not induce additional hardening.
- Compared with ordinary hard cutting, heating cutting more easily produces uniform serrated chips while processing bearing steel.

Residual stress measurement

SuPo: Poster Session 1 (cont.)

Room : Foyer, 10:30-11:00 (Core Time), Sunday, October 11

SuPo_3(13) 10:30-11:00

3D Mapping and Stability Prediction for Autonomous Wheelchairs

Aryan Naveen, Haitao Luo, Zhimin Chen and Bing Li

Department of Automotive Engineering, Clemson University, United States

- Autonomous wheelchairs can fulfill the needs of higher degree of independence and mobility capability for many populations;
- Effective 3D mapping of the environment is critical for the wheelchair dynamic stability;
- We proposed a novel LiDAR-camera sensor based LiDAR SLAM and mesh generation approach for the 3D mapping;
- Our results show the effectiveness of wheelchair dynamic stability prediction;

Intelligent wheelchair 3D mapping methodology

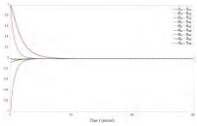
SuPo_3(14) 10:30-11:00

Robust Large-Angle Attitude Maneuver Strategy Design of UCAV

Jiafan He, Aiguo Fei, Qingwei Li and Chao Liu

Science and Technology on Information Systems Engineering Laboratory, Nanjing Research Institute of Electronics Engineering, Nanjing, China

- A nonlinear coordinate transformation is proposed based on SO(3)
- The maneuver strategy shows robustness with respect to systematic parameters of UCAV with flexibility.
- The input-to-state stability of the closed-loop system is verified.
- BIBO property with unmodeled disturbance torques as external input.



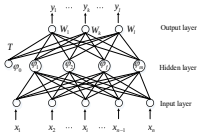
Attitude maneuver tacking error performance

SuPo_3(15) 10:30-11:00

Comparison of Forward and Reverse Decoding Methods of Knee Joint Moments based on sEMG

Yabin Wang, Xiaodong Zhang, Hanzhe Li, and Qinyi Sun
College of Mechanical Engineering, Xi'an Jiaotong University, China

- To find optimal model to calculate joint moment for assistance efficiency assessment of exoskeleton robot
- Establish forward and reverse decoding model of knee joint moments (DMKJM) based on surface electromyography
- Reverse DMKJM based on RBF network (DMKJM-R) and the forward DMKJM based on Hill model (DMKJM-H)
- Improve accuracy of assistance efficiency assessment for exoskeleton robots.



The structure of generalized RBF network

SuPo_3(16) 10:30-11:00

A Novel Wrist Joint Torque Prediction Method Based on EMG and LSTM

Yi Zhang, Xiaodong Zhang, Zhufeng Lu, Zhiming Jiang and Teng Zhang
School of Mechanical Engineering, Xi'an Jiaotong University, China

- To control the prosthetic hand move continuously as user's intention
- Method based on LSTM to predict continuous wrist joint torque from EMG signal
- 0.9289 on average of the Pearson correlation coefficient between predicted result and reference torque
- Can be used in the control of prosthetic limb to move continuously

SuPo_3(17) 10:30-11:00

Research on Multi-signature Secure Communication Model of Industrial IoT Intelligent Production System based on Shamir Mechanism

Mingshi LI
Shenyang Institute of Computing Technology, Chinese Academy of Sciences, University of Chinese Academy of Sciences, China

- Verification platform for intelligent production system of IIoT
- Multi-signature secure communication model of Industrial IoT intelligent production system based on Shamir mechanism
- Prediction method for missing communication data of IIoT intelligent production system

Industrial IoT intelligent production system

MoA1: Human-Machine Interaction

Session Chairs: Baoping Tang and Haibo Xu

Room : Lily Room 1-2, 09:00-10:15, Monday, October 12

MoA1(1) 09:00-09:15

Dense Points Aided Performance Evaluation Criterion of Human Obsevation for Image-based 3D Reconstruction

Yaojing Li and Hongpeng Wang and Xiaoyang Zhang
Nankai University, China

- Design assessment for uniformity in sample windows and combine it with density attributes
- Present new 3D reconstruction performance evaluation criteria based on dense point cloud
- Lead to better camera deployment strategy for 3D reconstruction according to the criteria

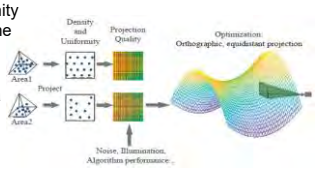


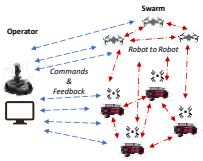
Figure. Schematic diagram of the influence process of evaluation criteria on reconstruction optimization

MoA1(2) 09:15-09:30

Operator Aware Dynamic Bandwidth Management for Teleoperation

Haytham M. Dbouk, Imad H. Elhajj, and Naseem Daher
Electrical and Computer Engineering Department, American University of Beirut, Lebanon

- Real-time operator-aware **dynamic** bandwidth management scheme for the teleoperation of robotic swarms.
- Integrated **personalization** with bandwidth allocation through a two-level **adaptive** algorithm, which dynamically updates the communication channels between the robots and the user.
- A **scalable** method that can be employed in large robotic swarm's collaborations.



Teleoperation of a swarm

MoA1(3) 09:30-09:45

Asynchronous Brain Machine Interface system for Autonomous Assembly Robot Based on Facial Expression Paradigm

Rui Li, Di Liu, Weiping Fu, Shiqiang Yang
School of mechanical and precision instrument engineering, Xi'an University of Technology, China
Xiaodong Zhang
Shaanxi Key Laboratory of Intelligent Robot, Xi'an Jiaotong University, China

- An asynchronous BMI system based on facial expression paradigm was constructed
- Hurst exponent is adopted in feature extraction algorithm
- The SVM algorithm is used for pattern recognition
- Accuracy and TPR and FPR were used to evaluate the performance of the classifier

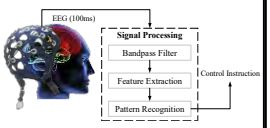
The schematic description of BMI system

MoA1(4) 09:45-10:00

A Semi-Asynchronous Real-Time Facial Expression Assisted Brain Control Method: An Extension

Zhufeng Lu, Xiaodong Zhang
School of Mechanical Engineering, Xi'an Jiaotong University, China
Hanzhe Li
School of Mechanical Engineering, Xi'an Jiaotong University, China

- An extended version of facial expression assisted brain control method, aiming at real-time and precise needs of peripheral control
- With semi-asynchronous strategy and up to eight instruction sets, which uses 100ms EEGs for real-time decoding
- The accuracy rate of semi-asynchronous real-time processing is 88.8% with eight instructions and 92.8% with abridged six instructions.



MoA1(5) 10:00-10:15

Face Feature Extraction Based on Partition Threshold Model

Yuqing Tian, Siyu Wang, Sheng Bi, Ning Xi*
Industrial Manufacturing and System Engineering Department, The University of Hong Kong, China

- Problem: Conditional binarization of human faces under different illumination
- Features: Combine the skin color, the edge information, and the pixel information
- Method: Use the partition threshold model to calculate the appropriate threshold in each partition
- Key modules: Skin color detection, partition threshold, contour extraction

Comparison of traditional binarization method (bottom left) and this paper (bottom right) of Input(top)

MoA2: Intelligent Diagnosis and Analysis

Session Chairs: Fei Wang and Dongsheng Zhang

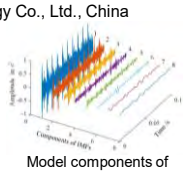
Room : Lily Room 4-5, 09:00-10:15, Monday, October 12

MoA2(1) 09:00-09:15

Denoising Method for Bearing Vibration Signal Based on EEMD and Wavelet Packet Transform

Shenglong Xie[1,2,3], Weimin Zhang[2], Yujun Lu[3], Xin Shao[4], Dijian Chen[1*] and Qing Lu[5]
1. School of Mechanical and Electrical Engineering, China Jiliang University, China
2. Zhejiang Xizi Heavy Machinery Co., Ltd., China
3. Faculty of Mechanical Engineering and Automation, Zhejiang Sci-Tech University, China
4. Zhejiang Academy of Special Equipment Science, China
5. Baowu Equipment Intelligent Technology Co., Ltd., China

- The EEMD method is applied to decompose the vibration signals.
- The correlation analysis of the high frequency IMFs containing noise is implemented.
- The denoised IMFs are reconstructed with other IMFs to achieve signal denoising.



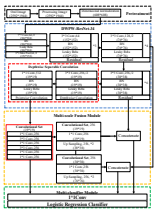
Model components of EEMD decomposition

MoA2(2) 09:15-09:30

A defect detection method of gear end-face based on modified YOLO-V3

Yingtao Su, Ping Yan*
The State Key Laboratory of Mechanical Transmission, Chongqing University, China

- A gear image preprocessing method based on gray histogram, it's used to eliminate the unfavorable and unobvious defects caused by the workshop processing environment and non-machined areas
- Based on the newly designed feature extraction backbone network DWPW-ResNet34 that takes into account both accuracy and efficiency
- Realize the real-time detection of metal gear end-face defects in the production process.



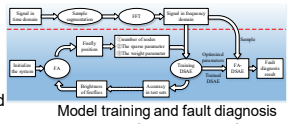
The modified network structure of YOLO-V3

MoA2(3) 09:30-09:45

Fault diagnosis of rotating machinery based on FA-DSAE

Han Zhou, Ping Yan, Jie Pei, Dayuan Wu, You Guo
Key Laboratory of Mechanical Transmission, Chongqing University, Chongqing 400044, China

- Firefly algorithm is adopted to optimize the super-parameters of DAE.
- The structures of DAE are obtained adaptively.
- The deep unsupervised feature learning method is adopted to avoid the dependence on diagnosis experience.
- In order to enhance the feature learning, some strategies are taken.



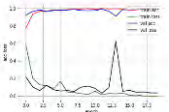
Model training and fault diagnosis process of the proposed fault diagnosis method

MoA2(4) 09:45-10:00

Research on Intelligent Fault Diagnosis Method for Rolling Bearing Based on One-Dimensional LeNet-5 Convolutional Neural Network

Shenglong Xie[1,2,3], Yujun Lu[2], Wenxin Zhang[3], Junjiang Zhu[1], Xin Shao[4*], and Qing Lu[5]
1. School of Mechanical and Electrical Engineering, China Jiliang University, China
2. Faculty of Mechanical Engineering and Automation, Zhejiang Sci-Tech University, China
3. Zhejiang Xizi Heavy Machinery Co., Ltd., China
4. Zhejiang Academy of Special Equipment Science, China
5. Baowu Equipment Intelligent Technology Co., Ltd., China

- A one-dimensional LeNet-5 neural network is constructed.
- The training samples are input into the convolution neural network for learning.
- The trained model is used for bearing fault pattern identification.



The accuracy and loss function of one-dimensional LeNet-5

MoA2(5) 10:00-10:15

Helical Gear Machining Quality Estimation Based on Processing Parameters Importance Analysis

Dayuan Wu, Ping Yan*, You Guo and Han Zhou
State Key Laboratory of Mechanical Transmission, Chongqing University, China
Runzhong Yi
Department Name, University Name, Country

- KPCA is used to preliminary reduce the dimension of quality inspection data of helical gear
- Auto-Birch clustering algorithm is conducted to obtain one-dimensional quality grade label
- Quality label is used as the decision attribute of rough set for importance analysis
- Voting Regression is adopted to establish the predictive model for helical machining error

Flowchart of MQP- PPIA

MoB1: Intelligent Control

Session Chairs: Guangzhong Cao and Xiaojun Shi

Room : Lily Room 1-2, 10:45-12:00, Monday, October 12

MoB1(1) 10:45-11:00

Constrained Predictive Position Control of the Planar Switched Reluctance Motor Using Threshold Function

Zhi-Hui Xu, Su-Dan Huang and Guang-Zhong Cao
College of Mechatronics and Control Engineering, Shenzhen University, China
Jun-Di Sun
Department of Electrical Engineering, Southwest Jiaotong University, China
Gang Jing, and Yan Liu
Research Institute of Tsinghua University in Shenzhen, China

- Using model predictive control to achieve position control of planar switched reluctance motor
- Propose a method using threshold function to achieve model predictive position control
- Simulations and experiments verify the feasibility and effectiveness of the method

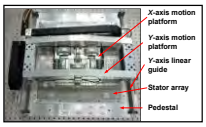


Figure 1. The mechanical structure of the PSRM.

MoB1(2) 11:00-11:15

The adaptive control method of pre-landing robot based on multi-body transfer matrix method

Haiming Shen and Xiaodong Zhang
the School of Mechanical Engineering, Xi'an Jiaotong University, China

- The vibration model of inspection robot based on multi-body transfer matrix method is established
- The influence of wind and rotor vibration on vibration characteristics of pre-landing gripper are analyzed
- The PID adaptive control system of pre-landing gripper is constructed by radial basis function network structure
- The pre-landing adaptive control system is simulated and analyzed by the Matlab software

Structure diagram of inspection robot for high voltage transmission line

MoB1(3) 11:15-11:30

Predictive Position Control With Stable Control Parameters of Planar Switched Reluctance Motors

Zhi-Yong Hu, Su-Dan Huang, Guang-Zhong Cao, and Long Chen
College of Mechatronics and Control Engineering, Shenzhen University, China
Gang Jing, and Yan Liu
Research Institute of Tsinghua University in Shenzhen, China

- Apply model predictive control to Planar Switched Reluctance Motors
- Propose a method to judge the stability of model predictive control parameters
- Simulation and experiment verify the validity of the theory

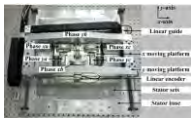


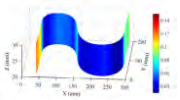
Figure 1. The mechanical structure of the PSRM.

MoB1(4) 11:30-11:45

Dimensional surface error prediction of thin-walled parts in five-axis flank milling

Liping Wang and Shuyi Ge
Department of Mechanical Engineering, Tsinghua University, China

- A dimensional surface error caused by the static deflection in five-axis flank milling is presented for thin-walled parts.
- The flexible cutting force is distributed on the finite element (FE) model of workpiece, while the stiffness of workpiece varies with the material removal
- Considering the effect of deflection on cutting force model, a flexible iterative calculation method is proposed.
- The deformation of the cutting tool is analyzed and a FEA model of the part is given.



MoB1(5) 11:45-12:00

Precise Control Method on Prosthetic Hand Using sEMG Signals *

Mostafa Orban[1], Xiaodong Zhang[1], Member, IEEE, Zhufeng Lu[1], Antonio Marcal[1], Ahmed Emad[2], Gilbert Masengo[1]
[1]Shaanxi Key Laboratory of Intelligent Robot, School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi, China.
[2]School of Mechanical Engineering, Pyramids Higher Institute of Engineering and technology, Cairo, Egypt

- A prosthetic hand precise control method using sEMG signal as control command was introduced.
- the PID controller using different tuning methods genetic algorithm and Ziegler–Nichols was applied.
- GA proved to be better by decreasing the rise time, improving the settling time and eliminating the overshoot in the system.
- The EMG decoding combined with the controller was realized to perform the desired four-hand movement with delay time less than 160 ms.

MoB2: Human Intention Understanding

Session Chairs: Ping Yan and Haibo Xu

Room : Lily Room 4-5, 10:45-12:00, Monday, October 12

MoB2(1) 10:45-11:00

A Fault-Tolerant Algorithm to Enhance Generalization of EMG-Based Pattern Recognition for Lower Limb Movement

Qinyi Sun, Xiaodong Zhang, Hanzhe Li, Runlin Dong,Yabin Wang and Guangyue Liu
College of Mechanical Engineering, Xi'an Jiaotong University, China

- Real-time application of exoskeleton remains a challenge due to the limited stability of electromyogram (EMG)
- To enhance generalization of EMG based pattern recognition (PR), the most accurate feature set was first selected in static data
- A BP classifier was trained based on the decision stream and features set to recover misclassification

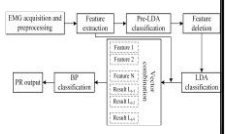


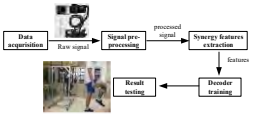
Figure Overall schematic structure of system with proposed fault-tolerant algorithm

MoB2(2) 11:00-11:15

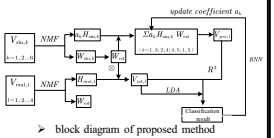
Multi-joint motor intention recognition of lower limbs based on muscle synergies

Guangyue Liu, Xiaodong Zhang, Member, IEEE , Qinyi Sun, Runlin Dong

Large amounts of sample data and time are necessary to allow the learning of discriminators to enable estimation of human intentions and motions from EMG signals based on EMG pattern classification. And it may cause an increased burden or a secondary injury for the users who has a certain degree of motor impairment. To solve this question, this paper proposes a method using lower limb single-joint motions to estimate unlearned multiple-joint motions based on muscle synergy combinations. This approach allows combined motions (unlearned motions) to be classified through learning of individual motions (such as knee flexion and hip flexion) only, meaning that the number of motions can be increased without increasing the number of learning samples or the learning time needed to control devices. The effectiveness of the proposed method was demonstrated through motion classification tests. The experiments showed 4 unlearned combine motions can be predict using 6 single motion and result in an average accuracy of 84.83%.



➢ steps of method verification



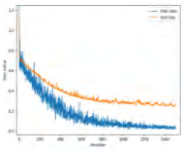
➢ block diagram of proposed method

MoB2(3) 11:15-11:30

Deep Learning Based Recognition of Hand Movement Intention EEG in Patients with Spinal Cord Injury

Yongyu Jiang, Xiaodong Zhang, Zhufeng Lu and Yachun Wang
School of Mechanical Engineering, Xi'an Jiaotong University, China
Chaoyang Chen
Department of Biomedical Engineering, Wayne State University, USA

- Brain-controlled prosthetic hands can help patients with SCI to carry out daily activities
- EEG signals from patients with spinal cord injury were collected
- Deep learning method is introduced for EEG signal perception and recognition
- Excellent Robustness, accuracy and recognition speed

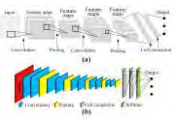


MoB2(4) 11:30-11:45

RP-based Voluntary Movement Intention Detection of Lower limb using CNN

Hanzhe Li, Xiaodong Zhang*, Zhufeng Lu, Runlin Dong, Qinyi Sun
School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an, China
Shaanxi Key Laboratory of Intelligent Robot, Xi'an Jiaotong University, Xi'an, China

- The different CNN models were established as a classifier. The lower limb voluntary movement intention detection system based on EEG was constructed and six healthy subjects were recruited in this experiment.
- The experimental results show that window length of EEG classification data was set as 300 ms to get a better detection accuracy and time performance.
- The average detection accuracy of right leg voluntary movement using AlexNet, VGGNet-16 and VGGNet-19 was 72.1%, 83.0% and 84.2% respectively.



Two different CNN layer structures. (a) AlexNet model. (b) VGGNet-16 model.

MoB2(5) 11:45-12:00

A Virtual Induction Approach for EEG Signal of Patient Movement Intention with Lower Limb Motion Assisted Robot

Runlin Dong, Xiaodong Zhang, Hanzhe Li, Xiaojun Shi
Shaanxi Key Laboratory of Intelligent Robots, Xi'an Jiaotong University, China

- Virtual induction rehabilitation strategy
- A method to induce subjects to generate movement intention based on virtual reality technology and a lower extremity motion assisted exoskeleton robot system
- Virtual induction system to generate movement intention of subjects
- Enhance active movement intention of subjects to produce the EEG signals with obvious characteristics after virtual induction

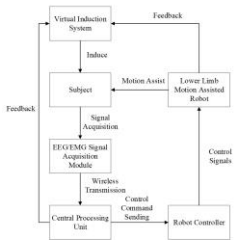


Figure 1. Virtual induction rehabilitation strategy

MoPo: Poster Session 2

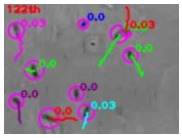
Room : Foyer, 10:15-10:45 (Core Time), Monday, October 12

MoPo(1) 10:15-10:45

Multiple Object Tracking for Similar, Monotonic Targets

Yifei Qian, Hui Shi, Runhuai Yang* and Yuping Duan*
Department of Biomedical Engineering, Anhui Medical University, China
Maojin Tian
Hefei National Laboratory for Physical Sciences at the Microscale and Department of Physics, University of Science and Technology of China, China

- Detection and tracking for non-fluorescent labeled particles
- Two-step detection algorithm based on threshold segmentation and morphology operation
- Employ Kalman filter to estimate the particle state
- The Hungarian algorithm is hired to correlate particles between video frames



Multiple bacteria tracking graph with trajectories and real-time velocities

MoPo(2) 10:15-10:45

Key Technologies of Data Monitoring for Coal Machinery Equipment in the IOT Environment

Juanli Li,Menghui Li,Fangyuan Yan and Dong Miao
College of Mechanical and Vehicle Engineering, Taiyuan University of Technology, China

- The data monitoring method of coal machine equipment based on the perception of IoT is proposed.
- The key technologies of data acquisition, data transmission, data processing and application are studied.
- A data monitoring system in the IoT environment is established.

MoPo(3) 10:15-10:45

Cyclic Weighted Median Method for L_1 Low-Rank with Nonlocal for Single color image denoising

Qiong Luo[1,2,3], Jiaxin Liu[4], Zhi Han[1,2], Yong Li[5], Yandong Tang[1,2], and Shengchuan Li[4]
1. State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, China
2. Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, Shenyang, China;
3. University of Chinese Academy of Sciences, Beijing, China
4. State Grid Liaoning Electric Power Research Institute, Shenyang, China
5. State Grid Shandong Electric Power Company, Shandong, China

- Cyclic weighted median alleviates the non-smoothness and non-convexity of the L_1 norm
- Introduce non-local prior into cyclic weighted median
- Experiments prove that the proposed method is superior to all competitive methods.

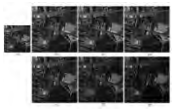
Comparison of different methods under different noise cases

MoPo(4) 10:15-10:45

Relaxed Low Tensor Train Rank Representation with Structural Smoothness for Super-resolution

Shengchuan Li[1], Huidi Jia[2,3,4], Xi'ai Chen[2,3,@], Sun Li[5], Zhi Han[2,3], Yandong Tang[2,3] and Jiaxin Liu[1]
1 State Grid Liaoning Electric Power Research Institute, China
2 State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China
3 Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, China
4 University of Chinese Academy of SciencesChina
5 State Grid Shandong Electric Power Company, China

- We propose a relaxed low TT rank representation with structural smoothness for HSI SR.
- The low TT rank regularization is designed to learn the spatial-spectral redundancies and spatial self-similarities.
- We use a weighted 3DTV regularization model HSI tensor's local spatial-spectral.



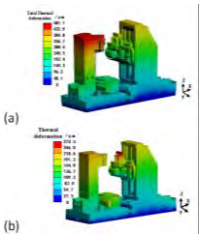
Reconstruction results on real-world HSI data

MoPo(5) 10:15-10:45

Thermal Characteristic Optimization of a CNC Forming Gear Grinding Machine

Xiaojun Shi, Shuxian Li, and Xin Yao
the School of Mechanical Engineering, Xi' an Jiaotong University, China

- Coolant has strong influence on the thermal error of gear grinding machine.
- Coolant spraying layout is reconstructed based on symmetrical design of machine tool thermal structure.
- Thermal deformation of the machine tool key points can be maximized reduced by 73.4%.



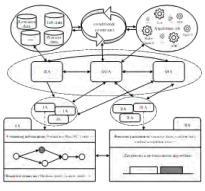
Comparison of total thermal deformation simulation results (a) before and (b) after coolant spraying construction

MoPo(6) 10:15-10:45

Multi-Agent Scheduling System in Cloud Manufacturing Environment

Xiaoxue Bi , Dong Yu , Jinsong Liu and Yi Hu
Shenyang Institute of Computing Technology ,
Chinese Academy of Sciences, Shenyang , China
University of Chinese Academy of Sciences , Beijing , China
Shenyang CASNC Technology Co., Ltd., Shenyang , China

- Multi-agent scheduling system framework and behavior in cloud manufacturing environment
- Design and application of multi-agent scheduling system platform in cloud manufacturing
- Responsive algorithm in agent to meet the flexible response in cloud manufacturing



Multi-agent system framework

MoPo: Poster Session 2 (cont.)

Room : Foyer, 10:15-10:45 (Core Time), Monday, October 12

MoPo_2(7) 10:15-10:45

Measuring method of Radial Run Out of High Speed Railway Wheelset

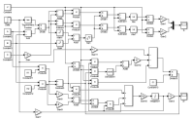
Aiming at the automatic measure technical problem about wheel radial runout, a non-contact method of measurement which uses self-create journal positioning mode is proposed to greatly improves the coaxiality of the axis of rotation, thus the v-shaped block and high-precision bearing are constructed as the positioning datum, in shaft end of wheel set a mechanism for wheel set rotating measurement is driven by using motor to implement accurate positioning measurement of radial runout of rolling round of wheel tread. The collected data are processed and analyzed by using method of median filtering to finally obtain the radial runout value of wheelset. The results show that: accuracy of measurement of the method ≤±0.03mm to fully guarantee the requirements which radial runout of wheelset tread≤±0.1mm meeting actual requirements of radial runout measurement of high speed railway wheelset.

MoPo_2(8) 10:15-10:45

Research on Steering Stability Control of Electric Vehicle Driven by Dual In-Wheel Motor

Xiangrong Guo and .Hong Li
the Electrical & Information Engineering Department, Changsha University of Science and Technology,
Yi Chen
the Automotive Engineering Department,HuNan Industry Polytechnic, China

- Slip rate and yaw angle speed are selected as the factors reflecting vehicle stability
- The controlled slip rate always keeps in a stable range of 0%~20%
- The controlled yaw angular velocity can basically track the ideal rate except for the light fluctuation before stabilization
- The proposed control strategy can suppress vehicle slip and yaw motion at the same time



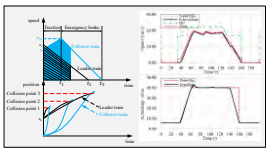
Electronic Differential Model

MoPo_2(9) 10:15-10:45

The Safety Braking Protection Model of Virtually Coupled Train Platoon in Subway

Qiao Zhou and ChunYu Zhang
Research Institute, Guangdong University of Technology , China
ChunYU Zhang
Research Institute, Lanzhou Jiaotong University , China

- A safety braking protection model of Virtually Coupled Train is proposed
- The maximum safe speed of the Follower Train is given by detailed calculation procedure
- It can maintain 40m tracking interval for driving safely under the maximum speed of 80km/h



The Safety Braking Protection Model

MoPo_2(10) 10:15-10:45

Simulation and Experiment of Motion process base on Pneumatic conveying in flexible materials

XiaoYu Wang and Hao Li
Mechanical Engineering Department, Dalian Jiaotong University, China
Yan Zheng and Sijia Gao
Mechanical Engineering Department, Dalian University of Technology, China

- With the advent of industry 4.0, it is of great significance to apply pneumatic conveying technology to the transportation of flexible materials. In this paper, we use suction pneumatic conveying method to transport condoms and adjust the shape of the condom in the negative pressure pipe.

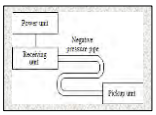


Figure1. Sequence of delivery and shaping units

MoPo_2(11) 10:15-10:45

Binocular Human Body Attitude Distance Localization Recognition Algorithm Based on Dual Convolution

Jianming Sun , Wenbo Wang and Zidong Chen
School of Computer and Information Engineering, Harbin University of Commerce, China

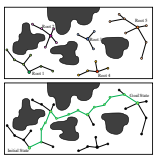
An algorithm based on real-time accurate target recognition and distance location for UAVs, the existing target location and discrimination methods often fail to meet practical requirements.The image information collected under the common single camera can only obtain two-dimensional information,and the relative distance of the camera based on the target cannot be obtained.However,the commonly used dual camera-based distance acquisition algorithm is too complicated,not stable enough, and requires developers to have higher the level of knowledge,the high threshold for development,and the difficulty of application.Therefore,this paper proposes to train the feature extraction network based on the two-channel Darknet-53 basic structure through the dual camera under the human body posture recognition image dataset,and initialize the YOLOv2 network with its parameters, and to train the human body position in the human body posture image,relative distance, and category.Experimental results verify that the human body position and category recognition of human posture using this method improves the recognition accuracy by 3.83% and 4.81%compared with the single-convolution chain,and the accuracy of the target-based relative distance is achieved 65.21%.The algorithm can be effectively applied to the UAV to quickly recognize the human body posture and obtain a better recognition effect to meet the real-time demand.

MoPo_2(12) 10:15-10:45

PR-RRT*: Motion Planning of 6-DOF Robotic Arm Based on Improved RRT Algorithm

Yi Liang, Hengyang Mu, Diansheng Chen, Xiaodong Wei and Min Wang
School of Mechanical Engineering and Automation, Beihang University, China

- RRT*-Based sampling-based motion planning algorithm.
- Simultaneously-growing multiple trees making up a complete path.
- Redundant path points deletion.



PR-RRT* algorithm schematic

MoPo: Poster Session 2 (cont.)

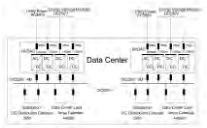
Room : Foyer, 10:15-10:45 (Core Time), Monday, October 12

MoPo_3(13) 10:15-10:45

Microgrid Solution of Smart Energy Station Based on HVDAC System

Hao Tian, Wenjing Wang, Zijie Zhang, Huijuan Shi, Zhongxi Liu
Jiangsu Keneng Electric Power Engineering Consulting *Co., Ltd.* , China

- An AC / DC microgrid is built for energy utilization in smart energy stations
- HVDAC system replaces traditional lead-acid batteries with energy storage modules, based on HVDC system
- HVDAC system improves power efficiency in smart energy station, and saves investment



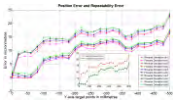
Position of HVDAC system in microgrid

MoPo_3(14) 10:15-10:45

The Research on the Influence of Position Errors on the Angular Errors, Straightness Errors and Squareness Errors

HuanLao Liu, MiaoJing Su, LeiLei Zhou, PeiMing Peng and Can Liu
School of Mechanical and Power Engineering, Guangdong Ocean University, China

- Geometric errors before and after compensation are measured by laser interferometer and ball bar.
- With the improvement of the positioning accuracy of machine tool, the angular errors are improved.
- With the improvement of the positioning accuracy of machine tool, the straightness error are also improved.
- The position errors compensation of the machine tool has little effect on squareness errors.



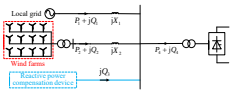
The Y-axis's position errors without compensation

MoPo_3(15) 10:15-10:45

Placement of Synchronous Condensers for Voltage Stability of Large-scale Wind Power Transmission via HVDC system

Xuetao Dong and Yanhui Qin
State Grid Xinjiang Company Limited Electric Power Research Institute, China
Zeyu Cao, Zhichao Yang, and Bingtuan Gao
School of Electrical Engineering, Southeast University, China

- An optimization method of placing synchronous condensers at key nodes of large-scale wind power system integrated to local Alternative Current (AC) system and transmitted by HVDC is proposed.
- Particle Swarm Optimization (MOPSO) algorithm is employed to solve the optimal model
- Simulations were performed on a modified IEEE-39 node standard test system.



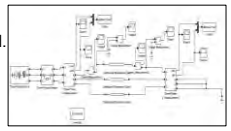
Equivalent circuit diagram of the wind power transmission system

MoPo_3(16) 10:15-10:45

An Online Method of Measuring DC Resistance of Transmission Lines

Shun Lan, Siyue Li, Xiaokang Li, Bang Wang, Hanling Mao, Zhenfeng Huang, and Xinxin Li
School of Mechanical Engineering, Guangxi University, China

- Based on the RLCG parameter line model, the current and voltage expressions are derived.
- A simplified RL distributed model is proposed.
- Construct a three-phase transmission line simulation model to verify the RLCG parameter model.
- Experiments show that the simplified RL model can calculate the resistance value effectively.



The distributed-element model of three-phase transmission lines.

MoPo_3(17) 10:15-10:45

A Review on Kinematic, Workspace, Trajectory Planning and Path Planning of Hyper-Redundant Manipulators

1 INTRODUCTION
THE RESEARCH STATUS OF HYPER-REDUNDANT MANIPULATORS IN THE WORLD IS BRIEFLY INTRODUCED, AND THE MAIN USES OF HYPER-REDUNDANT MANIPULATORS ARE ANALYZED.

2 DEFINITION AND TYPES
THE DEFINITION OF HYPER-REDUNDANT MANIPULATORS IS DESCRIBED AND ITS TYPES ARE ANALYZED;THE DEFINITION OF HYPER-REDUNDANT MANIPULATORS IS DESCRIBED AND ITS TYPES ARE ANALYZED.

3 MODEL OF KINEMATICS
THE FORWARD KINEMATICS AND INVERSE KINEMATICS OF HYPER-REDUNDANT MANIPULATORS ARE ANALYZED, AND THE MAIN SOLVING METHODS OF FORWARD KINEMATICS AND INVERSE KINEMATICS ARE SUMMARIZED.

4 WORKSPACE
THE WORKSPACE OF HYPER-REDUNDANT MANIPULATORS IS ANALYZED, AND THE MAIN METHODS TO SOLVE THE WORKSPACE OF HYPER-REDUNDANT MANIPULATORS ARE SUMMARIZED;

5 TRAJECTORY PLANNING
THE TRAJECTORY PLANNING OF HYPER-REDUNDANT MANIPULATORS IS ANALYZED, AND THE ADVANTAGES AND DISADVANTAGES OF DIFFERENT TRAJECTORY PLANNING METHODS ARE SUMMARIZED.

6 PATH PLANNING
THE PATH PLANNING ALGORITHM OF HYPER-REDUNDANT MANIPULATORS IS ANALYZED, AND THE APPLICATION FIELDS, ADVANTAGES AND DISADVANTAGES OF DIFFERENT PATH PLANNING ALGORITHMS ARE SUMMARIZED.

7 DISCUSSION AND FUTURE WORK
THE FUTURE RESEARCH FOCUS OF HYPER-REDUNDANT MANIPULATORS IS DISCUSSED AND THE FUTURE DEVELOPMENT DIRECTION IS PROSPECTED.

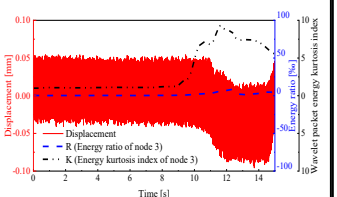
Authors: Zhao-cai Du; Guang-Yao Ouyang; Jun Xue; Yan-bin Yao

MoPo_3(18) 10:15-10:45

Machining Chatter Monitoring Based on Wavelet Packet Energy Kurtosis Index of Vibration Signals

Peisheng Lou and Kaibo Lu*
CMVE, TYUT, CN
Hongwei Fan
SX KLMEEIM, XUST, CN
Wencheng Pan , Fengshou Gu and Andrew Longstaff
CEPE, HUD, UK

- Chatter characteristics analysis
- The turning experiments
- Wavelet packet energy



Comparison of indicators of *K* and *R* for chatter detection

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